



LUBRICANTS

PHILLIPS 66 LUBRICANTS PRODUCT GUIDE



LUBRICANTS

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Engine Oil

Automotive Engine Oils

Shield® Armor
Shield Choice
Shield Classic
Shield Defense
Shield Euro-Tech
Shield Euro-Tech++
Shield Firebird
Shield Valor

Fleet & Commercial Engine Oils

Firebird™ Heavy Duty EC Diesel Engine Oil
Fleet Supreme EC® Diesel Engine Oil
Guardol ECT® Diesel Engine Oil with Liquid Titanium®
Guardol® FE Diesel Engine Oil with Liquid Titanium
Guardol NG
Heavy Duty Diesel Engine Oil
Power-D® Engine Oil
Ramar® Diesel XDO
Super HD II Diesel Engine Oil
T5X® Heavy Duty Diesel Engine Oil
T5X Off-Road Mobile Hydraulic Fluid
T5X PLUS Heavy Duty Diesel Engine Oil
Triton® Arctic Diesel Engine Oil



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Triton® ECT Diesel Engine Oil

Triton Euro Diesel Engine Oil

Triton FE Diesel Engine Oil

Natural Gas Engine Oils

El Mar® Ashless Heavy Duty GEO

El Mar Ashless Supreme GEO

El Mar GEO

El Mar LA4 EXD

El Mar LF-D GEO

El Mar Low Ash

El Mar Mid Ash Heavy Duty GEO

El Mar Mid Ash Supreme GEO

El Mar T GEO

El Mar W GEO

2-Cycle & Small HP Engine Oils

4T Mineral MA

4T Semi-Synthetic MA

4T Semi-Synthetic MB

4T Synthetic MA

Airkool HP 2-Cycle Motor Oil

Injex® TC-W3® 2-Cycle Motor Oil

Synjex® TC-W3® 2-Cycle Motor Oil

Unimix®-2-Cycle Motor Oil

Environmentally Conscious Lubricants

Ecoterra® Hydraulic Oil

Ecoterra Paper Machine Oil

Ecoterra Rock Drill Fluid

Ecoterra AW Hydraulic Oil

Firebird™ Tractor Hydraulic Fluid

Gear Lubricants

Compounded Gear Oil

Extra Duty Gear Oil



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Gear Shield®
Gear Shield Synthetic
GLW
GLW-E
High Performance Gear Oil
MP Gear Lube
Open Gear Lube
Syncon® EP Plus Gear Oil
Syncon Mist Oil
Syncon Premium EP Gear Oil
Syncon WTL
Syngear SS
Transmission Oil SAE 90
Triton® OG SS
Triton Syngear FE
Triton Synlube LDO
Triton Synthetic Gear Lube
Triton Synthetic Transoil 50

Greases

Bentone
Cable Lube
Calcium S
Cotton Picker
Coupling Grease
Dynalife® HT
Dynalife L-EP
Food Machinery Grease
Megaplex® XD3
Megaplex XD5
Milube® WR
Moly Low Temp
Multiplex® Red
Omniguard®
Omniguard 460
Omniguard SRI



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Omniguard® XD5
Paper Machine Grease
Polytac®
Polytac EP
RedTac®
Super-STA® & Super-STA M
Tacna® HD
Triton®
Triton ELL
Triton Low Temp
Triton OSP 320
Triton XD5
Trolley Wire Lube
Unoba® EP

Industrial Oils

Compressor & R&O Oils

Air Compressor Oil
Ammonia Compressor Oil
Gas Compressor Oil
Multipurpose R&O Oil
Premium Gas Compressor Oil
Premium Rotary Air Compressor
Oil Refrigerant Compressor Oil
Special Compressor Oil
Syncon® R&O Oil (ISO VG 32-68)
Syncon R&O Oil (ISO VG 100-680)
Syncon Refrigeration Oil
Syndustrial® PAG Compressor Oil
Syndustrial R&O Oil
Syndustrial Rotary Compressor Oil
Ultra Clean Multipurpose R&O Oil
Wet Gas Compressor Oil

Hydraulics

Arctic Low Pour Hydraulic Oil



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FR Fluid-Glycol
Hydraulic AW
Hydraulic AW/D
Megaflow® AW HVI Hydraulic Oil
Megaflow AW Hydraulic Oil
Megaflow AW Ultra-Clean Hydraulic Oil
Powerflow™ AW Hydraulic Oil
Powerflow HE Hydraulic Oil
Powerflow NZ HE Hydraulic Oil
Powerflow NZ HE-E Hydraulic Oil
Powerflow NZ Hydraulic Oil
Quintolubric® 818-02
Quintolubric 958-30
Syncon® AW Hydraulic Fluid
Syncon FG Hydraulic Fluid
Syndustrial® Hydraulic Fluid
Ultra Powerflow HE Hydraulic Oil

Metalworking Fluids

Hydrokool® HD
Hydrokool SS
Koolkut® 8052B
Koolkut ACM
Koolkut HD NC
Koolkut SCF
Koolkut Spectrum
Koolkut Transparent
Multi-Way Oil HD
Soluble Oil
Solube Oil HD
TCS Slideway Lubricant

Specialty Industrial Oils

AAR 963 Oil
Arbor Oil
Bearing Oil M



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Circulating Oil
CP Oil
Diamond Class® Heat Transfer Fluids
Food Machinery Oil
Heat Transfer Oil
High Pressure Machine Oil
Industrial Oil
Marok®
Paper Machine Oil
Pump Oil
Quench Oil
Rock Drill Oil
Rolling Oil
Special Bar & Chain Oil
Spindle Oil
Spindle Wet
Steaval D-150
Syncon® Barrier Oil
Transformer Oil
Ultra-Clean Spindle Oil
Uniguide® II
White Oil
Wireline
Wool Processing Oil
XD Bearing Oil

Turbine Oils

Diamond Class® AW Turbine Oil
Diamond Class Turbine Oil
Syncon Turbine Oil
Syndustrial® Turbine Oil
Turbine Oil
Ultra-Clean Turbine Oil

Power Transmission Fluids

CVT Fluid



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PowerDrive® Fluid
PowerDrive Fluid 6000
PowerDrive Synthetic All Season TO-4 Fluid
PowerDrive Synthetic Arctic TO-4 Fluid
PowerTran® Fluid
PowerTran XP
Super ATF
Triton® Heavy Duty ATF
Triton Synthetic ATF
Type F ATF
VersaTrans® ATF
VersaTrans LV ATF

Engine Coolants

Automotive Coolants

Shield® Coolant/Antifreeze

Heavy Duty Coolants

Guardol® OAT HD Coolant/Antifreeze

Technical Handbook



LUBRICANTS

AVIATION PRODUCTS



Aviation Anti-Rust Oil

Phillips 66® Aviation Anti-Rust Oil is a rust preventive oil specially formulated to help protect aircraft piston engines against rust and corrosion during extended periods of inactivity. Airframe manufacturers have used it for many years as “Fly Away Oil” for new or rebuilt aircraft engines that are expected to sit idle for extended periods of time. Aviation Antirust Oil may be used as “break-in oil” where an all-mineral oil is desired, and is particularly suited for situations where the engine to be broken in may not be immediately put into regular service.

When preparing an aircraft for storage, drain the used engine oil and refill with Aviation Anti-Rust Oil. Start the engine and warm it up to normal operating temperature to ensure that the new oil is fully circulated throughout the engine and allowed to coat all engine parts. For best results, fly the aircraft prior to storage. Covering exhaust and intake ports is recommended to minimize exposure to moisture during storage.

Aviation Anti-Rust Oil is **not** designed to be an everyday operational engine oil in aircraft that are flown frequently. It does not contain ashless dispersant additives. Operation time on this oil should not exceed 10 hours. When returning the plane back to normal operation after storage, this oil should be replaced with regular operational engine oil such as Phillips 66 X/C® 20W-50 Aviation Oil.

Aviation Anti-Rust Oil is compatible with our other aviation engine oils, and may be used as a “supplement” to those products to enhance rust and corrosion protection when used in infrequently flown aircraft, particularly where high humidity is a concern. When used as a supplement, we recommend replacing up to 10% of the crankcase volume with Aviation Antirust Oil in place of the normal operational engine oil.

Applications

- Engine preservative oil
- Limited-time “break-in” oil

Aviation Antirust Oil meets the requirements of:

- SAE Standard J1966
- U.S. Military Specification MIL-C-6529C
- U.S. Military Specification MIL-L-6082E (Base Oil) (obsolete)

Features/Benefits

- Excellent rust and corrosion protection

Rust & Corrosion Preventive Oil for Aircraft Piston Engines

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Aviation Anti-Rust Oil

Typical Properties	
SAE Grade	20W-50
Gravity, °API	28.8
Specific Gravity @ 60°F	0.883
Density, lbs/gal @ 60°F	7.35
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	240 (464)
Pour Point, °C (°F)	-24 (-11)
Viscosity, Kinematic	
cSt @ 40°C	176
cSt @ 100°C	19.1
Viscosity Index	123
Cold Cranking Viscosity, cP @ -15°C	8,865
Ash Content, SAE J1787, wt %	Nil
Copper Corrosion, ASTM D130	Pass

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.

12-15-16

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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Aviation Smoke Oil

Phillips 66 Aviation Smoke Oil is a high quality fluid for use in both piston engine and turbine engine smoke systems. Phillips 66 Aviation Smoke oil can be readily vaporized due to its low viscosity. It also possess good low temperature properties. It is also the smoke oil of choice for the Phillips 66 Aerostars Aerobatic team.

Applications

Aircraft smoke systems requiring a paraffin based light viscosity oil

- Piston powered aircraft smoke system
- Turbine powered aircraft smoke system

Features/Benefits

- Paraffin based
- Easy vaporization due to low viscosity
- Good low-temperature properties

**Paraffin based
smoke oil for
use in both
piston and
turbine powered
aircraft**

Aviation Smoke Oil

Typical Properties	
ISO Grade	10/15
Gravity, °API @ 60°F	33.8
Specific Gravity @ 60°F	0.856
Density, lbs/gal @ 60°F	7.13
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	196 (385)
Pour Point, °C (°F)	-34 (-29)
Viscosity	
cSt @ 40°C	12.6
cSt @ 100°C	3.0
SUS @ 100°F	72.0
SUS @ 210°F	36.4
Viscosity Index	87
Acid Number, ASTM D664, mg KOH/g	<0.05
Aniline Point, ASTM D611, °C (°F)	96 (205)

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Type A Aviation Oil

Phillips 66® Type A Aviation Oil is an ashless dispersant, single-grade engine oil specially formulated for use in aircraft piston engines. The ashless dispersant formulation helps minimize the formation of engine sludge, varnish, piston deposits and combustion chamber deposits, resulting in a much cleaner engine compared with the use of straight (non-dispersant) mineral oils.

Type A Aviation Oil has many years of outstanding field performance in a wide variety of aviation applications. It is available in two grades, 100AD (SAE 50) and 120AD (SAE 60). Both grades are FAA approved.

Applications

- Opposed piston aircraft engines that require an SAE 50 or Commercial Grade 100 engine oil (Type A 100AD)
- Radial piston aircraft engines that require an SAE 60 or Commercial Grade 120 engine oil (Type A 120AD)

Type A Aviation Oil meets the requirements of:

- Avco Lycoming Material Specification No. 301G
- Pratt & Whitney Service Bulletin No. 1183 Rev. U
- SAE Standard J1899
- Teledyne Continental Material Specification MHS-24B
- U.S. Military Specification MIL-L-22851D (obsolete) for additive treatment

QPL Approval Numbers: D07L1-50 (Type A 100AD), D07L1-60 (Type A 120AD)

Features/Benefits

- Ashless dispersant helps minimize engine sludge and varnish deposits for a cleaner engine
- High film strength for protection against wear and piston scuffing
- Protects against rust and corrosion
- Formulated with the same high-quality base oils as used in Phillips 66® X/C® Aviation Oil

Ashless Dispersant, Single-Grade Engine Oil for Aircraft Piston Engines

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Type A Aviation Oil

Typical Properties		
Grade	100AD	120AD
SAE Grade	50	60
Gravity, °API	28.5	0.887
Specific Gravity @ 60°F	0.884	7.39
Density, lbs/gal @ 60°F	7.36	4.0
Color, ASTM D1500	3.5	4.0
Flash Point (COC), °C (°F)	256 (493)	266 (511)
Pour Point, °C (°F)	-27 (-17)	-27 (-17)
Viscosity, Kinematic		
cSt @ 40°C	204	257
cSt @ 100°C	20.2	23.4
Viscosity Index	115	113
Acid Number, ASTM D664, mg KOH/g	0.15	0.15
Ash Content, SAE J1787, wt %	Nil	Nil
Copper Corrosion, ASTM D130	Pass	Pass
Foam Test, ASTM D892	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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Type M Aviation Oil

Phillips 66® Type M Aviation Oil is an ashless, non-dispersant, multi-grade engine oil recommended for use in aircraft piston engines where the operator prefers a mineral oil-based engine oil that does not contain dispersant additives. It provides easier starting and quicker oil circulation at low temperatures compared with single-grade mineral oils, while maintaining high film strength at high temperatures and under high loads for protection against wear and piston scuffing.

Type M Aviation Oil typically is used as break-in oil for newly overhauled engines where all-mineral type oils are recommended. The multi-grade formulation helps reduce cylinder glazing tendency during break-in. Break-in normally is accomplished in less than 25 hours of engine operation.

Applications

- Aircraft piston engines where the operator prefers a non-dispersant engine oil
- “Break-in” oil for newly overhauled aircraft engines

Type M Aviation Oil meets the requirements of:

- SAE Standard J1966
- U.S. Military Specification MIL-L-6082 (obsolete)

QPL approval number: N06L1-20W-50 (Type M)

Features/Benefits

- Easier starting and quicker oil circulation at low temperatures compared with single-grade oils
- High film strength for protection against wear and piston scuffing, even under high-load conditions, such as takeoff, and at elevated operating temperatures
- Reduces cylinder glazing tendency during break-in, compared with single grade oils

**Non-Dispersant,
Multi-Grade
Engine Oil for
Aircraft Piston
Engines**

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SMOOTHLY. 



Type M Aviation Oil

Typical Properties	
SAE Grade	20W-50
Gravity, °API	30.4
Specific Gravity @ 60°F	0.874
Density, lbs/gal @ 60°F	7.28
Color, ASTM D1500	2.0
Flash Point (COC), °C (°F)	234 (453)
Pour Point, °C (°F)	-30 (-22)
Viscosity, Kinematic	
cSt @ 40°C	166
cSt @ 100°C	19.5
Viscosity Index	135
Cold Cranking Viscosity, cP @ -15°C	5,360
Ash Content, SAE J1787, wt %	Nil

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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Victory® Aviation Oil 100AW

Phillips 66® Victory Aviation Oil 100AW is an ashless dispersant, single-grade engine oil pre-blended with the proper concentration of antiscuff/antiwear additive (LW-16702) mandated by Lycoming Service Bulletins 446E and 471B and Service Instruction 1409C. It is recommended for use in opposed piston and radial piston aircraft engines where cam lifter wear is a concern.

The ashless dispersant formulation helps minimize the formation of engine sludge, varnish, piston deposits and combustion chamber deposits, resulting in a much cleaner engine compared with the use of straight (nondispersant) mineral oils. This oil has a high viscosity index and low pour point compared with many other single-grade aircraft engine oils, allowing its use over a wide temperature range.

Victory Aviation Oil 100AW is FAA approved as an alternate method of compliance to AD80-04-03 R2, paragraph b.1.

Applications

- Opposed piston aircraft engines, especially where cam lifter wear is a concern

Victory Aviation Oil 100AW meets the requirements of:

- Avco Lycoming Material Specification No. 301G
- Pratt & Whitney Service Bulletin No. 1183 Rev. U
- SAE Standard J1899
- Teledyne Continental Material Specification MHS-24B
- U.S. Military Specification MIL-L-22851D (obsolete) for additive treatment

QPL approval number: D07L2-50

Features/Benefits

- Ashless dispersant helps minimize engine sludge and varnish deposits for a cleaner engine
- Pre-blended with Lycoming-approved antiwear additive
- High film strength for protection against wear and piston scuffing
- High viscosity index and low pour point for use over a wide temperature range
- Protects against rust and corrosion
- Formulated with the same high-quality base oils as used in Phillips 66 X/C® Aviation Oil

**Ashless
Dispersant,
Single-Grade
Engine Oil
With Antiwear
Additive for
Aircraft Piston
Engines**

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Victory® Aviation Oil 100AW

Typical Properties	
SAE Grade	50
Gravity, °API	27.0
Specific Gravity @ 60°F	0.893
Density, lbs/gal @ 60°F	7.44
Color, ASTM D1500	3.0
Flash Point (COC), °C (°F)	255 (491)
Pour Point, °C (°F)	-27 (-17)
Viscosity, Kinematic	
cSt @ 40°C	189
cSt @ 100°C	19.5
Viscosity Index	118
Acid Number, ASTM D664, mg KOH/g	0.04
Ash Content, SAE J1787, wt %	0.04
Copper Corrosion, ASTM D130	Pass
Foam Test, ASTM D892	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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X/C® 5606H & 5606A Aviation Hydraulic Fluids

Phillips 66® X/C 5606H and X/C 5606A Aviation Hydraulic Fluids are mineral oil-based, high viscosity index, ashless (zinc-free) antiwear hydraulic fluids designed to meet the severe demands of aerospace and industrial applications. They have excellent oxidation resistance and outstanding low-temperature properties for use over a wide temperature range. They provide excellent wear protection for hydraulic pumps and motors, protect hydraulic system components against rust and corrosion, and are resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

X/C 5606H Aviation Hydraulic Fluid meets the cleanliness requirements for “super clean” hydraulic fluid for use in modern aircraft hydraulic systems. X/C 5606A Aviation Hydraulic Fluid is recommended for use in hydraulic systems that do not require a “super clean” fluid. Both fluids are dyed red for identification and leak detection purposes.

Applications

X/C Aviation Hydraulic Fluids are recommended for use in non-pressurized systems operating between -54°C and 90°C (-65°F to 194°F), and in pressurized systems operating between -54°C and 135°C (-65°F to 275°F) at pressures up to 3,000 psi.⁽¹⁾ Typical applications include:

- Aircraft and missile control systems, autopilots and shock absorbers
- Auto wreckers, boom trucks and electrical service equipment (cherry pickers) where all-weather performance is required
- Industrial robotics
- Hydraulic systems that require a “super clean” fluid for extended service life and reliability (X/C 5606H)

⁽¹⁾ **Note:** Do not use these fluids in hydraulic systems with natural rubber elastomers.

X/C 5606H Aviation Hydraulic Fluid meets the requirements of:

- U.S. Military Specification MIL-PRF-5606H (supercedes MIL-O-5606, AN-O-336, AN-VV-O-336 and AAF-3580)

X/C 5606A Aviation Hydraulic Fluid meets the requirements of:

- U.S. Military Specification MIL-H-5606A (obsolete)

**Zinc-Free
Antiwear
Hydraulic Fluids
For Aerospace &
Industrial
Applications**

CONTACT INFORMATION

**Phillips66
Aviation.com**

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1-800-368-7128

Technical Hotline:
1-877-445-9198

International
Customer Service:
1-832-765-2500

E-mail address:
**phillips66lubricants@
p66.com**



Features/Benefits

- Very high viscosity index for use over a wide temperature range
- Outstanding low-temperature properties
- Excellent wear protection
- Resists deposit formation and viscosity increase due to oxidation
- Protects against rust and corrosion
- Good foam resistance
- Does not contain zinc or other heavy metals



X/C® 5606H Aviation Hydraulic Fluid

Typical Properties

ISO Grade	15
Gravity, °API	31.0
Specific Gravity @ 60°F	0.871
Density, lbs/gal @ 60°F	7.25
Color, Visual	Red
Flash Point (PMCC), °C (°F)	90 (194)
Pour Point, °C (°F)	-64 (-83)
Viscosity, Kinematic	
cSt @ -54°C	2,450
cSt @ -40°C	495
cSt @ 40°C	13.5
cSt @ 100°C	5.1
Viscosity Index	382
Acid Number, ASTM D664, mg KOH/g	0.05
Copper Corrosion, ASTM D130, 71°C (160°F), 72 hours	1b
Dielectric Strength, ASTM D877, kv ⁽²⁾	49.6
Evaporation Loss, ASTM D972, 71°C (160°F), 6 hours, wt %	13.6
Foam Resistance, ASTM D892, 75°F	25-0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.65
Gravimetric Filtration, FTM 313, mg/100 ml, 0.45 microns @ 25°C,	
Filter time, minutes	6
Particle Contamination, FTM 3012, Automatic Counter,	
Particle Size, microns	
5-15	1,200
16-25	175
26-50	60
51-100	5
100+	0
Water Content, ASTM D6304, ppm	60

⁽²⁾ At the point of manufacture

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X/C® 5606A Aviation Hydraulic Fluid

Typical Properties

ISO Grade	15
Specific Gravity @ 60°F	0.871
Density, lbs/gal @ 60°F	7.25
Color, Visual	Red
Flash Point (PMCC), °C (°F)	90 (194)
Pour Point, °C (°F)	-64 (-83)
Viscosity, Kinematic	
cSt @ -40°C (-40°F)	495
cSt @ 54°C (130°F)	10.2
Viscosity Index	382
Acid Number, ASTM D664, mg KOH/g	0.05
Precipitation Number, ASTM D91	0

Health and Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://w3apps.phillips66.com/NetMSDS>.



X/C® Aviation Oil

Phillips 66® X/C Aviation Oil is an ashless dispersant, multi-grade engine oil specially formulated for year-round use in aircraft piston engines. It provides distinct performance benefits compared with single-grade engine oils, including easier starting and faster oil circulation at low temperatures, reduced warm-up time, and reduced oil consumption in most engines. It maintains its film strength under high loads and at high temperatures to protect against wear and piston scuffing. The ashless dispersant formulation helps minimize the formation of engine sludge, varnish, piston deposits and combustion chamber deposits, resulting in a much cleaner engine compared with the use of straight (non-dispersant) mineral oils.

X/C Aviation Oil was the first FAA-approved mineral oil-based, ashless dispersant, multi-viscosity aviation engine oil. It has more than 30 years of outstanding, proven performance in a wide variety of aviation uses, including flight schools, charter and cargo airlines, acrobatic aircraft, spray planes, race planes and virtually any other general aviation application. It is available throughout the United States and is exported to other countries around the world.

Applications

X/C 20W-50 Aviation Oil is recommended for use in opposed piston engines. It can replace Commercial Grade 65, 80 or 100 single-grade engine oils with no sacrifice in performance.

X/C 25W-60 Aviation Oil is recommended for use in radial piston engines and in other aviation piston engines originally designed to run on heavier-grade oils, such as Commercial Grade 120.

Both viscosity grades are recommended for use during break-in and then as the operational oil until TBO.

X/C Aviation Oil meets the requirements of:

- Avco Lycoming Material Specification No. 301G
- Pratt & Whitney Service Bulletin No. 1183 Rev. U
- SAE Standard J1899
- Teledyne Continental Material Specification MHS-24B
- U.S. Military Specification MIL-L-22851D (obsolete) for additive treatment
QPL Approval Numbers: D07L1-20W-50 (X/C 20W-50), D07L1-25W-60 (X/C 25W-60) X/C® Aviation Oil

**Ashless
Dispersant,
Multi-Grade
Engine Oil for
Aircraft Piston
Engines**

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Features/Benefits

- Ashless dispersant helps minimize engine sludge and varnish deposits for a cleaner engine
- Easier starting and faster oil circulation at low temperatures compared with single-grade oils
- Reduced warm-up time and cooler operating temperatures compared with single-grade oils
- High film strength for protection against wear and piston scuffing, even under high-load conditions, such as takeoff, and at elevated operating temperatures
- Provides cleaner and quicker break-in than traditional all-mineral, non-additized, single-grade oils
- Protects against rust and corrosion
- Reduces oil consumption in most engines
- Suitable for year-round use

X/C® Aviation Oil

Typical Properties		
SAE Grade	20W-50	25W-60
Gravity, °API	30.1	28.8
Specific Gravity @ 60°F	0.876	0.883
Density, lbs/gal @ 60°F	7.29	7.35
Color, ASTM D1500	2.5	4.0
Flash Point (COC), °C (°F)	235 (455)	253 (487)
Pour Point, °C (°F)	-33 (-27)	-27 (-17)
Viscosity, Kinematic		
cSt @ 40°C	159	245
cSt @ 100°C	19.8	24.8
Viscosity Index	144	128
Cold Cranking Viscosity, cP	5,200	8,200
@ (°C)	(-15)	(-10)
Acid Number, ASTM D664, mg KOH/g	0.15	0.15
Ash Content, SAE J1787, wt %	Nil	Nil
Copper Corrosion, ASTM D130	Pass	Pass
Foam Test, ASTM D892	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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AUTOMOTIVE ENGINE OILS



LUBRICANTS

Shield Armor

Phillips 66® Shield Armor Full Synthetic Motor Oil is a premium quality, full-synthetic automotive engine oil designed to provide maximum engine protection for both turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fueled passenger cars and light trucks under all operating conditions. It is particularly recommended for vehicles operating at extreme temperatures or under severe driving conditions, such as towing heavy loads.

Shield Armor Full Synthetic Motor Oil is formulated with synthetic base stocks. The full-synthetic formulation, compared with conventional engine oils, provides improved protection against viscosity breakdown and deposit formation at high temperatures; lower volatility for reduced oil consumption; and faster oil circulation at low temperatures for easier starting and better protection during cold starts.

Shield Armor Full Synthetic Motor Oil exceeds new car warranty requirements as defined by ILSAC GF-5. It is uniquely formulated to help combat low speed pre-ignition (LSPI) in turbocharged gasoline direct injection engines. It meets or exceeds "Resource Conserving" requirements for fuel economy improvement, emission system and turbocharger protection, and protection of engines operating on ethanol-containing fuels up to E85. It is backward serviceable for use where API SN or earlier "S" category engine oils are recommended.

Applications

- Turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fuel passenger cars, light trucks and sport utility vehicles, including gasoline-electric hybrids, especially when operating under severe conditions
- Four-stroke cycle gasoline engines in other mobile or stationary equipment

Shield Armor Full Synthetic Motor Oil is licensed for:

- ILSAC GF-5
- API Service SN Plus with Resource Conserving

Shield Armor Full Synthetic Motor Oil meets or exceeds the requirements of:

- Chrysler MS-6395
- Ford WSS-M2C945-B1 (SAE 5W-20)
- Ford WSS-M2C946-B1 (SAE 5W-30)
- Ford WSS-M2C947-B1 (SAE 0W-20)
- GM6094M (obsolete specification)

Premium Full-Synthetic Passenger Car Engine Oil

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Features/Benefits

- Helps protect against low speed pre-ignition (LSPI) in turbocharged gasoline direct-injection engines (TGDI)
- Exceeds ILSAC GF-5 requirements for new cars under warranty
- Enhanced performance benefits at extreme temperatures compared with conventional engine oils
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust and bearing corrosion
- Low volatility for reduced oil consumption
- Excellent low-temperature pumpability for protection during cold starts
- Highly resistant to foaming
- Formulated to protect turbochargers and emission control system catalysts
- Formulated for use in vehicles operating on ethanol-containing fuels up to E85

Shield™ Armor

Typical Properties				
SAE Grade	0W-20	5W-20	5W-30	10W-30
Specific Gravity @ 60°F	0.847	0.848	0.851	0.852
Density, lbs/gal @ 60°F	7.05	7.06	7.09	7.10
Color, ASTM D1500	3.0	3.0	3.0	3.0
Flash Point (COC), °C (°F)	229 (444)	229 (444)	235 (455)	232 (450)
Pour Point, °C (°F)	-43 (-45)	-41 (-42)	-40 (-40)	-39 (-38)
Viscosity, Kinematic				
cSt @ 40°C	46.0	45.4	61.2	63.2
cSt @ 100°C	8.8	8.4	10.9	10.4
Viscosity Index	174	164	171	153
Cold Cranking Viscosity, cP	5,000	3,650	4,900	3,750
@ (°C)	(-35)	(-30)	(-30)	(-25)
High Temp/High Shear Viscosity, cP @ 150°C	2.6	2.6	3.0	3.1
Sulfated Ash, ASTM D874, wt %	0.96	0.96	1.02	0.96
Total Base Number (TBN), ASTM D2896	8.0	8.0	8.6	8.0
Phosphorus, wt %	0.077	0.077	0.077	0.077
Zinc, wt %	0.085	0.085	0.085	0.085

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://www.phillips66.com/SDS>



LUBRICANTS

Shield Choice

Phillips 66® Shield Choice Synthetic Blend Motor Oil is a premium quality, part-synthetic automotive engine oil designed to provide excellent engine protection for both turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fueled passenger cars and light trucks under all operating conditions.

Shield Choice Synthetic Blend Motor Oil is formulated to provide excellent wear protection, to minimize sludge and varnish formation, and to resist viscosity and thermal breakdown, even in severe service. It also protects against rust and bearing corrosion, and is resistant to foaming. The

Shield Choice Synthetic Blend Motor Oil (except SAE 10W-40 & 20W-50) exceeds new car warranty requirements as defined by ILSAC GF-5. It is uniquely formulated to help combat low speed pre-ignition (LSPI) in turbocharged gasoline direct injection engines. Shield Choice (except SAE 10W-40 & 20W-50) meets "Resource Conserving" requirements for fuel economy improvement, emission system and turbocharger protection, and protection of engines operating on ethanol-containing fuels up to E85. It is backward serviceable for use where API SN or earlier "S" category engine oils are recommended.

Applications

- Turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fuel passenger cars, light trucks and sport utility vehicles, including gasoline-electric hybrids, especially when operating under severe conditions
- Four-stroke cycle gasoline engines in other mobile or stationary equipment

Shield Choice Synthetic Blend Motor Oil is licensed for:

- ILSAC GF-5 (except SAE 10W-40 and 20W-50)
- API Service SN Plus with Resource Conserving (except SAE 10W-40 and 20W-50 which is API SN Plus only)

Shield Choice Synthetic Blend Motor Oil meets or exceeds the requirements of:

- Chrysler MS-6395
- Ford WSS-M2C945-B1 (SAE 5W-20)
- Ford WSS-M2C946-B1 (SAE 5W-30)
- Ford WSS-M2C947-B1 (SAE 0W-20)
- GM6094M (obsolete specification)

Premium Synthetic Blend Passenger Car Engine Oil

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Features/Benefits

- Helps protect against low speed pre-ignition (LSPI) in turbocharged gasoline direct-injection engines (TGDI)
- Exceeds ILSAC GF-5 requirements for new cars under warranty
- Friction-modified for improved fuel economy
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against wear and bearing corrosion
- Low volatility for reduced oil consumption
- Highly resistant to foaming
- Formulated to protect turbochargers and emission control system catalysts
- Formulated for use in vehicles operating on ethanol-containing fuels up to E85

Shield™ Choice

Typical Properties						
SAE Grade	0W-20	5W-20	5W-30	10W-30	10W-40	20W-50
Specific Gravity @ 60°F	0.848	0.862	0.862	0.866	0.869	0.881
Density, lbs/gal @ 60°F	7.06	7.18	7.17	7.21	7.24	7.33
Color, ASTM D1500	3.0	3.0	3.0	3.0	3.0	3.5
Flash Point (COC), °C (°F)	218 (424)	218 (424)	216 (421)	229 (444)	227 (440)	230 (446)
Pour Point, °C (°F)	-34 (-29)	-30 (-22)	-30 (-22)	-30 (-22)	-30 (-22)	-30 (-22)
Viscosity, Kinematic						
cSt @ 40°C	46.0	49.8	65.4	65.1	106	176
cSt @ 100°C	8.8	8.5	10.9	10.4	15.8	19.6
Viscosity Index	174	147	158	148	150	128
Cold Cranking Viscosity, cP	5,400	6,150	6,150	4,550	6200	7200
@ (°C)	(-35)	(-30)	(-30)	(-25)	(-25)	(-15)
High-Temp/High-Shear Viscosity, cP @ 150°C	2.6	2.6	3.1	3.0	3.8	4.9
Sulfated Ash, ASTM D874, wt %	0.96	0.96	0.96	0.96	0.96	0.96
Total Base Number (TBN), ASTM D2896	8.0	8.0	8.0	8.0	8.0	8.0
Phosphorus, wt %	0.077	0.077	0.077	0.077	0.077	0.077
Zinc, wt %	0.085	0.085	0.085	0.085	0.085	0.085

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://www.phillips66.com/SDS>



LUBRICANTS

Shield Classic

Phillips 66® Shield Classic Motor Oil, SAE 20W-50 is a high-quality, conventional automotive engine oil recommended for use in gasoline-fueled passenger cars and light trucks operating under high-temperature conditions, such as towing heavy loads, where the vehicle manufacturer specifies an SAE 20W-50 engine oil. It also may be used in gasoline-fueled competition engines and high-performance street engines where SAE 20W-50 engine oil is preferred. It provides engine protection for both turbocharged gasoline direct-injection and conventional gasoline-fueled and flex-fueled passenger cars and light trucks under all operating conditions. It is not recommended for use in new cars under warranty.

Shield Classic Motor Oil is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, and to resist viscosity and thermal breakdown, even in severe service. It also protects against rust and bearing corrosion, and is resistant to foaming.

Applications

- Turbocharged gasoline direct-injection and conventional gasoline-fueled light trucks and sport utility vehicles where a SAE 20W-50 engine oil is specified
- Gasoline-fueled competition engines and high-performance street engines

Shield Classic Motor Oil is licensed for:

- API service SN
- Backward serviceable for use where API SN or earlier "S" category engine oils are recommended.

Features/Benefits

- Helps protect against low speed pre-ignition (LSPI) in turbocharged gasoline direct-injection engines (TGDI)
- Resists viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against wear
- Protects against rust and bearing corrosion
- Good foam resistance

Conventional Passenger Car Engine Oil

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Shield™ Classic

Typical Properties			
SAE Grade	30	40	20W-50
Specific Gravity @ 60°F	0.882	0.884	0.876
Density, lbs/gal @ 60°F	7.35	7.36	7.29
Color, ASTM D1500	3.5	3.5	3.5
Flash Point (COC), °C (°F)	250 (482)	254 (489)	230 (446)
Pour Point, °C (°F)	-33 (-27)	-28 (-18)	-30 (-22)
Viscosity, Kinematic			
cSt @ 40°C	95.0	128	155
cSt @ 100°C	11.5	13.6	19.6
Viscosity Index	109	102	145
Cold Cranking Viscosity, cP	--	--	6,600
@ (°C)	--	--	(-15)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.4	3.9	5.0
Sulfated Ash, ASTM D874, wt %	1.1	1.1	1.05
Total Base Number (TBN), ASTM D2896	9.3	9.3	8.8
Phosphorus, wt %	0.077	0.077	0.077
Zinc, wt %	0.085	0.085	0.085

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://www.phillips66.com/SDS>



LUBRICANTS

Shield Defense

Phillips 66® Shield Defense Synthetic Blend Motor Oil is a premium quality, part-synthetic automotive engine oil specially designed to provide excellent engine protection for both turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fueled passenger cars and light trucks under all operating conditions with more than 75,000 miles. It also is recommended for use in lower-mileage vehicles, including new cars under warranty.

Shield Defense Motor Oil is formulated with a blend of synthetic and conventional base stocks and a proprietary seal conditioner. The part-synthetic formulation provides enhanced protection against viscosity breakdown and the formation of sludge and varnish compared with conventional engine oils. Our proprietary SealMax seal conditioner helps recondition and revitalize engine seals, thereby helping to reduce oil consumption, minimize driveway leaks and reduce exhaust smoke. These performance benefits help to maximize engine performance and extend engine life in high-mileage vehicles, while also providing excellent engine protection in newer vehicles.

Shield Defense Motor Oil meets new car warranty requirements as defined by ILSAC GF-5. It is uniquely formulated to help combat low speed pre-ignition (LSPI) in turbocharged gasoline direct injection engines. It meets or exceeds "Resource Conserving" requirements for fuel economy improvement, emission system and turbocharger protection, and protection of engines operating on ethanol-containing fuels up to E85. It is backward serviceable for use where API SN or earlier "S" category engine oils are recommended.

Applications

- Turbocharged gasoline direct-injection, conventional gasoline-fueled and flex-fuel passenger cars, light trucks and sport utility vehicles, including gasoline-electric hybrids, especially when operating under severe conditions, especially those with more than 75,000 miles

Shield Defense Motor Oil is licensed for:

- ILSAC GF-5 (SAE 5W-20, 5W-30, 10W-30)
- API Service SN Plus with Resource Conserving (SAE 5W-20, 5W-30, 10W-30)
- API Service SN Plus (SAE 10W-40)

Shield Defense Motor Oil meets or exceeds the requirements of:

- Chrysler MS-6395 (Rev. T)
- Ford WSS-M2C945-B1 (SAE 5W-20)
- Ford WSS-M2C946-B1 (SAE 5W-30)
- GM6094M (obsolete specification)

**Synthetic Blend
Passenger Car
Engine Oil for
High Mileage
Vehicles;
Formulated with
SealMax®**

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Features/Benefits

- Helps protect against low speed pre-ignition (LSPI) in turbocharged gasoline direct-injection engines (TGDI)
- Meets ILSAC GF-5 requirements for new cars under warranty
- Part-synthetic formulation provides enhanced protection against deposit formation and oil thickening, compared with conventional engine oils
- Proprietary SealMax® seal conditioner helps recondition and revitalize engine seals to reduce oil consumption and leaks
- Protects against rust and bearing corrosion
- Low volatility for reduced oil consumption
- Excellent low-temperature pumpability for protection during cold starts
- Highly resistant to foaming
- Helps maximize engine performance and minimize exhaust smoke
- Formulated to protect turbochargers and emissions control system catalysts
- Formulated for use in vehicles operating on ethanol-containing fuels up to E85

Shield™ Defense

Typical Properties				
SAE Grade	5W-20	5W-30	10W-30	10W-40
Specific Gravity @ 60°F	0.863	0.861	0.867	0.870
Density, lbs/gal @ 60°F	7.18	7.17	7.22	7.24
Color, ASTM D1500	3.0	3.0	3.0	3.0
Flash Point (COC), °C (°F)	218 (424)	216 (421)	229 (444)	227 (441)
Pour Point, °C (°F)	-39 (-38)	-39 (-38)	-39 (-38)	-36 (-33)
Viscosity, Kinematic				
cSt @ 40°C	49.9	67.0	65.7	111
cSt @ 100°C	8.6	10.8	10.5	15.8
Viscosity Index	150	152	148	151
Cold Cranking Viscosity, cP				
@ (°C)	(-30)	(-30)	(-25)	(-25)
High-Temp/High-Shear Viscosity, cP @ 150°C	2.6	3.1	3.0	3.9
Sulfated Ash, ASTM D874, wt %	0.96	0.96	0.96	0.96
Total Base Number (TBN), ASTM D2896	8.0	8.0	8.0	8.0
Phosphorus, wt %	0.077	0.077	0.077	0.077
Zinc, wt %	0.085	0.085	0.085	0.085

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://www.phillips66.com/SDS>



LUBRICANTS

Shield Euro-Tech

Phillips 66® Shield Euro-Tech is a premium quality, full-synthetic, full-SAPS engine oil designed to provide maximum protection for European passenger cars under all operating conditions. It also is recommended for other vehicles operating at extreme temperatures or under severe driving conditions, such as towing heavy loads. It is recommended for use in many gasoline and light-duty diesel engines.

Shield Euro-Tech Motor Oil provides enhanced performance benefits compared with conventional engine oils. These benefits include better oxidation resistance and thermal stability at high temperatures for improved protection against viscosity breakdown and deposit formation; lower volatility for reduced oil consumption; and better low-temperature pumpability for easier starting and faster oil circulation at low temperatures.

Shield Euro-Tech Motor Oil meets or exceeds the performance requirements of API Service Category SN for the SAE 5W-40 viscosity and API Service Category SL for the SAE 5W-30 viscosity, and is approved for service fill under leading European OEM specifications.

Applications

- Audi: gasoline engines (except the R8 GT & R8 V10) and diesel engines without DPF, standard drain only
- BMW: most gasoline engines, except M-series & Z8 that require an SAE 10W-60 viscosity grade oil
- Mercedes-Benz: most gasoline engines
- Volkswagen: gasoline engines and diesel engines without DPF
- Passenger cars, light trucks and sport utility vehicles that do not require an ILSAC GF-5 oil for warranty coverage, especially when operating under severe driving conditions

Shield Euro-Tech Motor Oil is licensed for:

- API Service SL - SAE 5W-30
- API Service SN - SAE 5W-40

Shield Euro-Tech Motor Oil meets or exceeds the requirements of:

- ACEA A3/B4-12
- API Service CF
- Renault RN 0700 RN0710 - SAE 5W-40
- PSA B71 2296 - SAE 5W-40

Shield Euro-Tech Motor Oil is fully approved for service fill under the following OEM specifications

- BMW Long Life LL-01
- Mercedes Benz Sheet 229.50
- Volkswagen Standard 502.00 & 505.00
- Porsche A40 - SAE 5W-40

Premium Full-Synthetic Passenger Car Engine Oil for European & North American Vehicles





Features/Benefits

- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Excellent wear protection
- Protects against rust and bearing corrosion
- Low volatility for reduced oil consumption
- Excellent low-temperature pumpability for protection during cold starts
- Good foam resistance

Shield™ Euro-Tech

Typical Properties		
SAE Grade	5W-30	5W-40
Specific Gravity @ 60°F	0.853	0.854
Density, lbs/gal @ 60°F	7.10	7.13
Color, ASTM D1500	3.0	3.0
Flash Point (COC), °C (°F)	216 (421)	229 (444)
Pour Point, °C (°F)	-39 (-38)	-39 (-38)
Viscosity, Kinematic		
cSt @ 40°C	80	80
cSt @ 100°C	12.2	13.3
Viscosity Index	164	168
Cold Cranking Viscosity, cP	5700	5700
@ (°C)	(-30)	(-30)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.6	3.7
Sulfated Ash, ASTM D874, wt %	1.1	1.1
Total Base Number (TBN), ASTM D2896	10.0	10.0
Phosphorus, wt %	0.958	0.958
Zinc, wt %	0.1051	0.1051

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Shield Euro-Tech+

Phillips 66® Shield Euro-Tech+ is a premium quality, full-synthetic, low-SAPS engine oil designed to provide maximum protection for European passenger cars under all operating conditions. It also is recommended for other vehicles operating at extreme temperatures or under severe driving conditions, such as towing heavy loads. It is recommended for use in many gasoline and light-duty diesel engines.

Shield Euro-Tech+ Motor Oil provides enhanced performance benefits compared with conventional engine oils. These benefits include exceptional oxidation resistance and thermal stability at high temperatures for improved protection against viscosity breakdown and deposit formation; lower volatility for reduced oil consumption; and better low-temperature pumpability for easier starting and faster oil circulation at low temperatures.

Shield Euro-Tech+ Motor Oil meets or exceeds the performance requirements of API Service Category SN, and is approved for service fill under leading European OEM specifications for extended drain applications.

Applications

- Audi: diesel engines with DPF, extended drain
- BMW: most diesel engines
- Mercedes-Benz: most diesel engines
- Volkswagen: diesel engines with DPF, extended drain
- Passenger cars, light trucks and sport utility vehicles that do not require an ILSAC GF-5 oil for warranty coverage, especially when operating under severe driving conditions

Shield Euro-Tech+ Motor Oil is licensed for:

- API Service SN - SAE 5W-30

Shield Euro-Tech+ Motor Oil meets or exceeds the requirements of:

- ACEA C3-12
- API Service CF
- Chrysler MS 11106

Shield Euro-Tech+ Motor Oil is fully approved for service fill under the following OEM specifications

- BMW Long Life LL-04
- Mercedes Benz Sheet 229.51
- Volkswagen Standard 504.00 & 507.00
- Porsche C30

Premium Full-Synthetic Passenger Car Engine Oil for Diesel Powered European & North American Vehicles





Features/Benefits

- Exceptional resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Low-ash formulation to protect against diesel particulate filter plugging
- Excellent wear protection
- Protects against rust and bearing corrosion
- Low volatility for reduced oil consumption
- Excellent low-temperature pumpability for protection during cold starts
- Good foam resistance

Shield™ Euro-Tech+

Typical Properties	
SAE Grade	5W-30
Specific Gravity @ 60°F	0.853
Density, lbs/gal @ 60°F	7.10
Color, ASTM D1500	3.0
Flash Point (COC), °C (°F)	216 (421)
Pour Point, °C (°F)	-39 (-38)
Viscosity, Kinematic	
cSt @ 40°C	80
cSt @ 100°C	12.2
Viscosity Index	164
Cold Cranking Viscosity, cP	5900
@ (°C)	(-30)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.6
Sulfated Ash, ASTM D874, wt %	0.8
Total Base Number (TBN), ASTM D2896	8.85
Phosphorus, wt %	0.0794
Zinc, wt %	0.0875

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Shield Firebird

Phillips 66® Shield Firebird Motor Oil is an environmentally responsible, part-synthetic automotive engine oil designed to provide excellent engine protection for gasoline-fueled and flex-fuel passenger cars and light trucks under all operating conditions. It is formulated with a blend of synthetic and 70% or greater high-quality re-refined base stocks. The use of re-refined base stocks helps lessen the environmental impact of disposal of used oil.

Shield Firebird Motor Oil is formulated to provide excellent wear protection, to minimize sludge and varnish formation, and to resist viscosity and thermal breakdown, even in severe service. It also protects against rust and bearing corrosion, and is resistant to foaming. The part-synthetic formulation provides enhanced performance benefits at extreme temperatures compared with conventional engine oils, for extra protection under all driving conditions.

Shield Firebird Motor Oil is fully licensed by the API and meets new car warranty requirements as defined by ILSAC GF-5. It meets "Resource Conserving" requirements for fuel economy improvement, emission system and turbocharger protection, and protection of engines operating on ethanol-containing fuels up to E85. It is backward serviceable for use where API SM or earlier "S" category engine oils are recommended.

Applications

- Gasoline-fueled and flex-fuel passenger cars, light trucks and sport utility vehicles, including gasoline-electric hybrids, especially when operating under severe conditions
- Four-stroke cycle gasoline engines in other mobile or stationary equipment

Shield Firebird Motor Oil is licensed for:

- ILSAC GF-5
- API Service SN with Resource Conserving

Shield Firebird Synthetic Motor Oil meets or exceeds the requirements of:

- Chrysler MS-6395
- Ford WSS-M2C945-A (SAE 5W-20)
- Ford WSS-M2C946-A (SAE 5W-30)
- GM6094M (obsolete specification)

**Synthetic Blend
Passenger
Car Engine Oil
Formulated with
70% or Greater
Re-Refined
Base Stocks**

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Features/Benefits

- Meets ILSAC GF-5 requirements for new cars under warranty
- Friction-modified for improved fuel economy
- Resists viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against wear
- Protects against rust and bearing corrosion
- Good low-temperature pumpability for easier cold starts
- Good foam resistance
- Formulated to protect turbochargers and emissions control system catalysts
- Formulated for use in vehicles operating on ethanol-containing fuels up to E85
- Lessens the environmental impact of disposal of used oil

Shield™ Firebird

Typical Properties		
SAE Grade	5W-20	5W-30
Specific Gravity @ 60°F	0.866	0.866
Density, lbs/gal @ 60°F	7.21	7.21
Color, ASTM D1500	3.5	3.5
Flash Point (COC), °C (°F)	220 (428)	220 (428)
Pour Point, °C (°F)	-39 (-38)	-39 (-38)
Viscosity, Kinematic		
cSt @ 40°C	49.0	66.0
cSt @ 100°C	8.5	10.8
Viscosity Index	151	154
High-Temp/High-Shear Viscosity, cP @ 150°C	3.1	3.1
Sulfated Ash, ASTM D874, wt %	0.96	0.96
Total Base Number (TBN), ASTM D2896	8.0	8.0
Phosphorus, wt %	0.077	0.077
Zinc, wt %	0.085	0.085
Re-refined Content, Finished Oil, wt %	>70	>70

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

Shield Valor

Phillips 66® Shield Valor Full Synthetic Motor Oils are an ultra-premium quality automotive engine oil specially designed to meet the performance requirements of the GM dexos1™ Gen2 specification for gasoline-fueled GM vehicles. They also exceed ILSAC GF-5 warranty requirements for use in other vehicles.

Shield Valor Full Synthetic Motor Oils are formulated to reduce the occurrence of low speed preignition, provide wear protection, minimize sludge and varnish formation, protect against turbo charger deposits and resist viscosity and thermal breakdown, even in severe service. They also protect against bearing corrosion and are highly resistant to aeration and foaming. They meet stricter performance requirements than ILSAC GF-5 quality oils, resulting in improved engine life and performance. The full-synthetic formulation provides enhanced performance benefits at extreme temperatures compared with conventional engine oils.

Shield Valor Full Synthetic Motor Oil are fully licensed to dexos1 Gen2 for service fill in all GM vehicles. They also exceed new car warranty requirements for other vehicles as defined by ILSAC GF-5. They meet or exceeds "Resource Conserving" requirements for fuel economy improvement, emission system and turbocharger protection, and protection of engines operating on ethanol-containing fuels up to E85. They are backward serviceable for use where API SM or earlier "S" category engine oils are recommended.

Applications

- GM vehicles where a dexos1 Gen2 oil is specified
- Gasoline-fueled and flex-fuel passenger cars, light trucks and sport utility vehicles, including gasoline-electric hybrids, where the OEM specifies SAE 0W-20 or 5W-30 engine oil
- Four-stroke cycle gasoline engines in other mobile or stationary equipment

Shield Valor Full Synthetic is licensed or OEM-certified for:

- ILSAC GF-5
- API Service SN with Resource Conserving
- GM dexos1 Gen2

Shield Valor Full Synthetic meets or exceeds the requirements of:

- Chrysler MS-6395
- Ford WSS-M2C946-A
- GM4718M, GM6094M (obsolete specifications)
- Honda HT-06

Premium Full-Synthetic Passenger Car Engine Oil; Approved for GM dexos1™ Gen2

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Features/Benefits

- Exceeds ILSAC GF-5 requirements for new cars under warranty
- Reduces the occurrence of low speed preignition
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Excellent low-temperature pumpability for protection during cold starts
- Protects against sludge and varnish formation
- Protects against turbocharger deposits
- Protects against rust and bearing corrosion
- Low volatility for reduced oil consumption
- Highly resistant to aeration and foaming
- Formulated to protect turbochargers and emission control system catalysts
- Formulated for use in vehicles operating on ethanol-containing fuels up to E85

Shield™ Valor

Typical Properties		
SAE Grade	0W-20	5W-30
Specific Gravity @ 60°F	0.846	0.851
Density, lbs/gal @ 60°F	7.04	7.08
Color, ASTM D1500	3.0	3.0
Flash Point (COC), °C (°F)	226 (438)	220 (428)
Pour Point, °C (°F)	-40 (-40)	-40 (-40)
Viscosity, Kinematic		
cSt @ 40°C	45	64
cSt @ 100°C	8.5	11.0
Viscosity Index	169	165
Cold Cranking Viscosity, cP	5700	5000
@ (°C)	(-35)	(-30)
High Temp/High Shear Viscosity, cP @ 150°C	2.7	3.2
Sulfated Ash, ASTM D874, wt %	0.9	0.9
Total Base Number (TBN), ASTM D2896	8.7	8.7
Phosphorus, wt %	0.77	0.077
Zinc, wt %	0.085	0.085

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

FLEET & COMMERCIAL ENGINE OILS



LUBRICANTS

Firebird® Heavy Duty EC Diesel Engine Oil

Phillips 66® Firebird Heavy Duty EC (Emission Compatible) Diesel Engine Oil is an environmentally responsible API CK-4 engine oil developed for use in four-stroke cycle diesel engines designed to meet 2007 and later EPA on-highway exhaust emissions standards. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPFs), diesel oxidation catalysts (DOCs) and/or selective catalytic reduction (SCR). It is backward serviceable for use in pre-2007 diesel engines.

Firebird Heavy Duty EC is formulated with 100% re-refined base stocks. It has excellent soot dispersancy to protect against soot-induced oil thickening and abrasive wear, and excellent oxidation resistance to help minimize deposit formation. The low-ash formulation protects exhaust catalysts on low-emission engines and helps prolong DPF life. The use of re-refined base stocks helps lessen the environmental impact of disposal of used oil.

Firebird Heavy Duty EC meets or exceeds the performance requirements of API Service Category CK-4 and SN as well as leading OEM specifications for use in low-emission diesel engines. It is backward serviceable for use where earlier API "C" category engine oils, or the concurrent earlier OEM specifications, are specified. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm. However, for applications not using Ultra-Low Sulfur Diesel (ULSD), consult the engine manufacturer for recommended service interval.

Applications

- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment

Firebird Heavy Duty EC is licensed or OEM-certified for:

- API Service CK-4, CJ-4, CI-4 PLUS, SN
- Cummins CES 20086
- Detroit Diesel DFS 93K222
- Ford WSS-M2C171-F1

Firebird Heavy Duty EC meets or exceeds the requirements of:

- Caterpillar ECF-3, ECF-2, ECF-1-a
- Mack EOS 4.5
- Mercedes-Benz Sheet 228.31
- Volvo VDS-4.5

**API CK-4 Diesel
Engine Oil
Formulated with
Re-refined Base
Stocks**

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LUBRICANTS

- Diesel engines manufactured by OEMs not listed above, where the OEM specifies API CK-4 engine oil

Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Protects against particulate filter plugging
- Excellent soot control for protection against abrasive wear and soot-induced oil thickening
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust, bearing corrosion and wear
- Good resistance to foaming and aeration
- Lessens the environmental impact of used oil disposal

Firebird® Heavy Duty EC Diesel Engine Oil

Typical Properties	
SAE Grade	15W-40
Specific Gravity @ 60°F	0.8774
Density, lbs/gal @ 60°F	7.31
Color, ASTM D1500	L 4.0
Flash Point (COC), °C (°F)	235 (455)
Pour Point, °C (°F)	-31 (-24)
Viscosity, Kinematic	
cSt @ 40°C	111
cSt @ 100°C	15.0
Viscosity Index	139
Cold Cranking Viscosity, cP @ -20°C	5,400
High-Temp/High-Shear Viscosity, cP @ 150°C	4.2
Sulfated Ash, ASTM D874, wt %	0.99
Total Base Number (TBN), ASTM D2896	9.7
Zinc, wt %	0.1250
Re-refined Content, Base Oil, vol %	100

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

3/9/2018

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LUBRICANTS

Fleet Supreme EC® Diesel Engine Oil

Phillips 66® Fleet Supreme EC (Emission Compatible) Diesel Engine Oil is an API CK-4 engine oil developed for use in four-stroke cycle diesel engines designed to meet 2007 and later EPA on-highway exhaust emissions standards. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPFs), diesel oxidation catalysts (DOCs) and/or selective catalytic reduction (SCR). It is backward serviceable for use in pre-2007 diesel engines.

Fleet Supreme EC Diesel Engine Oil is designed for use in mixed fleets with both on-highway and off-road equipment operating in varying climates and under varying loads and service conditions. It has excellent soot dispersancy to protect against soot-induced oil thickening and abrasive wear, and excellent oxidation resistance to help minimize deposit formation. The low-ash formulation protects exhaust catalysts on low-emission engines and helps prolong DPF life.

Fleet Supreme EC Diesel Engine Oil meets or exceeds the performance requirements of API Service Category CK-4 and is approved under the latest OEM specifications for use in low-emission diesel engines. It is backward serviceable for use where earlier API "C" category engine oils, or the concurrent earlier OEM specifications, are specified. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm. However, for applications not using Ultra-Low Sulfur Diesel (ULSD), consult the engine manufacturer for recommended service interval.

Applications

- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment

Fleet Supreme EC Diesel Engine Oil is licensed or OEM-certified for:

- API Service CK-4, CJ-4, CI-4 PLUS, SN (SAE 15W-40 only)
- Cummins CES 20086
- Detroit Diesel DFS 93K222
- Mack EOS 4.5
- Mercedes-Benz Sheet 228.31 (SAE 15W-40)
- MTU MTL 5044 Type 2.1 (SAE 15W-40)
- Renault VI RLD-4
- Volvo VDS-4.5
- Ford WSS-M2C171-F1

**API CK-4 Diesel
Engine Oil for
Low-Emission
Engines**

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Fleet Supreme EC Diesel Engine Oil meets or exceeds the requirements of:

- ACEA E9
- Caterpillar ECF-3, ECF-2, ECF-1-a
- Chrysler MS-10902 (SAE 15W-40)
- Diesel engines manufactured by OEMs not listed above, where the OEM specifies API CK-4 engine oil

Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Protects against particulate filter plugging
- Excellent soot control for protection against abrasive wear and soot-induced oil thickening
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust, bearing corrosion and wear
- Good resistance to foaming and aeration

Fleet Supreme EC® Diesel Engine Oil

Typical Properties		
SAE Grade	10W-30	15W-40
Specific Gravity @ 60°F	0.871	0.879
Density, lbs/gal @ 60°F	7.26	7.32
Color, ASTM D1500	4.0	4.0
Flash Point (COC), °C (°F)	227 (441)	227 (441)
Pour Point, °C (°F)	-45 (-49)	-38 (-36)
Viscosity, Kinematic		
cSt @ 40°C	82.0	117
cSt @ 100°C	12.0	15.2
Viscosity Index	143	135
Cold Cranking Viscosity, cP @ (°C)	6000 (-25)	5800(-20)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.6	4.3
Sulfated Ash, ASTM D874, wt %	1.00	1.00
Total Base Number (TBN), ASTM D2896	9.7	9.7
Zinc, wt %	0.125	0.125
Phosphorus wt%	0.1116	0.1116

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

01-31-2018

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LUBRICANTS

Guardol ECT[®] Diesel Engine Oil with Liquid Titanium[®]

Phillips 66[®] Guardol ECT (Emission Compatible Technology) Diesel Engine Oil with Liquid Titanium protection additive is a premium quality, part-synthetic API CK-4 engine oil developed for use in four-stroke cycle diesel engines designed to meet 2007 and later EPA on-highway exhaust emissions standards. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPF), diesel oxidation catalysts (DOC) and/or selective catalytic reduction (SCR). It is backward serviceable for use in pre-2007 diesel engines.

Guardol ECT with Liquid Titanium is formulated with a blend of synthetic and high-quality Group II base stocks and a proprietary low-SAPS additive package to provide outstanding engine protection in new and older diesel engines. It is fortified with our exclusive Liquid Titanium protection additive for enhanced oxidation resistance and protection against wear. This additive enhancement provides increased engine protection from a strongly bonded titanium shield formed on the surface of critical engine parts, which reduces wear and helps extend component life.

Guardol ECT with Liquid Titanium has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. It provides excellent bearing corrosion protection and protects against sludge and varnish formation. The synthetic blend formulation provides enhanced thermal stability at high temperatures and improved low-temperature properties compared with conventional diesel engine oils.

Guardol ECT with Liquid Titanium meets or exceeds the performance requirements of API Service Category CK-4 and is approved under the latest OEM specifications for use in low-emission diesel engines. It is backward serviceable for use where earlier API "C" category engine oils, or the concurrent earlier OEM specifications, are specified. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm. However, for applications not using Ultra-Low Sulfur Diesel (ULSD), consult the engine manufacturer for recommended service interval.

**Premium
Synthetic Blend
API CK-4 Diesel
Engine Oil;
Fortified with
Liquid Titanium[®]
Protection
Additive**

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SMOOTHLY.**





LUBRICANTS

Applications

- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment

Guardol ECT with Liquid Titanium is licensed or OEM-certified for:

- API Service CK-4 CJ-4, CI-4 PLUS
- Cummins CES 20086
- Detroit Diesel DFS 93K222
- Mack EOS-4.5
- Mercedes-Benz Sheet 228.31 (SAE 15W-40)
- MTU MTL 5044 Type 2.1 (SAE 15W-40)
- Renault VI RLD-4 (SAE 15W-40)
- Volvo VDS-4.5
- Ford WSS-M2C171-F1

Guardol ECT with Liquid Titanium meets or exceeds the requirements of:

- ACEA E9
- Caterpillar ECF-3, ECF-2, ECF-1-a
- Chrysler MS-10902 (SAE 15W-40)
- JASO DH-2 (SAE 15W-40)
- Diesel engines manufactured by OEMs not listed above, where the OEM specifies API CK-4 engine oil

Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Exclusive Liquid Titanium protection additive provides enhanced oxidation resistance and protection against engine wear
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust and bearing corrosion
- Excellent low-temperature pumpability with soot-laden oil
- High shear stability
- Good resistance to foaming and aeration

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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LUBRICANTS

Guardol ECT® Diesel Engine Oil with Liquid Titanium®

Typical Properties		
SAE Grade	10W-30	15W-40
Specific Gravity @ 60°F	0.870	0.875
Density, lbs/gal @ 60°F	7.25	7.29
Color, ASTM D1500	4.0	4.0
Flash Point (COC), °C (°F)	226 (439)	240 (464)
Pour Point, °C (°F)	-40 (-40)	-40 (-40)
Viscosity, Kinematic		
cSt @ 40°C	80.0	119
cSt @ 100°C	12.0	15.4
Viscosity Index	144	135
Cold Cranking Viscosity, cP @ (°C)	6300 (-25)	6200(-20)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.6	4.26
Sulfated Ash, ASTM D874, wt %	1.00	1.00
Total Base Number (TBN), ASTM D2896	10.5	10.5
Titanium, wt%	0.010	0.010
Zinc, wt %	0.122	0.122
Phosphorus wt %	0.1100	0.1100

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

01-13-2017

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LUBRICANTS

Guardol FE[®] Diesel Engine Oil with Liquid Titanium[®]

Phillips 66[®] Guardol FE (Fuel Economy) Diesel Engine Oil with Liquid Titanium protection additive is a premium quality, part-synthetic API FA-4 engine oil developed for fuel economy benefits in 2017 and newer engines where FA-4 is specified.

Guardol FE with Liquid Titanium is formulated with a blend of synthetic and high-quality Group II base stocks and a proprietary low-SAPS additive package to provide outstanding engine protection in diesel engines specifying FA-4. It is fortified with our exclusive Liquid Titanium protection additive for enhanced oxidation resistance and protection against wear. This additive enhancement provides increased engine protection from a strongly bonded titanium shield formed on the surface of critical engine parts, despite lower HTHS requirements of FA-4.

Guardol FE with Liquid Titanium has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. It provides excellent bearing corrosion protection and protects against sludge and varnish formation. The synthetic blend formulation provides enhanced thermal stability at high temperatures and improved low-temperature properties compared with conventional diesel engine oils.

Guardol FE with Liquid Titanium meets or exceeds the performance requirements of API Service Category FA-4, and is approved under the latest OEM specifications for use in low-emission diesel engines. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm.

Applications

- On-highway diesel trucks recommending FA-4 to meet 2017 emissions standards

Guardol FE with Liquid Titanium is licensed or OEM-certified for:

- API Service FA-4
- Cummins CES 20087
- Detroit Diesel DFS 93K223

**Premium
Synthetic Blend
API FA-4 Diesel
Engine Oil;
Formulated for
Fuel Economy**

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Features/Benefits

- Excellent protection for newer low-emission diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Exclusive Liquid Titanium protection additive provides enhanced oxidation resistance and protection against engine wear
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust and bearing corrosion
- Excellent low-temperature pumpability with soot-laden oil
- High shear stability
- Good resistance to foaming and aeration

Guardol FE® Diesel Engine Oil with Liquid Titanium®

Typical Properties	
SAE Grade	10W-30
Specific Gravity @ 60°F	0.870
Density, lbs/gal @ 60°F	7.24
Color, ASTM D1500	4.1
Flash Point (COC), °C (°F)	226 (439)
Pour Point, °C (°F)	-40 (-40)
Viscosity, Kinematic	
cSt @ 40°C	66
cSt @ 100°C	9.9
Viscosity Index	133
Cold Cranking Viscosity, cP @ (°C)	5500 (-25)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.13
Sulfated Ash, ASTM D874, wt %	1.00
Total Base Number (TBN), ASTM D2896	10.5
Titanium, wt%	0.010
Zinc, wt %	0.122

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

01-17-17



LUBRICANTS

Guardol® NG

Phillips 66® Guardol NG is a high-quality, dispersant-detergent gas engine oil specially designed for use in vehicular natural gas engines that have slider-follower valve trains. It is formulated with a higher level of antiwear additives than conventional low-ash gas engine oils to meet the enhanced wear protection requirements of diesel engines converted to natural gas service. It is particularly recommended for use in transit buses, school buses, delivery trucks and other vehicles equipped with Cummins, Detroit Diesel or John Deere CNG or LNG engines.

Guardol NG is formulated to provide outstanding oxidation and nitration resistance, excellent wear protection, and protection against rust and corrosion. It minimizes the formation of sludge and deposits for good engine cleanliness, and protects against valve stem deposits and valve seat recession, resulting in reduced maintenance and extended engine life. It also has good resistance to foaming and aeration.

Applications

- Transit buses, school buses, delivery trucks and other vehicles equipped with slider-follower CNG or LNG engines

Guardol NG is OEM-certified for:

- Cummins CES 20085
- Detroit Diesel DFS 93K216 (Series 50G and Series 60G engines)

Guardol NG meets the performance requirements of:

- John Deere 6.8L and 8.1L CNG engines

Features/Benefits

- Excellent wear protection for diesel engines converted to natural gas service
- High dispersancy protects against sludge and varnish formation
- Outstanding resistance to oxidation and nitration
- Protects against scuffing and wear
- Protects against valve stem deposits and valve seat recession
- Protects against rust and corrosion
- Good foam resistance

Natural Gas Engine Oil for Vehicular Applications





LUBRICANTS

Guardol® NG

Typical Properties	
SAE Grade	15W-40
Specific Gravity @ 60°F	0.875
Density, lbs/gal @ 60°F	7.29
Color, ASTM D1500	7.5
Flash Point (COC), °C (°F)	227 (441)
Pour Point, °C (°F)	-36 (-33)
Viscosity, Kinematic	
cSt @ 40°C	114
cSt @ 100°C	15.2
Viscosity Index	139
Cold Cranking Viscosity (CCS), cP @ -20°C	6,300
Sulfated Ash, ASTM D874, wt %	0.76
Total Base Number (TBN), ASTM D2896	6.0
Phosphorus, wt %	0.080
Zinc, wt %	0.088

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-14-2016

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LUBRICANTS

Heavy Duty Diesel Engine Oil

Phillips 66® Heavy Duty Diesel Engine Oil is a high-quality universal fleet engine oil designed for use in on-highway diesel trucks and off-highway diesel equipment operating in moderate to hot climates. It also is recommended for passenger cars and light trucks with either diesel or gasoline engines where the OEM recommends SAE 20W-50 or 25W-50 engine oil.

Heavy Duty Diesel Engine Oil is formulated with advanced additive technology to provide outstanding wear protection, soot control and bearing corrosion protection. Excellent soot dispersancy protects against abrasive wear and soot-induced oil thickening, and ensures good low-temperature pumpability even with soot-laden oil. High dispersancy-detergency and a high alkaline reserve (TBN) provide extra protection in extended drain or severe service intervals.

Heavy Duty Diesel Engine Oil meets or exceeds the performance requirements of API Service Categories CH-4 and SL. It is backward serviceable for use where API CG-4 or earlier "C" category engine oils are specified. It is not recommended for use in newer, low-emission diesel engines designed to meet 2004 and later exhaust emission standards.

Applications

- Older diesel equipment with conventional, non-EGR engines
- Mixed fleets with both diesel and gasoline-fueled vehicles
- Off-highway construction, earth moving and mining equipment
- Farm equipment with diesel or gasoline engines

Heavy Duty Diesel Engine Oil is licensed for:

- API Service CH-4, SL (25W-50 SL only)

Features/Benefits

- Excellent soot control for protection against abrasive wear and soot-induced oil thickening
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Excellent wear protection
- High shear stability
- Excellent rust and bearing corrosion protection
- Good resistance to foaming and aeration

Universal Fleet Engine Oil

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Heavy Duty Diesel Engine Oil

Typical Properties		
SAE Grade	20W-50	25W-50
Specific Gravity @ 60°F	0.877	0.884
Density, lbs/gal @ 60°F	7.31	7.36
Color, ASTM D1500	L 4.0	L4.0
Flash Point (COC), °C (°F)	242 (468)	242(468)
Pour Point, °C (°F)	-27 (-17)	-38(-36)
Viscosity, Kinematic		
cSt @ 40°C	190	192
cSt @ 100°C	20.0	20.3
Viscosity Index	125	124
Cold Cranking Viscosity, cP @ (°C)	9,300(-15)	5500(-10)
High Temp/High Shear Viscosity, cP @ 150°C	4.1	4.1
Sulfated Ash, ASTM D874, wt %	1.39	1.39
Total Base Number (TBN), ASTM D2896	10.5	10.5
Zinc, wt %	0.119	0.119

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-27-2017

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LUBRICANTS

Power-D® Engine Oil

Phillips 66® Power-D Engine Oil is a premium quality universal fleet engine oil designed for use in on-highway diesel trucks and off-highway diesel equipment, as well as in passenger cars and light trucks with either diesel or gasoline engines. It is recommended for use both in EGR-equipped diesel engines and in older, non-EGR diesel engines. It also will provide excellent protection for gasoline engines for use in mixed commercial fleets.

Power-D Engine Oil is formulated with advanced additive technology to provide outstanding wear protection, soot control and bearing corrosion protection. Outstanding soot dispersancy protects against abrasive wear and soot-induced oil thickening, and ensures good low-temperature pumpability even with soot-laden oil. High dispersancy-detergency and a high alkaline reserve (TBN) provide extra protection in extended drain or severe service intervals, and in EGR-equipped engines.

Power-D Engine Oil meets or exceeds the performance requirements of API Service Categories CI-4 and SL, API CI-4 PLUS, and leading OEM specifications and worldwide standards for diesel engine oils. It is backward serviceable for use where API CH-4 or earlier "C" category engine oils, or the concurrent earlier OEM specifications, are specified.

Applications

- On-highway diesel trucks equipped with cooled-EGR, ACERT or other technologies to meet 2004 and earlier exhaust emission standards
- Older diesel equipment with conventional, non-EGR engines
- Mixed fleets with both diesel and gasoline-fueled vehicles
- Off-highway construction, earth moving and mining equipment
- Farm equipment with diesel or gasoline engines

Power-D Engine Oil is licensed or OEM-certified for:

- API Service CI-4 with CI-4 PLUS, CI-4, CH-4, SL
- Cummins CES 20078
- Detroit Diesel DFS 93K214
- Mack EO-N Premium Plus 03
- Mercedes-Benz Sheet 228.3
- Renault VI RLD-2
- Volvo VDS-3

Premium Universal Fleet Engine Oil

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Power-D Engine Oil meets or exceeds the requirements of:

- ACEA E7-04, E5-02, E3-96
- Caterpillar ECF-2, ECF-1-a
- Cummins CES 20077
- Global DHD-1
- MAN 271, 3275
- MTU MTL 5044 Type 2
- Diesel engines manufactured by OEMs not listed above, including International (Navistar), JohnDeere, Hino, Komatsu, Kubota and others

Features/Benefits

- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Excellent wear protection
- High shear stability
- Excellent rust and bearing corrosion protection
- Good low-temperature pumpability, even with soot-laden oil
- Good resistance to foaming and aeration
- Extended drain capability for non-EGR diesel engines

Power-D® Engine Oil

Typical Properties	
SAE Grade	15W-40
Specific Gravity @ 60°F	0.880
Density, lbs/gal @ 60°F	7.33
Color, ASTM D1500	L 4.0
Flash Point (COC), °C (°F)	240 (464)
Pour Point, °C (°F)	-40 (-40)
Viscosity, Kinematic	
cSt @ 40°C	117
cSt @ 100°C	15.2
Viscosity Index	135
Cold Cranking Viscosity, cP @ -20°C	6,400
High-Temp/High-Shear Viscosity, cP @ 150°C	4.3
Sulfated Ash, ASTM D874, wt %	1.50
Total Base Number (TBN), ASTM D2896	11.8
Zinc, wt %	0.128

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

02-24-17

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LUBRICANTS

Ramar® Diesel XDO

Phillips 66® Ramar Diesel XDO is a high-quality, zinc-free, heavy-duty diesel engine oil designed for use in all 2-stroke cycle and 4-stroke cycle railroad locomotive diesel engines. It also is recommended for use in railroad-type diesel engines used in marine service or in stationary service for power generation. It is formulated with a new technology, reduced ash (9 TBN) additive package that is particularly recommended for use in modern EMD and GE power units running on low or ultra-low sulfur diesel fuel.

Ramar Diesel XDO is formulated with an advanced additive technology that provides improved oxidative stability, soot dispersancy and wear protection for use in the newer, low exhaust emissions, low oil consumption railroad diesel engines. It has excellent oxidation resistance, high dispersancy and improved TBN retention to protect against deposit formation and help maintain engine cleanliness, even in extended drain or severe service intervals. It provides excellent wear protection and is non-corrosive to yellow metals. The additive package is zinc-free to protect silver bearings and bushings found in older EMD diesel engines, and is non-chlorinated to permit easier recycling or disposal of used oil.

Ramar Diesel XDO meets or exceeds the performance requirements of the LMOA Generation 5 and GE Generation 4 Long Life railroad diesel engine oil standards. The low-SAPS formulation is designed for use in diesel engines operating on low or ultra-low sulfur diesel fuel, and also is compatible with the future exhaust aftertreatment technologies under development for use in these engines.

Applications

- All 2-stroke cycle and 4-stroke cycle railroad locomotive diesel engines, including newer, low exhaust emissions power units
- Railroad-type diesel engines used in marine service
- Railroad-type diesel engines used in stationary service for power generation or offshore drilling equipment

Ramar Diesel XDO is recommended for use in locomotive diesel engines manufactured by:

- ALCO Engine Division of White Industrial Power, Inc.
- Baldwin-Lima-Hamilton
- Cleveland Engine Division of General Motors
- Electro-Motive Diesel (EMD)
- Fairbanks Morse
- General Electric Company

Railroad Locomotive & Marine Diesel Engine Oil





Features/Benefits

- New technology, reduced ash (9 TBN) additive package for modern railroad locomotive diesel engines
- High dispersancy-detergency to protect against sludge and varnish formation
- Improved TBN retention for extra protection in longer or more severe service intervals
- Helps keep engines clean and extend oil filter life
- Minimizes port blocking in 2-stroke cycle engines
- Protects against rust and corrosion
- Non-corrosive to silver engine components in older EMD engines
- Non-chlorinated additive system for easier recycling or disposal of used oil
- Low-SAPS formulation for compatibility with future exhaust aftertreatment technologies

Ramar® Diesel XDO

Typical Properties	
SAE Grade	40
Specific Gravity @ 60°F	0.888
Density, lbs/gal @ 60°F	7.39
Color, ASTM D1500	7.5
Flash Point (COC), °C (°F)	270 (518)
Pour Point, °C (°F)	-27 (-17)
Viscosity, Kinematic	
cSt @ 40°C	158
cSt @ 100°C	15.4
Viscosity Index	98
Sulfated Ash, ASTM D874, wt %	1.0
Total Base Number (TBN), ASTM D2896	9
Zinc, wt %	<0.001

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-14-2016

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LUBRICANTS

Super HD II Diesel Engine Oil

Phillips 66® Super HD II Diesel Engine Oil is a high-quality universal fleet engine oil designed for use in on-highway diesel trucks and off-highway diesel equipment, as well as in passenger cars and light trucks with either diesel or gasoline engines. It is recommended for use both in EGR-equipped diesel engines and in older, non-EGR diesel engines. It also will provide excellent protection for gasoline engines for use in mixed commercial fleets.

Super HD II is formulated with advanced additive technology to provide excellent wear protection, soot control and bearing corrosion protection. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and excellent oxidation resistance to help minimize deposit formation.

Super HD II meets or exceeds the performance requirements of API Service Categories CI-4 and SL, API CI-4 PLUS and leading OEM specifications for diesel engine oils. It is backward serviceable for use where API CH-4 or earlier "C" category engine oils, or the concurrent earlier OEM specifications, are specified.

Applications

- On-highway diesel trucks equipped with cooled-EGR, ACERT or other technologies to meet 2004 and earlier exhaust emission standards
- Older diesel equipment with conventional, non-EGR engines
- Mixed fleets with both diesel and gasoline-fueled vehicles
- Off-highway construction, earth moving and mining equipment
- Farm equipment with diesel or gasoline engines

Super HD II Diesel Engine Oil is licensed or OEM-certified for:

- API Service CI-4 with CI-4 PLUS, CI-4, CH-4, SL
- Mack EO-N Premium Plus 03
- Volvo VDS-2

Super HD II Diesel Engine Oil meets or exceeds the requirements of:

- ACEA E7-04, E5-02, E3-96
- Caterpillar ECF-2, ECF-1-a
- Cummins CES 20078
- MAN 271, 3275
- MTU MTL 5044 Type 2
- Diesel engines manufactured by OEMs not listed above, including International (Navistar), John Deere, Hino, Komatsu, Kubota and others

Universal Fleet Engine Oil





Features/Benefits

- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Excellent resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Excellent wear protection
- High shear stability
- Excellent rust and bearing corrosion protection
- Good low-temperature pumpability, even with soot-laden oil
- Good resistance to foaming and aeration
- Extended drain capability for non-EGR diesel engines

Super HD II Diesel Engine Oil

Typical Properties	
SAE Grade	15W-40
Specific Gravity @ 60°F	0.879
Density, lbs/gal @ 60°F	7.32
Color, ASTM D1500	L 4.0
Flash Point (COC), °C (°F)	240 (464)
Pour Point, °C (°F)	-39 (-38)
Viscosity, Kinematic	
cSt @ 40°C	117
cSt @ 100°C	15.4
Viscosity Index	138
Cold Cranking Viscosity, cP @ -20°C	6,250
High-Temp/High-Shear Viscosity, cP @ 150°C	4.2
Sulfated Ash, ASTM D874, wt %	1.39
Total Base Number (TBN), ASTM D2896	11.0
Zinc, wt %	0.119

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

T5X® Heavy Duty Diesel Engine Oil

Phillips 66® T5X Heavy Duty Diesel Engine Oil is a high-quality diesel engine oil designed for use in a wide variety of applications, including off-highway diesel equipment, farm machinery, marine engines, 2-stroke cycle diesel engines (SAE 40 only) and mixed commercial fleets. It also may be used in some heavy-duty manual transmissions in trucks and buses.

T5X Heavy Duty is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, to protect against rust and bearing corrosion, and to resist foaming. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and excellent oxidation resistance to help minimize deposit formation. The SAE 40 viscosity grade has low ash content to help minimize ash deposits and keep intake ports clear to maintain good power output in 2-stroke cycle applications.

T5X Heavy Duty SAE 30 & SAE 50 meets or exceeds the performance requirements of API Service Categories CF and SL. They are recommended primarily for use in off-highway diesel equipment and mixed commercial fleets with both diesel and gasoline vehicles.

T5X Heavy Duty SAE 40 meets or exceeds the performance requirements of API Service Categories CF-2 and CF, and also may be used in applications where API CD quality oil is specified. It is particularly recommended for use in 2-stroke cycle diesel engines in transit buses and marine fleets running on low-sulfur diesel fuel.

Applications

- 2-stroke cycle diesel engines in bus fleets and marine fleets (SAE 40)
- Off-highway trucks, heavy equipment and farm equipment
- Light trucks and farm equipment with gasoline engines (SAE 30, SAE 50)
- Heavy-duty manual transmissions in trucks and buses where the OEM specifies engine oil

T5X Heavy Duty meets or exceeds the requirements of:

- API Service CF-2⁽¹⁾, CF⁽¹⁾ (SAE 40)
- API Service CF⁽¹⁾, SL (SAE 30, SAE 50)
- Detroit Diesel 2-stroke cycle engines, Oil Type 1 (1.0% max. sulfated ash) (SAE 40)

⁽¹⁾ Obsolete service category.

Heavy-Duty Monograde Diesel Engine Oil





Features/Benefits

- Excellent soot control for protection against abrasive wear and soot-induced oil thickening
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- Protects against rust and bearing corrosion
- Good resistance to foaming and aeration
- Low-ash content to minimize ash deposits and help keep intake ports clean (SAE 40)

T5X® Heavy Duty Diesel Engine Oil

Typical Properties			
SAE Grade	30	40	50
Specific Gravity @ 60°F	0.883	0.886	0.891
Density, lbs/gal @ 60°F	7.35	7.38	7.42
Color, ASTM D1500	4.0	4.0	4.0
Flash Point (COC), °C (°F)	230 (446)	235 (455)	240 (464)
Pour Point, °C (°F)	-33 (-27)	-27 (-17)	-27 (-17)
Viscosity, Kinematic			
cSt @ 40°C	92.0	142	224
cSt @ 100°C	11.3	15.0	20.0
Viscosity Index	110	106	103
High-Temp/High-Shear Viscosity, cP @ 150°C	3.4	4.2	5.7
Sulfated Ash, ASTM D874, wt %	1.39	0.90	1.39
Total Base Number (TBN), ASTM D2896	10.5	6.8	10.5
Zinc, wt %	0.119	0.077	0.119

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

T5X® Off-Road Mobile Hydraulic Fluid

Phillips 66® T5X Off-Road Mobile Hydraulic Fluid is a high-performance hydraulic fluid designed primarily for use in the hydraulic systems of Caterpillar and other off-highway mobile equipment. It also may be used in the hydrostatic transmissions of some off-road equipment.

T5X Off-Road Mobile Hydraulic Fluid is formulated to provide excellent wear protection, to protect hydraulic system components against rust and corrosion, and to resist foaming. It has excellent oxidation resistance to minimize deposit formation and provide long service life, and high dispersancy-detergency to maintain hydraulic system cleanliness. It contains a high level of zinc-containing antiwear additive to meet Caterpillar requirements for use in the hydraulic systems of Caterpillar equipment. It has a high viscosity index for use over a wide temperature range.

T5X Off-Road Mobile Hydraulic Fluid is recommended for use in a wide range of hydraulic applications in the construction, mining and agricultural industries. However, it is not recommended for use in industrial hydraulic systems where excellent water separation is required, since the dispersant-detergent additives will emulsify some water and hold it in suspension.

Applications

- Hydraulic systems and some hydrostatic transmissions on Caterpillar and other off-highway mobile equipment
- Hydraulic systems operating over a wide temperature range

Features/Benefits

- High viscosity index for use over a wide temperature range
- Excellent wear protection for hydraulic system components
- High dispersancy-detergency for excellent system cleanliness
- Protects against deposit formation
- Protects against rust and corrosion
- Good resistance to foaming

**High-
Performance
Hydraulic
Fluid for Off-
Road Mobile
Equipment**

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T5X® Off-Road Mobile Hydraulic Fluid

Typical Properties	
SAE Grade	10W
Specific Gravity @ 60°F	0.872
Density, lbs/gal @ 60°F	7.26
Color, ASTM D1500	L 2.5
Flash Point (COC), °C (°F)	210 (410)
Pour Point, °C (°F)	-39 (-38)
Viscosity, Kinematic	
cSt @ 40°C	48.0
cSt @ 100°C	7.5
Viscosity Index	120
Sulfated Ash, ASTM D874, wt %	1.16
Total Base Number (TBN), ASTM D2896	8.7
Zinc, wt %	0.099

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

T5X® PLUS Heavy Duty Diesel Engine Oil

Phillips 66® T5X PLUS Heavy Duty Diesel Engine Oil is a high-quality diesel engine oil designed for use in off-highway diesel equipment, farm machinery, marine engines and mixed commercial fleets.

T5X PLUS Heavy Duty is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, to protect against rust and bearing corrosion, and to resist foaming. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and excellent oxidation resistance to help minimize deposit formation.

Applications

- Off-highway trucks, heavy equipment and farm equipment

T5X PLUS Heavy Duty meets or exceeds the requirements of:

- Former API Service CF
- API Service SL

Features/Benefits

- Excellent soot control for protection against abrasive wear and soot-induced oil thickening
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- Protects against rust and bearing corrosion
- Good resistance to foaming and aeration

**Heavy-Duty
Monograde
Diesel Engine
Oil**

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T5X® PLUS Heavy Duty Diesel Engine Oil

Typical Properties	
SAE Grade	40
Specific Gravity @ 60°F	0.879
Density, lbs/gal @ 60°F	7.32
Color, ASTM D1500	4.0
Flash Point (COC), °C (°F)	235 (455)
Pour Point, °C (°F)	-36 (-33)
Viscosity, Kinematic	
cSt @ 40°C	142
cSt @ 100°C	15.3
Viscosity Index	110
High-Temp/High-Shear Viscosity, cP @ 150°C	4.2
Sulfated Ash, ASTM D874, wt %	1.39
Total Base Number (TBN), ASTM D2896	10.5
Zinc, wt %	0.119

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

02-16-2017

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LUBRICANTS

Triton® Arctic Diesel Engine Oil

Phillips 66® Triton Arctic Diesel Engine Oil is a premium quality, full-synthetic engine oil developed for use in 4-stroke cycle diesel engines operating under arctic temperature conditions. It meets API CK-4 performance requirements for use in modern low-emission engines designed to meet 2007 and later EPA on-highway exhaust emissions standards, and is backward serviceable for use in older diesel engines. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPF), diesel oxidation catalysts (DOC) and/or selective catalytic reduction (SCR). The full-synthetic formulation and SAE 0W-40 viscosity grade provide excellent low-temperature properties for better performance in harsh arctic climates.

Triton Arctic Diesel Engine Oil is formulated with synthetic base stocks and an advanced low-SAPS additive package to provide outstanding wear protection, soot control and bearing corrosion protection in both conventional and EGR-equipped diesel engines. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. The full-synthetic formulation provides enhanced oxidation resistance and thermal stability at high temperatures and improved low-temperature properties compared with a conventional, non-synthetic formulation.

Triton Arctic Diesel Engine Oil is recommended for use in diesel engines where an API CK-4 quality engine oil is specified, and is backward serviceable for use where earlier API "C" category engine oils are specified.

Applications

- On- and off- highway diesel equipment operating at very low ambient temperatures
- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment

Triton Arctic Diesel Engine Oil meets or exceeds the requirements of:

- Diesel engines manufactured by Caterpillar, Cummins, Detroit Diesel, Mack, Mercedes-Benz, Volvo and other OEMs where the OEM specifies an SAE 0W-40, API CK-4 engine oil

Premium Full-Synthetic Diesel Engine Oil for Arctic Climates; Fortified with Liquid Titanium® Protection Additive

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Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Exclusive Liquid Titanium additive provides enhanced oxidation and wear control
- Protects against rust, bearing corrosion and wear
- Excellent low-temperature pumpability for easier starting and less wear during cold starts
- High shear stability
- High resistance to foaming and aeration

Triton® Arctic Diesel Engine Oil

Typical Properties	
SAE Grade	0W-40
Specific Gravity @ 60°F	0.846
Density, lbs/gal @ 60°F	7.04
Color, ASTM D1500	4.0
Flash Point (COC), °C (°F)	226 (439)
Pour Point, °C (°F)	-58 (-72)
Viscosity, Kinematic	
cSt @ 40°C	85
cSt @ 100°C	14.4
Viscosity Index	178
Cold Cranking Viscosity, cP @ -35°C	5,853
High-Temp/High-Shear Viscosity, cP @ 150°C	4.0
Sulfated Ash, ASTM D874, wt %	1.0
Total Base Number (TBN), ASTM D2896	10.8
Zinc, wt %	0.1215
Titanium, wt %	0.010

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

02-05-2018

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LUBRICANTS

Triton® ECT Diesel Engine Oil

Phillips 66® Triton ECT Diesel Engine Oil is a premium quality, full-synthetic engine oil developed for use in 4-stroke cycle diesel engines operating under extreme temperature conditions. It meets API CK-4 performance requirements for use in modern low-emission engines designed to meet 2007 and later EPA on-highway exhaust emissions standards, and is backward serviceable for use in older diesel engines. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPF), diesel oxidation catalysts (DOC) and/or selective catalytic reduction (SCR). The full-synthetic formulation and SAE 5W-40 viscosity grade provide excellent low-temperature properties for better performance in harsh winter climates.

Triton ECT is formulated with synthetic base stocks and an advanced low-SAPS additive package to provide outstanding wear protection, soot control and bearing corrosion protection in both conventional and EGR-equipped diesel engines. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. The full-synthetic formulation provides enhanced oxidation resistance and thermal stability at high temperatures and improved low-temperature properties compared with a conventional, non-synthetic formulation.

Triton ECT meets or exceeds the performance requirements of API Service Categories CK-4 and SN, and is approved under the latest OEM specifications for use in low-emission diesel engines. It is backward serviceable for use where earlier API "C" category engine oils, or the concurrent earlier OEM specifications, are specified. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm. However, for applications not using Ultra-Low Sulfur Diesel (ULSD), consult the engine manufacturer for recommended service interval.

Applications

- On- and off- highway diesel equipment operating at low ambient temperatures
- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment
- Mixed fleets with diesel and gasoline-fueled vehicles

Triton ECT Diesel Engine Oil is licensed, registered or approved for:

- API Service CK-4 CJ-4, CI-4 PLUS, SN
- Cummins CES 20086
- Detroit Diesel DFS 93K222
- Deutz DQC III-10
- Mack EOS 4.5, Volvo VDS 4.5
- Mercedes-Benz Sheet 228.31

**Premium Full
Synthetic API
CK-4 Diesel
Engine Oil;
Fortified with
Liquid Titanium
Protection
Additive**

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LUBRICANTS

- Renault VI RLD-4
- Ford WSS-M2C171-F-1

Triton ECT Full Synthetic meets or exceeds the requirements of:

- ACEA E9-08, E7-08
- Caterpillar ECF-3, ECF-2, ECF-1-a
- Diesel engines manufactured by OEMs not listed above, where the OEM specifies API CK-4 engine oil

Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Exclusive Liquid Titanium additive provides enhanced oxidation and wear control
- Protects against rust, bearing corrosion and wear
- Excellent low-temperature pumpability for easier starting and less wear during cold starts
- High shear stability
- High resistance to foaming and aeration

Triton[®] ECT Diesel Engine Oil

Typical Properties	
SAE Grade	5W-40
Specific Gravity @ 60°F	0.855
Density, lbs/gal @ 60°F	7.12
Color, ASTM D1500	4.0
Flash Point (COC), °C (°F)	240 (464)
Pour Point, °C (°F)	-48 (-54)
Viscosity, Kinematic	
cSt @ 40°C	96.0
cSt @ 100°C	14.5
Viscosity Index	166
Cold Cranking Viscosity, cP @ -30°C	6,230
High-Temp/High-Shear Viscosity, cP @ 150°C	4.2
Sulfated Ash, ASTM D874, wt %	1.0
Total Base Number (TBN), ASTM D2896	10.2
Titanium	0.010
Zinc, wt %	0.1288

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® Euro Diesel Engine Oil

Phillips 66® Triton Euro Diesel Engine Oil is a premium quality, full-synthetic engine oil developed for use in 4-stroke cycle diesel engines operating under extreme temperature conditions. It meets API CK-4 performance requirements for use in modern low-emission engines designed to meet 2007 and later EPA on-highway exhaust emissions standards, and is backward serviceable for use in older diesel engines. It is specially formulated for compatibility with exhaust aftertreatment systems using diesel particulate filters (DPF), diesel oxidation catalysts (DOC) and/or selective catalytic reduction (SCR). The full-synthetic formulation and SAE 5W-30 viscosity grade provide excellent low-temperature properties for better performance in harsh winter climates.

Triton Euro is formulated with synthetic base stocks and an advanced low-SAPS additive package to provide outstanding wear protection, soot control and bearing corrosion protection in both conventional and EGR-equipped diesel engines. It has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. The full-synthetic formulation provides enhanced oxidation resistance and thermal stability at high temperatures and improved low-temperature properties compared with a conventional, non-synthetic formulation.

Triton Euro meets or exceeds the performance requirements of API Service Categories CK-4 and SN, and is approved under the latest OEM specifications for use in low-emission diesel engines. It is backward serviceable for use where earlier API "C" category engine oils, or the concurrent earlier OEM specifications, are specified. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm. However, for applications not using Ultra-Low Sulfur Diesel (ULSD), consult the engine manufacturer for recommended service interval.

Applications

- On- and off- highway diesel equipment operating at low ambient temperatures
- On-highway diesel trucks equipped with EGR and exhaust aftertreatment systems to meet 2007/2010 emissions standards
- Older diesel equipment with conventional, non-EGR engines or ACERT engines
- Off-highway construction, earth moving and mining equipment
- Mixed fleets with diesel and gasoline-fueled vehicles

Triton Euro Diesel Engine Oil meets requirements of:

- API Service CK-4, SN
- Cummins CES 20086
- Detroit Diesel DFS 93K222
- Deutz DQC IV-10
- Mack EOS 4.5, Volvo VDS 4.5
- Mercedes-Benz Sheet 228.51

**Premium Full
Synthetic API
CK-4 Diesel
Engine Oil**

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- Renault VI RLD-4
- ACEA E6
- Caterpillar ECF-3, ECF-2, ECF-1-a
- Diesel engines manufactured by OEMs not listed above, where the OEM specifies API CK-4 engine oil

Features/Benefits

- Excellent protection for newer low-emission diesel engines and older diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust, bearing corrosion and wear
- Excellent low-temperature pumpability for easier starting and less wear during cold starts
- High shear stability
- High resistance to foaming and aeration

Triton[®] Euro Diesel Engine Oil

Typical Properties	
SAE Grade	5W-30
Specific Gravity @ 60°F	0.8540
Density, lbs/gal @ 60°F	7.11
Color, ASTM D1500	3.4
Flash Point (COC), °C (°F)	220 (428)
Pour Point, °C (°F)	-45 (-48)
Viscosity, Kinematic	
cSt @ 40°C	73
cSt @ 100°C	12.0
Viscosity Index	155
Cold Cranking Viscosity, cP @ -30°C	5780
High-Temp/High-Shear Viscosity, cP @ 150°C	3.6
Sulfated Ash, ASTM D874, wt %	.95
Total Base Number (TBN), ASTM D2896	10.1
Zinc, wt %	0.0823

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton FE® Diesel Engine Oil

Phillips 66® Triton FE (Fuel Economy) Diesel Engine Oil is a premium quality, full-synthetic API FA-4 engine oil developed for fuel economy benefits in 2017 and newer engines where FA-4 is specified.

Triton FE is formulated with the highest quality synthetic base stocks and a proprietary low-SAPS additive package to provide outstanding engine protection in diesel engines specifying FA-4. This additive enhancement provides increased engine protection of critical engine parts, despite lower HTHS requirements of FA-4.

Triton FE has excellent soot dispersancy to protect against abrasive wear and soot-induced oil thickening, and to ensure good low-temperature pumpability even with highly soot-laden oil. It provides excellent bearing corrosion protection and protects against sludge and varnish formation. The synthetic formulation provides enhanced thermal stability at high temperatures and improved low-temperature properties compared with conventional diesel engine oils.

Triton FE meets or exceeds the performance requirements of API Service Category FA-4, SN and is approved under the latest OEM specifications for use in low-emission diesel engines. It is formulated for use in diesel engines operating on diesel fuels with sulfur content up to 500 ppm.

Applications

- On-highway diesel trucks recommending FA-4 to meet 2017 emissions standards
- Mixed fleets with diesel and gasoline fueled vehicles

Triton FE is licensed or OEM-certified for:

- API Service FA-4, SN
- Cummins CES 20087
- Detroit Diesel DFS 93K223

**Premium Full
Synthetic API
FA-4 Diesel
Engine Oil;
Formulated for
Fuel Economy**

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Features/Benefits

- Excellent protection for newer low-emission diesel engines
- Specially formulated to protect exhaust aftertreatment systems
- Outstanding soot control for protection against abrasive wear and soot-induced oil thickening
- Outstanding resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against rust and bearing corrosion
- Excellent low-temperature pumpability with soot-laden oil
- High shear stability
- Good resistance to foaming and aeration

Triton FE® Diesel Engine Oil

Typical Properties	
SAE Grade	5W-30
Specific Gravity @ 60°F	0.8540
Density, lbs/gal @ 60°F	7.11
Color, ASTM D1500	3.4
Flash Point (COC), °C (°F)	226 (439)
Pour Point, °C (°F)	-45 (-49)
Viscosity, Kinematic	
cSt @ 40°C	57
cSt @ 100°C	9.9
Viscosity Index	155
Cold Cranking Viscosity, cP @ (°C)	5060 (-30)
High-Temp/High-Shear Viscosity, cP @ 150°C	3.0
Sulfated Ash, ASTM D874, wt %	.95
Total Base Number (TBN), ASTM D2896	10.1
Zinc, wt %	0.0823

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

11-16-17



LUBRICANTS

NATURAL GAS ENGINE OILS



LUBRICANTS

El Mar® Ashless Heavy Duty GEO

Phillips 66® El Mar Ashless Heavy Duty GEO is a high quality, ashless gas engine oil designed for use in naturally aspirated and moderately turbocharged 2-stroke cycle natural gas engines. Engines operating in this type of service typically are found on crude oil and gas transmission pipelines, electrical power generators, gas compressors, irrigation water pumps and well drilling rigs.

El Mar Ashless Heavy Duty GEO is formulated with field-proven performance additives to meet the rigorous lubrication demands of modern, fuel-efficient, low-emission gas engines. It provides excellent resistance to oxidation and nitration, protects against ring and liner wear, minimizes the formation of sludge and piston deposits for outstanding engine cleanliness, and protects against corrosion. The absence of ash-forming additives results in very clean intake ports to help maintain peak engine performance, and also helps extend spark plug life in spark-ignited gas engines.

Applications

- 2-stroke cycle and some 4-stroke cycle natural gas engines where the manufacturer specifies an ashless gas engine oil
- SAE 5W-30 special application only contact technical service

El Mar Ashless Heavy Duty GEO is recommended for use in natural gas engines manufactured by:

- Ajax
- Climax
- Colt-Fairbanks Morse
- Cooper Bessemer
- Dresser Clark
- Dresser Rand (Category I & II)
- Worthington

Features/Benefits

- Field-proven performance in providing outstanding engine cleanliness
- Ashless formulation helps minimize port deposits
- Good dispersancy protects against sludge and varnish formation
- Excellent resistance to oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Does not contain any bright stock, which can cause harmful carbon deposits

Ashless Natural Gas Engine Oil





LUBRICANTS

El Mar® Ashless Heavy Duty GEO

Typical Properties				
SAE Grade	30	40	15W-40	5W-30
Specific Gravity @ 60°F	0.883	0.889	0.875	0.8586
Density, lbs/gal @ 60°F	7.36	7.40	7.29	7.15
Color, ASTM D1500	3.0	3.5	2.5	3.0
Flash Point (COC), °C (°F)	211(412)	270 (518)	235(455)	214(418)
Pour Point, °C (°F)	-27(-17)	-27 (-17)	-36(-33)	-42(-44)
Viscosity, Kinematic				
cSt @ 40°C	94.7	142	107	61
cSt @ 100°C	11.0	14.2	14.3	10.45
Viscosity Index	101	97	136	161
Cold Cranking Viscosity, cP @ (°C)	---	---	6300 (-20)	5150(-30)
Sulfated Ash, ASTM D874, wt %	<0.01	<0.01	<0.01	<0.01
Total Base Number (TBN), ASTM D2896	1.0	1.0	1.0	1.0
Phosphorus, wt %	0.054	0.054	0.054	0.54

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

04-10-2018

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LUBRICANTS

El Mar® Ashless Supreme GEO

Phillips 66® El Mar Ashless Supreme GEO is a premium quality, ashless gas engine oil designed for use in naturally aspirated and turbocharged 2-stroke cycle natural gas engines. Engines operating in this type of service typically are found on crude oil and gas transmission pipelines, electrical power generators, gas compressors, irrigation water pumps and well drilling rigs.

El Mar Ashless Supreme GEO is formulated with advanced, field-proven performance additives to meet the rigorous lubrication demands of modern, fuel-efficient, low-emission gas engines. It provides excellent resistance to oxidation and nitration, protects against ring and liner wear, minimizes the formation of sludge and piston deposits for outstanding engine cleanliness, and protects against corrosion. The absence of ash-forming additives results in very clean intake ports to help maintain peak engine performance, and also helps extend spark plug life in spark-ignited gas engines.

Applications

- 2-stroke cycle and some 4-stroke cycle natural gas engines where the manufacturer specifies an ashless gas engine oil

El Mar Ashless Supreme GEO is recommended for use in natural gas engines manufactured by:

- Ajax
- Climax
- Colt-Fairbanks Morse
- Cooper Bessemer
- Dresser Clark
- Dresser Rand (Category I & II)
- Worthington

Features/Benefits

- Field-proven performance in providing outstanding engine cleanliness
- Ashless formulation helps minimize port deposits
- High dispersancy protects against sludge and varnish formation
- Excellent resistance to oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Does not contain any bright stock, which can cause harmful carbon deposits

**Premium
Ashless Natural
Gas Engine Oil**

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El Mar® Ashless Supreme GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.883	0.892	0.871
Density, lbs/gal @ 60°F	7.36	7.43	7.26
Color, ASTM D1500	3.0	3.5	3.0
Flash Point (COC), °C (°F)	260 (500)	270 (518)	240 (464)
Pour Point, °C (°F)	-30 (-22)	-27 (-17)	-40 (-40)
Viscosity, Kinematic			
cSt @ 40°C	92.8	142	106
cSt @ 100°C	11.0	14.3	14.4
Viscosity Index	103	98	139
Cold Cranking Viscosity, cP @ (°C)	---	---	6200 (-20)
Sulfated Ash, ASTM D874, wt %	<0.01	<0.01	<0.01
Total Base Number (TBN), ASTM D2896	1.3	1.3	1.3
Phosphorus, wt %	0.067	0.067	0.067

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-13-2016

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LUBRICANTS

El Mar® GEO

Phillips 66® El Mar GEO is a high-quality, non-detergent, ashless gas engine oil designed primarily for use in Ajax 2-stroke cycle natural gas engines. The SAE 15W-40 viscosity grade meets the low-temperature viscosity requirements of Ajax engines where cold starts and frequent start/stop cycles may be encountered.

El Mar GEO is formulated to provide excellent resistance to oxidation and nitration, protect against ring and liner wear, minimize the formation of sludge and piston deposits for excellent engine cleanliness, and protect against corrosion. The absence of ash-forming additives results in clean intake ports to help maintain peak engine performance, and also helps extend spark plug life in spark-ignited gas engines. This oil is formulated to meet the requirements of gas engines equipped with exhaust aftertreatment devices.

Applications

- Ajax 2-stroke cycle natural gas engines (SAE 15W-40)
- Older, horizontal-type 2-stroke cycle natural gas engines, such as those manufactured by Cooper-Bessemer and Worthington (SAE 30/40)

El Mar GEO Oil is approved for use under the following OEM specification:

- DuPont Specification A4V4

Note: El Mar GEO Oil is not recommended for use in high-speed, 4-stroke cycle natural gas engines.

Features/Benefits

- Ashless formulation helps minimize port deposits
- Protects against sludge and varnish formation
- Excellent resistance to oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Excellent water-separating properties
- Low carbon-forming tendency
- Compatible with emissions system catalysts
- Does not contain any bright stock, which can cause harmful carbon deposits

**Non-Detergent,
Ashless Natural
Gas Engine Oil**

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El Mar® GEO

Typical Properties		
SAE Grade	30/40	15W-40
Specific Gravity @ 60°F	0.885	0.869
Density, lbs/gal @ 60°F	7.37	7.24
Color, ASTM D1500	3.0	2.0
Flash Point (COC), °C (°F)	280 (536)	240 (464)
Pour Point, °C (°F)	-24 (-11)	-40 (-40)
Viscosity, Kinematic		
cSt @ 40°C	133	107
cSt @ 100°C	13.1	14.2
Viscosity Index	91	135
Cold Cranking Viscosity, cP @ (°C)	---	6,400(-20)
Acid Number, ASTM D974, mg KOH/g	0.14	0.04
Carbon Residue, ASTM D524, wt %	0.05	0.10
Sulfated Ash, ASTM D874, wt %	<0.01	<0.01
Phosphorus, wt %	0.003	0.011

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

El Mar® LA4 EXD GEO

Phillips 66® El Mar LA4 EXD GEO is a premium quality, next-generation, low-ash, dispersant-detergent gas engine oil designed for use in high-output 4-stroke cycle and some 2-stroke cycle natural gas engines operating under severe conditions. It is particularly recommended for use in stoichiometric and lean-burn gas engines fueled by natural gas or LPG, which typically are found on crude oil and gas transmission pipelines, electrical power generators, gas compressors, irrigation water pumps and well drilling rigs.

El Mar LA4 EXD GEO is formulated with high-quality Group II base stocks and the latest, state-of-the art, field-proven additive technology developed to meet the rigorous lubrication demands of modern, fuel-efficient, low-emission gas engines. It provides outstanding resistance to oil oxidation and nitration, and has a well-balanced alkaline reserve (TBN) to neutralize acids over long service intervals. It protects against ring and liner wear, minimizes the formation of sludge and piston deposits for outstanding engine cleanliness, and protects against corrosion. It also protects against valve stem deposits and valve recession, resulting in reduced maintenance and extended engine life. The additive package has low phosphorus content to meet the requirements of gas engines equipped with catalysts for exhaust after-treatment.

El Mar LA4 EXD GEO has demonstrated the capability to extend oil service intervals without compromising engine performance or component life. The use of high-quality, low-volatility base stocks helps reduce oil consumption, minimize exhaust system deposits and reduce the amount of make-up oil needed, thereby resulting in lower operating costs.

Applications

- Turbocharged, lean-burn and naturally aspirated 4-stroke cycle and some 2-stroke cycle natural gas engines where the manufacturer specifies a low-ash gas engine oil meeting API CF or API CD performance requirements
- Some gas engines burning landfill gas containing minimal levels of hydrogen sulfide

El Mar LA4 EXD GEO is recommended for use in natural gas engines manufactured by:

- Caterpillar
- Climax
- Colt-Fairbanks Morse
- Cooper Bessemer
- Dresser Rand (Category I, II, III)
- GE Jenbacher
- Minneapolis-Moline

**Premium, Next-
Generation,
Low-Ash Natural
Gas Engine Oil**

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LUBRICANTS

- Nordberg
- Superior
- Wartsila
- Waukesha
- Worthington

Features/Benefits

- Proven extended-drain capability for reduced maintenance costs and maximum productivity
- Field-proven performance in providing outstanding engine cleanliness
- High dispersancy protects against sludge and varnish formation
- Outstanding resistance to oil oxidation and nitration
- Enhanced protection against piston scuffing and ring and liner wear
- Excellent protection against rust and corrosion
- Low-ash formulation protects against valve stem deposits and valve recession
- Compatible with emissions system catalysts
- Does not contain any bright stock, which can cause harmful carbon deposits

EI Mar® LA4 EXD GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.877	0.880	0.871
Density, lbs/gal @ 60°F	7.30	7.33	7.25
Color, ASTM D1500	4.5	5.0	4.5
Flash Point (COC), °C (°F)	254 (489)	274 (525)	230 (446)
Pour Point, °C (°F)	-36 (-33)	-36 (-33)	-39 (-38)
Viscosity, Kinematic			
cSt @ 40°C	89.4	128	112
cSt @ 100°C	11.0	13.9	14.9
Viscosity Index	109	106	138
Cold Cranking Viscosity, cP @ (°C)	---	---	6000 (-20)
Sulfated Ash, ASTM D874, wt %	0.50	0.50	0.50
Total Base Number (TBN), ASTM D2896	5.5	5.5	5.5
Phosphorus, wt %	0.028	0.028	0.028
Zinc, wt %	0.033	0.033	0.033

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

El Mar® LF-D GEO

Phillips 66® El Mar LF-D (landfill-digester) GEO is a premium quality, next-generation, low-ash, gas engine oil designed for landfill gas applications. It is especially effective in controlling silica deposits formed during the combustion of siloxane gases found in many landfills.

El Mar LF-D GEO is formulated with high-quality Group II base stocks and the newest high dispersant additive technology developed to meet the rigorous lubrication demands of natural gas engines operating on landfill or digester fuel. It provides outstanding resistance to oil oxidation and nitration, and has a well-balanced alkaline reserve (TBN) to neutralize acids over long service intervals. It protects against ring and liner wear, minimizes the formation of silica deposits on cylinder heads and liners. The additive package is zinc and phenate free for use in landfill applications. Low ash content protects catalysts and all exhaust after-treatment hardware.

El Mar LF-D GEO has the capability to extend cylinder head and other engine component life. The combination of high-quality base stocks and enhanced silica deposit control helps reduce oil consumption thereby resulting in lower operating costs.

Applications

- Turbocharged, lean-burn and naturally aspirated 4-stroke cycle and some 2-stroke cycle natural gas engines where the manufacturer specifies a low-ash gas engine oil meeting API CF or API CD performance requirements
- Gas engines burning landfill gas containing hydrogen sulfide

El Mar LF-D GEO is recommended for use in natural gas engines manufactured by:

- Caterpillar
- GE Jenbacher
- Wartsila
- Waukesha

Features/Benefits

- Proven extended-drain capability for reduced maintenance costs and maximum productivity
- Field-proven performance in providing outstanding engine cleanliness
- High dispersancy protects against sludge and varnish formation
- Outstanding resistance to oil oxidation and nitration
- Enhanced protection against piston scuffing and ring and liner wear
- Excellent protection against rust and corrosion
- Compatible with emissions system catalysts

**Premium, Next-
Generation GEO
for landfill and
digester fuel**

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El Mar® LF-D GEO

Typical Properties	
SAE Grade	40
Specific Gravity @ 60°F	0.885
Density, lbs/gal @ 60°F	7.38
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	274 (525)
Pour Point, °C (°F)	-17(7)
Viscosity, Kinematic	
cSt @ 40°C	125
cSt @ 100°C	13.5
Viscosity Index	102
Cold Cranking Viscosity, cP @ (°C)	---
Sulfated Ash, ASTM D874, wt %	0.50
Total Base Number (TBN), ASTM D2896	6.2
Phosphorus, wt %	0.029

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

10-13-2017

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LUBRICANTS

El Mar® Low Ash GEO

Phillips 66® El Mar Low Ash GEO is a premium quality, low-ash, dispersant-detergent gas engine oil designed for use in high-output, 4-stroke cycle natural gas engines operating under heavy loads and extreme temperatures. Engines operating in this type of service typically are found on crude oil and gas transmission pipelines, electrical power generators, gas compressors, irrigation water pumps and well drilling rigs.

El Mar Low Ash GEO is formulated with field-proven performance additives to meet the rigorous lubrication demands of modern, fuel-efficient, low-emission gas engines. It provides excellent resistance to oil oxidation and nitration, protects against ring and liner wear, helps minimize engine sludge and piston deposits for outstanding engine cleanliness, and protects against corrosion. It also protects against valve stem deposits and valve recession, resulting in reduced maintenance and extended engine life. The additive package has low phosphorus content to meet the requirements of gas engines equipped with catalysts for exhaust after-treatment.

Applications

- Turbocharged, lean-burn and naturally aspirated 4-stroke cycle natural gas engines where the manufacturer specifies a low-ash gas engine oil meeting API CD performance requirements

El Mar Low Ash GEO is recommended for use in natural gas engines manufactured by:

- Caterpillar
- Climax
- Colt-Fairbanks Morse
- Dresser Rand (Category I, II, III)
- Minneapolis Moline
- Nordberg
- Ruston
- Superior
- Wartsila
- Waukesha
- Worthington

Premium Low-Ash Natural Gas Engine Oil

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Features/Benefits

- Field-proven performance in providing outstanding engine cleanliness
- Proven performance in lean-burn engines
- High dispersancy protects against engine sludge and varnish deposits
- Excellent resistance to oil oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Protects against valve stem deposits and valve recession
- Compatible with emissions system catalysts
- Does not contain any bright stock, which can cause harmful carbon deposits

El Mar® Low Ash GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.877	0.879	0.873
Density, lbs/gal @ 60°F	7.30	7.32	7.27
Color, ASTM D1500	6.5	7.0	7.0
Flash Point (COC), °C (°F)	254 (489)	275 (527)	240 (464)
Pour Point, °C (°F)	-36 (-33)	-35 (-31)	-39 (-38)
Viscosity, Kinematic			
cSt @ 40°C	94.0	131	108
cSt @ 100°C	10.7	13.7	14.6
Viscosity Index	97	100	139
Cold Cranking Viscosity, cP @ (°C)	---	---	6000 (-20)
Sulfated Ash, ASTM D874, wt %	0.45	0.45	0.45
Total Base Number (TBN), ASTM D2896	4.2	4.2	4.2
Phosphorus, wt %	0.028	0.028	0.028
Zinc, wt %	0.032	0.032	0.032

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

El Mar® Mid Ash Heavy Duty GEO

Phillips 66® El Mar Mid Ash Heavy Duty GEO is a high-quality, mid-ash, dispersant-detergent gas engine oil designed for use in naturally aspirated and moderately to highly turbocharged 4-stroke cycle natural gas engines. It is particularly recommended for use in natural gas engines and dual-fuel engines burning sour gas or landfill gas.

El Mar Mid Ash Heavy Duty GEO is formulated with field-proven performance additives to provide excellent resistance to oxidation and nitration, protect against piston scuffing and wear, and minimize the formation of sludge and piston deposits for good engine cleanliness. It has a high alkaline reserve (TBN) to protect engines operating under corrosive conditions, such as when burning sour gas, digester gas or landfill gas.

Applications

- 4-stroke cycle gas and dual-fuel engines burning sour gas or landfill gas
- 4-stroke cycle gas engines in wastewater treatment plants fueled by digester gas
- 4-stroke cycle converted irrigation engines running on natural gas or LPG
- Other 4-stroke cycle natural gas engines where the manufacturer specifies a mid-ash gas engine oil

Features/Benefits

- Excellent resistance to oxidation and nitration
- High alkaline reserve to combat acidic combustion by-products when burning sour gas
- High dispersancy protects against sludge and varnish formation
- Protects against scuffing and wear
- Protects against rust and corrosion
- Excellent low-temperature performance
- Does not contain any bright stock, which can cause harmful carbon deposits

Mid-Ash Natural Gas Engine Oil

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El Mar® Mid Ash Heavy Duty GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.876	0.880	0.877
Density, lbs/gal @ 60°F	7.29	7.32	7.30
Color, ASTM D1500	3.5	3.5	3.0
Flash Point (COC), °C (°F)	234 (453)	260 (500)	232 (450)
Pour Point, °C (°F)	-36 (-33)	-27 (-17)	-45 (-49)
Viscosity, Kinematic			
cSt @ 40°C	85.4	138	114
cSt @ 100°C	11.1	15.1	14.8
Viscosity Index	117	111	134
Cold Cranking Viscosity, cP @(°C)	---	---	6,300 (-20)
Sulfated Ash, ASTM D874, wt %	1.0	1.0	1.0
Total Base Number (TBN), ASTM D2896	7.9	7.9	7.9
Phosphorus, wt %	0.097	0.097	0.097
Zinc, wt %	0.109	0.109	0.109

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

El Mar® Mid Ash Supreme GEO

Phillips 66® El Mar Mid Ash Supreme GEO is a premium quality, mid-ash, dispersant-detergent gas engine oil designed for use in naturally aspirated and moderately to highly turbocharged 4-stroke cycle natural gas engines. It is particularly recommended for use in natural gas engines and dual-fuel engines burning sour gas or landfill gas.

El Mar Mid Ash Supreme GEO is formulated with field-proven performance additives to provide excellent resistance to oxidation and nitration, protect against piston scuffing and wear, and minimize the formation of sludge and piston deposits for good engine cleanliness. It has a high alkaline reserve (TBN) to protect engines operating under corrosive conditions, such as when burning sour gas, digester gas or landfill gas.

El Mar Mid Ash Supreme GEO is recommended for use in other 4-stroke cycle natural gas engines that require a mid-ash gas engine oil containing 1% (nominal) sulfated ash.

Applications

- 4-stroke cycle gas and dual-fuel engines burning sour gas or landfill gas
- 4-stroke cycle gas engines in wastewater treatment plants fueled by digester gas
- 4-stroke cycle converted irrigation engines running on natural gas or LPG
- Other 4-stroke cycle natural gas engines where the manufacturer specifies a mid-ash gas engine oil

El Mar Mid Ash Supreme GEO is recommended for use in natural gas engines manufactured by:

- Colt-Fairbanks Morse
- Cooper Superior
- Nordberg
- Waukesha

Premium Mid-Ash Natural Gas Engine Oil





Features/Benefits

- Field-proven performance in providing outstanding engine cleanliness
- Proven performance in lean-burn engines
- High dispersancy protects against engine sludge and varnish deposits
- Excellent resistance to oil oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Protects against valve stem deposits and valve recession
- Compatible with emissions system catalysts
- Does not contain any bright stock, which can cause harmful carbon deposits

El Mar® Mid Ash Supreme GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.886	0.894	0.875
Density, lbs/gal @ 60°F	7.38	7.45	7.29
Color, ASTM D1500	8.0	8.0	8.0
Flash Point (COC), °C (°F)	216 (421)	225 (437)	232 (450)
Pour Point, °C (°F)	-33 (-27)	-24 (-11)	-39 (-38)
Viscosity, Kinematic			
cSt @ 40°C	91.0	146	102
cSt @ 100°C	10.9	14.4	14.1
Viscosity Index	104	96	141
Cold Cranking Viscosity, cP @ (°C)	---	---	5800 (-20)
Sulfated Ash, ASTM D874, wt %	1.0	1.0	1.0
Total Base Number (TBN), ASTM D2896	8.2	8.2	8.2
Phosphorus, wt %	0.028	0.028	0.028
Zinc, wt %	0.032	0.032	0.032

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-13-2016

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LUBRICANTS

El Mar® T GEO

Phillips 66® El Mar T GEO is a high-quality, very low-ash, dispersant-detergent gas engine oil designed for use in naturally aspirated and moderately turbocharged, low- to medium-speed 2-stroke cycle and 4-stroke cycle natural gas engines.

El Mar T GEO is formulated with field-proven performance additives to meet the rigorous lubrication demands of modern, fuel-efficient, low-emission gas engines. It provides excellent resistance to oxidation and nitration, protects against ring and liner wear, helps minimize engine sludge and piston deposits for excellent engine cleanliness, and protects against corrosion. It provides excellent deposit control to keep ports clean on 2-stroke cycle engines and to help both 2-stroke cycle and 4-stroke cycle gas engines operate at peak performance.

Applications

- Low- to medium-speed, 2-stroke cycle gas engines where port plugging is a concern
- Low- to medium-speed, naturally aspirated 4-stroke cycle gas engines
- Medium-speed, 4-stroke cycle gas engines operating under moderate loads

El Mar T GEO is recommended for use in natural gas engines manufactured by:

- Ajax
- Cooper Bessemer
- Cooper Superior
- Dresser Clark
- Dresser Rand (Category I & II)
- Waukesha

Features/Benefits

- Field-proven performance in providing excellent engine cleanliness
- Good dispersancy protects against sludge and varnish formation
- Low-ash formulation helps minimize port deposits
- Excellent resistance to oxidation and nitration
- Protects against scuffing and wear
- Protects against rust and corrosion
- Does not contain any bright stock, which can cause harmful carbon deposits

Very Low-Ash Natural Gas Engine Oil

KEEPING THE
WORLD
RUNNING
SMOOTHLY.





El Mar® T GEO

Typical Properties			
SAE Grade	30	40	15W-40
Specific Gravity @ 60°F	0.884	0.888	0.869
Density, lbs/gal @ 60°F	7.36	7.39	7.24
Color, ASTM D1500	3.5	3.5	3.0
Flash Point (COC), °C (°F)	260 (500)	280 (536)	233 (451)
Pour Point, °C (°F)	-30 (-22)	-30 (-22)	-39 (-38)
Viscosity, Kinematic			
cSt @ 40°C	92.0	149	103
cSt @ 100°C	10.8	14.4	14.0
Viscosity Index	101	94	138
Cold Cranking Viscosity, cP (-20°C)	---	---	6,100
Sulfated Ash, ASTM D874, wt %	0.14	0.14	0.14
Total Base Number (TBN), ASTM D2896	2.4	2.4	2.4

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

El Mar® W GEO

Phillips 66® El Mar W GEO is a high-quality, mid-ash, dispersant-detergent gas engine oil designed for use in naturally aspirated and moderately to highly turbocharged 4-stroke cycle natural gas engines. It is particularly recommended for use in natural gas engines and dual-fuel engines burning sour gas or landfill gas.

El Mar W GEO is formulated to provide excellent resistance to oxidation and nitration, protect against piston scuffing and wear, and minimize the formation of engine sludge and piston deposits for good engine cleanliness. It has a high alkaline reserve (TBN) to protect engines operating under corrosive conditions, such as when burning sour gas, digester gas or landfill gas. It also is recommended for use in other 4-stroke cycle natural gas engines that require a mid-ash gas engine oil containing 1% (nominal) sulfated ash.

Applications

- 4-stroke cycle gas and dual-fuel engines burning sour gas or landfill gas
- 4-stroke cycle gas engines in wastewater treatment plants fueled by digester gas
- 4-stroke cycle converted irrigation engines running on natural gas or LPG
- Other 4-stroke cycle natural gas engines where the manufacturer specifies a mid-ash gas engine oil

Features/Benefits

- Excellent resistance to oxidation and nitration
- High alkaline reserve to combat acidic combustion by-products when burning sour gas
- High dispersancy protects against sludge and varnish formation
- Protects against scuffing and wear
- Protects against rust and corrosion
- Excellent low-temperature performance
- Does not contain any bright stock, which can cause harmful carbon deposits

Mid-Ash Natural Gas Engine Oil

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WORLD
RUNNING
SMOOTHLY.**





El Mar® W GEO

Typical Properties	
SAE Grade	30/40
Specific Gravity @ 60°F	0.881
Density, lbs/gal @ 60°F	7.34
Color, ASTM D1500	3.0
Flash Point (COC), °C (°F)	240 (464)
Pour Point, °C (°F)	-30 (-22)
Viscosity, Kinematic	
cSt @ 40°C	132
cSt @ 100°C	14.1
Viscosity Index	104
Sulfated Ash, ASTM D874, wt %	0.94
Total Base Number (TBN), ASTM D2896	9.0
Phosphorus, wt %	0.079
Zinc, wt %	0.088

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-13-2016

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LUBRICANTS

2-CYCLE & SMALL HP ENGINE OILS



LUBRICANTS

4T Mineral MA

Phillips 66® 4T Mineral MA is a high-quality, mineral-based engine oil designed primarily for use in 4-stroke cycle motorcycles, scooters, and all-terrain vehicles (ATVs). It also may be used as transmission oil in motorcycles and ATVs where the manufacturer specifies the use of motor oil in the transmission.

4T Mineral MA is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, and to resist viscosity and thermal breakdown at high temperatures. It also protects against rust and bearing corrosion and is resistant to excessive foam buildup and air entrainment.

4T Mineral MA meets the performance requirements of major motorcycle manufacturers and API Service SL. It meets JASO MA friction test requirements for use in motorcycle engines with integrated clutch and transmission.

Applications

- 4-stroke cycle motorcycles, scooters, and ATVs
- 4-stroke cycle gasoline engines in other mobile or stationary equipment where an API Service SL quality oil is specified

4T Mineral MA meets the requirements of and is approved for:

- JASO T 903:2011 Performance Classification MA

Features/Benefits

- Resists viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- High shear stability
- Protects against rust and bearing corrosion
- Good resistance to foaming and air entrainment
- Proper frictional properties to avoid clutch slippage

**Conventional
Engine Oil for
4-Stroke Cycle
Motorcycles,
Scooters & ATVs**

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4T Mineral MA

Typical Properties			
SAE Grade	10W-30	20W-50	25W-50
Specific Gravity @ 60°F	0.871	0.879	0.883
Density, lbs/gal @ 60°F	7.25	7.32	7.35
Color, ASTM D1500	2.5	2.5	2.5
Flash Point (COC), °C (°F)	226 (439)	255 (491)	245 (473)
Pour Point, °C (°F)	-43 (-46)	-39 (-38)	-36 (-33)
Viscosity, Kinematic			
cSt @ 40°C	76.5	176	196
cSt @ 100°C	11.4	19.1	19.8
Viscosity Index	141	123	116
Cold Cranking Viscosity, cP	5,900	8,550	6,004
@ (°C)	(-25)	(-15)	(-10)
High Temp/High Shear Viscosity, cP @ 150°C	3.2	4.8	5.2
Sulfated Ash, ASTM D874, wt %	0.95	0.95	1.09
Total Base Number (TBN), ASTM D2896	7.6	7.6	7.6
Phosphorus, wt %	0.100	0.100	0.114
Zinc, wt %	0.110	0.110	0.125

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

4T Semi-Synthetic MA

Phillips 66® 4T Semi-Synthetic MA is a premium quality, part-synthetic engine oil designed primarily for use in 4-stroke cycle motorcycles, scooters, and all-terrain vehicles (ATVs). It also may be used as transmission oil in motorcycles and ATVs where the manufacturer specifies the use of motor oil in the transmission.

4T Semi-Synthetic MA is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, and to resist viscosity and thermal breakdown at high temperatures. It also protects against rust and bearing corrosion and is resistant to excessive foam buildup and air entrainment. The part-synthetic formulation provides additional thermal stability at high temperatures.

4T Semi-Synthetic MA meets the performance requirements of major motorcycle manufacturers and API Service SL. It meets JASO MA friction test requirements for use in motorcycle engines with integrated clutch and transmission.

Applications

- 4-stroke cycle motorcycles, scooters, and ATVs
- 4-stroke cycle gasoline engines in other mobile or stationary equipment where an API Service SL quality oil is specified

4T Semi-Synthetic MA meets or exceeds the requirements of and is approved for:

- JASO T 903:2011 Performance Classification MA

Features/Benefits

- Enhanced resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- High shear stability
- Protects against rust and bearing corrosion
- Good resistance to foaming and air entrainment
- Proper frictional properties to avoid clutch slippage

**Part-Synthetic
Engine Oil for
4-Stroke Cycle
Motorcycles,
Scooters & ATVs**

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RUNNING
SMOOTHLY. 



4T Semi-Synthetic MA

Typical Properties		
SAE Grade	10W-40	15W-50
Specific Gravity @ 60°F	0.868	0.872
Density, lbs/gal @ 60°F	7.23	7.26
Color, ASTM D1500	2.5	2.5
Flash Point (COC), °C (°F)	234 (453)	234 (453)
Pour Point, °C (°F)	-46 (-51)	-46 (-51)
Viscosity, Kinematic		
cSt @ 40°C	107	157
cSt @ 100°C	15.3	19.9
Viscosity Index	150	147
Cold Cranking Viscosity, cP	6,950	6,115
@ (°C)	(-25)	(-20)
High Temp/High Shear Viscosity, cP @ 150°C	4.2	5.0
Sulfated Ash, ASTM D874, wt %	0.98	0.98
Total Base Number (TBN), ASTM D2896	7.7	7.7
Phosphorus, wt %	0.114	0.114
Zinc, wt %	0.125	0.125

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

4T Semi-Synthetic MB

Phillips 66® 4T Semi-Synthetic MB is a premium quality, part-synthetic engine oil designed primarily for use in 4-stroke cycle motorcycles, scooters, and all-terrain vehicles (ATVs). It also may be used as transmission oil in motorcycles and ATVs where the manufacturer specifies the use of motor oil in the transmission.

4T Semi-Synthetic MB is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, and to resist viscosity and thermal breakdown at high temperatures. It also protects against rust and bearing corrosion and is resistant to excessive foam buildup and air entrainment. The part-synthetic formulation provides additional thermal stability at high temperatures.

4T Semi-Synthetic MB meets the performance requirements of major motorcycle manufacturers and API Service SL. It meets JASO MB friction test requirements for use in motorcycle engines without integrated clutch and transmission.

Applications

- 4-stroke cycle motorcycles, scooters, and ATVs
- 4-stroke cycle gasoline engines in other mobile or stationary equipment where an API Service SL quality oil is specified

4T Semi-Synthetic MB meets or exceeds the requirements of and is approved for:

- JASO T 903:2011 Performance Classification MB

Features/Benefits

- Enhanced resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- High shear stability
- Protects against rust and bearing corrosion
- Good resistance to foaming and air entrainment

**Part-Synthetic
Engine Oil for
4-Stroke Cycle
Motorcycles,
Scooters & ATVs**

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SMOOTHLY. 



4T Semi-Synthetic MB

Typical Properties	
SAE Grade	10W-30
Specific Gravity @ 60°F	0.868
Density, lbs/gal @ 60°F	7.23
Color, ASTM D1500	3.5
Flash Point (COC), °C (°F)	236 (457)
Pour Point, °C (°F)	-41 (-41)
Viscosity, Kinematic	
cSt @ 40°C	68.2
cSt @ 100°C	10.4
Viscosity Index	139
Cold Cranking Viscosity, cP	5,500
@ (°C)	(-25)
High Temp/High Shear Viscosity, cP @ 150°C	3.0
Sulfated Ash, ASTM D874, wt %	1.00
Total Base Number (TBN), ASTM D2896	7.6
Phosphorus, wt %	0.100
Zinc, wt %	0.110

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

4T Synthetic MA

Phillips 66® 4T Synthetic MA is a premium quality, synthetic engine oil designed primarily for use in 4-stroke cycle motorcycles, scooters, and all-terrain vehicles (ATVs). It also may be used as transmission oil in motorcycles and ATVs where the manufacturer specifies the use of motor oil in the transmission.

4T Synthetic MA is formulated to provide excellent wear protection, to minimize the formation of sludge and varnish, and to resist viscosity and thermal breakdown at high temperatures. It also protects against rust and bearing corrosion and is resistant to excessive foam buildup and air entrainment. The synthetic formulation provides additional thermal stability at high temperatures.

4T Synthetic MA meets the performance requirements of major motorcycle manufacturers and API Service SL. It meets JASO MA friction test requirements for use in motorcycle engines with integrated clutch and transmission.

Applications

- 4-stroke cycle motorcycles, scooters, and ATVs
- 4-stroke cycle gasoline engines in other mobile or stationary equipment where an API Service SL quality oil is specified

4T Synthetic MA meets or exceeds the requirements of and is approved for:

- JASO T 903:2011 Performance Classification MA

Features/Benefits

- Enhanced resistance to viscosity and thermal breakdown at high temperatures
- Protects against sludge and varnish formation
- Protects against scuffing and wear
- High shear stability
- Protects against rust and bearing corrosion
- Good resistance to foaming and air entrainment
- Proper frictional properties to avoid clutch slippage

**Synthetic
Engine Oil for
4-Stroke Cycle
Motorcycles,
Scooters & ATVs**

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SMOOTHLY.**





4T Synthetic MA

Typical Properties	
SAE Grade	10W-40
Specific Gravity @ 60°F	0.857
Density, lbs/gal @ 60°F	7.14
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	234 (453)
Pour Point, °C (°F)	-46 (-51)
Viscosity, Kinematic	
cSt @ 40°C	102
cSt @ 100°C	15.0
Viscosity Index	154
Cold Cranking Viscosity, cP	6,184
@ (°C)	(-25)
High Temp/High Shear Viscosity, cP @ 150°C	4.2
Sulfated Ash, ASTM D874, wt %	0.98
Total Base Number (TBN), ASTM D2896	7.7
Phosphorus, wt %	0.114
Zinc, wt %	0.125

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Airkool HP 2-Cycle Motor Oil

Phillips 66® Airkool HP 2-Cycle Motor Oil is a premium quality, low-ash, API TC engine oil specially formulated for use in high-output commercial chain saws, motorcycles and other air-cooled 2-stroke cycle gasoline engines. It may be used in either direct oil injection or premix engines.

Airkool HP 2-Cycle Motor Oil has a high level of detergency to help minimize piston ring sticking and exhaust port deposits to maintain good power output in 2-stroke cycle engines. It has excellent lubricity to protect against piston and cylinder scuffing, and helps reduce spark plug fouling and pre-ignition problems. It is pre-diluted with a high-flash solvent for easy mixing with gasoline at low temperatures for premix applications.

Airkool HP 2-Cycle Motor Oil meets JASO FD and ISO-L-EGD low-smoke requirements.

Applications

- High-output commercial chain saws that operate at 17,000-20,000 rpm
- Motorcycles, scooters, and all-terrain vehicles (ATVs)
- Lawn-care equipment (mowers, weed trimmers, leaf blowers)
- Other air-cooled 2-stroke cycle gasoline engines where an API TC oil is specified⁽¹⁾

Airkool HP 2-Cycle Motor Oil meets or exceeds the requirements of:

- API Service TC
- ISO-L-EGD
- JASO FD, FC, FB

⁽¹⁾ **Note:** Airkool HP 2-Cycle Motor Oil is **not** recommended for use in water-cooled 2-stroke cycle engines. Where the engine manufacturer specifies NMMA TC-W3®, TC-WII®, or TC-W® quality oil, use Phillips 66 2T Unimix® 2-Cycle Motor Oil.

Features/Benefits

- Low-ash formulation helps minimize engine deposits and pre-ignition
- High detergency helps minimize piston ring sticking and reduce exhaust port blocking
- Protects against piston and cylinder scuffing
- Reduces spark plug fouling
- Excellent rust and corrosion protection
- Meets JASO FD low-smoke requirements
- Keeps engine parts clean
- Mixes easily with gasoline at low temperatures for premix applications
- Dyed for easy visibility when mixed with gasoline
- Suitable for either direct oil injection or premix engines⁽²⁾

⁽²⁾ **Note:** For premix engines, always follow the manufacturer's recommendation for choosing the proper fuel-to-oil mixing ratio.

**API TC Engine
Oil for Air-
Cooled,
2-Stroke Cycle
Engines**

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Airkool HP 2-Cycle Motor Oil

Typical Properties	
Specific Gravity @ 60°F	0.858
Density, lbs/gal @ 60°F	7.14
Color, ASTM D1500	Blue
Flash Point (COC), °C (°F)	78 (172)
Flash Point (PMCC), °C (°F)	73 (163)
Pour Point, °C (°F)	-40 (-40)
Viscosity, Kinematic	
cSt @ 40°C	48.4
cSt @ 100°C	8.3
Viscosity Index	147
Sulfated Ash, ASTM D874, wt %	0.11

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

10-03-16

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LUBRICANTS

Injex® TC-W3® 2-Cycle Motor Oil

Phillips 66® Injex TC-W3 2-Cycle Motor Oil is a premium quality, ashless engine oil specially designed for use in water-cooled and most air-cooled 2-stroke cycle engines. It is specially formulated to provide protection equivalent to many OEM-branded 2-cycle engine oils. It is TC-W3® certified by the National Marine Manufacturers Association (NMMA), and also meets API TC and JASO FB performance requirements for use in air-cooled 2-stroke cycle engines. It may be used in either direct injection (DI) or premix engines.

Injex TC-W3 2-Cycle Motor Oil is formulated to minimize piston ring sticking and exhaust port deposits to maintain good power output in 2-stroke cycle engines. It also protects against piston and cylinder scuffing and helps reduce spark plug fouling and pre-ignition problems. It provides rust and corrosion protection in service and during storage. It is pre-diluted with a high-flash solvent for easy mixing with gasoline at low temperatures for premix applications. It contains a synthetic polymer to help reduce exhaust smoke.

Applications

- Outboard marine engines
- Personal watercraft
- Motorcycles, scooters, and all-terrain vehicles (ATVs)
- Snowmobiles
- Low output chainsaws
- Lawn-care equipment (mowers, weed trimmers, leaf blowers)

Injex TC-W3 2-Cycle Motor Oil is licensed under the following industry specification:

- NMMA TC-W3® (Certification No. RL-01371R)

Injex TC-W3 2-Cycle Motor Oil meets or exceeds the requirements of:

- API Service TC
- JASO FB
- NMMA TC-WII®, TC-W® (obsolete specifications)

Features/Benefits

- Formulated to provide protection equivalent to many OEM-branded 2-cycle oils
- Exceeds major outboard manufacturers warranty requirements
- Ashless detergent/dispersant formulation helps minimize engine deposits and pre-ignition

**Premium
Ashless Engine
oil for 2-Stroke
Cycle Engines,
NMMA TC-W3®
Certified**

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SMOOTHLY. 



- Minimizes piston ring sticking and helps reduce exhaust port blocking
- Protects against piston and cylinder scuffing
- Excellent lubricity for use in high-output outboard engines
- Reduces spark plug fouling
- Excellent rust and corrosion protection
- Keeps engine parts clean
- Mixes easily with gasoline at low temperatures for premix applications
- Dyed for easy visibility when mixed with gasoline
- Suitable for either direct oil injection or premix engines⁽¹⁾

⁽¹⁾ **Note:** For premix engines, always follow the manufacturer's recommendation for choosing the proper fuel-to-oil mixing ratio.

Injex® TC-W3® 2-Cycle Motor Oil

Typical Properties	
Specific Gravity @ 60°F	0.865
Density, lbs/gal @ 60°F	7.20
Color, ASTM D1500	Blue
Flash Point (COC), °C (°F)	108 (226)
Flash Point (PMCC), °C (°F)	81 (178)
Pour Point, °C (°F)	-44 (-47)
Viscosity, Brookfield, cP @ -25°C	6,200
Viscosity, Kinematic	
cSt @ 40°C	40.7
cSt @ 100°C	7.1
Viscosity Index	132
Sulfated Ash, ASTM D874, wt %	<0.001

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

10-03-16

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LUBRICANTS

Synjex® 2-Cycle Motor Oil

Phillips 66® Synjex 2-Cycle Motor Oil is a premium quality, full-synthetic, ashless engine oil designed for use in high-performance water-cooled 2-stroke cycle engines, and in most air-cooled 2-stroke cycle engines. It is particularly recommended for use in equipment operating at very low ambient temperatures. It is suitable for use for TC-W3 applications, and also meets API TC and JASO FB performance requirements for use in air-cooled 2-stroke cycle engines. It may be used in either direct injection (DI) or premix engines.

Synjex 2-Cycle Motor Oil is formulated to minimize piston ring sticking and exhaust port deposits to maintain good power output in 2-stroke cycle engines. It also protects against piston and cylinder scuffing and helps reduce spark plug fouling and pre-ignition problems. It provides rust and corrosion protection in service and during storage. It is pre-diluted with a high-flash solvent for easy mixing with gasoline at low temperatures for premix applications. The synthetic base oil provides outstanding low-temperature performance. It also contains a synthetic polymer to help reduce exhaust smoke.

Synjex 2-Cycle Motor Oil is environmentally friendly. It has low aquatic toxicity and meets the classification of readily biodegradable in the Modified Sturm carbon dioxide evolution test.

Applications

- Outboard marine engines
- Personal watercraft
- Motorcycles, scooters, and all-terrain vehicles (ATVs)
- Snowmobiles
- Low output chainsaws
- Lawn-care equipment (mowers, weed trimmers, leaf blowers)

Synjex 2-Cycle Motor Oil is suitable for use under the following industry specification:

- NMMA TC-W3®

Synjex 2-Cycle Motor Oil meets or exceeds the requirements of:

- API Service TC
- JASO FB

Features/Benefits

- Ashless detergent/dispersant formulation helps minimize engine deposits and pre-ignition
- Minimizes piston ring sticking and helps reduce exhaust port blocking
- Protects against piston and cylinder scuffing

**Premium Full-Synthetic
Ashless Engine
Oil for 2-Stroke
Cycle Engines**

KEEPING THE
WORLD
RUNNING
SMOOTHLY. 



LUBRICANTS

- Excellent lubricity for use in high-output outboard engines
- Reduces spark plug fouling
- Excellent rust and corrosion protection
- Outstanding low temperature performance
- Keeps engine parts clean
- Readily biodegradable
- Low aquatic toxicity
- Mixes easily with gasoline at low temperatures for premix applications
- Dyed for easy visibility when mixed with gasoline
- Suitable for either direct oil injection or premix engines⁽¹⁾

⁽¹⁾ **Note:** For premix engines, always follow the manufacturer's recommendation for choosing the proper fuel-to-oil mixing ratio.

Synjex® 2-Cycle Motor Oil

Typical Properties	
Specific Gravity @ 60°F	0.941
Density, lbs/gal @ 60°F	7.84
Color, ASTM D1500	Purple
Flash Point (COC), °C (°F)	140 (284)
Flash Point (PMCC), °C (°F)	117 (243)
Pour Point, °C (°F)	-40 (-40)
Viscosity, Kinematic	
cSt @ 40°C	51.1
cSt @ 100°C	8.6
Viscosity Index	145
Sulfated Ash, ASTM D874, wt %	<0.001

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

08-30-16

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LUBRICANTS

Unimix® 2-Cycle Motor Oil

Phillips 66® Unimix 2-Cycle Motor Oil is a high-quality, ashless engine oil specially designed for use in water-cooled and most air-cooled 2-stroke cycle engines. It is TC-W3® certified by the National Marine Manufacturers Association (NMMA), and also meets API TC and JASO FB performance requirements for use in air-cooled 2-stroke cycle engines. It is recommended for use in low- to mid-horsepower (up to 115 HP) engines, and may be used in either direct oil injection or premix engines.

Unimix 2-Cycle Motor Oil is formulated to minimize piston ring sticking and exhaust port deposits to maintain good power output in 2-stroke cycle engines. It also protects against piston and cylinder scuffing and helps reduce spark plug fouling and pre-ignition problems. It provides rust and corrosion protection in service and during storage. It is pre-diluted with a high-flash solvent for easy mixing with gasoline at low temperatures.

Applications

- Outboard marine engines
- Personal watercraft
- Motorcycles, scooters and all-terrain vehicles (ATVs)
- Snowmobiles
- Low-output chain saws
- Lawn-care equipment (mowers, weed trimmers, leaf blowers)

Unimix 2-Cycle Motor Oil is licensed under the following industry specification:

- NMMA TC-W3® (Certification No. RL-13135T)

Unimix 2-Cycle Motor Oil meets or exceeds the requirements of:

- API Service TC
- JASO FB
- NMMA TC-WII®, TC-W® (obsolete specifications)

Features/Benefits

- Meets all outboard and personal watercraft manufacturers warranty requirements where a TC-W3® oil is specified
- Ashless dispersant/detergent formulation helps minimize engine deposits and pre-ignition
- Minimizes piston ring sticking and helps reduce exhaust port blocking
- Protects against piston and cylinder scuffing
- Good lubricity
- Reduces spark plug fouling

**Ashless Engine
Oil for 2-Stroke
Cycle Engines,
NMMA TC-W3®
Certified**

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- Good rust and corrosion protection
- Keeps engine parts clean
- Mixes easily with gasoline at low temperatures for premix applications
- Dyed for easy visibility when mixed with gasoline
- Suitable for either direct oil injection or premix engines⁽¹⁾

⁽¹⁾ **Note:** For premix engines, always follow the manufacturer's recommendation for choosing the proper fuel-to-oil mixing ratio.

Unimix® 2-Cycle Motor Oil

Typical Properties	
Specific Gravity @ 60°F	0.862
Density, lbs/gal @ 60°F	7.18
Color, ASTM D1500	Blue
Flash Point (COC), °C (°F)	102 (216)
Flash Point (PMCC), °C (°F)	81 (178)
Pour Point, °C (°F)	-38 (-36)
Viscosity, Brookfield, cP @ -25°C	4,310
Viscosity, Kinematic	
cSt @ 40°C	30.9
cSt @ 100°C	5.6
Sulfated Ash, ASTM D874, wt %	<0.001

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

10-03-16

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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LUBRICANTS

ENVIRONMENTALLY CONSCIOUS LUBRICANTS



LUBRICANTS

Ecoterra® Hydraulic Oil

Phillips 66® Ecoterra Hydraulic Oil is a high-quality, zinc-free antiwear hydraulic oil specifically developed for use in industrial and mobile equipment operating in environmentally sensitive areas. It is specially formulated for reduced environmental impact in case of leaks or spills. It is non-toxic to fish and aquatic species as determined by OECD Test Method 203 1-12, and is classified as inherently biodegradable by the OECD Test Method 301B. It passes the visual “no sheen” requirements of the U.S. EPA Static Sheen Test.

Ecoterra Hydraulic Oil is formulated with an ashless (zinc-free) antiwear additive package to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Ecoterra Hydraulic Oil is recommended for use in place of conventional zinc-containing hydraulic oils in applications where there is the possibility of soil or water contamination. It also may be used as a lower-cost alternative to synthetic, readily biodegradable hydraulic fluids. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Hydraulic equipment used in environmentally sensitive areas, such as national parks, wildlife refuges, ski resorts and other recreational areas
- Hydraulic equipment in amusement parks and zoos
- Hydraulic jacks and other equipment in machine shops
- Oil drilling rigs and offshore platforms
- Chain drives
- Electric motor bearings
- Service station lifts
- Hydraulic systems where the equipment manufacturer specifies an ashless, zinc-free antiwear hydraulic oil

Ecoterra Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HLP
- DIN 51524 Part 2, Antiwear Hydraulic Oils, Type HLP
- Eaton-Vickers I-286-S, M-2950-S
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- U.S. EPA/U.S. Coast Guard Static Sheen Test, Federal Register Vol. 58, No.41
- U.S. Steel 127

Non-toxic, Zinc-Free Antiwear Hydraulic Oil; Inherently Biodegradable

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Features/Benefits

- Non-toxic to aquatic organisms
- Inherently biodegradable
- Does not contain zinc or other heavy metals
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Lower-cost alternative to synthetic biodegradable hydraulic fluids

Note: Ecoterra® Hydraulic Oil is **not** compatible with zinc-containing hydraulic oils, and may cause residue, gelling, or filter plugging if mixed with such fluids. Mixing the two products will lessen the environmental benefits normally gained by using Ecoterra® Hydraulic Oil.

Ecoterra® Hydraulic Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.862	0.869	0.873
Density, lbs/gal @ 60°F	7.18	7.23	7.27
Color, ASTM D1500	0.5	1.0	1.0
Flash Point (COC), °C (°F)	227 (440)	232 (450)	241 (465)
Pour Point, °C (°F)	-34 (-29)	-33 (-27)	-30 (-22)
Viscosity			
cSt @ 40 °C	32.0	46.0	68.0
cSt @ 100 °C	5.4	6.8	8.8
SUS @ 100 °F	165	237	352
SUS @ 210 °F	44.4	49.0	55.9
Viscosity Index	102	102	102
Acid Number, ASTM D974, mg KOH/g	0.22	0.22	0.22
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1404, minutes to pass	10	15	15
Dielectric Strength, ASTM D877, kV ⁽¹⁾	35	35	35
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.62	0.54	0.44
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>12	>12	>12
Oxidation Stability			
TOST, ASTM D943-04a, hours	8,000	8,000	8,000
RPVOT, ASTM D2272, minutes	>500	>500	>500
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Aquatic Toxicity, Rainbow Trout, OECD 203 1-12, 1000mg/L, 96 hours, LC50	Non-toxic	Non-toxic	Non-toxic
Biodegradability in 28 days, OECD 301B, %	22	22	22

⁽¹⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Ecoterra® Paper Machine Oil

Phillips 66® Ecoterra® Paper Machine Oil is a high-quality, ashless circulating oil developed for use in modern papermaking machines. It is recommended for use in paper machines manufactured by all leading OEMs. It is specially formulated to provide excellent detergency while still maintaining excellent water-separating properties. It does not contain zinc or other heavy metals, and is non-toxic to aquatic species.

Ecoterra Paper Machine Oil is formulated with an ashless additive package specially tailored for papermaking machines. It has good oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent detergency to help maintain system cleanliness. It has excellent water-separating properties to minimize the formation of emulsions, and passes the Pall Filterability Test for both new oil and “aged” oil contaminated with water. It has good load-carrying capacity for wear protection, protects system components against rust and corrosion, and has good foam resistance.

Applications

- Circulating systems of paper machines, including wet-end systems, dryer sections, and calender stacks
- Circulating systems for heavily loaded bearings where moisture contamination is a problem and operating temperatures are high
- Reduction gears and gear-head motors
- Vacuum pumps and water pumps

Features/Benefits

- Ashless formulation; does not contain zinc or other heavy metals
- Non-toxic to aquatic organisms
- Excellent detergency
- Excellent water-separating properties
- Excellent filterability for use with fine porosity filters
- Good oxidation resistance and thermal stability
- High load-carrying capacity
- Protects against rust and corrosion
- Good foam resistance

Ashless Paper Machine Circulating Oil





Ecoterra® Paper Machine Oil

Typical Properties			
ISO Grade	150	220	320
Specific Gravity @ 60°F	0.884	0.888	0.892
Density, lbs/gal @ 60°F	7.36	7.40	7.43
Color, ASTM D1500	3.0	3.5	4.0
Flash Point (COC), °C (°F)	270 (518)	270 (518)	280 (536)
Pour Point, °C (°F)	-12 (10)	-12 (10)	-12 (10)
Viscosity			
cSt @ 40°C	150	220	320
cSt @ 100°C	14.5	19.0	24.0
SUS @ 100°F	789	1,163	1,704
SUS @ 210°F	77.7	96.8	119
Viscosity Index	95	97	95
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	50	60	70
Zinc, wt %	Nil	Nil	Nil

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Ecoterra® Rock Drill Fluid

Phillips 66® Ecoterra® Rock Drill Fluid is a high-quality, adhesive, extreme-pressure (EP) lubricant specially developed for the lubrication of percussion rock drills used surface and underground mining operations. It also is recommended for other air-powered tools such as jackhammers, pavement breakers and drifters. It is formulated with an ashless, chlorine-free additive package for reduced environmental impact.

Ecoterra Rock Drill Fluid is specially formulated with select non-chlorinated additives to provide excellent protection for pneumatic percussion tools. It has high load-carrying capacity to protect against wear and seizure of sliding metal surfaces under heavy or shock-load conditions. It has good adhesiveness to metal surfaces in the presence of moisture, and contains inhibitors to protect against rust and corrosion. It has good oxidation resistance and thermal stability at high temperatures for long service life. The non-chlorinated additive package helps reduce environmental impact in case of leaks or stray mist, and facilitates waste oil disposal.

Applications

- Pneumatic equipment such as drifters, jackhammers, pavement breakers, rock drills, and stoppers

Features/Benefits

- Non-chlorinated additive package for reduced environmental impact
- Excellent extreme-pressure properties
- Protects against wear and seizure
- Good adhesiveness to metal surfaces in the presence of moisture
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Low odor
- Low fogging tendency
- Good foam resistance

**Ashless, Non-Chlorinated,
Extreme-Pressure Air
Tool Lubricant**

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Ecoterra® Rock Drill Fluid

Typical Properties			
ISO Grade	100	150	320
Specific Gravity @ 60°F	0.879	0.884	0.890
Density, lbs/gal @ 60°F	7.32	7.36	7.42
Color, ASTM D1500	3.5	3.5	3.5
Flash Point (COC), °C (°F)	208 (406)	208 (406)	247 (477)
Pour Point, °C (°F)	-36 (-33)	-33 (-27)	-21 (-6)
Viscosity			
cSt @ 40°C	100	150	320
cSt @ 100°C	11.7	15.3	24.7
SUS @ 100°F	520	786	1,701
SUS @ 210°F	66.5	80.9	122
Viscosity Index	105	103	99
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0
Rust Test, ASTM D665A	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	75	75	75

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Firebird AW Hydraulic Oil

Phillips 66® Firebird AW Hydraulic Oil is an environmentally responsible anti-wear hydraulic oil formulated with a blend of high-quality conventional and re-refined base stocks. It is recommended for use in a wide variety of industrial, mobile and marine hydraulic system applications. The use of re-refined base stocks helps lessen the environmental impact of disposal of used oil.

Firebird AW Hydraulic Oil is formulated to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has good oxidation resistance at high temperatures to minimize deposit formation and provide long service life. It has good water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Firebird AW Hydraulic Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Hydraulic systems on industrial, mobile and marine equipment
- Automated machine tools
- Hydraulic elevators, hoists, presses and floor jacks
- Marine cargo winches and steering systems
- Mobile construction equipment
- Service station lifts
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Electric motor bearings

Firebird AW Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Eaton-Vickers I-286-S, M-2950-S
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- U.S. Steel 127

**Anti-wear
Hydraulic Oil
Formulated with
Re-refined Base
Stocks**

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Features/Benefits

- Excellent wear protection for hydraulic pumps and motors
- Good oxidation resistance
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- Lessens the environmental impact of used oil disposal

Firebird AW Hydraulic Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.865	0.867	0.876
Density, lbs/gal @ 60°F	7.22	7.22	7.29
Color, ASTM D1500	1.0	1.0	3.0
Flash Point (COC), °C (°F)	224 (435)	243 (469)	241 (466)
Pour Point, °C (°F)	-36 (-33)	-36 (-33)	-30 (-22)
Viscosity			
cSt @ 40°C	32.0	46.0	68.0
cSt @ 100°C	5.4	6.8	8.6
SUS @ 100°F	150	214	315
SUS @ 210°F	44.0	48.5	54.5
Viscosity Index	102	102	97
Acid Number, ASTM D974, mg KOH/g	0.41	0.41	0.41
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	15	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182, Failure Load Stage	11	11	11
Oxidation Stability, TOST, ASTM D943-04a, hours	>4,000	>4,000	>2,500
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Zinc, wt %	0.043	0.043	0.043
Re-refined Content, Finished Oil, vol %	56	56	56

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

5-08-17

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LUBRICANTS

Firebird® Tractor Hydraulic Fluid

Phillips66® Firebird Tractor Hydraulic Fluid is an environmentally responsible tractor transmission fluid formulated with a blend of high-quality conventional and re-refined base stocks. It is designed for use in farm tractors and other off-highway equipment requiring one lubricant for the transmission, final drive, wet brakes and hydraulic systems. It meets the performance requirements of all major brands of farm tractors and other farm equipment that utilize a common fluid reservoir. The use of re-refined base stocks helps lessen the environmental impact of disposal of used oil.

Firebird Tractor Hydraulic Fluid is formulated to provide excellent oxidation resistance, excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has carefully balanced frictional properties to ensure proper operation of wet brakes and transmission clutches.

Applications

Firebird Tractor Hydraulic Fluid is recommended for use where the equipment manufacturer specifies:

- AGCO Power Fluid 821XL, Q-1826, Q-1802 (Type 55 Fluid), Q-1766B
- Case IH MS1210, MS1209, MS1207, MS1206
- Case New Holland (CNH) MAT3525 (134-D Fluid), MAT3506, MAT3505
- Denison Hydraulics HF-0, HF-1, HF-2
- Ford ESN-M2C134-D, ESN-M2C86-C, ESN-M2C86-B, ESN-M2C41-B
- Ford-New Holland FNHA-2-C-201.00
- John Deere JDM J20C, J14C (Type 303 Fluid)
- Kubota UDT Fluid
- Landini Tractor II Hydraulic Fluid
- Massey Ferguson CMS M1145/M1143, M1141, M1135, M1129A
- Sundstrand Hydrostatic Transmission Fluid
- Vickers (Eaton) M-2950-S, I-286-S
- Volvo VME WB 101 (VCE 1273.03)
- Firebird Tractor Hydraulic Fluid also meets API GL-4 performance requirements.

**Tractor Hydraulic/
Transmission Fluid
Formulated With
≥ 70% Re-Refined
Base Stocks**

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Features/Benefits

- Excellent oxidation resistance and thermal stability
- Excellent wear protection for clutches, gears and hydraulic pumps
- Prevents brake chatter and grabbing
- Protects against rust and corrosion
- Excellent seal compatibility
- Good foam resistance
- Suitable for year-round use in most climates

Lessens the environmental impact of disposal of used oils

Firebird® Tractor Hydraulic Fluid

Typical Properties	
SAE Grade	
Specific Gravity @ 60°F	0.879
Density, lbs/gal @ 60°F	7.32
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	210 (410)
Pour Point, °C (°F)	-43 (-45)
Viscosity, Brookfield	
cP @ -20°C	2,800
cP @ -35°C	27,000
Viscosity, Kinematic	
cSt @ 40°C	61.0
cSt @ 100°C	9.4
Viscosity Index	135
Total Base Number (TBN), ASTM D2896	9.6
Zinc, wt %	0.149
Re-refined Content, Base Oil, wt%	70

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

GEAR LUBRICANTS



LUBRICANTS

Compounded Gear Oil

Phillips 66® Compounded Gear Oil is a high-quality, compounded lubricant developed for the lubrication of industrial and automotive worm gear drives operating at moderate to high temperatures, and for the lubrication of steam engine cylinders and valves.

Compounded Gear Oil is formulated with heavy paraffinic base oils compounded with acidless tallow (fatty oil). It has high film strength and excellent oiliness characteristics for effective lubrication of worm gears. It emulsifies with water to maintain excellent lubricity in the presence of steam and moisture to protect and lubricate cylinder and valve surfaces in steam engines.

Applications

- Industrial worm gear drives made with non-ferrous alloys (bronze-on-steel)
- Differentials on antique automobiles that require a high-viscosity, compounded gear oil
- Steam engine cylinders and valves
- Bearings on steam-heated calender or mixer rolls
- Screw-down bolts and nuts on aluminum and steel rolling mills
- Heavily loaded, low-speed bearings subject to moisture contamination
- Cylinders of gas compressors handling wet natural gas
- Applications where an SAE 140, SAE 190 or SAE 250, API GL-2 gear oil is specified

Compounded Gear Oil meets the following industry specification(s):

- AGMA 9005-F16 Compounded Lubricants (CP)

Features/Benefits

- Excellent lubricity for protection of sliding surfaces against scuffing
- High film strength
- Emulsifies with water to resist washing
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Non-corrosive to bronze or brass

Compounded Worm Gear & Steam Cylinder Lubricant

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Compounded Gear Oil

Typical Properties			
ISO Grade	460	680	1000
AGMA Grade (obsolete)	7 Comp	8 Comp	8A Comp
AGMA Classification	CP	CP	CP
SAE Grade	140	190	250
Specific Gravity @ 60°F	0.894	0.909	0.924
Density, lbs/gal @ 60°F	7.45	7.57	7.69
Color, ASTM D1500	7.0	8.0	8.0
Flash Point (COC), °C (°F)	>300 (>572)	>300 (>572)	>300 (>572)
Pour Point, °C (°F)	-8 (18)	-5 (23)	0 (32)
Viscosity			
cSt @ 40°C	460	680	1,000
cSt @ 100°C	31.0	37.0	45.0
SUS @ 100°F	2,463	3,687	5,481
SUS @ 210°F	152	181	219
Viscosity Index	97	89	84
Acid Number, ASTM D974, mg KOH/g	0.20	0.20	0.20
Copper Corrosion, ASTM D130	1a	1a	1a

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-02-16

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LUBRICANTS

Extra Duty Gear Oil

Phillips 66® Extra Duty Gear Oil is a premium quality, heavy-duty, extreme pressure (EP) industrial gear oil developed for the lubrication of heavily loaded enclosed gear drives operating under moderate to severe service conditions. It is specially formulated with “clean gear” additive technology to minimize deposit formation and provide excellent gearbox cleanliness. It is recommended for use in all applications where the equipment manufacturer specifies an AGMA EP gear oil.

Extra Duty Gear Oil is formulated to provide extreme-pressure and antiwear properties, excellent deposit control, protection against rust and corrosion, and resistance to foaming. It has high load-carrying capacity for protection against scuffing and wear. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It protects gears and bearings against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Extra Duty Gear Oil “M” is specially formulated for use in enclosed gearboxes equipped with mist lubrication systems. It contains a mist suppressant to reduce fogging and stray mist.

Applications

- Enclosed industrial gear drives operating under heavy loads, high peak loads or intermittent shock loads
- Enclosed spur, bevel, helical, herringbone and planetary gear drives where the equipment manufacturer specifies an AGMA EP gear oil
- Heavily loaded plain and rolling-element bearings

Extra Duty Gear Oil meets the requirements of the following industry specifications:

- ANSI/AGMA Standard 9005-E02, Anti-Scuff/Anti-Wear (EP) Oils
- DIN 51517 Part 3, Lubricating Oils, Type CLP
- Fives Cincinnati P-77 (ISO VG 150), P-74 (ISO VG 220), P-59 (ISO VG 320), P-35 (ISO VG 460) (approved)
- German Steel Industry SEB 181226, Type CLP
- ISO 12925-1, Type L-CKC
- U.S. Steel 224

**Premium
Extreme-
Pressure
Industrial Gear
Oil; Formulated
with “Clean
Gear” Additive
Technology**

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Features/Benefits

- High load-carrying capacity for protection against scuffing and wear
- Excellent oxidation resistance and thermal stability
- Excellent deposit control for gearbox cleanliness
- Protects against rust and corrosion
- Fast water separation
- Quick foam release
- Effective mist suppression ("M" grades)

Extra Duty Gear Oil

Typical Properties						
ISO Grade	68	100	150	220	220M	320
AGMA Grade	2 EP	3 EP	4 EP	5 EP	5 EP	6 EP
Specific Gravity @ 60°F	0.876	0.880	0.884	0.888	0.888	0.892
Density, lbs/gal @ 60°F	7.29	7.33	7.36	7.40	7.39	7.42
Color, ASTM D1500	3.0	3.5	4.0	4.5	4.0	5.0
Flash Point (COC), °C (°F)	235 (455)	235 (455)	243 (469)	252 (486)	243 (469)	254 (489)
Pour Point, °C (°F)	-33 (-27)	-33 (-27)	-33 (-27)	-27 (-17)	-21(-6)	-18 (0)
Viscosity						
cSt @ 40°C	68.0	100	150	220	220	320
cSt @ 100°C	8.7	11.3	14.4	18.4	19.0	23.7
SUS @ 100°F	353	522	789	1,166	1,163	1,706
SUS @ 210°F	55.5	65.0	77.3	94.2	96.8	118
Viscosity Index	99	99	93	92	97	94
Acid Number, ASTM D974, mg KOH/g	0.73	0.73	0.73	0.73	0.73	0.73
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a	1a
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0	0/0	0/0
Four-Ball EP, ASTM D2783, Weld Load, kgf	---	---	250	250	250	250
Four-Ball Wear, ASTM D4172						
Scar Diameter, mm	0.30	0.30	0.30	0.30	0.30	0.30
FZG Scuffing Test, ASTM D5182						
Failure Load Stage	12	12	>12	>12	>12	>12
Timken OK Load, ASTM D2782, lb		---	---	60	60	60

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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Extra Duty Gear Oil

Typical Properties						
ISO Grade	320M	460	460M	680	800	1000
AGMA Grade	6 EP	7 EP	7 EP	8 EP		8A EP
Specific Gravity @ 60°F	0.888	0.895	0.894	0.910	0.896	0.924
Density, lbs/gal @ 60°F	7.39	7.46	7.44	7.57	7.46	7.69
Color, ASTM D1500	5.0	5.5	5.5	8.0	6.0	8.0
Flash Point (COC), °C (°F)	243 (469)	254 (489)	246 (276)	>300 (>572)	>300 (>572)	>300 (>572)
Pour Point, °C (°F)	-18 (0)	-18 (0)	-15 (5)	-3 (27)	-12 (10)	0 (32)
Viscosity						
cSt @ 40°C	320	460	460	680	800	1000
cSt @ 100°C	23.7	30.5	30.4	32.2	50.1	39.5
SUS @ 100°F	1,706	2,466	2,466	3,725	4,596	5,535
SUS @ 210°F	118	150	149	158	243	193
Viscosity Index	94	96	95	70	110	66
Acid Number, ASTM D974, mg KOH/g	0.73	0.73	0.73	0.73	0.73	0.73
Copper Corrosion, ASTM D130	1a	1a	1a	1b	1b	1b
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	10/0	10/0	10/0
Four-Ball EP, ASTM D2783, Weld Load, kgf	250	250	250	250	250	250
Four-Ball Wear, ASTM D4172						
Scar Diameter, mm	0.30	0.38	0.38	0.38	0.38	0.38
FZG Scuffing Test, ASTM D5182						
Failure Load Stage	>12	>12	>12	>12	>12	>12
Timken OK Load, ASTM D2782, lb	60	60	60	60	60	60

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-07-17

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LUBRICANTS

Gear Shield®

Phillips 66® Gear Shield is a viscous, adhesive, petroleum resin/asphaltic-based gear lubricant cut back with a volatile, non-chlorinated solvent for ease of application. It is recommended primarily for the lubrication and cushioning of open and semi-enclosed gears found on stationary equipment, such as ball and rod mills, kilns and paper mills. It also may be used for the lubrication of some cable-actuated equipment, such as marine winches.

Gear Shield is specially formulated to provide high load-carrying capacity to protect heavily loaded gears from scoring and galling. It forms a heavy, tenacious film (after solvent evaporation) that adheres well to metal surfaces and will not harden or flake off at low temperatures. This film has good resistance to water washout and protects the gears against rust and corrosion.

Gear Shield is available in three grades for use over a wide range of operating temperatures.

Applications

- Open and semi-enclosed gears, such as those found on mining ball and rod mills, cement mills, drying kilns, and papermaking machinery and presses
- Mills used to process minerals such as gold, copper, iron, taconite and phosphate
- Guides and sliding surfaces with large clearances, where asphaltic-type lubricants are specified
- Cables on draglines, clamshells, shovels, hoists and other cable-operated equipment where cable clamp safety devices are not used

Gear Shield meets the requirements of the following industry specification:

- ANSI/AGMA Standard 9005-E02

Features/Benefits

- Excellent adhesion to metal surfaces
- Forms a heavy, tenacious film to lubricate and cushion gear teeth
- Good extreme-pressure properties for protection under heavy or shock loads
- Good resistance to water washout
- Protects against rust and corrosion
- Will not flake off at low temperatures
- Drains freely from gear guards
- Does not contain any chlorine, lead or carcinogens
- Easy application, by spraying, brushing or dripping⁽¹⁾
- Suitable for use with automatic lubrication equipment

⁽¹⁾**Caution:** This product contains solvent. Proper ventilation and fire safety precautions must be taken during application.

**Chlorine-Free,
Solvent-Cutback
Open Gear
Lubricant for
Mills & Kilns**

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SMOOTHLY. 



Gear Shield®

Typical Properties			
Grade	NCW	P	NC
Specific Gravity @ 60°F	0.960	0.920	0.960
Density, lbs/gal @ 60°F	8.00	7.66	8.00
Color, Visual	Black	Black	Black
Appearance	Viscous	Viscous	Viscous
Consistency	Semi-fluid	Semi-fluid	Semi-fluid
Flash Point (COC), with solvent, °C (°F)	>93 (>199)	>121 (>250)	>121 (>250)
Flash Point (COC), without solvent, °C (°F)	>260 (>500)	>260 (>500)	>260 (>500)
Solvent Content, wt %	23	12	16
Viscosity (with solvent)			
cSt @ 40°C	900-1,600	5,400-8,700	4,000-6,000
SUS @ 100°F	5,000-8,000	25,000-40,000	20,000-30,000
Viscosity (without solvent)			
cSt @ 100°C	1,000-2,200	1,070-1,700	1,000-2,200
SUS @ 210°F	5,000-10,000	5,000-8,000	5,000-10,000
Copper Corrosion, ASTM D130	4b	2b	4b
Four-Ball EP, ASTM D2596			
Weld Load, kgf	400	400	400
Load-Wear Index, kgf	67	70	77
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.42	0.60	0.49
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>12	>12	>12
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	45	45	45
Usable Temperature Range			
°C	-18 to 49	-9 to 49	0 to 49
°F	0 to 120	15 to 120	32 to 120

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-16

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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LUBRICANTS

Gear Shield® Synthetic

Phillips 66® Gear Shield Synthetic is a viscous, adhesive, transparent synthetic-based gear lubricant cut back with a volatile, non-chlorinated solvent for ease of application. It is recommended primarily for the lubrication and cushioning of open and semi-enclosed gears found on stationary equipment, such as ball and rod mills, kilns and paper mills.

Gear Shield Synthetic is specially formulated to provide high load-carrying capacity to protect heavily loaded gears from scoring and galling. It forms a heavy, tenacious film (after solvent evaporation) that adheres well to metal surfaces and will not harden or flake off at low temperatures. This film has good resistance to water washout and protects the gears against rust and corrosion.

Applications

- Open and semi-enclosed gears, such as those found on mining ball and rod mills, cement mills, drying kilns, and papermaking machinery and presses
- Mills used to process minerals such as gold, copper, iron, taconite and phosphate
- Guides and sliding surfaces with large clearances, where asphaltic-type lubricants are specified
- Cables on draglines, clamshells, shovels, hoists and other cable-operated equipment where cable clamp safety devices are **not** used

Gear Shield Synthetic meets the requirements of the following industry specification:

- ANSI/AGMA Standard 9005-E02

Features/Benefits

- Excellent adhesion to metal surfaces
- Forms a heavy, tenacious film to lubricate and cushion gear teeth
- Good extreme-pressure properties for protection under heavy or shock loads
- Good resistance to water washout
- Protects against rust and corrosion
- Will not flake off at low temperatures
- Drains freely from gear guards
- Does not contain any chlorine, lead or carcinogens
- Easy application, by spraying, brushing or dripping⁽¹⁾
- Suitable for use with automatic lubrication equipment

⁽¹⁾**Caution:** This product contains solvent. Proper ventilation and fire safety precautions must be taken during application.

**Chlorine-Free,
Solvent-Cutback
Synthetic Open
Gear Lubricant
for Mills & Kilns**

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Gear Shield® Synthetic

Typical Properties	
Grade	Synthetic
Specific Gravity @ 60°F	0.913
Density, lbs/gal @ 60°F	7.60
Color, Visual	Amber
Color, ASTM D1500	2.0
Appearance	Viscous
Consistency	Semi-fluid
Flash Point (COC), with solvent, °C (°F)	>150 (>302)
Viscosity (with solvent)	
cSt @ 40°C	7,200
SUS @ 100°F	33,350
Viscosity (without solvent)	
cSt @ 40°C	55,100
SUS @ 100°F	255,225
Four-Ball EP, ASTM D2596	
Weld Load, kgf, without solvent	620
Load-Wear Index, kgf, without solvent	128
Rust Test, ASTM D665 A&B	Pass
Usable Temperature Range	
°C	-18 to 49
°F	0 to 120

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

GLW

Phillips 66® GLW is a premium quality, extreme-pressure (EP) industrial gear oil developed for the lubrication of heavily loaded enclosed gear drives operating in wet or dry environments under severe service conditions. It is specially formulated to quickly separate from water to maintain effective lubrication even in the presence of water. It is particularly recommended for use in industrial and mining equipment operating in contaminated environments where an AGMA EP gear oil with excellent water-separating properties is specified or preferred.

GLW is formulated to provide excellent lubricity and wear protection even in the presence of water and other contaminants. It has high load-carrying capacity, high film strength, and protects against rust and corrosion for extended equipment life. It has good oxidation resistance and thermal stability at high temperatures and is formulated with “clean gear” additive technology to minimize deposit formation and provide outstanding gearbox cleanliness. It has good seal compatibility, excellent water-separating properties and is resistant to excessive foam buildup that can interfere with proper lubrication.

GLW is recommended for use in Joy Machinery longwall mining equipment as well as other mining, industrial and heavy mobile equipment operating under extreme loads and/or exposed to water contamination.

Applications

- Enclosed gear drives of longwall mining machinery
- Enclosed industrial gear drives operating in the presence of water, such as in steel mills and rock quarries
- Gear drives and pinion stands of metal rolling mills, ball mills and cement mills
- Enclosed gear drives on excavation and heavy construction equipment

GLW meets the requirements of the following industry and OEM specifications:

- ANSI/AGMA Standard 9005-E02, Anti-Scuff/Anti-Wear (EP) Oils
- DIN 51517 Part 3, Lubricating Oils, Type CLP
- Fives Cincinnati P-74 (ISO VG 220), P-59 (ISO VG 320) (approved)
- German Steel Industry SEB 181226, Type CLP
- ISO 12925-1, Type L-CKC & Type L-CKD
- Joy Mining Machinery TO-MEP (ISO VG 220), TO-HEP (ISO VG 320), TO-HD (ISO VG 460)
- U.S. Steel 224

Features/Benefits

- Excellent performance in wet or contaminated gearboxes
- Outstanding load-carrying capacity
- Excellent protection against scuffing and wear

**Severe-Duty,
Extreme-
Pressure
Industrial Gear
Oil; Separates
from Water**

**KEEPING THE
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RUNNING
SMOOTHLY.**





LUBRICANTS

- Good oxidation resistance and thermal stability
- Outstanding deposit control for gearbox cleanliness
- Protects against rust and corrosion
- Excellent water-separating properties
- Good seal compatibility
- Environmentally responsible; does not contain chlorinated paraffins

GLW

Typical Properties			
ISO Grade	220	320	460
AGMA Grade	5 EP	6 EP	7 EP
Specific Gravity @ 60°F	0.890	0.894	0.898
Density, lbs/gal @ 60°F	7.41	7.44	7.48
Color, ASTM D1500	4.5	5.0	5.5
Flash Point (COC), °C (°F)	249 (480)	254 (489)	254 (489)
Pour Point, °C (°F)	-27 (-17)	-18 (0)	-15 (5)
Viscosity			
cSt @ 40°C	220	320	460
cSt @ 100°C	18.7	23.7	32.0
SUS @ 100°F	1,164	1,706	2,457
SUS @ 210°F	95.5	118	157
Viscosity Index	95	94	101
Acid Number, ASTM D974, mg KOH/g	1.09	1.09	1.09
Copper Corrosion, ASTM D 130	1b	1b	1b
Demulsibility, ASTM D1401, 30 minutes @ 180°F	Pass	Pass	Pass
Falex Pin & Vee Block True Load, ASTM D 3233-B, lbf	>4,250	>4,250	>4,250
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball EP, ASTM D2783			
LWI, kgf	57	57	57
Weld Load, kgf	270	270	270
FZG Scuffing Test, ASTM 5182 (mod.), Failure Load Stage	>12	>12	>12
Oxidation Stability, ASTM D2893			
Viscosity Increase @ 121°C, %	4.6	4.9	5.0
Rust Test, ASTM D655 A&B	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	70	70	70

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

GLW-E

Phillips 66® GLW-E is a premium quality, extreme-pressure (EP) industrial gear oil developed for the lubrication of heavily loaded enclosed gear drives operating in wet environments under severe service conditions. It is specially formulated to emulsify readily with water to maintain effective lubrication in the presence of water. It is particularly recommended for use in industrial and mining equipment operating in a highly contaminated, wet environment where an emulsifiable AGMA EP gear oil is specified or preferred.

GLW-E is formulated to provide excellent lubricity and wear protection even in the presence of water and other contaminants. It has high load-carrying capacity, retains its high film strength in the presence of water, and protects against rust and corrosion for extended equipment life. It has good oxidation resistance and thermal stability at high temperatures and is formulated with “clean gear” additive technology to minimize deposit formation and provide outstanding gearbox cleanliness. It has good seal compatibility, will emulsify readily with water and is resistant to excessive foam buildup that can interfere with proper lubrication.

GLW-E is recommended for use in Joy Machinery longwall mining equipment as well as other mining, industrial and heavy mobile equipment operating under extreme loads and/or exposed to water contamination.

Applications

- Enclosed gear drives of longwall mining machinery
- Enclosed industrial gear drives operating in the presence of water, such as in steel mills and rock quarries
- Gear drives and pinion stands of metal rolling mills, ball mills and cement mills
- Enclosed gear drives on excavation and heavy construction equipment

GLW-E meets the requirements (except demulsibility) of the following industry and OEM specifications:

- ANSI/AGMA Standard 9005-E02, Anti-Scuff/Anti-Wear (EP) Oils
- DIN 51517 Part 3, Lubricating Oils, Type CLP
- German Steel Industry SEB 181226, Type CLP
- ISO 12925-1, Type L-CKC & Type L-CKD
- Joy Mining Machinery TO-MEP (ISO VG 220), TO-HEP (ISO VG 320), TO-HD (ISO VG 460)
- U.S. Steel 224

Features/Benefits

- Excellent performance in wet or contaminated gearboxes
- Outstanding load-carrying capacity
- Excellent protection against scuffing and wear

**Severe-Duty,
Extreme-
Pressure
Industrial Gear
Oil; Emulsifies
with Water**

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SMOOTHLY. 



LUBRICANTS

- Good oxidation resistance and thermal stability
- Outstanding deposit control for gearbox cleanliness
- Protects against rust and corrosion
- Emulsifies readily with water
- Good seal compatibility
- Environmentally responsible; does not contain chlorinated paraffins

GLW-E

Typical Properties			
ISO Grade	220	320	460
AGMA Grade	5 EP	6 EP	7 EP
Specific Gravity @ 60°F	0.890	0.893	0.898
Density, lbs/gal @ 60°F	7.41	7.44	7.47
Color, ASTM D1500	3.0	5.0	5.0
Flash Point (COC), °C (°F)	249 (480)	254 (489)	255 (491)
Pour Point, °C (°F)	-18 (0)	-18 (0)	-15 (5)
Viscosity			
cSt @ 40°C	220	320	460
cSt @ 100°C	18.9	23.7	31.7
SUS @ 100°F	1,164	1,723	2,459
SUS @ 210°F	96.4	118	155
Viscosity Index	96	93	100
Acid Number, ASTM D974, mg KOH/g	1.09	1.09	1.09
Copper Corrosion, ASTM D 130	1b	1b	1b
Demulsibility, ASTM D1401, 60 minutes @ 180°F			
Free Water, mL	0	0	0
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball EP, ASTM D2783			
LWI, kgf	57	57	57
Weld Load, kgf	315	315	315
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.26	0.26	0.26
FZG Scuffing Test, ASTM 5182 (mod.), Failure Load Stage	>14	>14	>14
Oxidation Stability, ASTM D2893			
Viscosity Increase @ 121°C, %	5.5	5.5	5.5
Rust Test, ASTM D655 A&B	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	70	70	70

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

High Performance Gear Oil

Phillips 66® High Performance Gear Oil is a heavy-duty, API GL-5 automotive gear lubricant specially designed for use in racing applications. It also will provide excellent protection in passenger car and truck axles with either conventional or limited-slip differentials.

High Performance Gear Oil is formulated with a thermally stable and thermally durable additive package fortified with additional extreme-pressure (EP) and antifoam additives to provide excellent protection for gear sets operating under severe conditions involving high speeds, high temperatures and/or high loads. The carefully balanced formulation is designed to minimize oxidative sludge and varnish formation, reduce wear, prevent scoring damage, and protect against metal fatigue and spalling damage under shock-load conditions.

High Performance Gear Oil is friction-modified to reduce chatter in limited-slip and positraction axles. It may be used for initial fill of new or rebuilt limited-slip differentials, for top-off and for refill after a complete drain.

Applications

- Axles on racing vehicles
- Passenger car and truck axles with either conventional or limited-slip differentials
- Suitable for initial fill of new or rebuilt limited-slip differentials, for top-off and for refill after a complete drain

High Performance Gear Oil meets or exceeds the requirements of:

- API Service GL-5
- Mack GO-J
- MIL-PRF-2105E
- SAE J2360

Features/Benefits

- Excellent oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- Protects against rust and corrosion
- Good foam resistance
- Friction-modified to prevent chatter in limited-slip and positraction differentials

Note: High Performance Gear Oil is not recommended for use in synchromesh manual transmissions with copper or bronze bushings.

**High-
Performance,
Friction-
Modified
Automotive
Gear Lubricant,
API GL-5**

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High Performance Gear Oil

Typical Properties	
SAE Grade	80W-90
Specific Gravity @ 60°F	0.883
Density, lbs/gal @ 60°F	7.35
Color, ASTM D1500	3.0
Flash Point (COC), °C (°F)	212 (414)
Pour Point, °C (°F)	-30 (-22)
Viscosity, Brookfield	
cP @ -26°C	90,000
Viscosity, Kinematic	
cSt @ 40°C	139
cSt @ 100°C	14.5
Viscosity Index	103

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-15-16

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LUBRICANTS

MP Gear Lube

Phillips 66® Gear Lube is a multipurpose, API GL-5 automotive gear lubricant specifically designed for use in passenger car and truck axles with hypoid gear sets. It also is recommended for use in some heavy-duty manual transmissions in trucks and buses.

MP Gear Lube is formulated to provide long service life and extended gear life in automotive differentials operating under varying conditions of speed, load, temperature and torque. The carefully balanced formulation is designed to minimize oxidative sludge and varnish formation, reduce wear, prevent scoring damage, and protect against metal fatigue and spalling damage under shock-load conditions.

Applications

- Service fill of conventional differentials in passenger cars and trucks
- Top-off only of limited-slip differentials in passenger cars and light trucks⁽¹⁾
- Service fill of differentials, final drives and transfer cases in some off-highway equipment
- Non-synchronized manual transmissions in trucks, buses and heavy equipment where the manufacturer specifies an API GL-5 or MT-1 gear oil

⁽¹⁾**Note:** For complete drain and refill, many limited-slip differentials may require the manufacturer's specified gear lubricant or supplemental additive. Refer to the owner's manual for specific requirements.

MP Gear Lube meets or exceeds the requirements of:

- API Service GL-5, MT-1
- Meritor O76-A (SAE 85W-140), O76-D (SAE 80W-90), O76-E (SAE 75W-90)
- MIL-PRF-2105E

MP Gear Lube is registered or approved for:

- Mack GO-J (SAE 80W-90, 85W-140)
- MAN 342 Type M2 (SAE 75W-90, SAE 80W-90)
- MAN 342 Type M1 (SAE 85W-140)
- SAE J2360 (SAE 80W-90, 85W-140)

**Multipurpose
Automotive Gear
Lubricant, API
GL-5/MT-1**

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Features/Benefits

- Excellent oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure (EP) properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- Protects against rust and corrosion
- Good foam resistance

MP Gear Lube

Typical Properties				
SAE Grade	75W-90	90	80W-90	85W-140
Specific Gravity @ 60°F	0.878	0.892	0.880	0.894
Density, lbs/gal @ 60°F	7.31	7.43	7.40	7.48
Color, ASTM D1500	1.0	2.5	2.5	2.5
Flash Point (COC), °C (°F)	190 (374)	220 (428)	220 (428)	225 (437)
Pour Point, °C (°F)	-45 (-49)	-11 (12)	-30 (-22)	-12 (10)
Viscosity, Brookfield				
cP @ -40°C	120,000	---	---	---
cP @ -26°C	---	---	105,000	---
cP @ -12°C	---	---	---	110,000
Viscosity, Kinematic				
cSt @ 40°C	101	183	146	336
cSt @ 100°C	15.0	17.2	14.5	25.0
Viscosity Index	156	95	97	96

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Open Gear Lube

Phillips 66® Open Gear Lube is a viscous, tacky, petroleum resin-based gear lubricant cut back with a volatile, non-chlorinated solvent for ease of application. It is recommended primarily for the lubrication and cushioning of open and semi-enclosed gears on mining shovels, draglines and excavation equipment used in underground and surface mines and in rock quarries. It also may be used for the lubrication of some cable-actuated equipment.

Open Gear Lube is specially formulated to provide high load-carrying capacity to protect heavily loaded gears from scoring and galling. It forms a heavy, tenacious film (after solvent evaporation) that adheres well to metal surfaces and will not harden or flake off at low temperatures. This film provides good resistance to water washout and protects gears against rust and corrosion.

Open Gear Lube is available in three grades for use over a wide range of operating temperatures.

Applications

- Open and semi-enclosed gears found on mining shovels, draglines and excavation equipment
- Guides and sliding surfaces with large clearances, where asphaltic-type lubricants are specified
- Cables on draglines, clamshells, hoists and other cable-operated equipment where cable clamp safety devices are not used

Open Gear Lube meets the requirements of the following industry specification:

- ANSI/AGMA Standard 9005-E02

Features/Benefits

- Excellent adhesion to metal surfaces
- Forms a heavy, tenacious film to lubricate and cushion gear teeth
- Good extreme-pressure properties for protection under heavy or shock loads
- Good resistance to water washout
- Protects against rust and corrosion
- Will not flake off at low temperatures
- Does not contain any chlorine, lead or carcinogens
- Easy application, by spraying, brushing or dripping⁽¹⁾
- Suitable for use with automatic lubrication equipment

⁽¹⁾**Caution:** This product contains solvent. Proper ventilation and fire safety precautions must be taken during application.

**Chlorine-
Free, Solvent-
Cutback Open
Gear Lubricant
for Shovels &
Draglines**

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Open Gear Lube

Typical Properties			
Grade	585 W	585 NC	595 NC
Specific Gravity @ 60°F	0.980	0.978	1.000
Density, lbs/gal @ 60°F	8.16	8.14	8.33
Color, Visual	Black	Black	Black
Appearance	Viscous	Viscous	Viscous
Consistency	Semi-fluid	Semi-fluid	Semi-fluid
Flash Point (COC), with solvent, °C (°F)	150 (302)	>93 (>199)	>93 (>199)
Solvent Content, wt %	26	12	8
Viscosity (without solvent)			
cSt @ 100°C	540	540	540
SUS @ 210°F	2,600	2,600	2,600
Copper Corrosion, ASTM D130	4a	4a	4a
Four-Ball EP, ASTM D2596			
Weld Load, kgf	400	400	400
Load-Wear Index, kgf	53	65	65
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.40	0.50	0.50
Rust Test, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	45	45	45
Usable Temperature Range			
°C	-40 to 0	-18 to 10	0 to 49
°F	-40 to 32	0 to 50	32 to 120

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-16

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LUBRICANTS

Syncon® EP Plus Gear Oil

Phillips 66® Syncon EP Plus Gear Oil is a premium quality, synthetic, extreme-pressure industrial gear lubricant developed for the lubrication of enclosed gear drives and heavily loaded plain or rolling-element bearings operating at extreme temperatures or in severe service. It is suitable for use over a wider temperature range than conventional mineral oil-based gear oils. It meets the performance requirements of major gear drive manufacturers.

Syncon EP Plus Gear Oil is formulated with synthetic polyalphaolefin (PAO) base oils, a viscosity modifier, and a non-chlorinated extreme-pressure additive package. It has outstanding oxidation resistance and thermal stability at high temperatures to help minimize deposit formation and provide long service life. It has high load-carrying capacity for protection against scuffing and wear, protects against rust and corrosion, and is resistant to excessive foaming that can interfere with proper lubrication. It has a high viscosity index and low pour point for use in equipment operating at extreme temperatures or over a very wide temperature range.

Applications

- Heavily loaded enclosed gear drives, such as those found in mine hoists and mining machinery
- Enclosed industrial gear drives operating at very low or very high temperatures, or operating continuously at higher than normal operating temperatures
- Heavily loaded plain and rolling-element bearings operating at extreme temperatures
- Applications where the equipment manufacturer recommends a high VI, synthetic, extreme-pressure gear oil

Syncon EP Plus Gear Oil meets the requirements of the following industry and OEM specifications:

- ANSI/AGMA Standard 9005-F16, Anti-Scuff Lubricants (AS)
- DIN 51517 Part 3, Lubricating Oils, Type CLP HC
- German Steel Industry SEB 181226, Type CLP HC
- ISO 12925-1:1996, Type L-CKC
- Joy Machinery Specification TO-SHEP (ISO VG 320), TO-SMEP (ISO VG 220)
- U.S. Steel 224

**High VI
Synthetic PAO-
Based Extreme-
Pressure
Industrial Gear
Lubricant**

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Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Outstanding low-temperature properties
- High viscosity index and low pour point for use over wide temperatures
- Excellent extreme-pressure properties
- Protection against scuffing and wear
- Protects against rust, corrosion, and foaming
- Non-chlorinated additive system
- Suitable for year-round use
- Extended service intervals compared to mineral oil-based gear oils

Syncon® EP Plus Gear Oil

Typical Properties					
ISO Grade	150	220	320	460	680
AGMA Grade (obsolete)	4 EP	5 EP	6 EP	7 EP	8 EP
AGMA Classification	AS	AS	AS	AS	AS
Specific Gravity @ 60°F	0.861	0.865	0.866	0.870	0.875
Density, lbs/gal @ 60°F	7.17	7.20	7.21	7.24	7.29
Color, ASTM D1500	1.0	1.0	1.0	1.0	1.0
Flash Point (COC), °C (°F)	249 (480)	249 (480)	249 (480)	249 (480)	249 (480)
Pour Point, °C (°F)	-49 (-56)	-49 (-56)	-44 (-47)	-47 (-53)	-42 (-44)
Viscosity					
cSt @ 40°C	150	220	320	460	680
cSt @ 100°C	20.9	27.5	35.3	47.6	64.4
SUS @ 100°F	769	1,134	1,660	2,392	3,549
SUS @ 210°F	105	135	170	230	311
Viscosity Index	163	161	156	162	166
Acid Number, ASTM D974, mg KOH/g	0.76	0.76	0.76	0.76	0.76
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a	1a	1a
Four-Ball EP, ASTM D2783, Weld Load, kgf	315	315	315	315	315
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.45	0.45	0.45	0.45	0.45
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>12	>12	>12	>12	>12
Oxidation Stability, ASTM D2893B					
Viscosity Increase @ 121°C, %	<6	<6	<8	<10	<10

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-08-16

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LUBRICANTS

Syncon® Mist Oil

Phillips 66® Syncon Mist Oil is a premium quality, synthetic, extreme-pressure (EP) gear lubricant developed for use in oil mist lubrication systems for enclosed industrial gear drives operating under extreme-temperature conditions.

Syncon Mist Oil is formulated with synthetic polyalphaolefin (PAO) base oils, a misting agent, and specially tailored additives that provide extreme-pressure properties plus rust and corrosion protection. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation, and has high load-carrying capacity for protection against scuffing and wear. The misting agent helps reduce fogging and stray mist.

Applications

Syncon Mist Oil is recommended for use in oil mist lubrication systems for:

- Lightly to moderately loaded enclosed industrial gear drives with spur, helical, herringbone, or bevel gears
- Chain drives
- Plain and rolling-element bearings in rolling, rod, and wire mills

Syncon Mist Oil meets the requirements of the following industry specifications:

- ANSI/AGMA Standard 9005-F16, Anti-Scuff Lubricants (AS)
- U.S. Steel 224

Note: Syncon Mist Oil is **not** recommended for use in worm gear drives with bronze or brass bull gears, since these types of gears require heavier viscosity lubricants with oiliness agents.

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent low-temperature fluidity
- High load-carrying capacity
- Reduces stray mist
- Low fogging tendency
- Protects against scuffing and wear
- Protects against rust and corrosion

**Synthetic PAO-
Based Extreme-
Pressure
Industrial Gear
Lubricant for
Mist Lubrication
Systems**

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Syncon® Mist Oil

Typical Properties	
ISO Grade	100
AGMA Grade (obsolete)	3 EP
AGMA Classification	AS
Specific Gravity @ 60°F	0.862
Density, lbs/gal @ 60°F	7.18
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	274 (525)
Pour Point, °C (°F)	-36 (-33)
Viscosity	
cSt @ 40°C	93.0
cSt @ 100°C	13.2
SUS @ 100°F	477
SUS @ 210°F	72.2
Viscosity Index	141
Acid Number, ASTM D974, mg KOH/g	0.22
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Demulsibility, ASTM D1401, minutes to pass	10
Four-Ball EP, ASTM D2783, Weld Load, kgf	250
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.33
Oxidation Stability, S-200 ASTM D2893B, viscosity @ 100°C increase, %	2.5

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-08-16

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LUBRICANTS

Syncon® Premium EP Gear Oil

Phillips 66® Syncon Premium EP Gear Oil is a premium quality, synthetic, extreme-pressure gear lubricant specifically recommended for lubricating the heavily loaded gears and rolling-element bearings in motorized wheel gearboxes found on mining haul trucks. It also is recommended for lubrication of enclosed industrial gear drives operating at extreme temperatures.

Syncon Premium EP Gear Oil is formulated with synthetic polyalphaolefin (PAO) base oils, a non-chlorinated extreme-pressure additive and select inhibitors. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has high load-carrying capacity to protect against scuffing and wear, protects against rust and corrosion, and is resistant to excessive foaming that can interfere with proper lubrication.

Syncon Premium EP Gear Oil meets the performance requirements of General Electric Transportation Systems Specification D50E27. It is approved for use in GE AC and DC electric motorized wheel gearboxes found on Komatsu, Terex, Euclid and Hitachi mining haul trucks.

Applications

- GE motorized wheels found on mining haul trucks
- Enclosed industrial gear drives operating at very high or very low temperatures, or operating continuously at higher than normal operating temperatures ⁽¹⁾
- Heavily loaded plain and rolling-element bearings operating at extreme temperatures
- Applications where the equipment manufacturer recommends a synthetic extreme-pressure gear oil

Syncon Premium EP Gear Oil meets the requirements of the following industry and OEM specifications:

- ANSI/AGMA Standard 9005-E02, Anti-Scuff/Anti-Wear (EP) Oils
- DIN 51517 Part 3, Lubricating Oils, Type CLP HC
- GE Specification D50E27 (approved)
- German Steel Industry SEB 181226, Type CLP HC
- ISO 12925-1:1996, Type L-CKC
- Joy Machinery Specification TO-SHEP (ISO VG 320)
- U.S. Steel 224

⁽¹⁾**Note:** Syncon Premium EP Gear Oil is not recommended for use in worm gear drives with bronze-on-steel gears, or in automotive differentials with hypoid gears.

**Synthetic PAO-
Based Extreme-
Pressure Gear
Lubricant for
GE Motorized
Wheels**

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Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Outstanding low-temperature properties
- High load-carrying capacity
- Protects against scuffing and wear
- Protects against rust and corrosion
- Non-chlorinated additive system
- Suitable for year-round use
- Extended service intervals compared to conventional mineral oil-based gear oils

Syncon® Premium EP Gear Oil

Typical Properties		
ISO Grade	320	680
AGMA Grade	6 EP	8 EP
Specific Gravity @ 60°F	0.877	0.885
Density, lbs/gal @ 60°F	7.30	7.37
Color, ASTM D1500	1.0	1.0
Flash Point (COC), °C (°F)	238 (460)	238 (460)
Pour Point, °C (°F)	-34 (-30)	-26 (-15)
Viscosity		
cSt @ 40°C	320	680
cSt @ 100°C	29.0	51.6
SUS @ 100°F	1,682	3,601
SUS @ 210°F	142	250
Viscosity Index	123	132
Acid Number, ASTM D974, mg KOH/g	0.40	0.40
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1b	1b
Four-Ball EP, ASTM D2783, Weld Load, kgf	250	250
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.36	0.38
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>12	>12
Oxidation Stability, ASTM D2893B, Viscosity Increase @ 121°C, %	<4	<4
Precipitation Number, ASTM D91, mL	Trace	Trace
Rust Test, ASTM D665 A&B	Pass	Pass
Timken OK Load, ASTM D2782, lb	>60	>60

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Syncon® WTL

Phillips 66® Syncon WTL is a state-of-the-art, synthetic, extreme-pressure (EP) gear lubricant specifically developed for the lubrication of heavily loaded gears and rolling-element bearings in gearboxes on older and new-generation wind turbine generators.

Syncon WTL is formulated with synthetic polyalphaolefin (PAO) base oils, a non-chlorinated extreme-pressure additive package and select inhibitors. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It also has outstanding low-temperature fluidity for use over a wide temperature range. The advanced additive technology provides high load-carrying capacity for outstanding protection against scuffing and wear, as well as excellent protection against rust and corrosion.

Applications

- Gear drives of wind turbine generators
- Enclosed industrial gear drives operating under severe-service conditions, such as heavy loads or high operating temperatures, or in extreme temperature environments
- Applications where the equipment manufacturer specifies a synthetic AGMA 6 EP gear oil (obsolete) or ISO 320 AS gear oil (new)

Syncon WTL meets or exceeds the requirements of the following industry specifications:

- ANSI/AGMA Standard 9005-F16, Anti-Scuff Lubricants (AS)
- ANSI/AGMA/AWEA 6006-A03
- DIN 51517 Part 3, Lubricating Oils, Type CLP
- ISO 12925-1, Type CKD

Syncon WTL is listed on the latest Flender T7300 approved lubricants list (02/2017) and is approved against Revision 15 of the Flender specification.

Features/Benefits

- Outstanding performance in wind turbine generator gearboxes
- Outstanding oxidation resistance and thermal stability at high temperatures
- Very high load-carrying capacity for protection against scuffing and wear
- Excellent protection against micropitting
- Protects against rust and corrosion
- Non-chlorinated additive system
- Outstanding low-temperature properties
- High viscosity index and low pour point for year-round use

Synthetic PAO-Based Extreme-Pressure Gear Lubricant for Wind Turbine Generators





Syncon® WTL

Typical Properties	
ISO Grade	320
AGMA Grade (obsolete)	6 EP
AGMA Classification	AS
Specific Gravity @ 60°F	0.862
Density, lbs/gal @ 60°F	7.18
Color, ASTM D1500	1.5
Flash Point (COC), °C (°F)	246 (475)
Pour Point, °C (°F)	-45 (-49)
Viscosity	
cSt @ 40°C	320
cSt @ 100°C	34.9
SUS @ 100°F	1,660
SUS @ 210°F	170
Viscosity Index	152
Acid Number, ASTM D974, mg KOH/g	0.83
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Four-Ball EP, ASTM D2783, Weld Load, kgf	250
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.35
FZG Micropitting Test, FVA 54/11 @ 90°C	
Fail Stage	>10
Classification	High
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>14
Rust Test, ASTM D665 A&B	Pass
Timken OK Load, ASTM D2782, lb	95

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

10-23-17

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LUBRICANTS

Syngear SS

Phillips 66® Syngear SS is a synthetic, multipurpose, API GL-5 automotive gear lubricant. It is specifically designed for use in passenger car and truck axles with hypoid gear sets operating in extreme temperatures or under severe driving conditions. It is formulated to provide long service life and extended gear life in automotive differentials operating under varying conditions of speed, load, temperature and torque. The carefully balanced formulation is designed to minimize oxidative sludge and varnish formation, reduce wear, prevent scoring damage, and protect against metal fatigue and spalling damage under shock-load conditions.

Syngear SS combines outstanding thermal stability and oxidation resistance at high temperatures with outstanding low-temperature properties to ensure excellent performance over a wide temperature range. It has been shown in field tests to lower operating temperatures in axles when compared with conventional mineral gear oils.

Applications

- Service fill of conventional differentials, and top-off only of limited-slip differentials, in passenger cars and trucks⁽¹⁾
- Service fill of differentials, final drives and transfer cases in some off-highway equipment
- Non-synchronized manual transmissions in trucks, buses and heavy equipment where the manufacturer specifies an SAE 75W-140, API GL-5 or MT-1 gear oil

⁽¹⁾ **Note:** *For complete drain and refill, many limited-slip differentials may require the manufacturer's specified gear lubricant or supplemental additive. Refer to the owner's manual for specific requirements.*

Syngear SS meets or exceeds the requirements of:

- API Service GL-5, MT-1
- Ford WSL-M2C192-A
- Meritor O76-M
- MIL-PRF-2105E
- SAE J2360

Syngear SS is approved for service fill under the following OEM specification:

- Mack GO-J

**Premium
Synthetic
Automotive
Gear Lubricant,
API GL-5/MT-1**

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SMOOTHLY.**





Features/Benefits

- Extended drain, all-season performance
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- High shear stability
- Outstanding low-temperature properties
- Protects against rust and corrosion
- Good foam resistance
- Reduces axle operating temperatures compared with conventional mineral gear oils

Syngear SS

Typical Properties	
SAE Grade	75W-140
Specific Gravity @ 60°F	0.867
Density, lbs/gal @ 60°F	7.22
Color, Visual	1.5
Flash Point (COC), °C (°F)	190 (374)
Pour Point, °C (°F)	-46 (-51)
Viscosity, Brookfield	
cP @ -40°C	139,000
Viscosity, Kinematic	
cSt @ 40°C	185
cSt @ 100° C	25.6
Viscosity Index	172

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

Transmission Oil SAE 90

Phillips 66® Transmisison Oil SAE 90 is an SAE 90 mineral oil gear lubricant recommended for use in manual transmissions, transfer cases and rear axle assemblies of automotive, farm and off-highway equipment where the manufacturer specifies an API GL-1 gear oil. It also may be used in light-duty industrial applications where a non-compounded ISO VG 150 or AGMA 4 mineral oil is specified.

Transmisison Oil SAE 90 has good film strength and rust inhibition to protect gears, bearings and synchronizers. It also has good oxidation resistance to help minimize deposit formation, and good resistance to foaming.

Applications

- Heavy-duty, multiple-speed manual transmissions and transfer cases in trucks and buses where the manufacturer specifies an API GL-1, SAE 90 gear oil
- Lightly loaded enclosed industrial gear drives where the OEM specifies a R&O type, AGMA 4 gear oil
- General-purpose lubrication in applications that require a non-compounded, ISO VG 150 mineral oil

Mineral Gearlube 90 meets the requirements of:

- API Service GL-1

Features/Benefits

- Good film strength for wear protection
- Good oxidation resistance
- Protects against rust and corrosion
- Good foam resistance

Note: Mineral Gearlube 90 does not contain extreme-pressure or oiliness additives. It is not recommended for use in hypoid gear sets typically found in automotive and truck rear axles, or in worm gear drives

**SAE 90 Mineral
Gear Lubricant,
API GL-1**

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Transmission Oil SAE 90

Typical Properties	
SAE Grade	90
ISO Grade	150
AGMA Grade	4
Specific Gravity @ 60°F	0.875
Density, lbs/gal @ 60°F	7.28
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	277 (531)
Pour Point, °C (°F)	-17 (1)
Viscosity,	34.0
cSt @ 40°C	155
cSt @ 100°C	15.5
SUS @ 100°F	813
SUS @ 210°F	81.8
Viscosity Index	101

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-14-16

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LUBRICANTS

Triton® OG SS

Phillips 66® Triton® OG SS is a high-performance, semi-synthetic gear lubricant specifically developed to meet the demands of heavily loaded, slow moving gears and bearings. It is recommended primarily for the lubrication and cushioning of open and semi-enclosed gear drives found in mills and kilns.

Triton OG SS is formulated with a carefully selected combination of synthetic base stocks, high-viscosity mineral oils and extreme-pressure additives to minimize wear in large roller and thrust bearings and to protect heavily loaded, low-speed gears under boundary lubrication conditions. The use of synthetic base stocks produces a lubricant with high viscosity index that allows for good pumpability at lower temperatures while maintaining excellent film thickness at higher temperatures.

Triton OG SS does not contain heavy metals, bitumen or solid additives.

Applications

- Large roller and thrust bearings in sugar mills
- Open and semi-enclosed gear drives in rotary kilns and mills found in cement, limestone and gypsum production
- Slow-speed, heavily loaded plain and rolling contact bearings

Triton OG SS meets the requirements of the following industry specification:

- ANSI/AGMA Standard 9005-E02

Features/Benefits

- Excellent adhesion to metal surfaces
- Extreme-pressure protection
- High film strength reduces the tendency for fluid “squeeze out” in highly loaded and slowly rotating gears and bearings
- Good resistance to water washout
- Excellent pumpability at low ambient temperatures
- Does not contain heavy metals, bitumen or solid additives
- Solvent-free formulation
- Amber-colored product
- Suitable for use in existing lubricant spray systems, allowing for easy conversion from lubricants containing bitumen

**Semi-Synthetic
Open Gear
Lubricant for
Mills and Kilns**

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SMOOTHLY.**





Triton® OG SS

Typical Properties	
AGMA Grade	14R
Specific Gravity @ 60°F	0.899
Density, lbs/gal @ 60°F	7.50
Color, Visual	Amber
Texture	Tacky
Flash Point (COC), °C (°F)	210 (410)
Pour Point, °C (°F)	-13 (9)
Viscosity	
cSt @ 40°C	15,834
cSt @ 100°C	551
Viscosity Index	185
Copper Corrosion, ASTM D130	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	400
Four-Ball Wear, ASTM D4172B, Scar Diameter, mm	0.49
Timken OK Load, ASTM D2782, lb	65

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-16

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LUBRICANTS

Triton® Syngear FE

Phillips 66® Triton® Syngear FE is a premium quality, synthetic, fuel-efficient (FE) API GL-5 automotive gear lubricant designed for use in passenger car and truck axles with hypoid gear sets operating in extreme temperatures or under severe driving conditions. It has been specifically formulated to provide improved fuel economy compared to typical mineral SAE 80W-90 or synthetic SAE 75W-90 gear oils.

Triton Syngear FE is formulated to provide long service life, extended gear life and better fuel economy in automotive differentials operating under varying conditions of speed, load, temperature and torque. The carefully balanced formulation is designed to minimize oxidative sludge and varnish formation, reduce wear, prevent scoring damage, and protect against metal fatigue and spalling damage under shock-load conditions. The full-synthetic formulation provides enhanced oxidation resistance and thermal stability at high temperatures and better low-temperature properties compared with conventional mineral oil-based automotive gear oils, resulting in longer service intervals and better performance over a wider temperature range. In standard industry and commercial fleet tests, this product has shown a fuel savings of 1.0-1.5% compared to typical synthetic SAE 75W-90 gear oils.

Triton Syngear FE is fully approved for 500,000-mile drain intervals in drive axles in linehaul service under Dana®/Eaton® Roadranger® or extended warranties.

Applications

- Service fill of conventional differentials in passenger cars and trucks
- Top-off only of limited-slip differentials in passenger cars and light trucks⁽¹⁾
- Service fill of differentials, final drives and transfer cases in some off-highway equipment
- Non-synchronized manual transmissions in trucks, buses and heavy equipment where the manufacturer specifies an API GL-5 or MT-1 gear oil

⁽¹⁾**Note:** For complete drain and refill, many limited-slip differentials may require the manufacturer's specified gear lubricant or supplemental additive. Refer to the owner's manual for specific requirements.

Triton Syngear FE meets or exceeds the requirements of:

- API Service GL-5, MT-1
- International (Navistar) TMS 6816
- Mack GO-J Plus
- Meritor O76-N
- MIL-PRF-2105E
- SAE J2360

**Premium
Synthetic,
Fuel-Efficient
Automotive
Gear Lubricant,
API GL-5/MT-1**

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Triton Syngear FE is approved for service fill under the following OEM specifications:

- Dana SHAES-256 Rev C, SHAES-429

Features/Benefits

- Extended drain, all-season performance
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- High shear stability
- Outstanding low-temperature properties
- Protects against rust and corrosion
- Good foam resistance
- Higher fuel efficiency compared to typical conventional SAE 80W-90 and synthetic SAE 75W-90 gear oils

Triton® Syngear FE

Typical Properties	
SAE Grade	75W-90
Specific Gravity @ 60°F	0.891
Density, lbs/gal @ 60°F	7.42
Color, Visual	L 2.0
Flash Point (COC), °C (°F)	215 (419)
Pour Point, °C (°F)	-45 (-49)
Viscosity, Brookfield	
cP @ -40°C	90,000
Viscosity, Kinematic	
cSt @ 40°C	103
cSt @ 100° C	15.0
Viscosity Index	152

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-15-16

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LUBRICANTS

Triton® Synlube LDO

Phillips 66® Triton® Synlube LDO is a synthetic, API GL-5 automotive gear lubricant specially designed for long-drain service and extended warranty protection in passenger car and truck axles with hypoid gear sets.

Triton Synlube LDO is formulated to provide long service life and extended gear life in automotive differentials operating under varying conditions of speed, load, temperature and torque. It combines excellent oxidation resistance and thermal stability at high temperatures with outstanding low-temperature properties to ensure excellent performance over a wide temperature range. It has excellent water-separating properties to prevent the formation of emulsions and retain its lubricating properties even in the presence of a small amount of water.

Triton Synlube LDO is approved for 500,000-mile drain intervals in drive axles under Meritor extended warranties.

Applications

- Service fill of conventional differentials in passenger cars and trucks
- Top-off only of limited-slip differentials in passenger cars and light trucks⁽¹⁾
- Service fill of differentials, final drives and transfer cases of some off-highway equipment
- Non-synchronized manual transmissions in trucks, buses and heavy equipment where the manufacturer specifies an API GL-5 or MT-1 gear oil

⁽¹⁾**Note:** For complete drain and refill, many limited-slip differentials may require the manufacturer's specified gear lubricant or supplemental additive. Refer to the owner's manual for specific requirements.

Triton Synlube LDO meets or exceeds the requirements of:

- API Service GL-5, MT-1
- Mack GO-J
- MIL-PRF-2105E
- SAE J2360

Triton Synlube LDO is approved for service fill under the following OEM specifications:

- Meritor O76-R for extended-drain lubricants

**Synthetic
Long-Drain
Automotive
Gear Lubricant,
API GL-5/MT-1**

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SMOOTHLY. 



Features/Benefits

- Extended drain/extended warranty protection
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- High shear stability
- Outstanding low-temperature properties
- Excellent water-separating properties
- Protects against rust and corrosion
- Good foam resistance
- Compatible with synthetic and conventional automotive gear oils

Triton® Synlube LDO

Typical Properties		
SAE Grade	75W-90	80W-140
Specific Gravity @ 60°F	0.874	0.882
Density, lbs/gal @ 60°F	7.28	7.34
Color, ASTM D1500	L 8.0	L 8.0
Flash Point (COC), °C (°F)	200 (392)	200 (392)
Pour Point, °C (°F)	-45 (-49)	-36 (-33)
Viscosity, Brookfield		
cP @ -40°C	119,000	-----
cP @ -26°C	-----	48,000
Viscosity, Kinematic		
cSt @ 40°C	114	222
cSt @ 100°C	17.2	25.5
Viscosity Index	166	146

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® Synthetic Gear Lube

Phillips 66® Triton® Synthetic Gear Lube is a synthetic, multipurpose, extreme-pressure, API GL-5 automotive gear lubricant. It is specifically designed for use in passenger car and truck axles with hypoid gear sets operating in extreme temperatures or under severe driving conditions.

Triton Synthetic Gear Lube is formulated to provide long service life and extended gear life in automotive differentials operating under varying conditions of speed, load, temperature and torque. The carefully balanced formulation is designed to minimize oxidative sludge and varnish formation, reduce wear, prevent scoring damage, and protect against metal fatigue and spalling damage under shock-load conditions. The full-synthetic formulation provides enhanced oxidation resistance and thermal stability at high temperatures and better low-temperature properties compared with conventional mineral oil-based automotive gear oils, resulting in longer service intervals and better performance over a wider temperature range recommendation.

Applications

- Service fill of conventional differentials in passenger cars and trucks
- Top-off only of limited-slip differentials in passenger cars and light trucks⁽¹⁾
- Service fill of differentials, final drives and transfer cases in some off-highway equipment
- Non-synchronized manual transmissions in trucks, buses and heavy equipment where the manufacturer specifies an API GL-5 or MT-1 gear oil

⁽¹⁾**Note:** For complete drain and refill, many limited-slip differentials may require the manufacturer's specified gear lubricant or supplemental additive. Refer to the owner's manual for specific requirements.

Triton Synthetic Gear Lube meets or exceeds the requirements of:

- API Service GL-5, MT-1
- International (Navistar) TMS 6816
- MIL-PRF-2105E
- SAE J2360

Triton Synthetic Gear Lube is approved for service fill under the following OEM specifications:

- Dana SHAES-429
- Mack GO-J

**Premium
Synthetic
Automotive
Gear Lubricant,
API GL-5/MT-1-
VI Approved**

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Features/Benefits

- Extended drain, all-season performance
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent thermal durability and extreme-pressure properties for extended gear life
- High load-carrying capacity for protection against scuffing and wear
- High shear stability
- Outstanding low-temperature properties
- Protects against rust and corrosion
- Good foam resistance
- Potential fuel savings compared with conventional SAE 85W-140 gear oils

Triton® Synthetic Gear Lube

Typical Properties	
SAE Grade	80W-140
Specific Gravity @ 60°F	0.902
Density, lbs/gal @ 60°F	7.51
Color, ASTM D1500	8.0
Flash Point (COC), °C (°F)	200 (392)
Pour Point, °C (°F)	-40 (-40)
Viscosity, Brookfield	
cP@ -26°C	75,000
Viscosity, Kinematic	
cSt @ 40°C	284
cSt @ 100°C	30.6
Viscosity Index	146

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® Synthetic Transoil 50

Phillips 66® Synthetic Transoil 50 is a full-synthetic SAE 50 transmission lubricant designed for use in heavy-duty manual transmissions in trucks and buses operating in extreme temperatures and/or extended service intervals. It combines improved low-temperature properties with outstanding oxidation resistance and thermal stability at high temperatures to provide excellent all-weather, year-round performance.

Triton Synthetic Transoil 50 has excellent shear stability and antiwear properties to protect synchronizers, reduce component wear and promote longer transmission life. It is particularly recommended for use in newer, higher torque manual transmissions coupled with increased horsepower engines. It is fully approved for extended drain service (up to 500,000 miles in linehaul service) in Eaton Roadranger® and Meritor transmissions.

Applications

- Heavy-duty manual and semi-automatic transmissions in trucks and buses where the OEM specifies a non-EP, API MT-1 SAE 50 or API GL-1 SAE 90 gear oil, or an SAE 50 heavy-duty engine oil

Triton Synthetic Transoil 50 meets or exceeds the requirements of:

- API Service GL-1, MT-1
- International (Navistar) TMS 6816

Triton Synthetic Transoil 50 is approved for service fill under the following OEM specifications:

- Eaton PS-164 Rev 7
- Mack TO-A Plus
- Meritor O-81

Features/Benefits

- Extended drain, all-season performance
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Excellent low-temperature properties for easier shifting in cold weather
- High shear stability
- High load-carrying capacity
- Protects against component wear and gear micropitting
- Protects against rust and corrosion
- Good foam resistance
- Excellent seal compatibility
- Potential fuel economy improvement compared with non-synthetic transmission fluids

Premium Full-Synthetic SAE 50 Manual Transmission Fluid, API MT-1

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Triton® Synthetic Transoil 50

Typical Properties	
SAE Grade	50
Specific Gravity @ 60°F	0.860
Density, lbs/gal @ 60°F	7.16
Color, Visual	Amber
Flash Point (COC), °C (°F)	221 (430)
Pour Point, °C (°F)	-45 (-49)
Viscosity, Brookfield	
cP @ -40°C	104,000
Viscosity, Kinematic	
cSt @ 40°C	132
cSt @ 100°C	17.5
Viscosity Index	146

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

02-26-18

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LUBRICANTS

GREASES



LUBRICANTS

Bentone

Phillips 66® Bentone is a high-quality, extreme-pressure (EP), clay-thickened grease developed for the lubrication of industrial equipment operating under heavy loads and at high temperatures. It is particularly recommended for medium-to-large, low-speed bearings operating at very high temperatures where conventional soap-based greases typically fail to provide satisfactory lubrication.

Bentone is manufactured with high-quality, heavy paraffinic base oils and a non-soap, bentonite clay thickener. It is fortified with extreme-pressure and antiwear additives to provide outstanding protection for bearings and moving parts exposed to heavy loads and high operating temperatures. It retains its consistency at high temperatures and has good water washout resistance and good storage stability.

Applications

- Banbury mixers
- Drying ovens
- Jaw crushers
- Kiln cars
- Rolling and strip mills
- Steel mills
- Aluminum, cement, glass and rubber plants

Features/Benefits

- Non-melt clay thickener
- Excellent resistance to changes in consistency at high temperatures
- Good extreme pressure and antiwear properties
- Adheres to metallic surfaces
- Good shear stability
- High film strength
- Resists water washout
- Good mechanical and storage stability

Extreme-Pressure, Clay-Thickened Grease for High-Temperature Applications

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Bentone

Typical Properties	
NLGI Grade	2
Thickener	Bentonite Clay
Color	Golden
Dropping Point, °C (°F)	>288 (>550)
Density, lbs/gal	7.71
Penetration, ASTM D217, Worked (60 strokes)	265-295
Texture	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	250
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	45
Base Oil Properties	
Viscosity	
cSt @ 40°C	450
cSt @ 100°C	31.5
SUS @ 100°F	2,400
SUS @ 210°F	154
Viscosity Index	101
Usable Temperature Range ⁽¹⁾	
°C	-7 to 190
°F	20 to 375

⁽¹⁾ **Note:** Prolonged or continuous exposure to temperatures above 204°C (400°F) will accelerate base oil oxidation and decrease the service life of the grease. In such applications, frequent relubrication is recommended.

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-16

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LUBRICANTS

Cable Lube

Phillips 66® Cable Lube is a heavy-duty lubricant developed for the lubrication and preservation of wire ropes and cables. It is formulated with a heavy residual base oil and special rust and corrosion inhibitors, and is cut back with a volatile, non-chlorinated solvent for ease of application without heating. Its low viscosity and special wetting properties permit penetration to the core of the wire rope or cable. The solvent evaporates, leaving behind a tough, semi-fluid lubricant in the core and on each wire strand.

Cable Lube clings tenaciously and is not readily displaced by water. It contains an effective rust inhibitor for further protection. Between treatments, lubrication is supplied from the core, which acts as a reservoir to distribute the lubricant to each wire and strand.

Cable Lube reduces friction and wear between the wires and strands. The coating on the exterior of the cable protects and lubricates the cable and serves as a cushion between the cable and the sheaves or drums. This residual film remains pliable even at low ambient temperatures.

Applications

- Wire ropes and cables
- Hoists, cranes and aerial tramways
- Logging and mining equipment
- Mill machinery
- Open and semi-enclosed gears and pinions
- Guides and sliding surfaces

Note: Whenever possible, Cable Lube should be applied when the cable is flexing, such as when it is going over a sheave. This facilitates the penetration of the lubricant to the core and permits more uniform coating of the wire strands. It also is desirable, but not necessary, to clean the cable before application.

CAUTION: Cable Lube should not be stored near sources of heat. The container should be tightly closed to avoid fire hazard and to reduce loss of solvent. Loss of solvent decreases the penetrating qualities of the lubricant. During application, proper precautions should be taken to ensure adequate ventilation and due attention should be given to any potential fire hazard.

Features/Benefits

- Good penetrating ability
- Preserves and conditions hemp cores
- Reduces friction and wear between wires and strands
- Resists throw-off during high speed operation
- Excellent resistance to water washout
- Excellent rust and corrosion protection

Multipurpose Wire Rope & Cable Lubricant

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Cable Lube

Typical Properties	
ISO Grade (with solvent)	15
Specific Gravity @ 60°F	0.883
Density, lbs/gal @ 60°F	7.36
Color	Black
Flash Point, COC, °C (°F)	82 (180)
Pour Point, °C (°F)	-60 (-76)
Texture (after solvent evaporation)	Tacky
Viscosity (with solvent)	
cSt @ 40°C	14.5
SUS @ 100°F	80
Viscosity (without solvent)	
cSt @ 40°C	1,375
cSt @ 100°C	150
SUS @ 100°F	7,100
SUS @ 210°F	722
Viscosity Index (without solvent)	127
Four-Ball EP, ASTM D2596, Weld Load, kgf	250
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.40

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Calcium S

Phillips 66® Calcium S is a high-quality, extreme-pressure (EP) calcium stearate grease specially developed for use by automobile manufacturers and parts suppliers to the automobile industry. It is recommended for the lubrication of window regulators, door hinges and similar automotive hardware.

Calcium S is manufactured with high-quality, low-viscosity base oils and a calcium stearate soap thickener. It is fortified with extreme-pressure and antiwear additives, plus rust and oxidation inhibitors. It has excellent oxidation resistance for long service life, has good load-carrying capacity for protection against wear, and protects metal parts against rust and corrosion. It has good resistance to water washout, and excellent low-temperature pumpability.

Applications

- Window regulators, door hinges and similar hardware on automotive vehicles
- Sliding mechanisms on automobile seats
- Industrial equipment where a water-resistant, extreme-pressure calcium grease with excellent low-temperature pumpability is recommended

Calcium S is recommended for use where the OEM specifies:

- Ford WSB-M1C163-D

Calcium S is approved by Meritor for use in the manufacture of automotive window regulators.

Features/Benefits

- Excellent oxidation resistance
- Good load-carrying capacity
- Good wear protection
- Protects against rust and corrosion
- Good resistance to water washout
- Excellent low-temperature pumpability
- Excellent storage stability

**Extreme-
Pressure
Calcium Grease
for Automotive
Hardware**

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Calcium S

Typical Properties	
NLGI Grade	2
Thickener	Calcium Stearate
Color	Amber
Dropping Point, °C (°F)	140 (284)
Density, lbs/gal	7.34
Penetration, Worked (60 strokes), ASTM D217	265-295
Texture	Smooth
Copper Corrosion, ASTM D4048	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.55
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	45
Base Oil Properties	
Viscosity	
cSt @ 40°C	15.1
cSt @ 100°C	3.2
SUS @ 100°F	83
SUS @ 210°F	37
Viscosity Index	58
Usable Temperature Range	
°C	-51 to 107
°F	-60 to 225

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Cotton Picker

Phillips 66® Cotton Picker is a high-quality, semi-fluid lithium grease developed for the lubrication of cotton picker spindle heads on the front of mechanical cotton pickers. It is formulated to protect the spindle heads, as well as the rapidly rotating cotton plant strippers.

Cotton Picker is manufactured with high-quality base oils and lithium 12-hydroxystearate soap thickener. It is fortified with rust and oxidation inhibitors to protect the spindle heads and bearings against corrosion. Its semi-fluid consistency helps ensure complete lubrication and ease of starting of machinery during the fall harvest season as temperatures begin to drop. It is dyed green for ease of identification.

Applications

- Cotton picker spindles, picker bars, and chassis bearings

Cotton Picker is recommended for use where the OEM specifies:

- John Deere JDN 305, JDN 360
- International Harvester IH B-27

Features/Benefits

- Protects spindles and bearings
- Eliminates spindles seizure or freeze-up
- Permits easy starting in cold weather
- Protects against rust and corrosion

Semi-Fluid, Non-EP Lithium Grease for Cotton Picker Spindles

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Cotton Picker

Typical Properties	
NLGI Grade	00
Thickener	Lithium
Color	Dark Green
Dropping Point, °C (°F)	---
Density lbs/gal	7.38
Penetration, Worked (60 strokes), ASTM D217	400-430
Texture	Semi-fluid
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.60
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Base Oil Properties	
Viscosity	
cSt @ 40°C	22.5
cSt @ 100°C	4.2
SUS @ 100°F	118
SUS @ 210°F	40.4
Viscosity Index	80
Usable Temperature Range	
°C	-29 to 93
°F	-20 to 200

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Coupling Grease

Phillips 66® Coupling Grease is a high-performance, polymer-containing lithium grease developed for use in grease-lubricated flexible couplings, such as those commonly found in mining equipment, power plants, manufacturing plants and chemical plants. It has exceptional resistance to oil separation when subjected to the high centrifugal forces typically encountered with medium and high-speed gear, metallic grid and chain couplings.

Coupling Grease is specifically formulated to the lower (softer) end of the NLGI No. 1 grade to meet most OEM requirements. It is manufactured with high-quality, high-viscosity base oils and lithium 12-hydroxystearate soap thickener. It is fortified with special extreme-pressure (EP) additives, oxidation and corrosion inhibitors, and polymers to withstand the centrifugal action in couplings and adhere to the moving parts to provide lubrication, minimize friction and help extend coupling life. It has outstanding performance in the Koppers K36 Centrifugal Oil Separation Test.

Applications

- Gear, metallic grid and flexible-chain couplings
- Couplings commonly used in mining and gas field equipment
- Couplings and universal joints operating under high centrifugal forces
- Couplings used between electric motors and gearboxes in industrial and chemical plants

Coupling Grease meets the requirements of the following industry specifications:

- ANSI/AGMA Standard 9001-B97, Type CG-1 & CG-2 for medium and high-speed couplings

Features/Benefits

- Outstanding resistance to oil separation
- Excellent oxidation resistance and thermal stability
- High load-carry capacity
- Protects against rust and corrosion
- Minimizes friction and wear to help extended coupling life

**High-
Performance,
Extreme-
Pressure
Lithium Grease
for Industrial
Couplings**

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Coupling Grease

Typical Properties	
NLGI Grade	0.5/1
Thickener	Lithium
Color	Dark Amber
Dropping Point, °C (°F)	>177 (>350)
Density, lbs/gal	7.55
Penetration, ASTM D217	
Worked 60 strokes	335
Worked 10,000 strokes	305
Texture	Tacky
Four-Ball EP, ASTM D2596, Weld Load, kgf	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.40
Koppers Centrifugal Oil Separation Test, K36, ASTM D4425	
24 hrs, 50°C, vol %	<2
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	50
Base Oil Properties	
Viscosity (with polymer)	
cSt @ 40°C	>3,200
cSt @ 100°C	142
Viscosity (without polymer)	
cSt @ 40°C	620
cSt @ 100°C	30
Usable Temperature Range	
°C	-12 to 121
°F	10 to 250

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Dynalife® HT

Phillips 66® Dynalife HT is a high-quality, multipurpose, extreme pressure (EP) lithium complex grease developed for the lubrication of automotive and industrial equipment operating under heavy loads and at moderate to high temperatures. It is recommended for use in a variety of automotive, agricultural, construction, mining and industrial applications. It is NLGI GC-LB certified for use as a multipurpose automotive wheel bearing and chassis lubricant.

Dynalife HT is manufactured with high-quality base oils, a special polymer and a lithium complex soap thickener. It is fortified with extreme pressure and antiwear additives plus rust and oxidation inhibitors. It has excellent thermal stability at high temperatures, high load-carrying capacity for excellent wear protection, and protects metal parts against rust and corrosion. It forms an effective seal to help minimize bearing contamination. Its tackiness properties and heavy base oil provide a high level of adhesion to bearing surfaces for improved retention, reduced leakage and excellent resistance to water washout.

Applications

- Agricultural, construction, mining and industrial equipment operating under heavy or shock loads
- Wheel bearings of passenger cars, trucks, high-performance vehicles, sport utility vehicles and motorcycles equipped with disc brakes
- Ball joints, universal joints, other chassis parts and water pumps on passenger cars, trucks and other mobile equipment
- Conveyor bearings
- Pellet mills manufactured by Bliss Industries (Grade No. 2)

Features/Benefits

- Excellent high-temperature performance
- Excellent wear protection
- High load-carrying capacity
- Protects against rust and corrosion
- Excellent resistance to water washout
- Good low-temperature pumpability
- NLGI GC-LB certified

**Multipurpose,
Heavy Base
Oil, Extreme
Pressure
Lithium
Complex
Grease; NLGI
GC-LB Certified**

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Dynalife® HT

Typical Properties		
NLGI Grade	1	2
Thickener	Lithium Complex	Lithium Complex
Color	Red	Red
Dropping Point, °C (°F)	260 (500)	260 (500)
Density, lbs/gal	7.44	7.44
Penetration, ASTM D217 (worked 60 strokes)	310-340	265-295
Texture	Smooth/Tacky	Smooth/Tacky
Four-Ball EP, ASTM D2596, Weld Load, kgf	315	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.45	0.45
Oxidation Stability, ASTM D942, 100 hours, Pressure Drop, psi (kPa)	2 (15)	2 (15)
Rust Prevention, ASTM D1743	Pass	Pass
Timken OK Load, ASTM D2509, lb	70	80
Water Washout Resistance, ASTM D1264, Weight Loss @ 175°F, %	7.50	2.75
Base Oil Properties		
Viscosity		
cSt @ 40°C	625	625
cSt @ 100°C	40.0	40.0
SUS @ 100°F	3,350	3,350
SUS @ 210°F	195	195
Viscosity Index	104	104
Usable Temperature Range		
°C	-18 to 177	-12 to 177
°F	0 to 350	10 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Dynalife® L-EP

Phillips 66® Dynalife L-EP is a multipurpose, extreme pressure (EP) lithium grease developed for use in a wide variety of industrial and automotive applications. It is a versatile, general-purpose grease recommended for use in applications where operating temperatures and loads are moderate. It is available in six grades to cover a wide range of applications.

Dynalife L-EP is manufactured with high-quality base oils, a special polymer and lithium-12-hydroxystearate soap thickener. It is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors. It has good load-carrying capacity for protection against wear, good oxidation resistance for long service life, protects metal parts against rust and corrosion, and is resistant to water washout. It has good resistance to structural breakdown and will not soften excessively during high-speed operation in rolling-element bearings. It forms a good seal to help minimize bearing contamination.

Applications

- Plain and rolling-element bearings in compressors, fans, centrifugal pumps and other industrial equipment where operating temperatures and loads are moderate
- Chassis parts, universal joints and water pumps on passenger cars, light trucks and other mobile equipment
- Track rollers, commercial lawn mowers, crushers and vibrating screens (semi-fluid grades)
- Underground mining machinery and other enclosed gearboxes where oil leakage is a problem (semi-fluid grades)
- Wheel bearings of passenger cars equipped with drum brakes
- Centralized grease lubrication systems
- General-purpose shop/industrial grease

Dynalife L-EP No. 1 is approved against the following OEM specification:

- Fives Cincinnati P-72

Features/Benefits

- Multipurpose grease for use in a wide variety of applications
- Good extreme-pressure and antiwear properties
- Good shear stability
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Resists water washout
- Good low-temperature pumpability
- Suitable for use in centralized lube systems

**Multipurpose
Extreme
Pressure
Lithium Grease**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Dynalife® L-EP

Typical Properties						
NLGI Grade	000	00	0	1	2	3
Thickener	Lithium	Lithium	Lithium	Lithium	Lithium	Lithium
Color	Amber	Amber	Amber	Amber	Amber	Amber
Dropping Point						
°C	---	---	172	177	177	177
°F	---	---	342	350	350	350
Density, lbs/gal	7.44	7.44	7.44	7.44	7.44	7.44
Penetration, ASTM D217						
Worked 60 strokes	445-475	400-430	355-385	310-340	265-295	220-250
Texture	Semi-fluid	Semi-fluid	Smooth	Smooth	Smooth	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	250	250	250	250	250	250
Four-Ball Wear, ASTM D2266						
Scar Diameter, mm	0.45	0.45	0.45	0.45	0.45	0.45
Oxidation Stability, ASTM D942, 100 hours						
Pressure Drop, psi (kPa)	5(35)	5(35)	5(35)	5(35)	5(35)	5(35)
Rust Prevention, ASTM D1743	Pass	Pass	Pass	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	40	40	40	40	40	40
Base Oil Properties						
Viscosity						
cSt @ 40°C	175	175	175	175	175	175
cSt @ 100°C	13.0	13.0	13.0	13.0	13.0	13.0
SUS @ 100°F	940	940	940	940	940	940
SUS @ 210°F	72	72	72	72	72	72
Viscosity Index	52	52	52	52	52	52
Usable Temperature Range						
°C	-34 to 65	-34 to 65	-29 to 107	-18 to 121	-18 to 121	-12 to 121
°F	-30 to 150	-30 to 150	-20 to 225	0 to 250	0 to 250	10 to 250

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Food Machinery Grease

Phillips 66® Food Machinery Grease is a premium quality, food-grade, extreme-pressure (EP) aluminum complex grease specially developed for the lubrication of machinery in food processing, bottling and packaging plants. It is registered by NSF International as an H1 lubricant for use where incidental food contact may occur, and also meets the requirements of the Canadian Food Inspection Agency (CFIA) for incidental food contact in Canadian food processing plants.

Food Machinery Grease is manufactured with high-quality base oils thickened with aluminum complex soap. It is compounded with special food-grade additives to provide excellent extreme-pressure and anti-wear properties, excellent oxidation resistance, protection against rust and corrosion, and good adhesion to metal surfaces. It has excellent resistance to water washout and provides excellent rust and corrosion protection in applications where the equipment is exposed to fruit acids, chemicals, or saline solutions.

Food Machinery Grease passes the visual “no sheen” requirements of the U.S. EPA Static Sheen Test.

Applications

- Food processing equipment in canneries, meat packing plants and poultry plants
- Bottling plants
- Seamers

Food Machinery Grease meets the requirements of the following government and industry specifications:

- Canadian Food Inspection Agency (CFIA) requirements for incidental food contact (LONO)
- FDA 21 CFR 178.3570 for incidental food contact
- NSF International H1 and former 1998 USDA H1 guidelines for incidental food contact (NSF Registration No. 142471)
- U.S. EPA/U.S. Coast Guard Static Sheen Test, Federal Register Vol. 58, No.41

Features/Benefits

- Excellent oxidation resistance
- Excellent resistance to water washout
- Good extreme-pressure and anti-wear properties
- Protects against rust and corrosion
- Good adhesion to metal surfaces
- Non-staining
- Suitable for use over a wide range of operating temperatures

Note: Aluminum complex greases have an inherent tendency to bleed a small amount of oil during storage. Containers of Food Machinery Grease should be stored in a temperature-controlled environment to minimize oil separation.

**Extreme-
Pressure,
Aluminum
Complex Food
Machinery
Grease; NSF H1
Registered**

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SMOOTHLY. 



Food Machinery Grease

Typical Properties	
NLGI Grade	2
Thickener	Aluminum Complex
Color	White
Dropping Point, °C (°F)	>260 (>500)
Density, lbs/gal	8.58
Penetration, ASTM D217, Worked (60 strokes)	265-295
Texture	Smooth, Adhesive
Copper Corrosion, ASTM D4048	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	500
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.60
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	<5 (<35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	40
Water Washout Resistance, ASTM D1264, Wt Loss @ 175°F, %	<5
Base Oil Properties	0.30
Viscosity (with polymer)	
cSt @ 40°C	220
cSt @ 100°C	21.0
SUS @ 100°F	1,155
SUS @ 210°F	106
Viscosity Index	113
Usable Temperature Range	
°C	-34 to 163
°F	-30 to 325

Health & Safety Information

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LUBRICANTS

Megaplex® XD3

Phillips 66® Megaplex XD3 is a high-performance, multipurpose, extreme pressure (EP) lithium complex grease developed to satisfy the severe lubrication requirements of construction and off road equipment manufactured by Caterpillar, Komatsu Dresser, Case New Holland, John Deere and others. It is particularly recommended for use in off-highway trucks and heavy equipment, such as bulldozers, motor graders and wheel loaders, operating under heavy or shock loads.

Megaplex XD3 is manufactured with high-quality, high-viscosity base oils, a special polymer and a lithium complex soap thickener. It is fortified with extreme-pressure and antiwear additives, 3% molybdenum disulfide (moly), a tackifier, and rust and oxidation inhibitors to provide excellent wear protection as well as excellent corrosion protection and resistance to water washout in equipment operating under wet conditions and/or high temperatures and subject to heavy or shock loading.

Megaplex XD3 Grade No. 1 is NLGI GC-LB certified for use as a multipurpose automotive wheel bearing and chassis lubricant.

Applications

- Chassis parts and wheel bearings of construction, mining and other heavy mobile equipment
- Universal joints, constant-velocity joints, brake self adjusting screws and clutch release bearings on off-highway trucks and other heavy equipment
- Tractor-trailer fifth wheels
- Heavily loaded plain and rolling-element bearings in industrial and mobile equipment where the manufacturer specifies a high temperature, extreme-pressure grease with 3% moly

Features/Benefits

- High dropping point (>500°F)
- High load-carrying capacity
- Excellent wear protection
- Contains 3% moly for extra protection against galling and wear under shock loads
- Excellent resistance to water washout
- Excellent resistance to separation
- Protects against rust and corrosion
- NLGI GC-LB certified (Grade No. 1)

**Extreme
Pressure
Lithium
Complex Grease
with 3% Moly
for Construction
and Off-Road
Equipment**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Megaplex® XD3

Typical Properties		
NGLI Grade	1	2
Thickener	Lithium Complex	Lithium Complex
Color	Gray-Black	Gray-Black
Dropping Point, °C (°F)	>260 (>500)	>260 (>500)
Density, lbs/gal	7.88	7.88
Penetration, ASTM D217 (worked 60 strokes)	310-340	265-295
Texture	Tacky	Tacky
Molybdenum Disulfide, wt %	3	3
Four-Ball EP, ASTM D2596, Weld Load, kgf	400	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.55	0.55
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)	5 (35)
Rust Prevention, ASTM D1743	Pass	Pass
Timken OK Load, ASTM D2509, lb	55	55
Base Oil Properties		
Viscosity		
cSt @ 40°C	460	460
cSt @ 100°C	30.0	30.0
SUS @ 100°F	2,470	2,470
SUS @ 210°F	147	147
Viscosity Index	94	94
Usable Temperature Range		
°C	-23 to 177	-18 to 177
°F	-10 to 350	0 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Megaplex® XD5

Phillips 66® Megaplex XD5 is a high-performance, multipurpose, extreme pressure (EP) lithium complex grease developed to satisfy the severe lubrication requirements of mining and off road equipment manufactured by Caterpillar, Terex, Komatsu Dresser, Le Tourneau, P&H and others. It is particularly recommended for use in AC and DC electric-drive haul trucks, cranes, scrapers, shovels and drag lines operating in severe service under heavy or shock loads.

Megaplex XD5 is manufactured with high-quality base oils, a special polymer and a lithium complex soap thickener. It is fortified with extreme-pressure and antiwear additives, 5% molybdenum disulfide (moly), a tackifier, and rust and oxidation inhibitors to provide excellent wear protection as well as excellent corrosion protection and resistance to water washout in equipment operating under wet conditions and/or high temperatures and subject to heavy or shock loading.

Megaplex XD5 Grades No. 0 and No. 1W are formulated with lower-viscosity base oils than the other two grades for better pumpability at low ambient temperatures.

Applications

- Chassis parts and wheel bearings on mining and other off-highway equipment
- Hydraulic excavator mining shovels, such as Caterpillar 5100 & 5200 series
- Mine haul trucks
- Heavily-loaded plain and rolling-element bearings in industrial and mobile equipment where the manufacturer specifies a high-temperature, extreme-pressure grease with 5% moly

Features/Benefits

- High dropping point (500°F)
- High load-carrying capacity
- Excellent wear protection
- Contains 5% moly for extra protection against galling and wear under shock loads
- Excellent resistance to water washout
- Excellent resistance to separation
- Protects against rust and corrosion

**Extreme
Pressure
Lithium
Complex Grease
with 5% Moly
for Construction
and Off-Road
Equipment**

**KEEPING THE
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RUNNING
SMOOTHLY.**





Megaplex® XD5

Typical Properties				
NGLI Grade	0	1W	1	2
Thickener	Lithium Complex	Lithium Complex	Lithium Complex	Lithium Complex
Color	Gray-Black	Gray-Black	Gray-Black	Gray-Black
Dropping Point, °C (°F)	260 (500)	260 (500)	260 (500)	260 (500)
Density, lbs/gal	7.92	7.92	7.96	7.99
Penetration, ASTM D217				
Worked 60 strokes	355-385	310-340	310-340	265-295
Texture	Tacky	Tacky	Tacky	Tacky
Molybdenum Disulfide, wt %	5	5	5	5
Four-Ball EP, ASTM D2596, Weld Load, kgf	315	315	315	400
Four-Ball Wear, ASTM D2266				
Scar Diameter, mm	0.50	0.65	0.50	0.50
Oxidation Stability, ASTM D942, 100 hrs				
Pressure Drop, psi (kPa)	4 (28)	4 (28)	4 (28)	4 (28)
Rust Prevention, ASTM D1743	Pass	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	55	50	55	55
Base Oil Properties				
Viscosity (with polymer)	2,470	---	2,470	---
cSt @ 40°C	180	140	245	470
cSt @ 100°C	13.7	13.0	19.0	30.0
SUS @ 100°F	962	739	1,304	2,526
SUS @ 210°F	75	72	97	147
Viscosity Index	60	83	86	92
Usable Temperature Range				
°C	-34 to 149	-34 to 149	-29 to 177	-18 to 177
°F	-30 to 300	-30 to 300	-20 to 350	0 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Milube® WR

Phillips 66® Milube WR is a premium quality, adhesive, extreme-pressure (EP) lithium complex grease specially developed for use in demanding industrial applications such as steel rolling mills where high loads, high temperatures and/or wet conditions exist.

Milube WR is manufactured with high-quality, high-viscosity base oils and a lithium complex soap thickener. It is a tacky grease designed to stay in place, and is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors. It has excellent oxidation resistance for long service life, high load-carrying capacity for excellent wear protection, and protects metal parts against rust and corrosion. It has excellent adhesion to bearing surfaces for improved retention and resistance to water, and has excellent resistance to structural breakdown even under severe operating conditions.

Applications

- Steel rolling mills
- Heavily loaded plain and rolling-element bearings in industrial and mobile equipment
- Chassis parts on heavy mobile equipment

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- Excellent extreme-pressure and antiwear properties
- High load-carrying capacity
- High shear stability
- Excellent resistance to water washout
- Protects against rust and corrosion
- Good adhesion to metal surfaces
- High dropping point (>500°F)
- Does not contain heavy metals or other environmentally undesirable components

**Premium
Adhesive,
Extreme-
Pressure
Lithium
Complex Grease**

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Milube® WR

Typical Properties		
NLGI Grade	1	2
Thickener	Lithium Complex	Lithium Complex
Color	Green	Green
Dropping Point, °C (°F)	>260 (>500)	>260 (>500)
Density, lbs/gal	7.41	7.41
Penetration, ASTM D217 (worked 60 strokes)	310-340	265-295
Texture	Smooth/Tacky	Smooth/Tacky
Copper Corrosion, ASTM D4048	1b	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	400	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.50	0.50
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	3 (21)	3 (21)
Rust Prevention, ASTM D1743	Pass	Pass
Timken OK Load, ASTM D2509, lb	55	55
Water Washout Resistance, ASTM D1264, 175°F, Wt Loss, %	3	3
Base Oil Properties		
Viscosity		
cSt @ 40°C	410	410
cSt @ 100°C	26	26
SUS @ 100°F	2,200	2,200
SUS @ 210°F	129	129
Viscosity Index	85	85
Usable Temperature Range		
°C	-18 to 177	-12 to 177
°F	0 to 350	10 to 350

Health & Safety Information

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LUBRICANTS

Moly Low Temp

Phillips 66® Moly Low Temp is a multipurpose, extreme-pressure (EP) aluminum complex grease developed for use in automotive and industrial equipment operating at low ambient temperatures down to -40°F. It has good mobility at low temperatures plus a high dropping point for year-round use in arctic climates.

Moly Low Temp is manufactured with low-viscosity base oils and an aluminum complex soap thickener. It is compounded with select additives that provide extreme-pressure and antiwear properties, good oxidation resistance, and rust and corrosion protection. It is fortified with 5% molybdenum disulfide (moly) for extra protection in equipment subject to heavy or shock loads. It has good shear stability and resistance to water washout. It is suitable for both winter and summer use in arctic climates.

Applications

- Mobile equipment and industrial machinery operating for prolonged periods at temperatures substantially below 32°F
- Chassis parts, wheel bearings, spring shackles and king pins on automotive and other mobile equipment operating in arctic climates
- Chassis parts and wheel bearings on mobile equipment such as lift trucks operating in refrigeration plants, cold storage rooms and sharp-freeze rooms
- Plain and rolling-element bearings, slides and linkages on industrial equipment operating in cold rooms or at low ambient temperatures
- Track roller bearings and chassis parts on tractors, coal haulers, snow removal equipment and other heavy equipment operating in cold climates

Features/Benefits

- Suitable for year-round use in mobile equipment and industrial machinery operating in arctic climates
- Good low temperature properties down to -40°F
- Good extreme-pressure and antiwear properties
- Contains moly for extra protection under heavy or shock loads
- Good oxidation resistance
- Protects against rust and corrosion
- Good shear stability
- Good resistance to water washout

**Extreme-
Pressure
Aluminum
Complex
Grease with 5%
Moly for Low-
Temperature
Applications**

**KEEPING THE
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RUNNING
SMOOTHLY.**





Moly Low Temp

Typical Properties	
NLGI Grade	1
Thickener	Aluminum Complex
Color	Gray-Black
Dropping Point, °C (°F)	260 (500)
Density, lbs/gal	7.68
Penetration, Worked (60 strokes), ASTM D217	310-340
Texture	Smooth
Molybdenum Disulfide, wt %	5
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	45
Base Oil Properties	
Viscosity	
cSt @ 40°C	25.0
cSt @ 100°C	4.3
SUS @ 100°F	130
SUS @ 210°F	40.7
Viscosity Index	58
Usable Temperature Range	
°C	-40 to 149
°F	-40 to 300

Health & Safety Information

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LUBRICANTS

Multiplex® Red

Phillips 66® Multiplex Red is a high-performance, multipurpose, extreme pressure (EP) lithium complex grease developed for the lubrication of automotive and industrial equipment operating under heavy loads and at moderate to high temperatures. It is particularly recommended for use in applications that are too severe or require higher performance than that provided by conventional extreme-pressure lithium greases.

Multiplex Red is manufactured with high-quality base oils, a special polymer and a lithium complex soap thickener. It is fortified with extreme pressure and antiwear additives, a tackifier, and rust and oxidation inhibitors to provide outstanding wear protection, excellent thermal stability at high temperatures, and excellent resistance to corrosion and water washout. It forms an effective seal to help minimize bearing contamination and provides a high level of adhesion to bearing surfaces for improved retention, reduced leakage and excellent resistance to water washout. It is dyed red for ease of identification.

Multiplex Red Grades No. 1 and No. 2 are NLGI GC-LB certified for use as multipurpose automotive wheel bearing and chassis lubricants.

Applications

- Wheel bearings of passenger cars, trucks, high-performance vehicles, sport utility vehicles and motorcycles, particularly vehicles with disc brakes
- Ball joints, universal joints, other chassis parts and water pumps on passenger cars, trucks and other mobile equipment
- Heavily-loaded plain and rolling-element bearings in industrial, mining and mobile equipment

Features/Benefits

- Excellent high-temperature performance
- Outstanding wear protection
- High load-carrying capacity
- Excellent resistance to water washout
- Protects against rust and corrosion
- Good low-temperature pumpability
- NLGI GC-LB certified (Grades No. 1 and No. 2)

**Multipurpose
Extreme-
Pressure
Lithium
Complex
Grease; NLGI
GC LB Certified**

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SMOOTHLY.**





Multiplex® Red

Typical Properties			
NLGI Grade	0	1	2
Thickener	Lithium Complex	Lithium Complex	Lithium Complex
Color	Dark Red	Dark Red	Dark Red
Dropping Point, °C (°F)	250 (482)	271 (520)	271 (520)
Density, lbs/gal	7.48	7.48	7.48
Penetration, ASTM D217 (worked 60 strokes)	355-385	310-340	265-295
Texture	Tacky	Tacky	Tacky
Four-Ball EP, ASTM D2596, Weld Load, kgf	400	400	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	<0.60	<0.60	<0.60
Oxidation Stability, ASTM D942, 100 hrs			
Pressure Drop, psi (kPa)	5 (35)	5 (35)	5 (35)
Rust Prevention, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	70	70	70
U.S. Steel Mobility, g/sec			
@ 4°C (40°F)	4.55	2.18	1.04
@ -7°C (20°F)	1.03	0.57	0.26
@ -18°C (0°F)	0.20	0.11	0.05
Base Oil Properties			
Viscosity (with polymer)			
cSt @ 40°C	170	170	220
cSt @ 100°C	13.8	13.8	18.0
SUS @ 100°F	905	905	1,170
SUS @ 210°F	75	75	93
Viscosity Index	70	70	89
Usable Temperature Range			
°C	-34 to 149	-34 to 177	-34 to 177
°F	-30 to 300	-30 to 350	-30 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Omniguard®

Phillips 66® Omniguard is a high-performance, multipurpose, extreme-pressure (EP), corrosion-preventive grease specially developed for use in industrial and automotive equipment operating in wet or corrosive environments. It is particularly recommended for equipment exposed to water contamination, saltwater corrosion and/or high temperatures.

Omniguard is manufactured with high-quality base oils and a non-soap, calcium sulfonate thickener. It is fortified with antiwear additives and rust and corrosion inhibitors. It protects against rust and corrosion in high-humidity, high-temperature applications such as those found in the steel, lumber, tire manufacturing and paper industries. It has excellent load-carrying capacity, high shear stability and outstanding resistance to water washout.

Omniguard Grade No. 2 is NLGI GC-LB certified for use as a multipurpose automotive wheel bearing and chassis lubricant.

Applications

- Industrial and automotive equipment operating at high temperatures and exposed to water contamination, high humidity or corrosive environmental conditions
- Marine equipment, heavy mobile equipment and cables exposed to salt water
- Paper machine wet- and dry-end bearings and hot calender stacks
- Rolling mills, hot roll tables, continuous casters, ingot buggies and slab mills
- Steel mill roller bearings, conveyors and gears
- Centralized lube systems and auto lubbers in service shops

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- Outstanding rust and corrosion protection, including resistance to saltwater corrosion
- Excellent extreme-pressure and antiwear properties
- Outstanding resistance to water washout
- Excellent shear stability
- High dropping point (>550°F)
- Light-colored, low staining
- NLGI GC-LB certified (Grade No. 2)

**Premium
Extreme-
Pressure,
Corrosion
Preventive
Calcium
Sulfonate
Grease**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Omniguard®

Typical Properties		
NLGI Grade	1	2
Thickener	Calcium Sulfonate	Calcium Sulfonate
Color	Tan	Tan
Dropping Point, °C (°F)	300 (572)	300 (572)
Density, lbs/gal	8.29	8.29
Penetration, ASTM D217 (worked 60 strokes)	310-340	265-295
Texture	Smooth	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	500	500
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.39	0.39
Oxidation Stability, ASTM D942, 100 hrs		
Pressure Drop, psi (kPa)	0 (0)	0 (0)
Roll Stability, ASTM D1831, Change in Penetration, %	7	7
Rust Prevention, ASTM D1743	Pass	Pass
Shear Stability, ASTM D217, Change (100,000 strokes), %	1	1
Timken OK Load, ASTM D2509, lb	65	65
Water Washout Resistance, ASTM D1264		
Weight Loss @ 175°F, %	2.81	2.81
Base Oil Properties		
Viscosity		
cSt @ 40°C	219	219
cSt @ 100°C	18.8	18.8
SUS @ 100°F	1,160	1,160
SUS @ 210°F	96	96
Viscosity Index	96	96
Usable Temperature Range		
°C	-29 to 177	-29 to 177
°F	-20 to 350	-20 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Omniguard® 460

Phillips 66® Omniguard 460 is a premium quality, multipurpose, extreme-pressure (EP) calcium sulfonate grease specially developed for use in industrial and automotive equipment operating under severe conditions involving high loads, high temperatures and/or wet environments.

Omniguard 460 is manufactured with high-quality base oils, a special polymer and a non-soap, calcium sulfonate thickener. It is fortified with antiwear additives and rust and corrosion inhibitors. It protects against rust and corrosion in high-humidity, high-temperature applications such as those found in the steel, lumber, tire manufacturing and paper industries. It has outstanding resistance to water washout, excellent load-carrying capacity to protect against wear, and outstanding shear stability to resist mechanical breakdown.

Applications

- Industrial equipment operating under unfavorable conditions involving water contamination, high loads and/or high temperatures
- Plain and rolling-element bearings operating in corrosive environmental conditions
- Rolling mills, hot roll tables, continuous casters, ingot buggies and slab mills
- Steel mill roller bearings, conveyors and gears
- Marine and heavy mobile equipment exposed to salt water
- Paper machine wet- and dry- end bearings and hot calender stacks
- Automotive wheel bearings and chassis parts

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- Outstanding rust and corrosion protection, including resistance to saltwater corrosion
- Excellent extreme-pressure and antiwear properties
- Outstanding resistance to water washout
- Outstanding shear stability
- Good adhesion to metal surfaces
- High dropping point (>550°F)
- Does not contain heavy metals or other environmentally undesirable components

**Premium
Extreme-
Pressure,
Water-Resistant
Calcium
Sulfonate
Grease**

**KEEPING THE
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RUNNING
SMOOTHLY.**





Omniguard® 460

Typical Properties		
NLGI Grade	1	2
Thickener	Calcium Sulfonate	Calcium Sulfonate
Color	Tan	Tan
Dropping Point, °C (°F)	300 (572)	300 (572)
Density, lbs/gal	8.26	8.39
Penetration, ASTM D217 (worked 60 strokes)	310-340	265-295
Texture	Smooth	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	500	500
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.39	0.39
Oxidation Stability, ASTM D942, 100 hrs		
Pressure Drop, psi (kPa)	0 (0)	0 (0)
Roll Stability, ASTM D1831, Change in Penetration, %	7	7
Rust Prevention, ASTM D1743	Pass	Pass
Shear Stability, ASTM D217, Change (100,000 strokes), %	2	2
Timken OK Load, ASTM D2509, lb	65	65
Water Washout Resistance, ASTM D1264, 175°F, Wt Loss, %	2.75	2.75
Base Oil Properties		
Viscosity (with polymer)		
cSt @ 40°C	460	460
cSt @ 100°C	30	30
SUS @ 100°F	2,470	2,470
SUS @ 210°F	147	147
Viscosity Index	94	94
Usable Temperature Range		
°C	-32 to 177	-29 to 190
°F	-25 to 350	-20 to 375

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Omniguard® SRI

Phillips 66® Omniguard SRI is a multipurpose lubricant developed for the lubrication and preservation of wire ropes and cables, and as a short-term corrosion preventive for metal parts and equipment exposed to wet or corrosive environments.

Omniguard SRI is specially formulated with a synthetic rust inhibitor (SRI) to protect wire ropes, cables, mobile equipment and marine equipment exposed to moisture or saltwater. It is diluted with a non-chlorinated solvent for ease of application. It may be applied by brush or spray, and penetrates rapidly to the core of wire ropes and cables to prevent rust and corrosion. It is particularly recommended for use in applications where traditional asphaltic-type lubricants are not suitable.

Applications

- Wire ropes and wound cables on shovels, draglines, winches, boom trucks, cable cars and ski lifts
- Corrosion preventive for equipment exposed to freshwater or saltwater, such as pumps and chains on offshore drilling rigs, ships and marine docks
- Corrosion preventive for metal parts, tools and other equipment in temporary storage or during shipment

Features/Benefits

- Outstanding rust and corrosion protection, including resistance to saltwater corrosion
- Excellent wetting and penetrating ability for wire ropes and cables
- Good low-temperature properties
- Transparent for easily visibility
- Easy to apply, by brush or by spray
- Excellent for protecting metal parts in temporary storage or during shipment⁽¹⁾

⁽¹⁾ **Note:** To ensure effective rust and corrosion protection, Omniguard® SRI should be reapplied as needed to prevent exposed surfaces.

**Multipurpose
Wire Rope
Lubricant &
Corrosion
Preventive**

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SMOOTHLY. 



Omniguard® SRI

Typical Properties	
ISO Grade (with solvent)	100
Specific Gravity @ 60°F	0.882
Density, lbs/gal	7.34
Color	Tan-Brown
Flash Point, COC, °C (°F)	>185 (>365)
Pour Point, °C (°F)	-50 (-58)
Thickener	Calcium Sulfonate
Viscosity, Kinematic (with solvent)	
cSt @ 40°C	91.7
Copper Corrosion, ASTM D130	1a
Four-Ball EP, ASTM D2596, Weld Load, kgf	250
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.40

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Omniguard® XD5

Phillips 66® Omniguard XD5 is a premium quality, high performance, extreme pressure (EP) calcium sulfonate grease developed to satisfy the severe lubrication requirements of mining and off road equipment manufactured by Caterpillar, Terex, Komatsu Dresser, Le Tourneau, P&H and others. It is particularly recommended for use in AC and DC electric-drive haul trucks, cranes, scrapers, shovels and drag lines operating under wet conditions and/or moderate to high temperatures and under heavy loading.

Omniguard XD5 is manufactured with high-quality base oils and a non-soap, calcium sulfonate thickener. It is compounded with select additives that provide extreme-pressure and antiwear properties, excellent rust and corrosion protection, and excellent oxidation resistance. It is fortified with 5% molybdenum disulfide (moly) for extra wear protection under heavy or shock loading. Functional polymers provide better adhesion to metal surfaces and enhanced resistance to water washout in wet environments.

Applications

- Chassis parts and wheel bearings of mine haul trucks and other off-highway equipment
- Heavily loaded plain and rolling-element bearings in industrial and mobile equipment where the manufacturer specifies a high-temperature, extreme-pressure grease with 5% moly

Features/Benefits

- High dropping point (>550°F)
- High load-carrying capacity
- Excellent wear protection
- Contains 5% moly for extra protection against galling and wear under shock loads
- Excellent oxidation resistance
- Excellent resistance to water washout
- Excellent rust and corrosion protection

**Extreme
Pressure
Calcium
Sulfonate
Grease with 5%
Moly for Mining
& Off-Road
Equipment**

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SMOOTHLY. 



Omniguard® XD5

Typical Properties			
NGLI Grade	0	1	2
Thickener	Calcium Sulfonate	Calcium Sulfonate	Calcium Sulfonate
Color	Gray-Black	Gray-Black	Gray-Black
Dropping Point, °C (°F)	>232 (>450)	>288 (>550)	>288 (>550)
Density, lbs/gal	8.10	8.29	8.29
Penetration, ASTM D217 (worked 60 strokes)	355-385	310-340	265-295
Texture	Smooth	Smooth	Smooth
Molybdenum Disulfide, wt %	5	5	5
Four-Ball EP, ASTM D2596, Weld Load, kgf	620	800	800
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	<0.50	<0.50	<0.50
Oxidation Stability, ASTM D942, 100 hrs			
Pressure Drop, psi (kPa)	3 (21)	3 (21)	3 (21)
Rust Prevention, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	60	60	60
Base Oil Properties			
Viscosity			
cSt @ 40°C	150	150	150
cSt @ 100°C	11.5	11.5	11.5
SUS @ 100°F	803	803	803
SUS @ 210°F	66	66	66
Viscosity Index	44	44	44
Usable Temperature Range			
°C	-34 to 149	-34 to 177	-29 to 177
°F	-30 to 300	-30 to 350	-20 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Paper Machine Grease

Phillips 66® Paper Machine Grease is a premium quality, synthetic, extreme-pressure (EP) lithium complex grease specifically developed for use in paper machines. It provides outstanding bearing protection at high temperatures and in the presence of water for use in both the dry and wet ends of paper machines.

Paper Machine Grease is manufactured with a high-viscosity, synthetic polyalphaolefin (PAO) base oil and a lithium complex soap thickener. It is fortified with extreme-pressure and anti-wear additives plus rust and oxidation inhibitors to provide excellent wear protection under heavy loads, protection against rust and corrosion in wet environments, and long service life. It has outstanding oxidation resistance at high temperatures, excellent pumpability at low temperatures, and excellent resistance to water washout.

Applications

- Paper machine wet end bearings, press section bearings, and high-temperature felt roll and calender stack bearings
- Plain and rolling-element bearings in industrial, mining, and mobile equipment operating under heavy loads and/or wet conditions

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent pumpability at low temperatures
- Excellent wear protection for longer equipment life
- High load-carrying capacity
- Protects against rust and corrosion
- Excellent resistance to water washout

**Premium
Synthetic,
Extreme-
Pressure
Lithium
Complex Grease
for Paper
Machines**

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RUNNING
SMOOTHLY. 



Paper Machine Grease

Typical Properties	
NLGI Grade	1.5
Thickener	Lithium complex
Color, Visual	Off-White
Dropping Point, °C (°F)	>260 (>500)
Density lbs/gal	7.84
Penetration, Worked (60 strokes), ASTM D217	295-310
Texture	Smooth
Copper Corrosion, ASTM D4048	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.45
Oil Separation, ASTM D1742, Weight Loss (24 hrs @ 25°C), %	<2
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	3 (21)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	65
Water Washout Resistance, ASTM D1264, Weight Loss @ 79°C, %	<1
Base Oil Properties	
Viscosity	
cSt @ 40°C	460
cSt @ 100°C	47.9
SUS @ 100°F	2,400
SUS @ 210°F	230
Viscosity Index	163
Usable Temperature Range	
°C	-29 to 177
°F	-20 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Polytac®

Phillips 66® Polytac is a high-quality, multipurpose, non-EP polyurea grease developed for the lubrication of rolling-element bearings in high-temperature, long-life applications where extreme-pressure protection is not required. It is particularly recommended for the lubrication of electric motor bearings, sealed-for-life bearings and other lightly loaded, high-speed antifriction bearings.

Polytac is manufactured with high-quality base oils, select inhibitors and a non-soap, polyurea thickener. It has excellent oxidation resistance and high shear stability for long service life. It provides excellent protection against rust and corrosion and has outstanding resistance to water washout.

Polytac provides significant performance advantages over conventional soap-thickened greases in high-temperature, sealed-for-life applications. It also is recommended for automotive and industrial applications where a shear stable, water-resistant, non-EP grease is required.

Applications

- Electric motor bearings
- Sealed-for-life bearings
- High-speed antifriction bearings
- Automotive and industrial applications where a long-life, high-temperature, non-EP grease is required

Features/Benefits

- Excellent high-temperature performance
- High shear stability
- Good wear protection
- Outstanding resistance to water washout
- Excellent rust and corrosion protection
- Excellent low-temperature pumpability

Non-EP Polyurea Grease for Electric Motor Bearings

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Polytac®

Typical Properties	
NLGI Grade	2
Thickener	Polyurea
Color	Red
Dropping Point, °C (°F)	260 (500)
Density, lbs/gal	7.40
Penetration, Worked (60 strokes), ASTM D217	265-295
Texture	Smooth
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Water Washout Resistance, ASTM D1264, Wt Loss @ 175°F, %	<2
Base Oil Properties	
Viscosity	
cSt @ 40°C	110
cSt @ 100°C	12.1
SUS @ 100°F	575
SUS @ 210°F	68
Viscosity Index	99
Usable Temperature Range	
°C	-34 to 163
°F	-30 to 325

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Polytac® EP

Phillips 66® Polytac EP is a high-performance, multipurpose, extreme-pressure polyurea grease specially developed to provide long service life in automotive and industrial applications. It provides significant performance advantages over conventional soap-thickened greases in high-temperature, long-life and sealed-for-life applications.

Polytac EP is manufactured with high-quality base oils and a non-soap, polyurea thickener. It is compounded with a non-sulfur-phosphorus EP additive that provides extra protection against wear under heavy loading for longer bearing life, without being corrosive to yellow metals. It has excellent thermal stability at high temperatures plus high shear stability for long service life. It also has excellent low-temperature pumpability, is highly resistant to water washout, and protects against rust and corrosion.

Polytac EP is NLGI GC-LB certified for use as a multipurpose automotive wheel bearing and chassis lubricant.

Applications

- Automotive wheel bearings, chassis parts, constant-velocity (CV) joints and underhood applications, such as alternators, air conditioner compressor clutch bearings, water pumps and idler pulleys
- Sealed-for-life bearings
- High-speed antifriction bearings
- Agitator bearings in washing machines
- Equipment in steel mills and chemical plants exposed to chemical contaminants
- Industrial applications where a high-temperature, long-life, extreme-pressure grease is required

Features/Benefits

- Excellent high-temperature performance
- Excellent shear stability
- Excellent wear protection
- High load-carrying capacity
- Excellent resistance to water washout
- Protects against rust and corrosion
- Excellent low-temperature pumpability
- NLGI GC-LB certified

**Multipurpose
Extreme-
Pressure
Polyurea
Grease; NLGI
GC-LB Certified**

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SMOOTHLY.**





Polytac® EP

Typical Properties	
NLGI Grade	2
Thickener	Polyurea
Color	Green
Dropping Point, °C (°F)	260 (500)
Density, lbs/gal	8.50
Penetration, ASTM D217 (worked 60 strokes)	265-295
Texture	Smooth
Copper Corrosion, ASTM D4048	1a
Four-Ball EP, ASTM D2596, Weld Load, kgf	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.50
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	5 (35)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	60
Water Washout Resistance, ASTM D1264, Wt Loss @ 175°F, %	2
Base Oil Properties	
Viscosity	
cSt @ 40°C	129
cSt @ 100°C	11.6
SUS @ 100°F	683
SUS @ 210°F	66
Viscosity Index	70
Usable Temperature Range	
°C	-34 to 163
°F	-30 to 325

Health & Safety Information

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LUBRICANTS

RedTac®

Phillips 66® RedTac is an adhesive, multipurpose, extreme-pressure lithium grease developed for use in a wide variety of automotive and industrial applications. It contains a polymer and a tackiness additive that provides improved retention, reduced leakage and outstanding resistance to water washout.

RedTac is manufactured with high-quality base oils, a special polymer and lithium-12-hydroxystearate soap thickener. It is fortified with extreme-pressure and antiwear additives, rust and oxidation inhibitors and a tackiness additive. It has good oxidation resistance, high load-carrying capacity for excellent wear protection, and protects metal parts against rust and corrosion. It provides a high level of adhesion to the bearing surface for improved retention and resistance to water washout, and has excellent resistance to structural breakdown even under severe operating conditions.

Applications

- Automotive chassis parts such as steering knuckles, ball joints, U-joints and tie-rod ends
- Wheel bearings on passenger cars and heavy equipment equipped with drum brakes
- Moderately loaded plain and rolling-element bearings in industrial equipment
- Enclosed industrial gear drives that require a semi-fluid, heavy base oil, extreme-pressure grease (NLGI Grade No. 0)
- Agricultural and construction equipment where an adhesive, water-resistant, extreme-pressure lithium grease is required

Features/Benefits

- Good high-temperature performance
- Adhesive; stays put
- Excellent resistance to water washout
- High load-carrying capacity
- Excellent wear protection
- Protects against rust and corrosion
- Good low-temperature pumpability

**Adhesive,
Multipurpose
Extreme-
Pressure
Lithium Grease**

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RedTac®

Typical Properties			
NLGI Grade	0	1	2
Thickener	Lithium	Lithium	Lithium
Color	Red	Red	Red
Dropping Point, °C (°F)	190 (374)	190 (374)	190 (374)
Density, lbs/gal	7.44	7.44	7.50
Penetration, Worked (60 strokes), ASTM D217	355-385	310-340	265-295
Texture	Tacky	Tacky	Tacky
Four-Ball EP, ASTM D2596, Weld Load, kgf	250	250	250
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	<0.60	<0.60	<0.60
Oxidation Stability, ASTM D942, 100 hrs			
Pressure Drop, psi (kPa)	5 (35)	5 (35)	5 (35)
Rust Prevention, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	60	60	60
Base Oil Properties			
Viscosity (with polymer)			
cSt @ 40°C	420	420	420
cSt @ 100°C	27.2	27.2	27.2
SUS @ 100°F	2,260	2,260	2,260
SUS @ 210°F	134	134	134
Viscosity Index	89	89	89
Usable Temperature Range			
°C	-12 to 121	-12 to 135	-12 to 135
°F	10 to 250	10 to 275	10 to 275

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Super-STA® & Super-STA® M

Phillips 66® Super-STA and Super-STA M are adhesive, multipurpose, extreme-pressure (EP) lithium greases developed for use in a wide variety of automotive and industrial applications. They contain a tackiness additive for improved retention, reduced leakage and enhanced resistance to water washout.

Super-STA and Super-STA M are manufactured with high-quality base oils and lithium-12-hydroxystearate soap thickener. They are fortified with extreme-pressure and antiwear additives, rust and oxidation inhibitors, and a tackiness additive. They have good oxidation resistance, high load-carrying capacity for excellent wear protection, and protect metal parts against rust and corrosion. They provide good adhesion to bearing surfaces for improved retention and resistance to water washout, and have excellent resistance to structural breakdown even under severe operating conditions.

Super-STA M is the same as Super-STA, but fortified with 1% molybdenum disulfide for extra protection under heavy or shock loading.

Applications

- Automotive chassis parts such as steering knuckles, ball joints, U-joints and tie-rod ends
- Wheel bearings on passenger cars and heavy equipment equipped with drum brakes
- Moderately loaded plain and rolling-element bearings in industrial equipment
- Agricultural and construction equipment where a tacky, water-resistant, extreme-pressure lithium grease is required
- General-purpose shop/industrial grease

Super-STA M No. 2 is recommended for use where the OEM specifies:

- Mack MG-C for chassis lubrication

Features/Benefits

- Multipurpose grease for use in a wide variety of industrial and automotive applications
- Good extreme-pressure and antiwear properties
- Good tackiness for improved retention
- High shear stability
- Protects against rust and corrosion
- Resists water washout
- Protects against fretting in splined shafts, pivot pins and other parts subject to oscillation, sliding or vibration (Super-STA® M)

**Adhesive,
Multipurpose,
Extreme-
Pressure
Lithium Greases**

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SMOOTHLY. 



Super-STA® & Super-STA® M

Typical Properties				
	Super-STA		Super-STA M	
NLGI Grade	1	2	1	2
Thickener	Lithium	Lithium	Lithium	Lithium
Color	Amber	Amber	Gray-Black	Gray-Black
Dropping Point, °C (°F)	200 (392)	200 (392)	200 (392)	200 (392)
Density, lbs/gal	7.14	7.14	7.30	7.40
Penetration, Worked (60 strokes), ASTM D217	310-340	265-295	310-340	265-295
Texture	Tacky	Tacky	Tacky	Tacky
Four-Ball EP, ASTM D2596, Weld Load, kgf	250	315	315	315
Four-Ball Wear, ASTM D2266				
Scar Diameter, mm	0.42	0.42	0.43	0.43
Rust Prevention, ASTM D1743	Pass	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	45	50	45	50
Base Oil Properties				
Viscosity				
cSt @ 40°C	190	190	190	190
cSt @ 100°C	17.0	17.0	17.0	17.0
SUS @ 100°F	1,000	1,000	1,000	1,000
SUS @ 210°F	88	88	88	88
Viscosity Index	95	95	95	95
Usable Temperature Range				
°C	-18 to 121	-18 to 121	-18 to 121	-18 to 121
°F	0 to 250	0 to 250	0 to 250	0 to 250

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Tacna® HD

Phillips 66® Tacna HD is a premium quality, adhesive, extreme pressure (EP) lithium complex grease developed for the lubrication of heavily loaded construction, mining and industrial equipment. It also is recommended for use as a chassis grease for heavy mobile equipment. It is formulated to provide long service life in severe service applications.

Tacna HD is manufactured with high-quality, high-viscosity base oils and a lithium complex soap thickener. It is fortified with extreme-pressure and antiwear additives, rust and oxidation inhibitors, and a tackiness additive. It has excellent oxidation resistance, high load-carrying capacity for excellent wear protection, and protects metal parts against rust and corrosion. It has excellent adhesion to bearing surfaces for improved retention and resistance to water washout, and has excellent resistance to structural breakdown even under severe operating conditions.

Applications

- Heavily loaded plain and rolling-element bearings in industrial and off-road equipment
- Chassis parts on heavy mobile equipment
- Construction equipment
- Dredging equipment
- Marine deck equipment
- Offshore drilling equipment
- Rock quarry equipment

Features/Benefits

- High load carrying capacity
- Excellent shock-load resistance
- Excellent oxidation resistance
- Adhesive to metal surfaces
- High shear stability
- Protects against rust and corrosion
- Excellent resistance to water washout

**Adhesive,
Heavy Base
Oil, Extreme
Pressure
Lithium
Complex Grease**

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SMOOTHLY.**





Tacna® HD

Typical Properties		
NLGI Grade	1	2
Thickener	Lithium Complex	Lithium Complex
Color	Red	Red
Dropping Point, °C (°F)	260 (500)	260 (500)
Density, lbs/gal	7.15	7.15
Penetration, Worked (60 strokes), ASTM D217	310-340	265-295
Texture	Smooth/Tacky	Smooth/Tacky
Copper Corrosion, ASTM D4048	1b	1b
Four-Ball EP, ASTM D2596, Weld Load, kgf	315	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.45	0.45
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	3 (21)	3 (21)
Rust Prevention, ASTM D1743	Pass	Pass
Timken OK Load, ASTM D2509, lb	55	55
Water Washout Resistance, ASTM D1264, Weight Loss @ 175°F, %	3	2
Base Oil Properties		
Viscosity		
cSt @ 40°C	400	400
cSt @ 100°C	26.0	26.0
SUS @ 100°F	2,150	2,150
SUS @ 210°F	129	129
Viscosity Index	87	87
Usable Temperature Range		
°C	-18 to 177	-12 to 177
°F	0 to 350	0 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton®

Phillips 66® Triton is a premium quality, synthetic, extreme-pressure (EP) lithium complex grease specifically developed to provide outstanding protection for industrial and automotive equipment operating at extreme temperatures or over a wide temperature range. It is available in three grades to cover a wide range of applications.

Triton is manufactured with synthetic polyalphaolefin (PAO) base oils and a lithium complex soap thickener. It is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors to provide excellent wear protection, protection against rust and corrosion, and long service life. It has outstanding oxidation resistance at high temperatures and outstanding pumpability at low temperatures.

Triton 100 is an NLGI No. 2 grease formulated with an ISO VG 100 base oil. It is recommended for lubrication of lightly loaded, high-speed bearings such as those found in electric motors and fans.

Triton 220 is an NLGI No. 2 grease formulated with an ISO VG 220 base oil. It is NLGI GC-LB certified for use as an automotive wheel bearing and chassis grease, and also is recommended for lubrication of medium-speed bearings in industrial equipment.

Triton 460 is a heavy-duty, NLGI No. 1.5 grease formulated with an ISO VG 460 base oil. It is recommended for lubrication of low- to medium-speed bearings in industrial, mining and mobile equipment operating under heavy loads and/or wet conditions.

Applications

- Lightly loaded, high-speed bearings in electric motors and fans (100 grade)
- Chassis parts and wheel bearings on passenger cars, trucks and other mobile equipment (220 grade)
- Heavily loaded plain and rolling-element bearings in industrial, mining and marine equipment, and in off-highway mobile equipment (220 & 460 grades)

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Outstanding pumpability at low temperatures
- Excellent wear protection for longer equipment life
- High load-carrying capacity
- Protects against rust and corrosion
- Good resistance to water washout
- NLGI GC-LB certified (220 grade)

**Premium
Synthetic,
Extreme-
Pressure
Lithium
Complex Grease**

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SMOOTHLY.**





Triton®

Typical Properties			
Grade	100	220	460
NLGI Grade	2	2	1.5
Thickener	Lithium Complex	Lithium Complex	Lithium Complex
Color	Purple	Purple	Purple
Dropping Point, °C (°F)	>260 (>500)	>260 (>500)	>260 (>500)
Density, lbs/gal	7.22	7.23	7.24
Penetration, ASTM D217 (worked 60 strokes)	265-295	265-295	295-310
Texture	Smooth	Smooth	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	250	250	250
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.60	0.60	0.60
Oxidation Stability, ASTM D942, 100 hrs			
Pressure Drop, psi (kPa)	5 (35)	5 (35)	5 (35)
Rust Prevention, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	55	55	55
U.S. Steel Mobility Test, LT37, g/min			
@ -40°C (-40°F)	---	---	1.8
@ -29°C (-20°F)	---	---	3.0
@ -18°C (0°F)	---	---	10.2
@ -7°C (20°F)	---	---	28.8
@ 4°C (40°F)	---	---	66.0
Water Washout Resistance, ASTM D1264			
175°F, Wt Loss, %	<6	<5	<5
Base Oil Properties			
Viscosity			
cSt @ 40°C	105	220	460
cSt @ 100°C	14.4	24.6	44.3
SUS @ 100°F	540	1,140	2,400
SUS @ 210°F	77	122	214
Viscosity Index	140	140	150
Usable Temperature Range			
°C	-40 to 177	-40 to 177	-40 to 177
°F	-40 to 350	-40 to 350	-40 to 350

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® ELL

Phillips 66® Triton ELL is a premium quality, synthetic, semi-fluid extreme-pressure (EP) lithium complex grease specially developed for the lubrication of wheel bearings on non-driven truck trailer axles equipped with oil seals. It is formulated to help optimize service intervals and reduce operating costs by providing effective lubrication and cooling of wheel bearings exposed to the prolonged high operating temperatures of over-the-road applications. It also is recommended for use in industrial gearboxes operating at high temperatures where oil leakage is a problem and conventional semi-fluid greases do not provide adequate service life.

Triton ELL is manufactured with a high-viscosity synthetic polyalphaolefin (PAO) base oil and a lithium complex soap thickener. It is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors to provide excellent wear protection, corrosion resistance and long service life. It has outstanding thermal stability at high temperatures and outstanding pumpability at low temperatures for use over a wide range of operating temperatures.

Applications

- Wheel bearings on non-driven trailer axles equipped with oil seals⁽¹⁾
- Plain and rolling-element bearings operating at extreme temperatures
- Conveyors
- Centralized lube systems
- Industrial gearboxes where oil leakage is a problem

⁽¹⁾ **Note:** Triton® ELL is formulated to provide long service life, typically coinciding with scheduled brake service. However, we recommend that you refer to the Preventive Maintenance Inspection (PMI) Guidelines published by the Technology and Maintenance Council (TMC) of the American Trucking Association for relubrication practices. This document provides the following general guidelines for relubrication of wheel bearings in over-the-road trucks:

"A" PM – 60 days or 25,000 miles
"B" PM – 180 days or 50,000 miles
"C" PM – 360 days or 100,000 miles

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Outstanding pumpability at very low temperatures
- Excellent wear protection
- Protects against rust and corrosion
- Resists water washout
- Excellent seal compatibility
- Formulated for extended service life

**Premium
Synthetic,
Semi-fluid,
Extreme-
Pressure
Lithium
Complex Grease
for Non-Driven
Trailer Axle
Wheel Bearings**

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Triton® ELL

Typical Properties	
NLGI Grade	00
Thickener	Lithium Complex
Color	Emerald Green
Dropping Point, °C (°F)	---
Density, lbs/gal	7.44
Penetration, ASTM D217 (worked 60 strokes)	400-430
Texture	Semi-fluid
Four-Ball EP, ASTM D2596, Weld Load, kgf	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	<0.60
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	3 (21)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	55
Base Oil Properties	
Viscosity	
cSt @ 40°C	420
cSt @ 100°C	44
SUS @ 100°F	2,400
SUS @ 210°F	225
Viscosity Index	160
Usable Temperature Range	
°C	-40 to 135
°F	-40 to 275

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® Low Temp

Phillips 66® Triton Low Temp is a premium quality, synthetic, extreme-pressure (EP) lithium grease developed to provide outstanding protection for lightly loaded industrial equipment, chassis parts and sliding mechanisms operating at moderate to very low temperatures.

Triton Low Temp is manufactured with a low-viscosity synthetic polyalphaolefin (PAO) base oil and lithium 12-hydroxystearate soap thickener. It is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors to provide excellent wear protection, corrosion resistance and long service life. It has outstanding pumpability at low temperatures. It has been used successfully with conventional grease guns to lubricate ski lifts and similar equipment operating at temperatures as low as -48°C (-55°F).

Applications

- Plain and rolling-element bearings on pulleys and conveyors operating in arctic climates
- Ski lift equipment
- Sliding mechanisms on automobile seats and industrial equipment
- Chassis parts on mobile equipment operating in arctic climates

Triton Low Temp is approved by General Motors Corporation under Part No. 9985377 for lubrication of the moving mechanisms for automobile seats and manual transmission shifters during vehicle assembly.

Features/Benefits

- Outstanding pumpability at moderate to very low temperatures
- Excellent protection in subzero weather
- Excellent wear protection
- Protects against rust and corrosion

**Premium
Synthetic,
Extreme-
Pressure
Lithium Grease
for Arctic
Climates**

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SMOOTHLY. 



Triton® Low Temp

Typical Properties	
NLGI Grade	1
Thickener	Lithium
Color	Light Amber
Dropping Point, °C (°F)	200 (392)
Density, lbs/gal	7.20
Penetration, ASTM D217 (worked 60 strokes)	310-340
Texture	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	250
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.50
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	4 (28)
Rust Prevention, ASTM D1743	Pass
Timken OK Load, ASTM D2509, lb	10
Base Oil Properties	
Viscosity	
cSt @ 40°C	26.2
cSt @ 100°C	5.1
SUS @ 100°F	135
SUS @ 210°F	43
Viscosity Index	125
Usable Temperature Range	
°C	-48 to 121
°F	-55 to 250

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® OSP 320

Phillips 66® Triton OSP 320 is a premium quality, synthetic, extreme-pressure (EP) calcium sulfonate grease specially developed for use in industrial and heavy mobile equipment operating under severe conditions involving high loads, high temperatures and/or high humidity.

Triton OSP 320 is manufactured with high-viscosity synthetic base oil, a calcium sulfonate thickener, and select additives to protect against rust and corrosion in high-humidity, high-temperature applications such as those found in the steel and paper industries. It has outstanding resistance to water washout, high load-carrying capacity to protect against wear, and outstanding shear stability to resist mechanical breakdown. The synthetic base oil allows its use over a wide temperature range.

Applications

- Industrial equipment operating under unfavorable conditions involving water contamination, high loads and/or high temperatures
- Plain and rolling-element bearings operating in corrosive environmental conditions
- Steel mill and slab mill roller bearings
- Marine and heavy mobile equipment exposed to salt water
- Paper machine wet-and dry-end bearings and hot calender stacks

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- Outstanding rust and corrosion protection, including resistance to saltwater corrosion
- Excellent extreme-pressure and antiwear properties
- Outstanding resistance to water washout
- Outstanding shear stability
- High dropping point (>550°F)
- Does not contain heavy metals or other environmentally undesirable components

**Premium
Synthetic,
Extreme-
Pressure,
Water-Resistant
Calcium
Sulfonate
Grease**

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Triton® OSP 320

Typical Properties	
NLGI Grade	2
Thickener	Calcium Sulfonate
Color	Blue
Dropping Point, °C (°F)	300 (572)
Penetration, ASTM D217 (worked 60 strokes)	265-295
Texture	Smooth
Four-Ball EP, ASTM D2596, Weld Load, kgf	400
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.50
Oxidation Stability, ASTM D942, 100 hrs, Pressure Drop, psi (kPa)	1 (7)
Rust Prevention, ASTM D1743	Pass
Water Washout Resistance, ASTM D1264, 175°F, Wt Loss, %	2
Base Oil Properties	
Viscosity	
cSt @ 40°C	334
cSt @ 100°C	44
SUS @ 100°F	1,700
SUS @ 210°F	212
Viscosity Index	189
Usable Temperature Range	
Minimum, °C (°F)	-34 (-30)
Maximum, Continuous Service, °C (°F)	190 (375)
Maximum, Intermittent Service, °C (°F)	204 (400)

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Triton® XD5

Phillips 66® Triton XD5 is a premium quality, synthetic, extreme pressure (EP) calcium sulfonate grease developed for use in off road equipment operating at moderate to very low temperatures. It is particularly recommended for use in mobile equipment such as haul trucks, backhoes, excavators, front-end loaders, motor graders and wheel dozers operating in wet conditions and under heavy loads.

Triton XD5 is manufactured with a low-viscosity synthetic polyalphaolefin (PAO) base oil and a non-soap, calcium sulfonate thickener. It is compounded with select additives to provide excellent oxidation resistance, extreme-pressure and antiwear properties, and protection against rust and corrosion. It is fortified with 5% molybdenum disulfide (moly) for extra wear protection under conditions involving heavy or shock loading. The low-viscosity synthetic base oil provides outstanding pumpability at low temperatures.

Triton XD5 has a distinctive platinum color for identification.

Applications

- Off-road construction and mining equipment operating at moderate to very low temperatures
- Steering linkages, kingbolt bearings, pin joints, universal joints and other articulated chassis components
- Heavily loaded plain and rolling-element bearings in off-road equipment
- Conveyor and fan bearings in chemical and manufacturing plants that require a corrosion-resistant grease with moly
- Centralized lube systems

Features/Benefits

- High load-carrying capacity
- Excellent wear protection
- Contains 5% moly for extra protection against galling and wear under shock loads
- Outstanding low-temperature properties
- Excellent resistance to water washout
- Protects against rust and corrosion

**Premium
Synthetic,
Extreme
Pressure
Calcium
Sulfonate
Grease with 5%
Moly for Off-
Road Equipment**

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Triton® XD5

Typical Properties			
NGLI Grade	0	1	2
Thickener	Calcium Sulfonate	Calcium Sulfonate	Calcium Sulfonate
Color	Platinum	Platinum	Platinum
Dropping Point, °C (°F)	>177 (>350)	>288 (>550)	>288 (>550)
Density, lbs/gal	7.45	7.45	7.45
Penetration, ASTM D217 (worked 60 strokes)	355-385	310-340	265-295
Texture	Tacky	Tacky	Tacky
Molybdenum Disulfide, wt %	5	5	5
Copper Corrosion, ASTM D4048	1a	1a	1a
Four-Ball EP, ASTM D2596, Weld Load, kgf	500	800	800
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.45	0.45	0.45
Oxidation Stability, ASTM D942, 100 hrs			
Pressure Drop, psi (kPa)	3 (21)	3 (21)	3 (21)
Rust Prevention, ASTM D1743	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	60	65	65
Water Washout Resistance, ASTM D1264			
Weight Loss @ 175°F, %	2	2	2
Base Oil Properties			
Viscosity			
cSt @ 40°C	35.0	35.0	35.0
cSt @ 100°C	6.0	6.0	6.0
SUS @ 100°F	180	180	180
SUS @ 210°F	46	46	46
Viscosity Index	117	117	117
Usable Temperature Range			
°C	-51 to 149	-51 to 177	-51 to 177
°F	-60 to 300	-60 to 350	-60 to 350

Health & Safety Information

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LUBRICANTS

Trolley Wire Lube

Phillips 66® Trolley Wire Lube is a semi-fluid lithium grease specifically developed for the lubrication of mine trolley wires and shoes. With proper maintenance and frequent relubrication, it extends the life of the wires and the sliders while keeping downtime and operating expenses to a minimum.

Trolley Wire Lube is manufactured with high-quality paraffinic base oils thickened with lithium-12-hydroxystearate soap. It is fortified with 10% graphite to reduce friction between the slider and the cable and help extend cable life.

Trolley Wire Lube can be applied by a trolley wire brush applicator box, or it can be pumped to the wire by a direct grease line through a centralized grease system. Its special friction reducing properties allow for less frequent application than many other trolley wire lubricants.

Applications

- Trolley wires and shoes
- Cables and wires exposed to moisture or salt water
- Wire ropes
- Hoists, cranes and aerial tramways
- Sliding mechanisms on underground mining equipment

Features/Benefits

- Water resistant
- Easy application
- Reduces friction
- Stays put
- Reduces slider and cable wear
- Stops slider “hop”
- Reduces maintenance and operating costs

**Semi-fluid
Lithium Grease
with 10%
Graphite for
Mine Trolley
Cables and
Shoes**

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SMOOTHLY. 



Trolley Wire Lube

Typical Properties	
NLGI Grade	<000
Thickener	Lithium
Color	Gray-Black
Dropping Point, °C (°F)	---
Density, lbs/gal	8.25
Penetration, ASTM D217 (worked 60 strokes)	---
Texture	Semi-fluid
Viscosity, Brookfield, ASTM D2983	
25°C, No. 4 Spindle, 20 RPM, 1 Minute, cP	650
Base Oil Properties	
Viscosity	
cSt @ 40°C	68
cSt @ 100°C	8.5
SUS @ 100°F	353
SUS @ 210°F	55
Viscosity Index	94

Health & Safety Information

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LUBRICANTS

Unoba® EP

Phillips 66® Unoba EP is a multipurpose, extreme-pressure lithium grease developed for use in a wide variety of industrial and automotive applications. It is a versatile, general-purpose grease for use in applications where operating temperatures and loads are moderate.

Unoba EP is manufactured with high-quality base oils and lithium 12-hydroxystearate soap thickener. It is fortified with extreme-pressure and antiwear additives plus rust and oxidation inhibitors. It has good load-carrying capacity for protection against wear, good oxidation resistance for long service life, protects metal parts against rust and corrosion, and is resistant to water washout. It has good resistance to structural breakdown and will not soften excessively during high-speed operation in rolling-element bearings. It forms a good seal to help minimize bearing contamination.

Unoba EP is available in multiple grades for use in a wide variety of applications. It is an excellent grease for use in centralized lube systems. The semi-fluid grades may be used in enclosed industrial gearboxes where oil leakage is a problem.

Applications

- Plain and rolling-element bearings in compressors, fans, centrifugal pumps and other industrial equipment where operating temperatures and loads are moderate
- Chassis parts, universal joints and water pumps on passenger cars, light trucks and other mobile equipment
- Track rollers, commercial lawn mowers, crushers and vibrating screens (semi-fluid grades)
- Enclosed gear drives on industrial, mining and mobile equipment where oil leakage is a problem (semi-fluid grades)
- Wheel bearings of passenger cars equipped with drum brakes
- Centralized grease lubrication systems
- General-purpose shop/industrial grease

Features/Benefits

- Multipurpose grease for use in a wide variety of applications
- Good extreme-pressure and antiwear properties
- Good shear stability
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Resists water washout
- Suitable for use in centralized lube systems

**Multipurpose
Extreme-
Pressure
Lithium Grease**

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Unoba® EP

Typical Properties				
NLGI Grade	00	0	1	2
Thickener	Lithium	Lithium	Lithium	Lithium
Color	Green	Green	Green	Green
Dropping Point, °C (°F)	---	172 (342)	177 (350)	177 (350)
Density, lbs/gal	7.36	7.39	7.42	7.47
Penetration, Worked (60 strokes), ASTM D217	400-430	355-385	310-340	265-295
Texture	Semi-fluid	Smooth	Smooth	Smooth
Four-Ball EP, ASTM 2596, Weld Load, kgf	315	315	315	315
Four-Ball Wear, ASTM D2266, Scar Diameter, mm	0.45	0.45	0.45	0.45
Oxidation Stability, ASTM D942, 100 hrs				
Pressure Drop, psi (kPa)	5 (35)	5 (35)	5 (35)	5 (35)
Rust Prevention, ASTM D1743	Pass	Pass	Pass	Pass
Timken OK Load, ASTM D2509, lb	50	50	50	50
Base Oil Properties				
Viscosity	190	190	190	190
cSt @ 40°C	175	142	142	142
cSt @ 100°C	13.5	13.0	13.0	13.0
SUS @ 100°F	935	750	750	750
SUS @ 210°F	74	72	72	72
Viscosity Index	61	81	81	81
Usable Temperature Range				
°C	-34 to 65	-20 to 107	-18 to 121	-18 to 121
°F	-30 to 150	-5 to 225	0 to 250	0 to 250

Health & Safety Information

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LUBRICANTS

COMPRESSOR & R&O OILS



LUBRICANTS

Air Compressor Oil

Phillips 66® Air Compressor Oil is a high-quality, non-detergent circulating oil developed primarily for use in older reciprocating air compressors. It also is recommended for use in other industrial applications where the equipment manufacturer specifies a non-detergent, ISO VG 100 / SAE 30 mineral oil.

Air Compressor Oil is formulated to provide excellent oxidation resistance, rust and corrosion protection, and resistance to foaming. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It protects against rust and corrosion. It has good water-separating properties to minimize the formation of emulsions and is resistant to excessive foam buildup.

Applications

- Older reciprocating air compressors with low discharge temperatures
- Deep well water pump gear drives
- Vacuum pumps
- Lightly loaded enclosed industrial gear drives where an AGMA 3 (non-EP) oil is specified
- Industrial applications that require a non-detergent, ISO VG 100 / SAE 30 oil

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Protects against sludge and varnish formation
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- Low carbon-forming tendency

Non-Detergent Air Compressor Oil

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Air Compressor Oil

Typical Properties	
ISO Grade	100
Specific Gravity @ 60°F	0.868
Density, lbs/gal @ 60°F	7.23
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	277 (531)
Pour Point, °C (°F)	-29 (-20)
Viscosity	
cSt @ 40°C	100
cSt @ 100°C	11.3
SUS @ 100°F	522
SUS @ 210°F	65.0
Viscosity Index	99
Acid Number, ASTM D974, mg KOH/g	0.08
Copper Corrosion, ASTM D130	1a
Demulsibility, ASTM D1401, minutes to pass	25
Foam Test, ASTM D892, Seq. I, mL	0/0
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Ammonia Compressor Oil

Phillips 66® Ammonia Compressor Oil is an inhibited paraffinic circulating oil specifically developed for use in reciprocating and rotary screw compressors in industrial refrigeration systems using ammonia or carbon dioxide.

Ammonia Compressor Oil is specially formulated to resist degradation when exposed to nitrogen compounds and acids formed when compressed ammonia comes into contact with the oil and condensed water. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It has a low pour point for use in ammonia refrigeration systems used for sub-zero cooling. It has excellent water-separating properties to minimize the formation of emulsions, protects system components against rust and corrosion, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Ammonia Compressor Oil meets the performance requirements of major manufacturers of ammonia refrigeration compressors. It is **not** recommended for use with CFC, HCFC or HFC refrigerants such as Freon®-12, Freon®-22 or R-134a.

Applications

- Refrigeration compressors using ammonia or carbon dioxide as the refrigerant
- Cold storage facilities
- Ice making machines
- Circulating systems in chemical plants and mills where contamination with moisture or aqueous gas is a problem

Features/Benefits

- Excellent resistance to chemical degradation
- Excellent oxidation resistance and thermal stability
- Provides longer service life than conventional naphthenic ammonia refrigeration oils
- Excellent water-separating properties
- Low pour point
- Protects against rust and corrosion
- Good foam resistance

Inhibited Paraffinic Circulating Oil for Ammonia Refrigeration Compressors

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Ammonia Compressor Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.864	0.867	0.871
Density, lbs/gal @ 60°F	7.20	7.22	7.25
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	220 (428)	225 (437)	228 (442)
Pour Point, °C (°F)	-33 (-27)	-33 (-27)	-33 (-27)
Viscosity			
cSt @ 40°C	32.0	46.0	68.0
cSt @ 100°C	5.6	6.8	8.8
SUS @ 100°F	165	237	352
SUS @ 210°F	45.0	49.0	55.9
Viscosity Index	114	102	102
Copper Corrosion, ASTM D130	1a	1a	1a
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Oxidation Stability, RPVOT, ASTM D2272, minutes	133	133	133
Rust Test, ASTM D665 A&B	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Gas Compressor Oil

Phillips 66® Gas Compressor Oil is a high-quality lubricant developed for the lubrication of oil-flooded rotary compressors in natural gas service and for cylinder lubrication in reciprocating compressors in natural gas service. It is formulated to minimize the effects of gas dilution and oil absorption in this type of service.

Gas Compressor Oil is specially formulated to provide excellent service and protection in gas compression service. It has excellent oxidation resistance and thermal stability at high temperatures to help minimize deposit formation and provide long service life. It protects against rust, corrosion and wear, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Applications

- Oil-flooded rotary screw, rotary lobe, and rotary vane compressors in natural gas service
- Industrial reciprocating compressors pumping natural gas
- Reciprocating compressors commonly found in remote gas gathering stations

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- Formulated to minimize the effects of gas dilution and oil absorption
- Good wear protection
- Protects against rust and corrosion
- Good foam resistance

Compressor Oil for Natural Gas Service

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Gas Compressor Oil

Typical Properties			
ISO Grade	100	150	220
Specific Gravity @ 60°F	0.874	0.879	0.885
Density, lbs/gal @ 60°F	7.28	7.32	7.37
Color, ASTM D1500	1.5	2.5	2.5
Flash Point (COC), °C (°F)	268 (514)	277 (531)	285 (545)
Pour Point, °C (°F)	-29 (-20)	-18 (0)	-15 (5)
Viscosity			
cSt @ 40°C	97.6	150	220
cSt @ 100°C	11.3	14.9	18.8
SUS @ 100°F	508	787	1,164
SUS @ 210°F	65.0	79.3	95.9
Viscosity Index	102	99	95
Acid Number, ASTM D974, mg KOH/g	0.14	0.14	0.14
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	5	10	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Rust Test, ASTM D665 A&B	Pass	Pass	Pass

Health & Safety Information

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LUBRICANTS

Multipurpose R&O Oil

Phillips 66® Multipurpose R&O Oil is a rust and oxidation (R&O)-inhibited, antiwear circulating oil developed for use in circulation systems, centrifugal air compressors, geared turbines, lightly loaded enclosed gear drives and many other industrial applications. It contains a low level of ashless (zinc-free) antiwear additive for mild wear protection.

Multipurpose R&O Oil is formulated to provide protection against rust, corrosion and deposit formation, plus mild wear protection. It has good oxidation resistance at high temperatures to minimize sludge and varnish formation, resulting in long service life. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can interfere with proper lubrication. An ashless antiwear additive provides mild wear protection to help increase equipment life.

Applications

- Air tools and other pneumatic equipment lubricated through air line lubricators
- Centrifugal air compressors
- Steam turbines and hydroelectric turbines, both direct-drive and with gear drives
- Lightly loaded enclosed industrial gear drives where the OEM specifies a R&O type oil (ISO VG 68 and higher, typically)
- Lightly loaded plain and rolling-element bearings, such as those in electric motors and blowers
- Vacuum pumps, deep-well water pumps and machine tools
- General-purpose machinery and shop lubrication

Multipurpose R&O Oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- AGMA Grades 0 through 7 (non-EP)
- Alstom Power HTGD 90 117 for geared turbines
- ASTM D4304 Type I Turbine Oil (ISO VG 32, 46, 68, 100)
- British Standard 489
- Denison Hydraulics HF-1
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- General Electric GEK 101941A, GEK 46506e, GEK 27070 (obsolete), GEK 28143A (obsolete)
- Ingersoll-Rand Centak centrifugal compressors
- Solar Turbines ES 9-224 Class II Turbine Oil
- U.S. Military MIL-L-17672D
- U.S. Steel 126

**Rust &
Oxidation-
Inhibited,
Antiwear
Circulating Oil**

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Features/Benefits

- Good oxidation resistance to minimize sludge and varnish formation
- Mild wear protection
- Protects against rust and corrosion
- Excellent water-separating properties
- Low carbon-forming tendency for use in centrifugal air compressors
- Good foam resistance

Multipurpose R&O Oil

Typical Properties					
ISO Grade	22	32	46	68	100
AGMA Grade	---	0	1	2	3
Specific Gravity @ 60°F	0.856	0.862	0.868	0.873	0.877
Density, lbs/gal @ 60°F	7.13	7.18	7.23	7.27	7.30
Color, ASTM 1500	0.5	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	210 (410)	232 (450)	238 (460)	243 (469)	268 (514)
Pour Point, °C (°F)	-40 (-40)	-40 (-40)	-40 (-40)	-34 (-29)	-34 (-29)
Viscosity					
cSt @ 40°C	22.0	32.5	45.0	68.0	101
cSt @ 100°C	4.3	5.4	6.7	8.8	11.3
SUS @ 100°F	115	168	232	352	527
SUS @ 210°F	40.7	44.4	48.7	55.9	65.0
Viscosity Index	101	99	101	102	98
Acid Number, ASTM D974, mg KOH/g	0.14	0.14	0.14	0.14	0.14
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	20	20	20	20
Foam Test, ASTM D892, Seq. I, ml	0/0	0/0	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172					
Scar Diameter, mm	---	0.54	0.48	0.45	0.45
FZG Scuffing Test, ASTM D5182					
Failure Load Stage	---	10	10	10	10
Oxidation Stability					
TOST, ASTM D943-04a, hours	---	4,500	4,500	4,500	4,500
RPVOT, ASTM D2272, minutes	---	750	750	700	700
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass	Pass

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Multipurpose R&O Oil

Typical Properties				
ISO Grade	150	220	320	460
AGMA Grade	4	5	6	7
Specific Gravity @ 60°F	0.882	0.885	0.889	0.892
Density, lbs/gal @ 60°F	7.35	7.37	7.40	7.43
Color, ASTM D1500	2.5	3.5	4.5	5.0
Flash Point (COC), °C (°F)	277 (531)	285 (545)	304 (579)	307 (585)
Pour Point, °C (°F)	-17 (1)	-15 (5)	-15 (5)	-15 (5)
Viscosity				
cSt @ 40°C	158	220	320	464
cSt @ 100°C	15.3	18.8	24.1	30.6
SUS @ 100°F	830	1,164	1,704	2,488
SUS @ 210°F	81.0	95.9	120	150
Viscosity Index	97	95	96	95
Acid Number, ASTM D974, mg KOH/g	0.14	0.14	0.14	0.14
Copper Corrosion, ASTM D130	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	20	20	25
Foam Test, ASTM D892, Seq. I, ml	0/0	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172				
Scar Diameter, mm	0.41	0.41	0.40	0.40
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	10	10	10	10
Oxidation Stability				
TOST, ASTM D943-04a, hours	4,000	4,000	4,000	4,000
RPVOT, ASTM D2272, minutes	700	700	700	700
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Premium Gas Compressor Oil

Phillips 66® Premium Gas Compressor Oil is a premium quality, part-synthetic lubricant developed for use in oil-flooded rotary screw and rotary vane gas compressors in natural gas service. It also is recommended for use as a cylinder lubricant and crankcase oil in reciprocating compressors in natural gas service. It is specially formulated to minimize the effects of gas dilution and oil absorption in this type of service.

Premium Gas Compressor Oil is formulated to provide excellent service and protection over a wide temperature range. It has excellent oxidation resistance and thermal stability at high temperatures to help minimize deposit formation, and has a high viscosity index and good low-temperature properties for year-round use. It protects against rust and corrosion, and contains a special inhibitor to resist corrosion caused by hydrogen sulfide in sour gas. The synthetic blend formulation provides enhanced oxidation resistance and lower volatility at high temperatures compared to conventional mineral oils, which can result in extended service intervals, lower oil consumption and reduced maintenance.

Applications

- Oil-flooded rotary screw and rotary vane gas compressors
- Industrial reciprocating compressors pumping natural gas
- Reciprocating compressors commonly found in remote gas gathering stations

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- High viscosity index and low pour point for use over a wide temperature range
- Formulated to minimize the effects of gas dilution and oil absorption
- Low varnish-forming tendency
- Resists hydrogen sulfide corrosion
- Protects against rust and corrosion

Premium Synthetic Blend Compressor Oil for Natural Gas Service

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Premium Gas Compressor Oil

Typical Properties		
ISO Grade	68	150
Specific Gravity @ 60°F	0.870	0.875
Density, lbs/gal @ 60°F	7.24	7.29
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	243 (470)	227 (441)
Pour Point, °C (°F)	-33 (-27)	-33 (-27)
Viscosity		
cSt @ 40°C	67.0	150
cSt @ 100°C	10.0	18.6
SUS @ 100°F	344	775
SUS @ 210°F	60.1	94.8
Viscosity Index	133	140
Acid Number, ASTM D974, mg KOH/g	0.22	0.22
Copper Corrosion, ASTM D130	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.50	0.50
Oxidation Stability, RPVOT, ASTM D2272, minutes	1,100	1,100
Rust Test, ASTM D665 A&B	Pass	Pass

Health & Safety Information

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LUBRICANTS

Premium Rotary Air Compressor Oil

Phillips 66® Premium Rotary Air Compressor Oil is a premium quality, part-synthetic lubricant developed for use in rotary air compressors operating under moderate to severe service conditions. The part-synthetic formulation provides enhanced thermal and oxidative stability at high temperatures to minimize the formation of sludge and varnish.

Premium Rotary Air Compressor Oil is formulated with a blend of synthetic and premium hydrocracked paraffinic base oils, plus select additives. It has excellent oxidation resistance and thermal stability at high temperatures, plus natural detergency, to minimize deposit formation and provide long service life. It has low volatility to help reduce oil consumption, good low-temperature properties, and protects against rust and corrosion. It also has good water-separating properties and is resistant to foam buildup.

Premium Rotary Air Compressor Oil is **not** recommended for use in reciprocating air compressors or in natural gas compression service.

Applications

- Oil-flooded rotary screw, rotary lobe, and rotary vane air compressors
- Circulating systems requiring a part-synthetic lubricant
- Industrial equipment operating over a wide temperature range where an inhibited mineral oil is recommended
- Industrial equipment where operating conditions are too severe for conventional mineral oil based R&O-inhibited circulating oils

Premium Rotary Air Compressor Oil meets the requirements of the following industry specifications:

- DIN 51506, Air Compressor Lubricant Standard, Grade VDL
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51517 Part 3, Lubricating Oils, Type CLP

Features/Benefits

- Part-synthetic formulation for enhanced performance benefits
- Excellent resistance to thermal breakdown at high temperatures
- Excellent oxidation resistance to minimize sludge and varnish formation
- Good wear protection

**Premium
Synthetic Blend
Lubricant for
Rotary Air
Compressors**

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- Natural detergency
- Protects against rust and corrosion
- Good low-temperature properties
- Good water-separating properties
- Good foam resistance
- Low carbon-forming tendency

Premium Rotary Air Compressor Oil

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.875
Density, lbs/gal @ 60°F	7.29
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	238 (460)
Pour Point, °C (°F)	-36 (-33)
Viscosity	
cSt @ 40°C	46.0
cSt @ 100°C	6.7
SUS @ 100°F	238
SUS @ 210°F	48.7
Viscosity Index	97
Acid Number, ASTM D974, mg KOH/g	0.17
Demulsibility, ASTM D1401, minutes to pass	15
Foam Test, ASTM D892, Seq. I, mL	15/0
Oxidation Stability, RPVOT, ASTM D2272, minutes	2,100
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

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LUBRICANTS

Refrigerant Compressor Oil

Phillips 66® Refrigerant Compressor Oil is a highly refined naphthenic mineral oil developed primarily for use in reciprocating and rotary screw compressors in refrigeration systems using ammonia, carbon dioxide, or non-HFC refrigerants. It also may be used as a general-purpose, light-duty lubricant for industrial machinery operating in cold environments.

Refrigerant Compressor Oil is manufactured from carefully selected wax-free base stocks to have a low pour point and a low floc point for use in refrigeration system compressors. It has excellent low-temperature properties, good oxidation stability, and low carbon-forming tendency to minimize deposit formation, provides good lubricity for protection against wear, and has excellent miscibility with non-HFC refrigerants. It also has good solvency and light color for use as a process oil or as a blending component in other lubricants.

Refrigerant Compressor Oil meets the performance requirements of leading OEMs for use in refrigeration system compressors where the manufacturer specifies a naphthenic mineral oil.

Applications

- Compressors in refrigeration systems using ammonia, carbon dioxide, or CFC or HCFC refrigerants, such as R-11, R-12, R-22, and R-502⁽¹⁾
- Plain and rolling-element bearings operating at low temperatures and under light loads
- Drive chains
- Process oil

⁽¹⁾ **Note:** Refrigerant Compressor Oil is **not** recommended for use with HFC refrigerants such as HFC R-134a.

Features/Benefits

- Excellent low-temperature properties
- Wax-free
- Good oxidation stability
- Low carbon-forming tendency
- Excellent miscibility with non-HFC refrigerants
- Good lubricity
- Good solvency
- Light color

Naphthenic Refrigeration Compressor Oil & Light-Duty Machine Oil

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Refrigerant Compressor Oil

Typical Properties				
ISO Grade	15	22	68	100
Specific Gravity @ 60°F	0.893	0.898	0.915	0.921
Density, lbs/gal @ 60°F	7.44	7.48	7.62	7.67
Color, ASTM D1500	0.5	0.5	2.5	3.0
Flash Point (COC), °C (°F)	162 (324)	174 (345)	184 (363)	194 (381)
Pour Point, °C (°F)	-51 (-60)	-48 (-54)	-32 (-36)	-29 (-20)
Floc Point, °C (°F)	-58 (-72)	-49 (-56)	-33 (-27)	-31 (-24)
Viscosity				
cSt @ 40°C	15.1	22.1	67.2	98.9
cSt @ 100°C	3.1	3.8	6.9	8.4
SUS @ 100°F	83.2	117	354	527
SUS @ 210°F	36.7	39.1	49.4	54.6
Viscosity Index	36	20	30	23
Acid Number, ASTM D964, mg KOH/g	0.05	0.05	0.05	0.05
Carbon Residue, ASTM D524, wt %	0.02	0.02	0.07	0.08
Aniline Point, ASTM D611, °C (°F)	78 (172)	80 (176)	82 (180)	82 (180)
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0	10/0

Health & Safety Information

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LUBRICANTS

Special Compressor Oil

Phillips 66® Special Compressor Oil is a high-quality, detergent compressor oil specifically developed for the lubrication of centrifugal and rotary gas compressors handling sour gas or process gas. It has a high alkaline reserve to neutralize the acids formed during compression of sour gas or process gas, and holds moisture in suspension until oil drain.

Special Compressor Oil is specially formulated to provide excellent service and protection in gas compression service. It has excellent oxidation resistance and thermal stability at high temperatures to help minimize deposit formation and provide long service life. It is formulated to neutralize acids formed during sour gas or process gas compression. It protects against rust and corrosion, and is resistant to excessive foam buildup that can interfere with proper lubrication. The detergent additive helps hold moisture in suspension until oil drain.

Applications

- Centrifugal and rotary gas compressors handling sour gas or process gas
- Process gas compressors
- Vacuum pumps

Features/Benefits

- Excellent oxidation resistance and thermal stability at high temperatures
- High alkaline reserve to neutralize acids formed during gas compression
- Holds moisture in suspension
- Protects against rust and corrosion
- Good foam resistance
- Low carbon-forming tendency

Detergent Compressor Oil for Sour Gas for Process Gas Service

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Special Compressor Oil

Typical Properties	
ISO Grade	68
Specific Gravity @ 60°F	0.875
Density, lbs/gal @ 60°F	7.29
Color, ASTM D1500	6.5
Flash Point (COC), °C (°F)	238 (460)
Pour Point, °C (°F)	-15 (5)
Viscosity	
cSt @ 40°C	66.3
cSt @ 100°C	8.9
SUS @ 100°F	343
SUS @ 210°F	56.2
Viscosity Index	108
Acid Number, ASTM D974, mg KOH/g	1.30
Foam Test, ASTM D892, Seq. I, mL	0/0
Oxidation Stability, RPVOT, ASTM D2272, minutes	247
Rust Test, ASTM D665 A&B	Pass
Sulfated Ash, ASTM D874, wt %	1.27
Total Base Number (TBN), ASTM D2896, mg KOH/g	9.9
Calcium, wt %	0.32
Zinc, wt %	<0.001

Health & Safety Information

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LUBRICANTS

Syncon® R&O Oil (ISO VG 32-68)

Phillips 66® Syncon R&O Oil (ISO VG 32-68) is a premium quality, synthetic, rust and oxidation (R&O)-inhibited circulating oil developed primarily for use in rotary screw and rotary vane air compressors operating under severe-service conditions or at extreme temperatures. It is particularly recommended for use in applications where operating conditions may be unfavorable or too severe for conventional mineral oil-based circulating oils.

Syncon R&O Oil is formulated with synthetic polyalphaolefin (PAO) base oils and select additives to provide excellent protection against wear, rust, corrosion, and foaming. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit and varnish formation and provide long service life. It has excellent low-temperature properties for use over a wide temperature range. It has good water-separating properties to reduce carryover and blockage of filters.

Syncon R&O Oil is compatible with mineral oil-based lubricants, but mixing should be avoided for optimum performance benefits. Syncon R&O Oil meets the requirements of the following industry and OEM specifications:

- AGMA 9005-F16 Inhibited, R&O, Lubricants

Applications

- Rotary and centrifugal air compressors where the manufacturer specifies a PAO-based lubricant
- Plain and rolling-element bearings operating at very high or very low temperatures
- Electric motor, fan, and blower bearings
- Vacuum pumps
- Industrial equipment operating over a wide temperature range where an inhibited mineral oil is recommended

Features/Benefits

- Outstanding resistance to thermal breakdown at high temperatures
- Outstanding oxidation resistance to minimize deposit and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- Excellent low-temperature fluidity

**Synthetic PAO-
Based, Rust
& Oxidation-
Inhibited Air
Compressor Oil**

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Syncon® R&O Oil (ISO VG 32-68)

Typical Properties			
ISO Grade	32	46	68
AGMA Grade (obsolete)	0	1	2
AGMA Classification	R&O	R&O	R&O
Specific Gravity @ 60°F	0.854	0.857	0.865
Density, lbs/gal @ 60°F	7.11	7.14	7.20
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	245 (473)	270 (518)	275 (527)
Pour Point, °C (°F)	-51 (-60)	-39 (-38)	-39 (-38)
Viscosity			
cSt @ 40°C	32.0	46.0	68.0
cSt @ 100°C	5.8	7.4	9.8
SUS @ 100°F	164	225	339
SUS @ 210°F	45.7	51.0	59.4
Viscosity Index	125	133	131
Acid Number, ASTM D974, mg KOH/g	0.17	0.17	0.17
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	15	15
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.47	0.42	0.41
FZG Scuffing Test, ASTM D5182, Failure Load Stage	9	9	9

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syncon® R&O Oil (ISO VG 100-680)

Phillips 66® Syncon R&O Oil (ISO VG 100-680) is a premium quality, synthetic, rust and oxidation (R&O)-inhibited circulating oil developed for use in circulating systems, lightly loaded enclosed gear drives, and other industrial equipment operating under severe-service conditions or at extreme temperatures. It is particularly recommended for use in applications where operating conditions may be unfavorable or too severe for conventional mineral oil-based circulating oils.

Syncon R&O Oil is formulated with synthetic polyalphaolefin (PAO) base oils and select additives to provide excellent protection against rust, corrosion, and deposit formation. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It protects system components against rust, corrosion, and wear. It has excellent low-temperature properties for use over a wide temperature range, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Syncon® R&O Oil is compatible with mineral oil-based lubricants, but mixing should be avoided for optimum performance benefits. Syncon R&O Oil meets the requirements of the following industry and OEM specifications:

- AGMA 9005-F16 Inhibited, R&O, Lubricants

Applications

- Plain and rolling-element bearings operating at very high or very low temperatures, and sealed-for-life bearings
- Lightly to moderately loaded enclosed industrial gear drives that do not require a compounded or extreme-pressure (EP) gear lubricant
- Circulating systems of paper machine dryer sections and calender stacks
- Industrial blowers
- Industrial worm gear drives with bronze-on-steel gears
- Reciprocating air compressors where the manufacturer specifies a PAO-based lubricant (ISO VG 100 or 150, typically)
- Lubrication of the upper cylinders of gas compressors handling natural gas or process gas (ISO VG 150 or 220, typically)
- Industrial equipment operating over a wide temperature range where an inhibited mineral oil is recommended

Note: For information on compatibility with seals, paints and plastics, please call our Technical Support.

**Synthetic PAO-
Based, Rust
& Oxidation-
Inhibited
Circulating Oil
for Gears &
Bearings**

KEEPING THE
WORLD
RUNNING
SMOOTHLY. 



Features/Benefits

- Outstanding resistance to thermal breakdown at high temperatures
- Outstanding oxidation resistance to minimize deposit and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- Excellent low-temperature fluidity
- Extended service intervals compared with mineral oil-based lubricants
- Compatible with mineral oil-based lubricants⁽¹⁾

⁽¹⁾**Note:** For optimum performance, the mineral oil lubricant should be drained before using Syncon R&O Oil. Mixing the two products can reduce the effectiveness and performance advantages normally gained by using Syncon R&O Oil.

Syncon® R&O Oil (ISO VG 100-680)

Typical Properties						
ISO Grade	100	150	220	320	460	680
AGMA Grade (obsolete)	3	4	5	6	7	8
AGMA Classification	R&O	R&O	R&O	R&O	R&O	R&O
Specific Gravity @ 60°F	0.861	0.866	0.871	0.875	0.882	0.882
Density, lbs/gal @ 60°F	7.17	7.21	7.25	7.29	7.34	7.34
Color, ASTM D1500	1.0	1.0	1.0	1.0	1.0	1.0
Flash Point (COC), °C (°F)	266 (511)	243 (469)	266 (511)	255 (491)	243 (469)	266 (511)
Pour Point, °C (°F)	-43 (-45)	-44 (-47)	-45 (-49)	-48 (-54)	-48 (-54)	-43 (-45)
Viscosity						
cSt @ 40°C	99.1	149	231	341	480	728
cSt @ 100°C	14.4	19.8	27.6	37.2	48.3	67.5
SUS @ 100°F	508	766	1,194	1,769	2,500	3,804
SUS @ 210°F	77.0	99.9	135	180	233	326
Viscosity Index	150	153	155	157	159	166
Acid Number, ASTM D974, mg KOH/g	1.50	1.50	1.50	1.50	1.50	1.50
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15	20	20	25	25
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0	0/0	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.40	0.40	0.40	0.40	0.40	0.40
FZG Scuffing Test, ASTM D5182, Failure Load Stage	12	12	12	12	12	12

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Syncon® Refrigeration Oil

Phillips 66® Syncon Refrigeration Oil is a premium quality, synthetic lubricant developed for use in rotary screw compressors in refrigeration systems using ammonia, methyl chloride, or carbon dioxide. It has better oxidation resistance than conventional paraffinic and naphthenic-based refrigeration compressor oils, resulting in less buildup of varnish and sludge deposits and longer service life. It is registered by NSF International as an H1 lubricant for use where incidental food contact may occur.

Syncon Refrigeration Oil is formulated with synthetic polyalphaolefin (PAO) base oils and a carefully balanced additive package to provide long service life, excellent deposit control, protection against rust and corrosion, and resistance to foaming. It has a very low pour point and outstanding thermal stability at high temperatures for use in ammonia refrigeration systems, where evaporator temperatures often reach -30°F (-34°C) and discharge temperatures can reach as high as 250°F (121°C). It also has lower volatility than conventional mineral oils, resulting in lower oil consumption.

Syncon Refrigeration Oil is **not** recommended for use with chlorinated hydrocarbons (CFCs) such as Freon R12, R22 or R502, or with fluorinated hydrocarbons such as HFC-134A.

Applications

- Rotary screw refrigeration compressors using ammonia, methyl chloride or carbon dioxide and operating under severe-service conditions
- Ammonia and carbon dioxide manufacturing plants
- Cold storage warehouses and distribution facilities
- Chemical plants
- Ice plants

Syncon Refrigeration Oil meets the requirements of the following industry specifications:

- NSF International H1 and former 1998 USDA H1 guidelines for incidental food contact (Registration No. 147856)

Syncon Refrigeration Oil is recommended for use in ammonia refrigeration compressors where the OEM specifies:

- Copeland Refrigeration Oil
- Frick Oil No. 2A, 3, 7, 9
- Vilter Refrigeration Oil
- York Oil "C"

**Synthetic PAO-
Based Lubricant
for Ammonia
Refrigeration
Compressors;
NSF H1
Registered**

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SMOOTHLY. 



Features/Benefits

- Outstanding low-temperature fluidity
- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent deposit control
- Low volatility for lower oil consumption and less makeup oil
- Protects against rust and corrosion
- Extended service intervals compared to conventional mineral oil-based refrigeration oils

Syncon® Refrigeration Oil

Typical Properties	
ISO Grade	68
Specific Gravity @ 60°F	0.832
Density, lbs/gal @ 60°F	6.93
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	243 (469)
Pour Point, °C (°F)	-54 (-65)
Viscosity	
cSt @ 40°C	70.0
cSt @ 100°C	10.0
SUS @ 100°F	360
SUS @ 210°F	60.0
Viscosity Index	126
Acid Number, ASTM D974, mg KOH/g	0.17
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Demulsibility, ASTM D1401, minutes to pass	10
Foam Test, ASTM D892, Seq. I, mL	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.79
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Syndustrial® PAG Compressor Oil

Phillips 66® Syndustrial PAG Compressor Oil is a premium quality, synthetic lubricant developed for use in centrifugal and oil-flooded rotary screw and rotary vane compressors processing natural gas, carbon dioxide, propane, or other hydrocarbon gases. It is specially formulated to resist hydrocarbon dilution and oil absorption in this type of service.

Syndustrial PAG Compressor Oil is formulated with synthetic polyalkylene glycol (PAG) base oils and carefully selected additives to provide long service life, excellent wear protection, resistance to washout and lubricant carryover, and protection against rust and corrosion. Special inhibitors help resist corrosion caused by hydrogen sulfide when processing sour gas. The combination of outstanding oxidation resistance and thermal stability at high temperatures, a very high viscosity index, and excellent low-temperature properties makes it suitable for year-round use over a wide temperature range.

Syndustrial PAG Compressor Oil is highly resistant to hydrocarbon gas dilution and absorption into the gas stream. Solubility of gas in the oil causes reduced lubricant viscosity, which can result in cylinder scoring and high wear rates. Absorption of the oil into the gas stream causes high oil consumption and carryover into the process gas, and can cause depletion of the protective oil film on the cylinder walls. Resistance to gas dilution and oil absorption helps maintain proper viscosity and oil film thickness to protect against wear.

Applications

- Oil-flooded rotary screw and rotary vane compressors processing natural gas, carbon dioxide, or other hydrocarbon gases
- Centrifugal compressors processing propane refrigerant, including York centrifugal compressors where York Oil Q (ISO VG 46) or York Oil R (ISO VG 68) is recommended

Note: Syndustrial PAG Compressor Oil is **not** compatible with petroleum compressor oils. Care should be taken to avoid mixing the two products. When switching over from mineral oil to Syndustrial PAG Compressor Oil, a complete flush, drain, and refill should be performed.

CAUTION: Syndustrial PAG Compressor Oil is not recommended for use in R-134a refrigeration compressors that require a PAG lubricant.

**Synthetic
Polyalkylene
Glycol-Based
Compressor Oil
for Natural Gas
Service**

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Features/Benefits

- Highly resistant to dilution by hydrocarbon gases
- Resists washout by condensed hydrocarbon liquids
- Resists absorption into the gas stream and subsequent carryover of the lubricant downstream
- Outstanding oxidation resistance and thermal stability at high temperatures
- High viscosity index and low pour point for use over a wide temperature range
- High film strength for wear protection
- Protects against rust and corrosion
- Extended service intervals compared with mineral oil-based lubricants
- Compatible with commonly used seals, gaskets, and hoses⁽¹⁾

⁽¹⁾ **Note:** Syndustrial PAG Compressor Oil is compatible with neoprene, silicone rubber, torlon, vespal and viton, as well as epoxy paints. It is **not** compatible with oil-based paints or with solvents, such as diesel fuel, kerosene, heptane, methanol, ethylene glycol or triethanolamine.

Syndustrial® PAG Compressor Oil

Typical Properties				
ISO Grade	46	68	100	150
Specific Gravity @ 60°F	1.03	1.04	1.04	1.05
Density, lbs/gal @ 60°F	8.58	8.66	8.66	8.75
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	263 (505)	232 (450)	232 (450)	263 (505)
Pour Point, °C (°F)	-51 (-60)	-39 (-38)	-36 (-33)	-49 (-56)
Viscosity				
cSt @ 40°C	46.9	68.0	100	150
cSt @ 100°C	9.9	14.8	19.4	27.8
SUS @ 100°F	236	340	503	682.5
SUS @ 210°F	59.6	78.4	97.8	135.6
Viscosity Index	204	230	218	227
Acid Number, ASTM D974, mg KOH/g	0.26	0.34	0.34	0.34
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a	1a
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.50	0.47	0.51	0.30
Oxidation Stability, RPVOT, ASTM D2272, minutes	1,550	2,100	2,100	1,500
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syndustrial® R&O Oil

Phillips 66® Syndustrial R&O Oil is a premium quality, synthetic diester lubricant developed for use in air compressors and select steam turbines operating under severe-service conditions, and in moisture-free environments. It is particularly recommended for use in applications where operating conditions may be unfavorable or too severe for conventional mineral oil-based lubricants.

Syndustrial R&O Oil is formulated to provide long service life and excellent performance over a wide temperature range. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It also has excellent low-temperature properties for use over a wide temperature range. It has good natural detergency to help minimize deposit formation in air compressors and on the bearing surfaces of steam turbines. It protects system components against rust, corrosion, and wear. It has good water-separating properties and is resistant to excessive foam buildup. It has lower volatility than conventional mineral oil-based lubricants for reduced oil consumption.

Applications

- Reciprocating air compressors⁽¹⁾
- Select rotary air compressors operating in a dry environment⁽¹⁾
- Elliott ring-oiled turbines, where a synthetic diester turbine oil is specified
- Circulating systems requiring a synthetic diester lubricant
- Steam turbines where the manufacturer specifies a synthetic diester lubricant
- Plain and rolling-element bearings operating at very high or very low temperatures
- Industrial equipment operating over a wide temperature range where an inhibited mineral oil is recommended⁽²⁾

⁽¹⁾ **Note:** Always follow the equipment manufacturer's recommendations regarding the use of diester lubricants and selection of proper viscosity grade. Typically, rotary air compressors and turbines require an ISO 32 or ISO 68 viscosity grade, and reciprocating compressors require an ISO 100 or ISO 150 viscosity grade.

⁽²⁾ **Note:** Syndustrial R&O Oil is **not** compatible with mineral oil-based lubricants. Mixing should be avoided to ensure optimum performance.

**Synthetic
Diester
Lubricant for Air
Compressors &
Some Turbines;
Rust & Oxidation
Inhibited**

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SMOOTHLY. 



Features/Benefits

- Excellent resistance to thermal breakdown at high temperatures
- Excellent oxidation resistance to minimize sludge and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Natural detergency
- Excellent low-temperature properties
- Extended service intervals compared with conventional mineral oil-based lubricants

Note: For information on compatibility with seals, paints and plastics, please call our Technical Support Hotline.

Syndustrial® R&O Oil

Typical Properties				
ISO Grade	32	68	100	150
Specific Gravity @ 60°F	0.941	0.965	0.961	0.957
Density, lbs/gal @ 60°F	7.84	8.04	8.00	7.97
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	243 (469)	254 (489)	260 (500)	265 (509)
Pour Point, °C (°F)	-51 (-60)	-42 (-44)	-39 (-38)	-39 (-38)
Viscosity				
cSt @ 40°C	31.0	65.0	98.5	150
cSt @ 100°C	5.0	8.4	10.9	15.1
SUS @ 100°F	161	337	515	786
SUS @ 210°F	43.0	54.5	63.5	80.1
Viscosity Index	79	98	94	101
Acid Number, ASTM D974, mg KOH/g	0.39	0.39	0.39	0.39
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	15	15
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.70	0.80	0.70	0.66
FZG Scuffing Test, ASTM D5182, Failure Load Stage	9	9	9	9
Oxidation Stability, RPVOT, ASTM D2272, minutes	>1,750	>1,750	>1,750	>1,750
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syndustrial® Rotary Compressor Oil

Phillips 66® Syndustrial Rotary Compressor Oil is a premium quality, readily biodegradable synthetic lubricant developed for use in centrifugal and rotary air compressors. It is particularly recommended for use in applications where operating conditions are unfavorable or too severe for conventional mineral oil-based compressor oils.

Syndustrial Rotary Compressor Oil is formulated with a blend of synthetic polyalkylene glycol (PAG) and synthetic ester base oils and carefully selected additives. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has high film strength to protect against wear, and also protects against rust and corrosion. It is classified as readily biodegradable, as defined by the OECD 301B test method, for reduced environmental impact in case of leaks or spills. It also passes the visual “no sheen” requirements of the U.S. EPA Static Sheen Test (Federal Register Vol. 58, No. 41).

Syndustrial Rotary Compressor Oil is formulated to outperform conventional paraffinic or naphthenic compressor oils in oxidation resistance and deposit control. It has better thermal stability at high temperatures to minimize sludge and varnish formation. It also has lower volatility for lower oil consumption. These benefits result in longer service intervals and less maintenance than with conventional petroleum oils.

Applications

- Centrifugal air compressors and oil-flooded rotary screw, rotary lobe and rotary vane air compressors where the manufacturer specifies a synthetic polyglycol/ester lubricant
- Drop-in replacement for OEM-branded polyglycol-based compressor oils

Note: Syndustrial Rotary Compressor Oil is **not** compatible with petroleum compressor oils and should not be mixed with such products. When converting from mineral oil to Syndustrial Rotary Compressor Oil, a complete flush, drain and refill should be performed.

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- High viscosity index and very low pour point for use over a wide temperature range
- Excellent cooling and heat transfer properties
- Excellent deposit control
- High film strength for wear protection

**Synthetic
Polyalkylene
Glycol/Ester-
Based Air
Compressor
Oil; Readily
Biodegradable**

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- Low volatility for lower oil consumption and less makeup oil
- Protects against rust and corrosion
- Extended service intervals compared with mineral oil-based lubricants
- Readily biodegradable for reduced environmental impact in case of leaks or spills
- Compatible with commonly used seals, gaskets, and hoses⁽¹⁾

⁽¹⁾ **Note:** Syndustrial Rotary Compressor Oil is compatible with neoprene, silicone rubber, torlon, vespal and viton, as well as epoxy paints. It is **not** compatible with oil-based paints or with solvents, such as diesel fuel, kerosene, heptane, methanol, ethylene glycol or triethanolamine.

Syndustrial® Rotary Compressor Oil

Typical Properties	
ISO Grade	32/46
Specific Gravity @ 60°F	0.964
Density, lbs/gal @ 60°F	8.03
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	251 (484)
Pour Point, °C (°F)	-57 (-71)
Viscosity	
cSt @ 40°C	35.9
cSt @ 100°C	7.3
SUS @ 100°F	182
SUS @ 210°F	50.6
Viscosity Index	174
Acid Number, ASTM D974, mg KOH/g	0.17
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Foam Test, ASTM D892, Seq. I, mL	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.53
Oxidation Stability, RPVOT, ASTM D2272, minutes	>1,800
Rust Test, ASTM D665 A&B	Pass
Biodegradability, OECD 301B, 28 days, %	>90

Health & Safety Information

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LUBRICANTS

Ultra-Clean Multipurpose R&O Oil

Phillips 66® Ultra-Clean Multipurpose R&O Oil is a rust and oxidation (R&O)-inhibited, anti-wear circulating oil specially developed for use in industrial equipment that requires an ultra-clean fluid. It provides the same performance features as Multipurpose R&O Oil plus the added benefit of fine filtration to a typical ISO Cleanliness Code of 17/15/11, for use in circulating systems with tight tolerances where particle contamination can cause operational problems.

Ultra-Clean Multipurpose R&O Oil is formulated to provide protection against rust, corrosion, and deposit formation, plus mild wear protection. It has good oxidation resistance at high temperatures to minimize sludge and varnish formation, resulting in long service life. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can interfere with proper lubrication. An ashless (zinc-free) anti-wear additive provides mild wear protection to help increase equipment life.

Applications

- Circulating systems where fluid cleanliness is critical
- Centrifugal air compressors
- Steam turbines and hydroelectric turbines, both direct-drive and those with gear drives
- Lightly loaded enclosed industrial gear drives where the OEM specifies a R&O-type oil (ISO VG 68, 100)
- Electric motor bearings
- Vacuum pumps and machine tools

Ultra-Clean Multipurpose R&O oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- Alstom Power HTGD 90 117 for geared turbines
- ASTM D4304 Type I Turbine Oil
- British Standard 489
- Denison Hydraulics HF-1
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- General Electric GEK 101941A, GEK 46506e, GEK 27070 (obsolete), GEK 28143b (obsolete)
- Solar Turbines ES 9-224 Class II Turbine Oil
- U.S. Military MIL-L-17672D
- U.S. Steel 126

**Rust &
Oxidation-
Inhibited, Anti-
Wear Circulating
Oil; Meets ISO
Cleanliness
Code 17/15/11**

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Features/Benefits

- Good oxidation resistance to minimize sludge and varnish formation
- Mild wear protection
- Protects against rust and corrosion
- Excellent water-separating properties
- Low carbon-forming tendency for use in centrifugal air compressors
- Good foam resistance
- Meets ISO Cleanliness Code rating of 17/15/11⁽¹⁾

⁽¹⁾Note: Applies only to unopened packaged containers as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

Ultra-Clean Multipurpose R&O Oil

Typical Properties			
ISO Grade	32	68	100
AGMA Grade	0	2	3
Specific Gravity @ 60°F	0.862	0.873	0.877
Density, lbs/gal @ 60°F	7.18	7.27	7.30
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	232 (450)	243 (469)	268 (514)
Pour Point, °C (°F)	-40 (-40)	-34 (-30)	-34 (-30)
Viscosity			
cSt @ 40°C	32.5	68.2	101
cSt @ 100°C	5.4	8.8	11.3
SUS @ 100°F	168	353	527
SUS @ 210°F	44.4	55.9	65.0
Viscosity Index	99	101	98
Acid Number, ASTM D974, mg KOH/g	0.14	0.14	0.14
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	20	20
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.54	0.45	0.45
FZG Scuffing Test, ASTM D5182, Failure Load Stage	10	10	10
Oxidation Stability			
TOST, ASTM D943-04a, hours	4,500	4,500	4,500
RPVOT, ASTM D2272, minutes	750	750	750
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Cleanliness Code, ISO 4406:1999	17/15/11	17/15/11	17/15/11

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Wet Gas Compressor Oil

Phillips 66® Wet Gas Compressor Oil is a high-quality lubricant developed for the lubrication of oil-flooded rotary compressors in natural gas service. It also is recommended for cylinder lubrication of reciprocating compressors in natural gas service. It is specially formulated to minimize the effects of gas dilution and oil absorption and to resist wash-off in compressors handling “wet” gas (natural gas containing liquid hydrocarbons and/or water).

Wet Gas Compressor Oil is specially formulated to provide excellent service and protection in gas compression service. It has excellent oxidation resistance and thermal stability at high temperatures to help minimize deposit formation and provide long service life. It is compounded with an oiliness additive that provides good metal-wetting ability to help resist lubricant wash-off in the presence of wet gas. It protects against rust, corrosion and wear, and is resistant to excessive foaming that can interfere with proper lubrication.

Wet Gas Compressor Oil is particularly recommended for use in applications where the gas outlet temperature is well above the condensation point of the gas.

Applications

- Oil-flooded rotary screw, rotary lobe and rotary vane compressors handling wet natural gas
- Industrial reciprocating compressors pumping wet natural gas
- Reciprocating compressors commonly found in remote gas gathering stations

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Resists lubricant “wash-off”
- Formulated to minimize the effects of gas dilution and oil absorption
- Good wear protection
- Protects against rust and corrosion
- Good foam resistance

Compounded Compressor Oil for “Wet” Natural Gas Service

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Wet Gas Compressor Oil

Typical Properties	
ISO Grade	220
Specific Gravity @ 60°F	0.889
Density, lbs/gal @ 60°F	7.40
Color, ASTM D1500	2.5
Flash Point (COC), °C (°F)	285 (545)
Pour Point, °C (°F)	-15 (5)
Viscosity	
cSt @ 40°C	218
cSt @ 100°C	18.5
SUS @ 100°F	1,154
SUS @ 210°F	94.6
Viscosity Index	94
Acid Number, ASTM D974, mg KOH/g	0.14
Copper Corrosion, ASTM D130	1a
Demulsibility, ASTM D1401, minutes to pass	15
Foam Test, ASTM D892, Seq. I, mL	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.40
Oxidation Stability, ASTM D943-04a, hours	4,000
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

HYDRAULIC OILS



LUBRICANTS

Arctic Low Pour Hydraulic Oil

Phillips 66® Arctic Low Pour Hydraulic Oil is a high-quality, low-viscosity anti-wear hydraulic oil specially developed for use in industrial and mobile equipment operating at extremely low temperatures. It has a very high viscosity index and low pour point for use in arctic conditions.

Arctic Low Pour Hydraulic Oil is formulated to provide outstanding low-temperature properties, good wear protection for hydraulic pumps and motors, resistance to deposit formation, and protection against rust and corrosion. It has good water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Arctic Low Pour Hydraulic Oil may be used in land-based hydraulic systems where the equipment manufacturer specifies a MIL-H-5606 fluid. It is **not** recommended for aircraft use.

Applications

- Industrial and mobile equipment operating in cold climates
- Bucket trucks (cherry pickers) used for servicing electrical power lines or for tree-trimming
- Surface mining equipment

Features/Benefits

- Outstanding low-temperature properties
- Very high viscosity index for use in arctic conditions
- Good wear protection for hydraulic pumps and motors
- Resists deposit formation and viscosity increase due to oxidation
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- High dielectric strength for use in electrical service bucket trucks (cherry pickers)⁽¹⁾

⁽¹⁾ **Note:** In order to maintain its high dielectric strength for use as electrical insulating oil, the oil must be kept clean and dry. Contamination with water will significantly decrease the dielectric strength.

**Low-Pour, High
VI Anti-wear
Hydraulic Oil for
Cold Climates**

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Arctic Low Pour Hydraulic Oil

Typical Properties	
ISO Grade	15
Specific Gravity @ 60°F	0.876
Density, lbs/gal @ 60°F	7.29
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	103 (217)
Pour Point, °C (°F)	-62(-80)
Viscosity	
cP @ -40°C (Brookfield)	450
cSt @ -40°C (Calculated)	226
cSt @ 40°C	15.0
cSt @ 100°C	5.6
SUS @ 100°F	77.4
SUS @ 210°F	44.6
Viscosity Index	383
Acid Number, ASTM D974, mg KOH/g	0.50
Demulsibility, ASTM D1401, minutes to pass	30
Dielectric Strength, ASTM D877, kV ⁽²⁾	35
Foam Test, ASTM D892	Pass
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.55
Rust Test, ASTM D665 A&B	Pass
Zinc, wt %	0.050

⁽²⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-07-16

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LUBRICANTS

FR Fluid-Glycol

Phillips 66® FR Fluid-Glycol is a water-glycol based fire-resistant hydraulic fluid developed for use in industrial hydraulic systems operating in areas subject to fire hazards. It contains sufficient water to snuff out a fire resulting from ignition of a fluid leak. It is suitable for use in hydraulic systems operating at 2,000 to 3,000 psi, and can withstand intermittent pressure spikes up to 5,000 psi.

FR Fluid-Glycol is formulated with diethylene glycol, 40% water and select additives that provide lubricity, wear protection and corrosion protection. It has good antiwear properties to ensure long life for hydraulic pumps and motors. Special rust and corrosion inhibitors provide corrosion protection in both the liquid phase and the vapor phase. The high water content provides fire resistance if the fluid comes into contact with an ignition source. This product contains less than 60 parts per billion (ppb) phenols, and does not contain any nitrites or nitrosamines. It is compatible with other water-glycol type fire-resistant hydraulic fluids. This product meets the performance requirements for an ISO HFC fire-resistant water-glycol hydraulic fluid.

FR Fluid-Glycol is compatible with most hydraulic pumps, including vane, piston and gear pumps. It is safe to use with most packing and seal materials except polyurethane and silicone. Cork shaft seals should be replaced with Buna N or other synthetic rubber. Leather packing should be avoided and zinc or cadmium-plated components should not be used.

Applications

Hydraulic systems on equipment operating in areas subject to fire hazards, such as:

- Steel and aluminum mills
- Molding and metal die casting machinery
- Welding machines
- Foundries
- Furnace charging equipment
- Open hearth and basic oxygen furnace (B.O.F.) equipment
- Power transmission plants

FR Fluid-Glycol meets the requirements of the following OEM specifications:

- ISO HFC (fire-resistant water-glycol mixture, >35% water)
- Denison Hydraulics HF-4
- U.S. Steel 171

Caution: FR Fluid-Glycol should **not** be used in systems where operating temperatures exceed 175°F (79°C). This product contains water and should not be stored at temperatures over 130°F (54°C). In addition, this product is **not** recommended for use as a conventional antifreeze coolant for automotive or industrial applications.

Water-Glycol Based Fire- Resistant Hydraulic Fluid





Features/Benefits

- Fire-resistant for safety
- Excellent wear protection for hydraulic pumps and motors
- Excellent rust and corrosion protection
- Good foam resistance
- Glycol content protects against freezing
- Compatible with other water-glycol fluids

FR Fluid-Glycol

Typical Properties	
ISO Grade	32/46
Specific Gravity @ 60°F	1.08
Density, lbs/gal @ 60°F	9.00
Color, Visual	Red
Freezing Point, °C (°F)	-55 (-48)
Viscosity	
cSt @ 40°C	39.3
cSt @ 100°C	8.5
SUS @ 100°F	198
SUS @ 210°F	54.7
Viscosity Index	202
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.48
pH (neat)	9.7
Rust Test, ASTM D665 A&B	Pass
Water, wt %	40

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

06-15-17

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LUBRICANTS

Hydraulic AW

Phillips 66® Hydraulic AW is a general-purpose anti-wear hydraulic oil developed for use in a wide range of industrial hydraulic system applications, especially in less demanding applications where premium performance is not required.

Hydraulic AW is formulated to provide good wear protection for hydraulic pumps and motors, good oxidation resistance, and protection against rust and corrosion. It has good water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Applications

- Hydraulic systems on industrial equipment
- Mining equipment, including drills, loaders and shuttle cars
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Electric motor bearings

Hydraulic AW meets the requirements of the following OEM specification:

- Eaton-Vickers I-286-S

Features/Benefits

- Protects against wear
- Good oxidation resistance
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance

General-Purpose Anti-wear Hydraulic Oil

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Hydraulic AW

Typical Properties				
ISO Grade	32	46	68	100
Specific Gravity @ 60°F	0.866	0.871	0.874	0.886
Density, lbs/gal @ 60°F	7.21	7.25	7.28	7.38
Color, ASTM D1500	0.5	0.5	0.5	2.5
Flash Point (COC), °C (°F)	216 (421)	227 (441)	238 (460)	225 (437)
Pour Point, °C (°F)	-18 (0)	-18 (0)	-18 (0)	-10 (14)
Viscosity				
cSt @ 40°C	32.0	46.0	68.0	100
cSt @ 100°C	5.3	6.7	8.6	10.1
SUS @ 100°F	165	238	353	526
SUS @ 210°F	44.0	48.7	55.2	60.6
Viscosity Index	96	97	97	76
Acid Number, ASTM D974, mg KOH/g	0.4	0.4	0.4	0.5
Foam Test, ASTM D892	Pass	Pass	Pass	Pass
Oxidation Stability, TOST, ASTM D943-04a, hours	>2,000	>2,000	>2,000	>2,000
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass
Zinc, wt %	0.031	0.031	0.031	0.031

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-16

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LUBRICANTS

Hydraulic AW/D

Phillips 66® Hydraulic Oil AW/D is a high-quality anti-wear hydraulic oil developed for use in industrial and mobile hydraulic systems where component cleanliness is critical. It is formulated with a dispersant/detergent additive to help keep the hydraulic system clean and free of deposits.

Hydraulic Oil AW/D is formulated to provide excellent wear protection for hydraulic pumps and motors, to protect hydraulic system components against rust and corrosion, and to maintain excellent hydraulic system cleanliness. It has good oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has high dispersancy-detergency to keep close-tolerance servo valves clean and freely operating for maximum system efficiency, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Hydraulic Oil AW/D is recommended for use in all types of high-pressure, high-speed hydraulic pumps. However, it should **not** be used in hydraulic systems where good water separation is required, since the dispersant/detergent additive will emulsify water and hold it in suspension.

Applications

- Hydraulic systems on industrial, mobile and marine equipment
- Automated machine tools
- Hydraulic elevators, hoists, presses and floor jacks
- Marine cargo winches and steering systems
- Mobile construction equipment
- Service station lifts
- Air tools and other pneumatic equipment lubricated through air line lubricators

Hydraulic Oil AW/D meets the requirements (except demulsibility) of the following industry and OEM specifications:

- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Eaton-Vickers I-286-S, M-2950-S
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- U.S. Steel 127

**Anti-wear
Hydraulic Oil
with Dispersant/
Detergent
Additive**

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Features/Benefits

- High dispersancy-detergency for excellent system cleanliness
- Excellent wear protection for hydraulic pumps and motors
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Good foam resistance

Hydraulic AW/D

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.860	0.865	0.867
Density, lbs/gal @ 60°F	7.16	7.20	7.22
Color, ASTM D1500	0.5	L 1.0	L 1.0
Flash Point (COC), °C (°F)	223 (433)	247 (477)	257 (495)
Pour Point, °C (°F)	-45 (-49)	-42 (-44)	-36 (-33)
Viscosity			
cSt @ 40°C	32.0	46.0	68.0
cSt @ 100°C	6.1	7.6	9.8
SUS @ 100°F	150	214	315
SUS @ 210°F	46.2	51.1	58.6
Viscosity Index	141	132	126
Acid Number, ASTM D974, mg KOH/g	0.42	0.42	0.42
Copper Corrosion, ASTM D130	1a	1a	1a
Foam Test, ASTM D892	Pass	Pass	Pass
FZG Scuffing Test, ASTM D5182, Failure Load Stage	11	11	11
Oxidation Stability, TOST, ASTM D943-04a, hours	>4,500	>4,500	>4,500
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Zinc, wt %	0.047	0.047	0.047

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

05-08-17

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LUBRICANTS

Megaflow® AW HVI Hydraulic Oil

Phillips 66® Megaflow AW HVI Hydraulic Oil is a high-quality, high viscosity index anti-wear hydraulic oil developed for use in industrial and mobile equipment operating in cold climates or in locations subject to wide variations in ambient temperatures. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps. It is particularly recommended for year-round use in mobile equipment such as bucket trucks, cranes and aerial lifts.

Megaflow AW HVI Hydraulic Oil is specially formulated to have a high viscosity index and a low pour point for use over a wider temperature range than conventional anti-wear hydraulic oils. It provides excellent wear protection for hydraulic pumps and motors, has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life, and protects hydraulic system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response. It has excellent low-temperature properties for cold start-ups. It also has a high dielectric strength for use as insulating oil in electrical service repair trucks.

Applications

- Industrial and mobile equipment operating in cold weather or in locations subject to wide temperature fluctuations
- Bucket trucks (cherry pickers) used for servicing electrical power lines or for tree-trimming
- Hydraulic hoists and service station lifts
- Marine cargo winches and steering systems
- Off-road construction, mining and marine equipment
- Chain drives
- Electric motor bearings

Megaflow AW Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- DIN 51524 Part 3, Anti-wear Hydraulic Oils, Type HVL
- Eaton-Vickers I-286-S, M-2950-S
- ISO 11158:1997, Family H (Hydraulic Systems), Type HV
- Parker Hannifin (Denison) HF-0, HF-1, HF-2

High VI Anti-wear Hydraulic Oil for Wide Temperature Ranges

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Features/Benefits

- Excellent service over a wide temperature range
- Excellent wear protection for hydraulic pumps and motors
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Excellent low-temperature properties for cold start-ups
- High dielectric strength for use in electrical service bucket trucks (cherry pickers)⁽¹⁾

⁽¹⁾**Note:** In order to maintain its high dielectric strength for use as electrical insulating oil, the oil must be kept clean and dry. Contamination with water will significantly decrease the dielectric strength.

Megaflow® AW HVI Hydraulic Oil

Typical Properties						
ISO Grade	15	22	32	46	68	100
Specific Gravity @ 60°F	0.857	0.858	0.861	0.868	0.874	0.878
Density, lbs/gal @ 60°F	7.14	7.14	7.17	7.23	7.28	7.31
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	181 (358)	193 (379)	204 (399)	213 (415)	218 (425)	218 (425)
Pour Point, °C (°F)	-61 (-78)	-50 (-58)	-45 (-49)	-45 (-49)	-42 (-44)	-42 (-44)
Viscosity						
cSt @ 40 °C	15.0	22.0	32.0	46.0	68.0	100
cSt @ 100 °C	3.8	4.7	6.0	7.7	10.2	13.5
SUS @ 100 °F	77.5	106	150	214	315	463
SUS @ 210 °F	37.5	40.6	45.9	51.5	60.0	72.2
Viscosity Index	151	136	136	135	135	135
Acid Number, ASTM D974, mg KOH/g	0.38	0.38	0.38	0.38	0.38	0.38
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15	15	15	15	15
Dielectric Strength, ASTM D877, kv ⁽²⁾	35	35	35	35	35	35
Foam Test, ASTM D892, Seq. I, mL	10/0	0/0	0/0	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182						
Failure Load Stage	---	---	---	12	12	12
Oxidation Stability						
TOST, ASTM D943-04a, hours	>5,000	>5,000	>5,000	>5,000	>5,000	>5,000
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass	Pass	Pass
Zinc, wt %	0.043	0.043	0.043	0.043	0.043	0.043

⁽²⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-06-16

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LUBRICANTS

Megaflow® AW Hydraulic Oil

Phillips 66® Megaflow AW Hydraulic Oil is a high-quality anti-wear hydraulic oil developed for use in a wide variety of industrial and mobile hydraulic system applications. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Megaflow AW Hydraulic Oil is formulated to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Applications

- Hydraulic systems on industrial, mobile and marine equipment
- Automated machine tools
- Elevators, hoists, presses and floor jacks
- Marine cargo winches and steering systems
- Mobile construction equipment
- Service station lifts
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Electric motor bearings
- Lightly to moderately loaded enclosed industrial gear drives that do not require a compounded or extreme-pressure (EP) gear oil

Megaflow AW Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HLP
- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Parker Hannifin (Denison) HF-0, HF-1, HF-2 (approved ISO 32, 46, and 68)
- Eaton-Vickers I-286-S, M-2950-S, 35VQ25A anti-wear performance (brochure 03-401-2010 Rev 1 ISO 32, 46, and 68)
- Fives Cincinnati P-68 (ISO VG 32), P-70 (ISO VG 46), P-69 (ISO VG 68) (approved)
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- U.S. Steel 127

**High-Quality
Anti-wear
Hydraulic Oil**

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Features/Benefits

- Excellent wear protection for hydraulic pumps and motors
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance

Megaflow® AW Hydraulic Oil

Typical Properties				
ISO Grade	22	32	46	68
Specific Gravity @ 60°F	0.855	0.862	0.869	0.874
Density, lbs/gal @ 60°F	7.12	7.18	7.24	7.27
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	196 (385)	216 (421)	227 (441)	238 (460)
Pour Point, °C (°F)	-40 (-40)	-37 (-35)	-37 (-35)	-33 (-27)
Viscosity				
cSt @ 40 °C	22.0	32.0	46.0	68.0
cSt @ 100 °C	4.3	5.4	6.8	8.7
SUS @ 100 °F	106	150	214	315
SUS @ 210 °F	39.9	44.0	48.5	54.9
Viscosity Index	101	102	102	99
Acid Number, ASTM D974, mg KOH/g	0.38	0.38	0.38	0.38
Copper Corrosion, ASTM D130	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	---	12	12	12
Oxidation Stability				
TOST, ASTM D943-04a, hours	>5,000	>5,000	>5,000	>5,000
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass
Zinc, wt %	0.043	0.043	0.043	0.043

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Megaflow® AW Hydraulic Oil

Typical Properties				
ISO Grade	100	150	220	320
Specific Gravity @ 60°F	0.878	0.882	0.881	0.887
Density, lbs/gal @ 60°F	7.31	7.35	7.34	7.38
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	252 (486)	274 (525)	282 (540)	274 (525)
Pour Point, °C (°F)	-32 (-26)	-33 (-27)	-30 (-22)	-24 (-11)
Viscosity				
cSt @ 40 °C	100	150	220	320
cSt @ 100 °C	11.0	14.7	19.2	24.3
SUS @ 100 °F	463	695	1,020	1,483
SUS @ 210 °F	62.8	76.8	95.1	117
Viscosity Index	94	96	98	96
Acid Number, ASTM D974, mg KOH/g	0.38	0.38	0.38	0.38
Copper Corrosion, ASTM D130	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	12	12	12	12
Oxidation Stability				
TOST, ASTM D943-04a, hours	>5,000	>4,500	>4,500	>4,500
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass
Zinc, wt %	0.043	0.043	0.043	0.043

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

05-09-17

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LUBRICANTS

Megaflow® AW Ultra-Clean Hydraulic Oil

Phillips 66® Megaflow AW Ultra-Clean Hydraulic Oil is a high-quality anti-wear hydraulic oil developed for use in industrial and mobile hydraulic systems that require an oil with a high level of fluid cleanliness. It provides the same performance benefits as Megaflow® AW Hydraulic Oil, plus it is filtered to a typical ISO Cleanliness Code of 17/15/11 for use in hydraulic systems with tight tolerances where particle contamination can cause operational problems.

Megaflow AW Ultra-Clean Hydraulic Oil is formulated to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Megaflow AW Ultra-Clean Hydraulic Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Hydraulic systems on industrial, mobile and marine equipment, especially where particle contamination can cause operational problems
- Automated machine tools
- Hydraulic elevators, hoists, presses and floor jacks
- Marine cargo winches and steering systems
- Service station lifts
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Electric motor bearings

Megaflow AW Ultra-Clean Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HLP
- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Eaton-Vickers I-286-S, M-2950-S
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- U.S. Steel 127

**High-Quality
Anti-wear
Hydraulic Oil;
Meets ISO
Cleanliness
Code 17/15/11**

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Features/Benefits

- Excellent wear protection for hydraulic pumps and motors
- Reliable operation of hydraulic valves and actuators
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Meets ISO Cleanliness Code rating of 17/15/11⁽¹⁾

⁽¹⁾**Note:** Applies only to unopened packaged containers as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

Megaflow® AW Ultra-Clean Hydraulic Oil

Typical Properties				
ISO Grade	32	46	68	100
Specific Gravity @ 60°F	0.862	0.869	0.874	0.878
Density, lbs/gal @ 60°F	7.18	7.24	7.27	7.31
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	216 (421)	227 (441)	238 (460)	252 (486)
Pour Point, °C (°F)	-37 (-35)	-37 (-35)	-33 (-27)	-32 (-26)
Viscosity				
cSt @ 40 °C	32.0	46.0	68.0	100
cSt @ 100 °C	5.4	6.8	8.7	11.0
SUS @ 100 °F	150	214	315	463
SUS @ 210 °F	44.0	48.5	54.9	62.8
Viscosity Index	102	102	99	94
Acid Number, ASTM D974, mg KOH/g	0.38	0.38	0.38	0.38
Copper Corrosion, ASTM D130	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10	10
Dielectric Strength, ASTM D877, kv ⁽²⁾	35	35	35	35
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	>12	>12	>12	>12
Oxidation Stability				
TOST, ASTM D943-04a, hours	>5,000	>5,000	>5,000	>5,000
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass
Zinc, wt %	0.043	0.043	0.043	0.043
Cleanliness Code, ISO 4460:1999 ⁽²⁾	17/15/11	17/15/11	17/15/11	17/15/11

⁽²⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Powerflow™ AW Hydraulic Oil

Phillips 66® Powerflow AW Hydraulic Oil is a premium quality anti-wear hydraulic oil developed for use in a wide variety of industrial and mobile hydraulic systems operating under high-pressure, high-temperature conditions. It is formulated to provide enhanced wear protection and deposit control for severe service applications. It is particularly recommended for use in plastic injection molding machines where deposit control in the hydraulic circuit of the electro-pneumatic servo valves is essential for trouble-free operation.

Powerflow AW Hydraulic Oil is formulated to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Powerflow AW Hydraulic Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Plastic injection molding machines
- Automated machine tools
- Elevators, hoists, presses and floor jacks
- Marine cargo winches and steering systems
- Mobile construction equipment
- Service station lifts
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Electric motor bearings

Powerflow AW Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HLP
- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Parker Hannifin (Denison) HF-0, HF-1, HF-2 (approved ISO 32, 46, and 68)
- Eaton-Vickers I-286-S, M-2950-S, 35VQ25A antiwear performance (brochure 03-401-2010 Rev 1 ISO 32, 46, and 68)
- Fives Cincinnati P-68 (ISO VG 32), P-70 (ISO VG 46), P-69 (ISO VG 68) (approved)
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- U.S. Steel 127

Premium Anti-wear Hydraulic Oil for Plastic Injection Molding Machines





Features/Benefits

- Outstanding performance in plastic injection molding machines
- Excellent wear protection for hydraulic pumps and motors
- Excellent oxidation resistance and thermal stability
- Excellent deposit control
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance

Powerflow™ AW Hydraulic Oil

Typical Properties				
ISO Grade	32	46	68	100
Specific Gravity @ 60°F	0.863	0.869	0.874	0.878
Density, lbs/gal @ 60°F	7.18	7.24	7.28	7.31
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	216 (421)	221 (430)	238 (460)	254 (489)
Pour Point, °C (°F)	-37 (-35)	-36 (-33)	-36 (-33)	-29 (-20)
Viscosity				
cSt @ 40 °C	32.0	46.0	68.0	100
cSt @ 100 °C	5.4	6.8	8.7	11.3
SUS @ 100 °F	150	214	315	463
SUS @ 210 °F	44.0	48.5	54.9	63.9
Viscosity Index	102	102	99	99
Acid Number, ASTM D974, mg KOH/g	0.60	0.60	0.60	0.60
Copper Corrosion, ASTM D130	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	12	12	12	12
Oxidation Stability				
TOST, ASTM D943-04a, hours	>7,500	>7,500	>7,500	>7,500
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass
Zinc, wt %	0.066	0.066	0.066	0.066

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Powerflow™ HE Hydraulic Oil

Phillips 66® Powerflow HE Hydraulic Oil is a premium quality, high viscosity index anti-wear hydraulic oil developed for use in industrial and mobile equipment operating in cold climates or in locations subject to wide variations in ambient temperatures. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps. It is particularly recommended for year-round use in mobile equipment such as bucket trucks, cranes and aerial lifts.

Powerflow HE Hydraulic Oil is specially formulated to have a high viscosity index and a low pour point for use over a wider temperature range than conventional anti-wear hydraulic oils. Its high viscosity index helps maintain oil viscosity at operating temperatures and reduce energy (power) loss caused by internal oil leakage in the hydraulic system, resulting in up to 6% higher system efficiency compared to conventional single-grade hydraulic oils.

Powerflow HE provides excellent wear protection for hydraulic pumps and motors, has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life, and protects hydraulic system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response. It has excellent low-temperature properties for cold start-ups. It also has a high dielectric strength for use as insulating oil in electrical service bucket trucks.

Applications

- Industrial and mobile equipment operating in cold weather or in locations subject to wide temperature fluctuations
- Bucket trucks (cherry pickers) used for servicing electrical power lines or for tree-trimming
- Hydraulic hoists and service station lifts
- Marine cargo winches and steering systems
- Off-road construction, mining and marine equipment
- Chain drives
- Electric motor bearings

Powerflow HE Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- DIN 51524 Part 3, Anti-wear Hydraulic Oils, Type HVLP
- Eaton-Vickers M-2950-S, I-286-S
- ISO 11158:1997, Family H (Hydraulic Systems), Type HV
- Parker Hannifin (Denison) HF-0, HF-1, HF-2

**Premium High-Efficiency,
High VI Anti-wear Hydraulic
Oil for Wide
Temperature
Ranges**

KEEPING THE
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SMOOTHLY. 



Features/Benefits

- High VI to reduce internal oil leakage and increase hydraulic system efficiency by up to 6% compared to conventional single-grade hydraulic fluids
- Excellent service over a wide temperature range
- Excellent wear protection for hydraulic pumps and motors
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Excellent low-temperature properties for cold start-ups
- High dielectric strength for use in electrical service bucket trucks (cherry pickers)⁽¹⁾

⁽¹⁾ **Note:** In order to maintain its high dielectric strength for use as electrical insulating oil, the oil must be kept clean and dry. Contamination with water will significantly decrease the dielectric strength.

Powerflow™ HE Hydraulic Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.862	0.867	0.870
Density, lbs/gal @ 60°F	7.18	7.22	7.24
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	204 (399)	216 (421)	227 (441)
Pour Point, °C (°F)	-51 (-60)	-43 (-45)	-36 (-33)
Viscosity			
cSt @ 40 °C	32.0	46.0	68.0
cSt @ 100 °C	6.7	8.6	11.6
SUS @ 100 °F	150	214	315
SUS @ 210 °F	48.2	54.5	65.0
Viscosity Index	173	171	166
Acid Number, ASTM D974, mg KOH/g	0.60	0.60	0.60
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10
Dielectric Strength, ASTM D877, kV ⁽²⁾	35	35	35
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182			
Failure Load Stage	-	12	12
Oxidation Stability			
TOST, ASTM D943-04a, hours	>7,000	>7,000	>7,000
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Zinc, wt %	0.066	0.066	0.066

⁽²⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Powerflow® NZ HE Hydraulic Oil

(Replaces Ecoterra HVI Hydraulic Oil)

Phillips 66® Powerflow NZ HE Hydraulic Oil is a high-quality, high viscosity index, zinc-free antiwear hydraulic oil developed for use in mobile equipment operating over a wide temperature range. It is particularly recommended for use in off-road equipment manufactured by Hitachi, John Deere and others. It passes the visual “no sheen” requirements of the U.S. EPA Static Sheen Test, and is classified as inherently biodegradable by the OECD Test Method 301B.

Powerflow NZ HE Hydraulic Oil is formulated with a zinc-free antiwear additive package to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It also has excellent low-temperature properties for cold start-ups. This fluid has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Powerflow NZ HE Hydraulic Oil has a high viscosity index and low pour point for use over a wider temperature range than conventional antiwear hydraulic oils. Its high viscosity index helps maintain oil viscosity at operating temperatures and reduce energy (power) loss caused by internal oil leakage in the hydraulic system, resulting in up to 6% higher system efficiency compared to conventional single-grade hydraulic oils.

Powerflow NZ HE Hydraulic Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps. It also meets the performance requirements of Hitachi Advanced Hydraulic Oil, and is fully compatible with the Hitachi fluid and with Hitachi seals and hoses.

Applications

- Off-road mobile construction and forestry equipment, such as backhoes, bulldozers, crawlers, excavators, skid-steer loaders and motor graders, where the manufacturer recommends a zinc-free hydraulic oil
- Hitachi construction equipment with 5,000-hour service intervals
- Industrial and mobile equipment operating in cold weather or in locations subject to wide temperature fluctuations
- Bucket trucks (cherry pickers) used for servicing electrical power lines
- Hydraulic hoists and service station lifts

Powerflow NZ HE Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HVLP
- DIN 51524 Part 3, Antiwear Hydraulic Oils, Type HVLP
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- Eaton-Vickers M-2950-S, I-286-S
- German Steel Industry SEB 181222
- Hitachi Advanced Hydraulic Oil (for use in dry systems only) (ISO VG 46)
- ISO 11158:1997, Family H (Hydraulic Systems), Type HV

**High-Efficiency,
High VI, Zinc-
Free Antiwear
Hydraulic Oil
for Off-Road
Equipment;
Separates
from Water;
Inherently
Biodegradable**

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- U.S. Steel 127
- U.S. EPA/U.S. Coast Guard Static Sheen Test, Federal Register Vol. 58, No. 41

Features/Benefits

- High VI to reduce internal oil leakage and increase hydraulic system efficiency by up to 6% compared to conventional single-grade hydraulic oils
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion (reduced sludge and deposit formation)
- Excellent water-separating properties
- Excellent wear protection for hydraulic pumps and motors
- Improved product compatibility with traditional zinc-based products
- Good filterability
- Inherently biodegradable
- Non-toxic to aquatic organisms
- Suitable for year-round use

Powerflow® NZ HE Hydraulic Oil

Typical Properties		
ISO Grade	32	46
Specific Gravity @ 60°F	0.861	0.865
Density, lbs/gal @ 60°F	7.17	7.21
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	210 (410)	218 (424)
Pour Point, °C (°F)	-54 (-65)	-51 (-60)
Viscosity		
cSt @ 40 °C	32.0	46.0
cSt @ 100 °C	6.6	8.6
SUS @ 100 °F	150	214
SUS @ 210 °F	47.9	54.5
Viscosity Index	168	168
Acid Number, ASTM D974, mg KOH/g	0.22	0.22
Copper Corrosion, ASTM D130	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10
Dielectric Strength, ASTM D877, kV ⁽¹⁾	35	35
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0
FZG Scuffing Test, ASTM D5182, Failure Load Stage	12	12
Oxidation Stability, TOST, ASTM D943-04, hours	>7000	>7000
Rust Test, ASTM D665 A&B	Pass	Pass
Aquatic Toxicity, Rainbow Trout, OECD 203 1-12, 1000 mg/L, 96 hours, LC50	Non-toxic	Non-toxic
Biodegradability in 28 days, OECD 301B, %	20 - 59	20 - 59

⁽¹⁾Note: At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Powerflow® NZ HE-E Hydraulic Oil

(Replaces Ecoterra HVI-E Hydraulic Oil)

Phillips 66® Powerflow NZ HE-E Hydraulic Oil is a high-quality, high viscosity index, zinc-free antiwear hydraulic oil developed for use in mobile equipment operating over a wide temperature range and in wet environments. It is specially formulated to emulsify readily with water to maintain effective lubrication in the presence of water. It is particularly recommended for use in off-road equipment manufactured by Hitachi, John Deere and others, operating under conditions where an emulsifiable hydraulic oil is specified or preferred.

Powerflow NZ HE-E Hydraulic Oil is formulated with a zinc-free antiwear additive package to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent low-temperature properties for cold start-ups. This fluid is also resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Powerflow NZ HE-E Hydraulic Oil has a high viscosity index and low pour point for use over a wider temperature range than conventional antiwear hydraulic oils. Its high viscosity index helps maintain oil viscosity at operating temperatures and reduce energy (power) loss caused by internal oil leakage in the hydraulic system, resulting in up to 6% higher system efficiency compared to conventional single-grade hydraulic oils.

Powerflow NZ HE-E Hydraulic Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps. It also meets the performance requirements of Hitachi Advanced Hydraulic Oil, and is fully compatible with the Hitachi fluid and with Hitachi seals and hoses.

Applications

- Off-road mobile construction and forestry equipment, such as backhoes, bulldozers, crawlers, excavators, skid-steer loaders and motor graders, where the manufacturer recommends an emulsifiable, zinc-free hydraulic oil
- Hitachi construction equipment with 5,000-hour service intervals

Powerflow NZ HE-E Hydraulic Oil meets the requirements (except demulsibility) of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HVLP
- DIN 51524 Part 3, Antiwear Hydraulic Oils, Type HVLP
- Parker Hannifin (Denison) HF-0, HF-1, HF-2
- Eaton-Vickers M-2950-S, I-286-S
- German Steel Industry SEB 181222
- Hitachi Advanced Hydraulic Oil (ISO VG 46)
- ISO 11158:1997, Family H (Hydraulic Systems), Type HV
- U.S. Steel 127

**High-Efficiency,
High VI, Zinc-
Free Antiwear
Hydraulic Oil
for Off-Road
Equipment;
Emulsifies with
Water**

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Features/Benefits

- Emulsifies readily with water
- High VI to reduce internal oil leakage and increase hydraulic system efficiency by up to 6% compared to conventional single-grade hydraulic oils
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion (reduced sludge and deposit formation)
- Excellent wear protection for hydraulic pumps and motors
- Improved product compatibility with traditional zinc-based products
- Good filterability
- Suitable for year-round use

Powerflow® NZ HE-E Hydraulic Oil

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.868
Density, lbs/gal @ 60°F	7.23
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	203 (397)
Pour Point, °C (°F)	-51 (-60)
Viscosity	
cSt @ 40 °C	46.0
cSt @ 100 °C	8.6
SUS @ 100 °F	214
SUS @ 210 °F	54.5
Viscosity Index	168
Copper Corrosion, ASTM D130	1b
Demulsibility, ASTM D1401, 30 minutes @ 54°C	
Emulsion, mL	80
Free Water, mL	0
Foam Test, ASTM D892, Seq. I, mL	0/0
FZG Scuffing Test, ASTM D5182, Failure Load Stage	12
Oxidation Stability, TOST, ASTM D943-04, hours	>7000
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Powerflow® NZ Hydraulic Oil

(Replaces Ecoterra Hydraulic Oil)

Phillips 66® Powerflow NZ Hydraulic Oil is a high-quality, zinc-free antiwear hydraulic oil specifically developed for use in industrial and mobile equipment operating in environmentally sensitive areas. It is specially formulated for reduced environmental impact in case of leaks or spills. It is non-toxic to fish and aquatic species as determined by OECD Test Method 203 1-12, and is classified as inherently biodegradable by the OECD Test Method 301B. It passes the visual “no sheen” requirements of the U.S. EPA Static Sheen Test.

Powerflow NZ Hydraulic Oil is formulated with a zinc-free antiwear additive package to provide excellent wear protection for hydraulic pumps and motors, and to protect hydraulic system components against rust and corrosion. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response.

Powerflow NZ Hydraulic Oil is recommended for use in place of conventional zinc-containing hydraulic oils in applications where there is the possibility of soil or water contamination. It also may be used as a lower-cost alternative to synthetic, readily biodegradable hydraulic fluids. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Hydraulic systems where the equipment manufacturer specifies a zinc-free antiwear hydraulic oil
- Hydraulic equipment used in environmentally sensitive areas, such as national parks, wildlife refuges, ski resorts and other recreational areas
- Hydraulic jacks and other equipment in machine shops
- Oil drilling rigs and offshore platforms
- Marine cargo winches and steering systems
- Hydraulic hoists and service station lifts
- Chain drives
- Electric motor bearings

Powerflow NZ Hydraulic Oil meets the requirements of the following industry and OEM specifications:

- Bosch Rexroth RE 90220, Type HLP
- DIN 51524 Part 2, Antiwear Hydraulic Oils, Type HLP
- Parker Hannifin (Denison) HF-0, HF-1, HF-2 (approved ISO 32, 46, and 68)
- Eaton-Vickers I-286-S, M-2950-S, 35VQ25A anti-wear performance (brochure 03-401-2010 Rev 1 ISO 32, 46, and 68)
- Fives Cincinatti P-68 (ISO VG 32), P-70 (ISO VG 46), P-69 (ISO VG 68) (approved)
- German Steel Industry SEB 181222
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM

Non-toxic, Zinc-Free Antiwear Hydraulic Oil; Inherently Biodegradable

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- U.S. Steel 127
- U.S. EPA/U.S. Coast Guard Static Sheen Test, Federal Register Vol. 58, No.41

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion (reduced sludge and deposit formation)
- Excellent water-separating properties
- Excellent wear protection for hydraulic pumps and motors
- Improved product compatibility with traditional zinc-based products
- Outstanding air release properties
- Inherently biodegradable
- Non-toxic to aquatic organisms

Note: Powerflow® NZ Hydraulic Oil is compatible with most zinc-containing hydraulic oils, however, mixing the two products will lessen the environmental and performance benefits normally gained by using Powerflow® NZ Hydraulic Oil.

Powerflow® NZ Hydraulic Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.861	0.865	0.868
Density, lbs/gal @ 60°F	7.17	7.21	7.23
Color, ASTM D1500	0.5	0.5	1.0
Flash Point (COC), °C (°F)	227 (440)	240 (464)	256 (493)
Pour Point, °C (°F)	-39 (-38)	-36 (-33)	-33 (-27)
Viscosity			
cSt @ 40 °C	32.0	46.0	68.0
cSt @ 100 °C	5.5	6.9	8.9
SUS @ 100 °F	150	214	315
SUS @ 210 °F	44.3	48.8	55.6
Viscosity Index	108	105	104
Acid Number, ASTM D974, mg KOH/g	0.22	0.22	0.22
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10
Dielectric Strength, ASTM D877, kV ⁽¹⁾	35	35	35
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
FZG Scuffing Test, ASTM D5182, Failure Load Stage	>12	>12	>12
Oxidation Stability			
TOST, ASTM D943-04a, hours	10,000+	10,000+	10,000+
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Aquatic Toxicity, Rainbow Trout, OECD 203 1-12, 1000mg/L, 96 hours, LC50	Non-toxic	Non-toxic	Non-toxic
Biodegradability in 28 days, OECD 301B, %	20 - 59	20 - 59	20 - 59

⁽¹⁾**Note:** At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Quintolubric® 818-02

Phillips 66® Quintolubric 818-02 is a synthetic, high water content anti-wear hydraulic fluid concentrate developed for use in hydraulic systems operating in areas subject to fire hazards, such as in steel mills, foundries, and underground mining equipment. When diluted with water, it forms a stable microemulsion that is inherently fire resistant because of its high water content (95%). It is approved by the MSHA for use in underground mining equipment.

Quintolubric 818-02 is formulated with a carefully balanced blend of dispersants and emulsifying agents, plus corrosion inhibitors, an ashless (zinc-free) anti-wear additive, and a biocide. It dilutes easily with water to form a stable microemulsion that is inherently fire resistant. It provides better wear protection than conventional soluble oils and protects hydraulic system components against rust and corrosion. The combination of a biocide and the extremely low oil content in the microemulsion makes this product highly resistant to bacterial growth. This product is readily biodegradable in accordance with the ISO 7827 standard.

Quintolubric 818-02 may be used in all hydraulic systems designed for high water content (HFA) fluids. It is compatible with conventional water treatment systems.

Applications

- Hydraulic systems subject to fire hazards
- Underground mining equipment requiring a fire-resistant, MSHA-approved hydraulic fluid
- Steel mills, foundries, and manufacturing plants

Features/Benefits

- Fire resistant
- Protects against wear
- Protects against rust and corrosion
- Forms a stable microemulsion
- Highly resistant to bacterial growth
- Compatible with conventional water treatment systems
- Readily biodegradable
- MSHA approved (Approval Number 35-A090005)

CAUTION: Quintolubric 818-02 should **not** be used in hydraulic systems where operating temperatures exceed 175°F. This product contains water and should not be stored at temperatures over 130°F or below 40°F. Water content should be closely monitored to insure safe operation.

**Synthetic, High
Water Content,
Fire-Resistant
Hydraulic Fluid
for Longwall
Mining; MSHA
Approved
& Readily
Biodegradable**

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Quintolubric® 818-02

Typical Properties	
Grade	818-02
Specific Gravity @ 60°F	1.02
Density, lbs/gal @ 60°F	8.50
Appearance, Visual	Yellow Green
Flash Point (COC), °C (°F)	N/A ⁽¹⁾
Pour Point, °C (°F)	-3 (27)
Viscosity	
cSt @ 100°F	7.7
SUS @ 100°F	51
pH (neat)	10.1

⁽¹⁾ **Note:** This product does not support combustion.

Note: Quintolubric® is a registered trademark of Quaker Chemical Corporation.

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Quintolubric® 958-30

Phillips 66® Quintolubric 958-30 is an invert emulsion (water-in-oil) fire-resistant hydraulic fluid designed for use in hydraulic systems operating in areas subject to fire hazards, such as in steel mills, foundries, and mining equipment. It combines the benefits of an oil-based hydraulic fluid with the fire-resistant properties of water. It is approved by the MSHA for use in underground mining equipment.

Quintolubric 958-30 is formulated with ~45% water emulsified with petroleum oil. When exposed to a source of ignition, the oil film may catch fire, but the fire is immediately snuffed out by steam from the water core. A carefully balanced additive package provides enhanced lubricity and excellent emulsion stability, as well as excellent wear protection and corrosion protection for hydraulic system components.

Applications

- Hydraulic systems subject to fire hazards
- Underground mining equipment requiring a fire-resistant, MSHA-approved hydraulic fluid
- Steel mills, foundries, and manufacturing plants

Features/Benefits

- Fire resistant
- Protects against wear
- Protects against rust and corrosion
- Forms a stable emulsion
- Resists bacterial growth
- MSHA approved (Approval Number 30-20-2)

CAUTION: Quintolubric 958-30 should **not** be used in hydraulic systems where operating temperatures exceed 175°F. This product contains water and should not be stored at temperatures over 130°F or below 40°F. Water content should be closely monitored to insure safe operation.

**Invert Emulsion
Type Fire-
Resistant
Hydraulic Fluid;
MSHA Approved**

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Quintolubric® 958-30

Typical Properties	
Grade	958-30
Specific Gravity @ 60°F	0.948
Density, lbs/gal @ 60°F	7.90
Appearance, Visual	Opaque White to Tan
Flash Point (COC), °C (°F)	N/A ⁽¹⁾
Pour Point, °C (°F)	-23 (-10)
Viscosity	
cSt @ 50°F	374
cSt @ 100°F	90
Viscosity Index	135
Freeze-Thaw Stability, 10 Cycles, Water Separation, %	None
Water Content, vol %	~45

⁽¹⁾**Note:** This product does not support combustion.

Note: Quintolubric® is a registered trademark of Quaker Chemical Corporation.

Health & Safety Information

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LUBRICANTS

Syncon® AW Hydraulic Fluid

Phillips 66® Syncon AW Hydraulic Fluid is a premium quality, synthetic antiwear hydraulic fluid developed for use in industrial and mobile equipment operating at extreme temperatures. It is particularly recommended for use in applications where operating conditions may be unfavorable or too severe for conventional mineral oil-based hydraulic oils.

Syncon AW Hydraulic Fluid is formulated with synthetic polyalphaolefin (PAO) base oils and an ashless (zinc-free) additive package to provide excellent performance over a wide temperature range. It provides excellent wear protection for hydraulic pumps and motors, and protects hydraulic system components against rust and corrosion. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It also has excellent low-temperature properties for cold start-ups. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foaming that can cause poor or sluggish hydraulic system response. It has a high dielectric strength for use as an insulating oil in electrical service bucket trucks.

Syncon AW Hydraulic Fluid meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Industrial and mobile equipment operating under extreme-temperature conditions
- Automated machine tools
- Bucket trucks (cherry pickers) used for servicing electrical power lines or for tree trimming
- Hydraulic hoists and service station lifts
- Mobile construction equipment
- Chain drives
- Electric motor bearings

Syncon AW Hydraulic Fluid meets the requirements of the following industry specifications:

- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- ISO 11158:1997, Family H (Hydraulic Systems), Type HM
- U. S. Steel 127

Synthetic PAO-Based, Antiwear Hydraulic Fluid

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Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Outstanding pumpability at low temperatures
- Excellent wear protection for hydraulic pumps and motors
- Protects against rust and corrosion
- Separates rapidly from water
- Good foam resistance
- High dielectric strength⁽¹⁾
- Compatible with conventional mineral oils and commonly used seals

⁽¹⁾**Note:** In order to maintain its high dielectric strength for use as an electrical insulating oil, the oil must be kept clean and dry. Contamination with water will significantly decrease dielectric strength.

Syncon® AW Hydraulic Fluid

Typical Properties		
ISO Grade	22	32
Specific Gravity @ 60°F	0.821	0.853
Density, lbs/gal @ 60°F	6.84	7.10
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	218 (424)	240 (464)
Pour Point, °C (°F)	-66 (-87)	-60 (-76)
Viscosity		
cSt @ 40°C	22.0	32.0
cSt @ 100°C	4.6	5.8
SUS @ 100°F	115	164
SUS @ 210°F	41.7	45.7
Viscosity Index	127	125
Acid Number, ASTM D974, mg KOH/g	0.17	0.17
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10
Dielectric Strength, ASTM D877, kV ⁽²⁾	35	35
Foam Test, ASTM D892	Pass	Pass
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.47	0.47
FZG Scuffing Test, ASTM D5182, Failure Load Stage	11	12
Oxidation Stability, RPVOT, ASTM D2272, minutes	2,000	2,000
Rust Test, ASTM D665 A&B	Pass	Pass

⁽²⁾ At point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syncon® FG Hydraulic Fluid

Phillips 66® Syncon FG Hydraulic Fluid is a premium quality, synthetic, food-grade anti-wear hydraulic fluid developed for use in the hydraulic systems of machinery found in food processing plants and beverage bottling plants, where incidental food contact may occur. It is also recommended for use in rotary screw and rotary vane air compressors in food and beverage plants.

Syncon FG Hydraulic Fluid is formulated with synthetic polyalphaolefin (PAO) base oils and an ashless (zinc-free) additive package to provide excellent service in hydraulic system applications. It provides excellent wear protection for hydraulic pumps and motors, and protects hydraulic system components against rust and corrosion. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It also has excellent low-temperature properties for cold start-ups. It has good water-separating properties to minimize the formation of emulsions, and is resistant to excessive foaming that can cause poor or sluggish hydraulic system response.

Syncon FG Hydraulic Fluid meets FDA requirements and former 1998 USDA H1 guidelines for incidental food contact, and is registered by NSF International as an H1 lubricant. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Bottling and canning machines
- Plastic injection blow-molding machines in food packaging plants
- Rotary screw and rotary vane air compressors
- Chain drives for conveyor belts
- Electric motor bearings
- Machinery operating in freezers used to store packaged food

Syncon FG Hydraulic Fluid meets the requirements of the following government and industry specifications:

- FDA 21 CFR 178.3570 for incidental food contact
- NSF International and former 1998 USDA H1 guidelines for incidental food contact

Features/Benefits

- Excellent wear protection for hydraulic pumps and motors
- Outstanding oxidation resistance to minimize sludge and varnish formation
- Protects against rust and corrosion
- Good water-separating properties
- Good foam resistance
- Excellent low-temperature properties for cold start-ups

Synthetic PAO-Based, Food-Grade Hydraulic Fluid





LUBRICANTS

Syncon® FG Hydraulic Fluid

Typical Properties			
ISO Grade	46	68	100
Specific Gravity @ 60°F	0.831	0.837	0.844
Density, lbs/gal @ 60°F	6.92	6.97	7.03
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	248 (478)	252 (486)	254 (489)
Pour Point, °C (°F)	-57 (-71)	-48 (-54)	-45 (-49)
Viscosity			
cSt @ 40°C	46.8	64.2	98.0
cSt @ 100°C	7.8	9.7	12.9
SUS @ 100°F	217	329	506
SUS @ 210°F	51.8	59.0	71.1
Viscosity Index	135	133	128
Acid Number, ASTM D974, mg KOH/g	0.67	0.67	0.67
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10
Foam Test, ASTM D892	Pass	Pass	Pass
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.35	0.37	0.38
FZG Scuffing Test, ASTM D5182, Failure Load Stage	11	11	11
Oxidation Stability, RPVOT, ASTM D2272, minutes	>1,700	>1,700	>1,700
Rust Test, ASTM D665 A&B	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-11-17

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LUBRICANTS

Syndustrial® Hydraulic Fluid

Phillips 66® Syndustrial Hydraulic Fluid is a premium quality, synthetic anti-wear hydraulic fluid specifically developed for use in industrial and mobile equipment operating in environmentally sensitive areas. It is readily biodegradable for reduced environmental impact in case of leaks or spills. Three grades are certified by the FMRC as fire-resistant for use in areas subject to fire hazards, and two grades are approved by the MSHA for use in underground mining equipment.

Syndustrial Hydraulic Fluid is formulated with synthetic polyol ester (POE) base oil and select ashless additives to provide excellent lubrication and wear protection for hydraulic pumps and motors. It also protects hydraulic system components against rust and corrosion. It has outstanding oxidation resistance and thermal stability at high temperatures, plus excellent detergency, to protect against sludge and varnish formation, and provide long service life. It is readily biodegradable as determined by the OECD 301C test method. It passes the visual “no sheen” requirements of the U. S. EPA Static Sheen Test.

The ISO 46, 68, and 100 viscosity grades are especially recommended for use in equipment operating in areas subject to fire hazards, such as steel mills, surface mines, and foundries. All three grades are approved by Factory Mutual Research Corporation (FMRC) as less flammable hydraulic fluids. The ISO 68 & 100 viscosity grades also are approved by the MSHA for use in underground mining equipment.

Syndustrial Hydraulic Fluid does not contain water, mineral oil, or phosphate ester. It may be used in hydraulic systems designed for conventional mineral oil-based hydraulic fluids without compromising overall hydraulic system integrity. However, it should not be mixed with other fluid types. When converting from water-glycol fluids, invert emulsions, or phosphate esters, the system should be flushed prior to conversion, and seal compatibility should be verified.⁽¹⁾

⁽¹⁾ **Note:** For information on fluid conversion or seal and elastomer compatibility, please call our Technical Support Hotline.

Applications

- Mobile and stationary equipment operating in environmentally sensitive areas (all grades)
- Hydraulic systems subject to fire hazards and/or extreme heat (ISO VG 46, 68, 100)
- Steel mill, foundries, and manufacturing plants (ISO VG 46, 68, 100)
- Underground mining equipment where a fire-resistant, MSHA-approved hydraulic fluid is required (ISO VG 68, 100)

Syndustrial Hydraulic Fluid meets the requirements of the following test:

- U.S. EPA/Coast Guard Static Sheen Test, Federal Register Vol. 58, No. 41

Syndustrial Hydraulic Fluid is approved as meeting the requirements of the following industry specification:

- Factory Mutual Group II, Type HFD-U (ISO 6743-4), Less Flammable Hydraulic Fluid (ISO VG 46, 68, 100)

**Readily
Biodegradable,
Synthetic Polyol
Ester Antiwear
Hydraulic Fluid;
Select Grades
FMRC Approved
as Fire-Resistant**

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Features/Benefits

- Fire resistant, with high flash point, fire point, and auto-ignition temperature for reduced risk of fire/explosion (ISO 46, 68, 100)
- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent wear protection for hydraulic pumps and motors
- Protects against rust and corrosion
- Good low-temperature fluidity
- Non-toxic, non-irritating, and contains no hazardous ingredients
- Readily biodegradable (all grades)
- Fire resistance certified by Factory Mutual Research Corporation (ISO 46, 68, 100)
- MSHA approved (Approval Number 35-A080004, ISO VG 68; Approval Number 30-20-3, ISO VG 100)

Syndustrial® Hydraulic Fluid

Typical Properties				
ISO Grade	32	46	68	100
Specific Gravity @ 60°F	0.948	0.920	0.920	0.922
Density, lbs/gal @ 60°F	7.90	7.66	7.66	7.68
Color, Visual	Lt Amber	Lt Amber	Lt Amber	Lt Amber
Flash Point (COC), °C (°F)	270 (518)	278 (532)	276 (529)	300 (572)
Fire Point (COC), °C (°F)	300 (572)	360 (680)	360 (680)	340 (645)
Auto-ignition Temperature, DIN 51794, °C (°F)	>375 (>705)	>400 (>750)	>400 (>750)	>400 (>750)
Pour Point, °C (°F)	-49 (-56)	-53 (-63)	-36 (-33)	-39 (-38)
Viscosity				
cSt @ 40°C	29.6	48.2	64.8	109
cSt @ 100°C	6.2	9.5	11.7	20.4
SUS @ 100°F	151	244	328	549
SUS @ 210°F	46.9	58.2	66.3	102
Viscosity Index	166	186	178	213
Acid Number, ASTM D974, mg KOH/g	0.30	1.80	1.20	1.10
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1b	1b	1b	1b
Foam Test, ASTM D892	Pass	Pass	Pass	Pass
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass
Biodegradability, OECD 301C, 28 days, %	>70	>70	>70	>70

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Ultra Powerflow™ HE Hydraulic Oil

Phillips 66® Ultra Powerflow HE is a premium quality, high viscosity index anti-wear hydraulic oil developed primarily for use in mobile equipment operating in cold climates or in locations subject to wide variations in ambient temperatures. It meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps. It is particularly recommended for use in construction equipment manufactured by Komatsu and others.

Ultra Powerflow HE is specially formulated to have a very high viscosity index and a low pour point for use over a wider temperature range than conventional anti-wear hydraulic oils. Its very high viscosity index helps maintain oil viscosity at operating temperatures and reduce energy (power) loss caused by internal oil leakage in the hydraulic system, resulting in up to 20% higher system efficiency compared to conventional single-grade hydraulic oils.

Ultra Powerflow HE provides excellent wear protection for hydraulic pumps and motors, has excellent oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life, and protects hydraulic system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can cause poor or sluggish hydraulic system response. It has excellent low-temperature properties for cold start-ups.

Applications

- Mobile equipment operating in cold weather or in locations subject to wide temperature fluctuations
- Off-road construction, mining and marine equipment

Ultra Powerflow HE meets the requirements of the following industry and OEM specifications:

- DIN 51524 Part 3, Anti-wear Hydraulic Oils, Type HVLP
- Eaton-Vickers I-286-S, M-2950-S
- ISO 11158:1997, Family H (Hydraulic Systems), Type HV
- Parker Hannifin (Denison) HF-0, HF-1, HF-2

**Ultra High-Efficiency,
High VI Anti-wear Hydraulic
Oil for Wide
Temperature
Ranges**

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Features/Benefits

- Very high VI to reduce internal oil leakage and increase hydraulic system efficiency by up to 20% compared to conventional single-grade hydraulic fluids
- Excellent service over a wide temperature range
- Excellent wear protection for hydraulic pumps and motors
- Excellent oxidation resistance and thermal stability
- High shear stability
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Excellent low-temperature properties for cold start-ups

Ultra Powerflow™ HE Hydraulic Oil

Typical Properties		
ISO Grade	32	46/68
Specific Gravity @ 60°F	0.859	0.870
Density, lbs/gal @ 60°F	7.15	7.24
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	199 (390)	216 (421)
Pour Point °C (°F)	-49 (-56)	-48 (-54)
Viscosity		
cSt @ 40 °C	32.0	56.0
cSt @ 100 °C	7.4	11.3
SUS @ 100 °F	150	260
SUS @ 210 °F	50.5	63.9
Viscosity Index	209	200
Acid Number, ASTM D974, mg KOH/g	0.60	0.60
Copper Corrosion, ASTM D130	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15
Dielectric Strength, ASTM D877, kV ⁽¹⁾	35	35
Foam Test, ASTM D892	Pass	Pass
Oxidation Stability		
TOST, ASTM D943-04a, hours	>7,000	>7,000
Rust Test, ASTM D665 A&B	Pass	Pass
Zinc, wt %	0.066	0.066

⁽¹⁾ Note: At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

01-22-18

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LUBRICANTS

METALWORKING FLUIDS



LUBRICANTS

Hydrokool™ HD

Phillips 66® Hydrokool HD is a premium quality, water-soluble, synthetic coolant developed for medium- to heavy-duty turning, milling, and grinding of ferrous metals, as well as grinding and light-duty machining of copper and copper alloys. It contains biocide and mixes easily with soft or hard water to form a high-quality synthetic metalworking fluid that provides excellent cooling properties and lubricity for maximum tool life and high-quality surface finishes on the machined parts.

Hydrokool HD is formulated to provide an optimum balance of lubricity and detergency for high-quality finishes on machined parts and for overall machine cleanliness. It is ideal for use in machine sumps, as well as in once-through applications because it is highly resistant to microbial and bacterial degradation that causes rancid odors. It forms a clear, amber-colored solution that permits easy observation of the machining operation. It has high lubricity to help minimize tool wear and prevent particle agglomeration. Special inhibitors help protect metal surfaces against rust and corrosion.

Hydrokool HD does not contain active sulfur, nitrites, phenols, or diethanolamine (DEA).

Applications

Hydrokool HD is recommended for medium- to heavy-duty machining of ferrous metals and metal alloys, and with water hardness greater than 350 ppm. Typical applications include:

- Broaching (light-duty)
- Drilling
- Grinding
- Milling
- Reaming
- Sawing
- Tapping
- Turning

Hydrokool HD also is recommended for light-duty grinding and machining of copper and copper alloys. It is not recommended for machining aluminum or aluminum alloys, as it can cause staining of some aluminum alloys.

Features/Benefits

- Excellent cooling and lubricating properties
- Helps extend cutting tool life
- Reduces grinding wheel wear
- Good surface finish
- Excellent rust protection
- Non-corrosive to non-ferrous metals
- Resists bacterial degradation
- Transparent for good visibility of the machining operation
- Mixes easily with water⁽¹⁾

⁽¹⁾ **Note:** When mixing, always add Hydrokool™ HD to water; **never** add water to Hydrokool™ HD. Typical concentrations (Hydrokool™ HD in water) range from 3% to 6% depending on the machining operation, type of metal, and water hardness. Coolant concentration may be monitored with a refractometer.

**Premium
Synthetic
Coolant for
Metalworking**

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Hydrokool™ HD

Typical Properties	
Specific Gravity @ 60°F	1.05
Density, lbs/gal @ 60°F	8.74
Color, ASTM D1500	3.5
Boiling Point, °C (°F)	100 (212)
Flash Point (COC), °C (°F)	N/A ⁽²⁾
Freezing Point, °C (°F)	0 (32)
pH, 5% (1:20) dilution	9.0
Water, wt %	60
Chlorine ⁽³⁾ , wt %	0.07
Fatty Oil, wt %	Nil
Sodium, wt %	0.20
Sulfur, Total, wt %	Nil
Sulfur, Active, wt %	Nil

⁽²⁾Note: This product does not support combustion.

⁽³⁾From the biocide.

Recommended Concentrations, Hydrokool™ HD in Water (Volume %)			
Operation	Carbon Steels, Cast Iron	High Alloy Steels	Tool Steel
Drilling, Milling, Turning	4	5	5
Light-Duty Broaching, Form Milling, Reaming, Sawing, Tapping	5	5-6	5-6
Grinding	3	3	3

Refractometer Reading					
Dilution Ratio	1:10	1:15	1:20	1:25	1:30
Reading	4.0	2.4	2.1	1.7	1.3

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Hydrokool™ SS

Phillips 66® Hydrokool SS is a premium quality, water-soluble, semi-synthetic coolant developed for general-purpose turning, milling and grinding of steel and high-speed steel alloys. It offers the ease of maintenance found in synthetic coolants plus the economy found in conventional soluble oils.

Hydrokool SS mixes with soft or hard water to form a high-quality, semi-synthetic metalworking fluid that provides excellent cooling properties and lubricity for maximum tool life and good surface finishes on the machined parts. It contains a biocide to combat the growth of harmful microorganisms in machine sumps and reservoirs.

Hydrokool SS is formulated to provide an optimum balance of lubricity and detergency for high-quality finishes on machined parts and for overall machine cleanliness. It is ideal for use in machine sumps as well as in once-through applications because it is highly resistant to microbial and bacterial degradation that causes rancid odors. It forms a clear, golden-colored solution that permits easy observation of the machining operation. An oiliness agent helps to minimize tool wear and prevent particle agglomeration. Special inhibitors help protect metal surfaces against rust and corrosion.

Hydrokool SS does not contain chlorine, active sulfur, nitrites, phenols, or diethanolamine (DEA).

Applications

Hydrokool SS is recommended for general-purpose machining and grinding of ferrous metals and metal alloys, with water hardness up to 350 ppm. Typical applications include:

- Broaching (light-duty)
- Drilling
- Grinding
- Milling
- Reaming
- Sawing
- Tapping
- Turning

Features/Benefits

- Excellent cooling and lubricating properties
- Helps extend cutting tool life
- Reduces grinding wheel wear
- Good surface finish
- Excellent rust protection
- Non-corrosive to non-ferrous metals
- Resists bacterial degradation
- Transparent for good visibility of the machining operation
- Mixes easily with water⁽¹⁾

⁽¹⁾ **Note:** When mixing, always add Hydrokool™ SS to water; **never** add water to Hydrokool™ SS. Typical concentrations (Hydrokool™ SS in water) range from 3% to 6% depending on the machining operation, type of metal, and water hardness. Coolant concentration may be monitored with a refractometer.

Premium Semi-Synthetic Coolant for Metalworking

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Hydrokool™ SS

Typical Properties	
Specific Gravity @ 60°F	1.05
Density, lbs/gal @ 60°F	8.74
Color, ASTM D1500	2.5
Boiling Point, °C (°F)	100 (212)
Flash Point (COC), °C (°F)	N/A ⁽²⁾
Freezing Point, °C (°F)	0 (32)
pH, 5% (1:20) dilution	9.5
Water, wt %	33
Chlorine, wt %	Nil
Fatty Oil, wt %	4.0
Sulfur, Total, wt %	2.2
Sulfur, Active, wt %	Nil

⁽²⁾**Note:** This product does not support combustion.

Recommended Concentrations, Hydrokool™ SS in Water (Volume %)			
Operation	Carbon Steels, Malleable Iron, Cast Iron	High Alloy Steels	Tool Steel
Drilling, Milling, Turning	4-5	4-5	4-5
Light-Duty Broaching, Form Milling, Reaming, Sawing, Tapping	4-6	5-6	5-6
Grinding	3-4	3-4	3-4

Refractometer Reading					
Dilution Ratio	1:10	1:15	1:20	1:25	1:30
Reading	10.3	7.2	5.4	4.6	3.0

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® 8052B

Phillips 66® Koolkut 8052B is a light-colored, low viscosity, chlorine-free tri-purpose oil formulated for use as a high-performance cutting oil, gear oil and hydraulic fluid in metalworking machines.

Koolkut 8052B is formulated with fatty acids, polymers and a chlorine-free extreme-pressure additive package. The combination of extreme-pressure properties and good oiliness characteristics helps minimize cutting tool wear and ensure a good surface finish on the machined parts.

Koolkut 8052B is transparent, allowing good observation of the machining operation. It is non-corrosive to copper and copper alloys and provides good rust protection for ferrous metals. The absence of chlorine ensures greater handling safety and safe disposal of waste oil.

Koolkut 8052B is ideal for use in automatic screw machines that use one fluid to lubricate the cutting tool and workpiece, the machine gears, and the hydraulic pumps and motors. It also is suitable for use in lathes where mixing of the hydraulic fluid and cutting oil may occur. The performance capabilities of most cutting oils are greatly reduced when diluted with typical hydraulic oils. Using Koolkut 8052B as a lubricating oil and cutting oil avoids this problem.

Applications

Koolkut 8052B is recommended for light to heavy-duty machining of ferrous and non-ferrous metals. Typical applications include:

- Boring
- Broaching
- Drilling
- Gear hobbing
- Grinding
- Milling
- Planing
- Sawing
- Screw machining
- Shaping
- Tapping

Koolkut 8052B is suitable for machining a wide variety of metals ranging from steels with a machinability rating of 90%, to metals such as inconel, monel and titanium with machinability ratings below 50%.

Features/Benefits

- Tri-purpose cutting oil, gear oil and hydraulic oil
- Helps extend cutting tool life
- Good surface finish
- Good rust protection
- Non-corrosive to copper and copper alloys
- Chlorine-free for reduced environmental impact
- Transparent for good visibility of the machining operation

**Tri-Purpose
Cutting Oil,
Gear Oil &
Hydraulic Oil**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Koolkut® 8052B

Typical Properties	
ISO Grade	22
Specific Gravity @ 60°F	0.901
Density, lbs/gal @ 60°F	7.50
Color, ASTM D1500	3.0
Flash Point (COC), °C (°F)	177 (350)
Pour Point, °C (°F)	-34 (-30)
Viscosity	
cSt @ 40°C	22.0
cSt @ 100°C	3.9
SUS @ 100°F	116
SUS @ 210°F	39.4
Viscosity Index	40
Acid Number, ASTM D974, mg KOH/g	3.5
Copper Corrosion, ASTM D130	1b
Chlorine, wt %	Nil
Fatty Oil, wt %	8.0
Phosphorus, wt %	0.10
Sulfur, wt %	0.30

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® ACM

Phillips 66® Koolkut® ACM is a low-viscosity, chlorine-free, inactive cutting oil developed for light-duty machining of aluminum, copper, magnesium, and other soft, non-ferrous metals. It is specially formulated with high quality base oils to provide good cooling and wetting of the cutting tool and workpiece, while penetrating and protecting them against corrosion and the formation of oxides.

Koolcut ACM is clear, allowing good observation of the machining operation. It is non-corrosive to copper and copper alloys and non-staining to aluminum, magnesium, and other soft metals.

Applications

- Grinding
- Milling
- Rolling
- Turning

Features/Benefits

- Excellent performance in machining soft metals
- Non-corrosive and non-staining
- Helps extend cutting tool life
- Good surface finish
- Non-corrosive to copper and copper alloys
- Chlorine-free for reduced environmental impact
- Clear for good visibility of the machining operation

**Chlorine-Free,
Light-Duty
Cutting Oil
for Aluminum,
Copper &
Magnesium**

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Koolkut® ACM

Typical Properties	
ISO Grade	10
Specific Gravity @ 60°F	0.901
Density, lbs/gal @ 60°F	7.50
Color, ASTM D1500	1.5
Flash Point (COC), °C (°F)	154 (310)
Pour Point, °C (°F)	-57 (-70)
Viscosity	
cSt @ 40°C	10.3
SUS @ 100°F	63
Copper Corrosion, ASTM D130	1a
Chlorine, wt %	Nil
Fatty Oil, wt %	Nil
Sulfur, Total, wt %	0.02
Sulfur, Active, wt %	Nil

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® HD NC

Phillips 66® Koolkut HD NC is a chlorine-free active cutting oil developed for medium-duty machining of cast iron, steel and high-speed steel. It is specially formulated with high quality base oils and fortified with oiliness additives and sulfur-containing extreme-pressure additives that provide excellent lubricity and anti-weld properties at the chip-tool interface, resulting in extended cutting tool life and good surface finishes on the machined parts.

Koolkut HD NC is transparent, allowing good observation of the machining operation. It is corrosive to non-ferrous metals such as copper and copper alloys, and is not recommended for machining non-ferrous metals if staining of the workpiece must be avoided.

Applications

Koolkut HD NC is recommended for light- to medium-duty machining of ferrous metals. Typical applications include:

- Boring
- Broaching
- Drilling
- Reaming
- Sawing
- Tapping
- Threading

Features/Benefits

- Excellent performance in most difficult machining operations
- Helps extend cutting tool life
- Good surface finish
- Chlorine-free for reduced environmental impact
- Transparent for good visibility of the machining operation

**Chlorine-Free,
Medium-Duty
Cutting Oil**

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Koolkut® HD NC

Typical Properties	
ISO Grade	32
Specific Gravity @ 60°F	0.883
Density, lbs/gal @ 60°F	7.35
Color, ASTM D1500	6.0
Flash Point (COC), °C (°F)	235 (455)
Pour Point, °C (°F)	-15 (5)
Viscosity	
cSt @ 40°C	30.0
cSt @ 100°C	5.0
SUS @ 100°F	155
SUS @ 210°F	43.0
Viscosity Index	87
Copper Corrosion, ASTM D130	1b
Chlorine, wt %	Nil
Fatty Oil, wt %	5.0
Sulfur, Total, wt %	2.20
Sulfur, Active, wt %	2.05

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® SCF

Phillips 66® Koolkut® SCF is a heavy-duty, active cutting oil developed for deep-hole drilling or gun drilling of cast iron, steel, high-speed steel, and other alloys. It is specially formulated with high-quality base oils and fortified with oiliness additives and sulfur-containing extreme-pressure additives that provide reduced friction and good anti-weld properties at the chip-tool interface, resulting in extended cutting tool life and good surface finishes on the machined parts.

Gun drilling uses a tungsten-carbide cutting tool to produce accurate, deep-hole configurations. The length of a gun-drilled hole can be up to 250 times its diameter. Gun drilling also is used to drill difficult and hard materials up to 370 Brinell hardness that cannot be economically machined with other types of drilling. Koolkut SCF is ideal for this type of drilling.

Koolkut SCF also is recommended for honing cylinders such as engine cylinders, clutch slave cylinders and brake wheel/master cylinders.

Koolkut SCF can cause staining of non-ferrous metals such as copper and copper alloys and is not recommended for machining non-ferrous metals.

Applications

- Boring
- Broaching
- Deep hole drilling
- Heavy-duty machining of cast iron, steel, and high-speed steel alloys
- Honing
- Milling
- Tapping
- Threading

Features/Benefits

- Excellent performance in most difficult machining operations
- Reduced friction
- Good anti-weld properties
- Helps extend cutting tool life
- Good surface finish
- Permits clear view of the workpiece

Heavy-Duty Cutting Oil for Gun Drilling & Cylinder Honing





Koolkut® SCF

Typical Properties	
ISO Grade	15
Specific Gravity @ 60°F	0.884
Density, lbs/gal @ 60°F	7.36
Color, ASTM D1500	4.5
Flash Point (COC), °C (°F)	182 (360)
Pour Point, °C (°F)	-18 (0)
Viscosity	
cSt @ 40°C	14.4
cSt @ 100°C	3.3
SUS @ 100°F	79.7
SUS @ 210°F	37.4
Viscosity Index	95
Copper Corrosion, ASTM D130	1b
Chlorine, wt %	3.2
Fatty Oil, wt %	10.0
Sulfur, Total, wt %	2.1
Sulfur, Active, wt %	1.86

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® Spectrum

Phillips 66® Koolkut® Spectrum is a general-purpose, active cutting oil developed for medium- to heavy-duty machining of cast iron, stainless steel, high-speed steel, and other alloys. It is specially formulated with high-quality base oils and fortified with sulfur-containing extreme-pressure additives that provide good anti-weld properties and reduced friction at the chip-tool interface, resulting in extended tool life and good surface finishes on the machined parts.

Koolkut Spectrum can cause staining of non-ferrous metals such as copper and copper alloys, and is not recommended for machining non-ferrous metals if staining is objectionable.

Applications

- Boring
- Broaching
- Drilling
- Milling
- Tapping
- Threading

Features/Benefits

- Excellent performance in most difficult machining operations
- Good anti-weld properties
- Helps extend cutting tool life
- Good surface finish
- Transparent for good visibility of the machining operation

General-Purpose Cutting Oil

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Koolkut® Spectrum

Typical Properties	
ISO Grade	32
Specific Gravity @ 60°F	0.885
Density, lbs/gal @ 60°F	7.37
Color, ASTM D1500	1.5
Flash Point (COC), °C (°F)	216 (421)
Pour Point, °C (°F)	-20 (-4)
Viscosity	
cSt @ 40°C	32.0
cSt @ 100°C	5.4
SUS @ 100°F	165
SUS @ 210°F	44.4
Viscosity Index	102
Copper Corrosion, ASTM D130	1b
Chlorine, wt %	1.18
Fatty Oil, wt %	Nil
Sulfur, Total, wt %	1.08
Sulfur, Active, wt %	0.7

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Koolkut® Transparent

Phillips 66® Koolkut® Transparent is a high-quality, clear, non-staining cutting oil developed for light- to medium-duty machining of ferrous and some non-ferrous metals, such as mild steel, ductile iron, and aluminum. It is transparent for good visibility of the workpiece during machining operations, and is non-staining to both ferrous and non-ferrous metals.

Koolkut Transparent is specially formulated with high-quality, low-sulfur base oils and fortified with chlorinated paraffins that provide good anti-weld properties and reduced friction at the chip-tool interface, resulting in extended tool life and good surface finishes on the machined parts.

Applications

Koolkut Transparent is recommended for light- to medium-duty machining of ferrous and non-ferrous metals. Typical applications include:

- Automatic screw machines
- Drilling
- High-speed, low feed rate, precision machining
- Light- to medium-duty machining of ductile iron
- Sawing
- Tapping and threading of mild steel
- Turning

Features/Benefits

- Multipurpose cutting oil for light- to medium-duty machining operations
- Transparent for good visibility of the machining operation
- Good anti-weld properties
- Helps extend cutting tool life
- Good surface finish
- Controls heat buildup
- Protects against rust and corrosion
- Non-staining to aluminum

Non-Staining, Transparent Cutting Oil

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Koolkut® Transparent

Typical Properties	
ISO Grade	32
Specific Gravity @ 60°F	0.890
Density, lbs/gal @ 60°F	7.41
Color, ASTM D1500	1.5
Flash Point (COC), °C (°F)	216 (420)
Pour Point, °C (°F)	-21 (-6)
Viscosity	
cSt @ 40°C	30.6
cSt @ 100°C	5.3
SUS @ 100°F	158
SUS @ 210°F	44.0
Viscosity Index	105
Copper Corrosion, ASTM D130	1a
Chlorine, wt %	1.95
Fatty Oil, wt %	Nil
Sulfur, Total, wt %	0.08
Sulfur, Active, wt %	Nil

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Multi-Way Oil HD

Phillips 66® Multi-Way Oil HD is a circulating oil developed for the lubrication of lathes and heavily loaded machine tool slideways. It is specially formulated to prevent stick-slip problems to ensure good surface finish on the machined part.

Multi-Way Oil HD is formulated with a special tackifier additive that allows machine tool carriages to start easily and move smoothly throughout their travel, thus preventing stick-slip problems. This reduces carriage chatter and ensures a smooth finish on the machined part. Its mild extreme-pressure properties prevent scoring of the slideways during carriage travel. The tackifier improves adhesion and prevents the oil from being squeezed off the slideways. It also helps prevent the oil from being washed away by cutting fluids. Additional additives provide protection against rust and corrosion and allow optimum coolant separation.

Multi-Way Oil HD, ISO VG 32 and 68, may be used as a combination way oil, hydraulic oil, and gear oil in machine tools where the circulating oil is supplied from a central reservoir.

Applications

- Horizontal and vertical slideways on machine tools, such as lathes, planers, shapers, drilling machines, milling machines, and screw machines
- Lumber mill saw carriages
- Pneumatic equipment such as jackhammers, pavement breakers, and rock drills
- Moderately loaded enclosed industrial gear drives that require an adhesive gear oil with mild extreme-pressure (EP) properties (ISO VG 220)
- Hydraulic systems operating at less than 1,000 psi (ISO VG 32, 68)

Features/Benefits

- Excellent anti-stick-slip performance
- Good surface finish
- Protects against scoring and wear
- Good adhesion for retention on slideways
- Protects against rust and corrosion
- Excellent coolant-separating properties

Machine Tool Slideway Lubricant

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Multi-Way Oil HD

Typical Properties			
ISO Grade	32	68	220
Specific Gravity @ 60°F	0.860	0.872	0.880
Density, lbs/gal @ 60°F	7.16	7.26	7.33
Color, ASTM D1500	5.0	5.0	6.0
Flash Point (COC), °C (°F)	213 (415)	234 (453)	260 (500)
Pour Point, °C (°F)	-18 (0)	-15 (5)	-15 (5)
Viscosity			
cSt @ 40°C	32.0	68.0	220
cSt @ 100°C	5.6	9.0	19.6
SUS @ 100°F	165	352	1,160
SUS @ 210°F	45.0	56.6	99.4
Viscosity Index	114	107	101
Acid Number, ASTM D664, mg KOH/g	0.35	0.35	0.35
Demulsibility, ASTM D1401, minutes to pass	15	15	15
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Stick-Slip Performance, ASTM D2877	0.74	0.73	0.67

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Soluble Oil

Phillips 66® Soluble Oil is a chlorine-free, water miscible metalworking fluid designed to emulsify easily and form a long-lasting, stable emulsion when mixed with water. It provides excellent cooling and lubricity for light- to medium-duty cutting and grinding of ferrous and non-ferrous metals, resulting in extended tool life and good surface finishes on the machined parts. It has been specially formulated to provide enhanced rust protection and greater emulsion stability when used with water qualities of varying hardness.

Soluble Oil is fortified with special emulsifiers to form a stable, milky emulsion when mixed with water. The high specific heat of water and the excellent metal wetting ability of the emulsion provide excellent cooling and lubricity for most machining operations that require soluble oil. This promotes longer tool life by dissipating heat and reducing friction between the cutting tool and the workpiece. Its improved emulsion stability allows extended time between sump clean outs. Its enhanced rust protection helps protect the cutting tool and the parts being machined.

Soluble Oil has very low foaming tendency, which allows its use in high-speed machining and grinding operations. It also provides a high level of rejection of tramp oil contamination to facilitate skimming and removal of tramp oils from sumps and reservoirs. It does not contain any chlorinated compounds, making disposal of the used fluid easier.

Note: Soluble Oil does not contain a biocide. A biocide such as Bioban™ P-1487 or Bioban™ GK should be added in service to combat the growth of harmful microorganisms in machine sumps and reservoirs.

Applications

- Light-to medium-duty machining operations, including broaching, drilling, grinding, milling, sawing, and tapping, with water hardness up to 500 ppm
- Machine shops working with a wide variety of ferrous and non-ferrous metals

Features/Benefits

- Excellent cooling and lubricating properties
- Helps extend cutting tool life
- Reduces grinding wheel wear
- Good surface finish
- Emulsifies easily with water⁽¹⁾
- Forms a stable macro emulsion
- Improved rust protection
- Rejects tramp oils
- Good antifoam properties
- Suitable for both ferrous and non-ferrous metals

⁽¹⁾ **Note:** When mixing, always add Soluble Oil to water; **never** add water to Soluble Oil. Typical concentrations (Soluble Oil in water) range from 3% to 10% for cutting operations and from 3% to 4% for grinding operations, depending on the type of metal and water hardness. Concentrations may be monitored with a refractometer.

CAUTION: Containers of Soluble Oil should be stored indoors. They should not be stored at temperatures below 40°F (4°C) or above 130°F (54°C).

Emulsifiable Metalworking Fluid

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Soluble Oil

Typical Properties	
Specific Gravity @ 60°F	0.919
Density, lbs/gal @ 60°F	7.65
Color, ASTM D1500	3.5
Flash Point (COC), °C (°F)	184 (363)
Pour Point, °C (°F)	-43 (-45)
Viscosity	
cSt @ 40°C	34.2
cSt @ 100°C	5.0
SUS @ 100°F	178
SUS @ 210°F	43.1
Viscosity Index	51
Emulsion Stability	Good
pH, 5% (1:20) dilution	10.3
Rust Test, ASTM D665 A&B	Pass
Chlorine, wt %	Nil
Fatty Oil, wt %	Nil
Sulfur, Total, wt %	0.43
Sulfur, Active, wt %	Nil

Recommended Concentrations, Soluble Oil in Water (Volume %)			
Operation	High Alloy Steels	Tool Steels	Nickel Alloys
Broaching, Milling, Tapping	10	10	10
Deep Drilling, Gear Hobbing, Gear Shaping, Sawing	5	7	7
Grinding	3	3	3

Refractometer Reading				
Dilution Ratio	1:10	1:15	1:20	1:25
Reading	10.0	6.7	5.0	3.3

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Soluble Oil HD

Phillips 66® Soluble Oil HD is a chlorinated, heavy-duty metalworking fluid designed to emulsify easily and form a stable emulsion when mixed with water. It provides excellent cooling and lubricity for medium- to heavy-duty cutting and grinding of ferrous and non-ferrous metals, resulting in extended tool life and good surface finishes on the machined parts.

Soluble Oil HD is formulated with naphthenic base oils and fortified with emulsifiers that form a stable emulsion when mixed with soft, medium, or hard water. The high specific heat of water and the excellent metal-wetting ability of the emulsion provide excellent cooling and lubricity for most machining operations. This promotes longer tool life by reducing friction between the cutting tool and the workpiece and by dissipating heat. Anti-wear and anti-weld additives provide extra protection for heavy-duty machining operations.

Soluble Oil HD provides excellent anti-wear properties and good rust protection for both the cutting tool and the parts being machined. It contains a biocide to combat a wide spectrum of microorganisms, resulting in longer sump life and good odor control. It has very low foaming tendency, which is an advantage in high-speed machining and grinding operations.

Note: Although Soluble Oil HD contains a biocide, the biocide can become depleted in service. A biocide such as Bioban™ P-1487 or Bioban™ GK should be added in service as needed to combat the growth of harmful microorganisms in machine sumps and reservoirs.

Applications

Soluble Oil HD is recommended for medium- to heavy-duty machining operations with water hardness up to 300 ppm. Typical applications include:

- Broaching
- Deep hole drilling (gun drilling)
- Gear hobbing and gear shaping
- Grinding
- Milling
- Reaming
- Sawing
- Tapping

Features/Benefits

- Excellent cooling and lubricating properties
- Excellent anti-wear and anti-weld properties
- Helps extend cutting tool life
- Good surface finish
- Emulsifies easily with water⁽¹⁾
- Forms a stable emulsion
- Good rust protection
- Good antifoam properties

⁽¹⁾**Note:** When mixing, always add Soluble Oil HD to water; **never** add water to Soluble Oil HD. Typical concentrations (Soluble Oil HD in water) range from 3% to 10% for cutting operations and from 3% to 4% for grinding operations, depending on the type of metal and water hardness. Concentration may be monitored with a refractometer.

CAUTION: Containers of Soluble Oil HD should be stored indoors. They should not be stored at temperatures below 40°F (4°C) or above 130°F (54°C).

**Heavy-Duty
Emulsifiable
Metalworking
Fluid**

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Soluble Oil HD

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.958
Density, lbs/gal @ 60°F	7.98
Color, Visual	Blue-Green
Flash Point (COC), °C (°F)	177 (351)
Pour Point, °C (°F)	-20 (-4)
Viscosity	
cSt @ 40°C	43.5
cSt @ 100°C	6.1
SUS @ 100°F	225
SUS @ 210°F	46.7
Viscosity Index	79
Emulsion Stability	Good
Foam Test, ASTM D892	Pass
pH, 5% (1:20) dilution	9.6
Rust Test, ASTM D665 A&B	Pass
Chlorine, wt %	2.2
Fatty Oil, wt %	3.3
Sulfur, Total, wt %	Nil
Sulfur, Active, wt %	Nil

Recommended Concentrations, Soluble Oil HD in Water (Volume %)			
Operation	High Alloy Steels	Aluminum Alloys	Nickel Alloys
Broaching, Milling, Tapping	10	7	10
Deep Hole Drilling, Gear Hobbing, Gear Shaping, Reaming, Sawing	5	5	7
Grinding	3	3	3

Refractometer Reading					
Dilution Ratio	1:10	1:15	1:20	1:25	1:30
Reading	10.3	7.2	5.4	4.6	3.0

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

TCS Slideway Lubricant

Phillips 66® TCS Slideway Lubricant is a premium quality circulating oil developed for the lubrication of lathes and heavily loaded machine tool slideways. It is specially formulated to prevent stick-slip problems to ensure good surface finish on the machined part, and to provide quick and effective separation from water and metalworking fluids.

TCS Slideway Lubricant is specially formulated to allow machine tool carriages to start easily and move smoothly throughout their travel, thus preventing stick-slip problems. This reduces carriage chatter and ensures a smooth finish on the machined part. Mild extreme-pressure properties prevent scoring of the slideways during carriage travel. A tackiness additive improves adhesion and prevents the oil from being squeezed off the slideways. It also helps prevent the oil from being washed away by cutting fluids. Additional proprietary additives provide protection against rust and corrosion and allow optimum separation from coolants and tramp oils.

TCS Slideway Lubricant is water-white in color to allow easy visibility of machined parts.

Applications

- Horizontal and vertical slideways on machine tools, such as lathes, planers, shapers, drilling machines, milling machines, and screw machines
- Lumber mill saw carriages
- Printing presses
- Other applications that require a clear, tacky slideway oil

Features/Benefits

- Excellent anti-stick-slip performance
- Excellent coolant-separating properties
- Good surface finish
- Protects against scoring and wear
- Good adhesion for retention on slideways
- Protects against rust and corrosion
- Water-white in color for easy visibility

**Premium
Machine Tool
Slideway
Lubricant**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





TCS Slideway Lubricant

Typical Properties			
ISO Grade	32	68	220
Specific Gravity @ 60°F	0.848	0.870	0.874
Density, lbs/gal @ 60°F	7.06	7.24	7.28
Color, ASTM D1500	0.0	0.0	0.0
Flash Point (COC), °C (°F)	205 (401)	232 (450)	280 (536)
Pour Point, °C (°F)	-15 (5)	-15 (5)	-12 (10)
Viscosity			
cSt @ 40°C	32.0	69.0	227
cSt @ 100°C	6.1	9.0	23.8
SUS @ 100°F	164	357	1,184
SUS @ 210°F	46.6	56.6	118
Viscosity Index	141	104	131
Acid Number, ASTM D664, mg KOH/g	1.3	1.3	1.3
Demulsibility, ASTM D1401, minutes to pass	20	20	20
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Stick-Slip Performance, ASTM D2877	<0.80	<0.80	<0.80

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

SPECIALTY INDUSTRIAL OILS



LUBRICANTS

AAR 963 Oil

Phillips 66® AAR 963 Oil is a high-quality lubricant specially developed for year-round lubrication of plain journal bearings in railcar journal boxes. It meets the requirements of the American Association of Railroads (AAR) Specification M-963-84 for All-Year Journal Box Lubricating Oil.

AAR 963 Oil is specially formulated for excellent year-round performance. It has good lubricity and antiwear properties to protect heavily loaded railcar journal bearings, provides protection against rust and corrosion, and has good foam resistance.

Applications

- Plain journal bearings in railcar journal boxes
- Traction motor suspension bearings on locomotives

AAR 963 Oil meets or exceeds the requirements of:

- AAR Specification M-963-84

Features/Benefits

- Formulated for year-round use
- Good wear protection
- Protects against rust and corrosion
- Good foam resistance

Railroad Journal Bearing Lubricant

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SMOOTHLY.**





AAR 963 Oil

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.874
Density, lbs/gal @ 60°F	7.28
Color, ASTM	0.5
Flash Point, COC, °C (°F)	235 (455)
Pour Point, °C (°F)	-37 (-35)
Viscosity	
cSt @ 40°C	50.0
cSt @ 100°C	8.4
SUS @ 100°F	255
SUS @ 210°F	54.4
Viscosity Index	143
Foam Test, ASTM D892, Seq. I, mL	0/0
Humidity Cabinet Test, ASTM D1748	Pass
Moisture, ASTM D95, wt %	< 0.1
Pentane Insolubles, ASTM D893 B, wt %	< 0.1
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

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LUBRICANTS

Arbor Oil

Phillips 66® Arbor Oil is a compounded oil developed primarily for use in the lumber industry to keep edger arbor blades clean and free of pitch and resins.

Arbor Oil is formulated with a special surfactant additive that helps minimize pitch and gum deposition that can interfere with proper movement and lubrication of the edger saws on the arbor. It has high film strength to protect saw bearings against scuffing and wear, and provides good lubricity to reduce friction between sliding surfaces. It has a low pour point for use at low ambient temperatures.

Arbor oil also may be used as a concrete form release oil. The surfactant additive inhibits the adherence of concrete to steel and wood surfaces.

Applications

- Edger arbors lubricated by spray, brush, or drip-feed systems
- Arbor bearings or other bearings where wood pitch, resins, or gums interfere with lubrication
- Coating of wood or metal forms prior to pouring concrete

Features/Benefits

- Softens and removes pitch and gum
- High film strength for protection against scuffing and wear
- Good lubricity to reduce friction between sliding surfaces
- Good metal-wetting ability
- Good service over a wide temperature range

CAUTION: This product reacts adversely with zinc. It should **not** be used to lubricate equipment that is galvanized or contains zinc alloys, not stored or handled in containers containing zinc alloys.

Compounded Edger Arbor Oil

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Arbor Oil

Typical Properties	
ISO Grade	22
Specific Gravity @ 60°F	0.862
Density, lbs/gal @ 60°F	7.18
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	230 (446)
Pour Point, °C (°F)	-21 (-6)
Viscosity	
cSt @ 40°C	24.0
cSt @ 100°C	4.7
SUS @ 100°F	125
SUS @ 210°F	42.0
Viscosity Index	114
Acid Number, ASTM D974, mg KOH/g	20.0

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Bearing Oil M

Phillips 66® Bearing Oil M is a high-quality, rust and oxidation (R&O)-inhibited circulating oil specifically developed for the lubrication of backup roll bearings manufactured by Morgan Construction Company. It meets the performance requirements for “super demulsibility” as defined by Morgan’s Advanced Lubricant Specification, Revision 2.5, for use in hot and cold rolling mill operations.

Bearing Oil M is formulated to provide rapid water separation, excellent oxidation resistance, protection against rust and corrosion, and resistance to foaming. It has excellent water-separating properties to minimize the formation of emulsions in circulating systems subject to contamination with large quantities of water, rolling solutions, dirt and scale. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It protects system components against rust and corrosion, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Applications

- Backup roll bearings manufactured by Morgan Construction Company
- Backup roll bearings in hot and cold rolling mills
- Bearing lubrication in steel mills
- Circulating systems where water contamination is a problem
- Large, slow-speed gears in mixers and mills

Bearing Oil M meets the requirements of the following industry and OEM specifications:

- Morgan Construction Advanced Lubricant Specification, Revision 2.5 (05/2009)
- SMS Siemag SN 180 Part 4 (07/2009)
- U.S. Steel 135, Mill Circulating Oil

Features/Benefits

- Excellent water-separating properties
- Excellent oxidation resistance and thermal stability
- Protects against rust and corrosion
- Good foam resistance

**Inhibited “Super
Demulsible”
Rolling & Steel
Mill Circulating
Oil**

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Bearing Oil M

Typical Properties					
Grade	M150	M220	M320	M460	M680
ISO Grade	150	220	320	460	680
Specific Gravity @ 60°F	0.878	0.883	0.887	0.891	0.907
Density, lbs/gal @ 60°F	7.32	7.35	7.39	7.42	7.55
Color, ASTM D1500	2.5	4.0	4.5	4.5	8.0
Flash Point (COC), °C (°F)	265 (509)	275 (527)	285 (545)	293 (559)	279 (534)
Pour Point, °C (°F)	-20 (-4)	-14 (7)	-14 (7)	-6 (21)	-12 (10)
Viscosity					
cSt @ 40°C	150	220	320	460	656
cSt @ 100°C	14.8	19.0	24.7	31.5	35.8
SUS @ 100°F	788	1,163	1,701	2,460	3,557
SUS @ 210°F	78.9	96.8	122	154	175
Viscosity Index	98	97	99	99	88
Acid Number, ASTM D974, mg KOH/g	0.05	0.05	0.05	0.05	0.29
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	<20	<20	<20	<40	<60
Demulsibility, ASTM D2711					
Free Water @ 52°C, mL	>30	>30	>30	>26	>26
Demulsibility, UEC Dynamic Endurance Test					
Water in Oil after Centrifuging, vol %	<10	<10	<10	<10	<15
Oil in Water after Centrifuging, vol %	<1	<1	<1	<1	<1
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0	0/0
Oxidation Stability, RPVOT					
ASTM D2272, minutes	350	350	340	335	245
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Circulating Oil

Phillips 66® Circulating Oil is a high-quality, rust-inhibited mineral oil specially developed for the lubrication of conveyor and crusher bearings in copper crushing mills.

Circulating Oil is formulated to provide protection against rust and corrosion and resistance to foaming. It has excellent water-separating properties to minimize the formation of emulsions in circulating systems subject to contamination with large quantities of water, minerals, dirt and scale.

Applications

- Ball mills, cement mills, hot and cold strip mills, plate mills
- Conveyor bearings in mining applications
- Plain and rolling-element bearings in ferrous and non-ferrous mills
- Circulating systems where water contamination is a problem
- Large, slow-speed bearings in mixers and mills

Features/Benefits

- Excellent water-separating properties to minimize the formation of emulsions
- Good oxidation resistance
- Protects against rust and corrosion
- Good foam resistance

Rust-Inhibited Circulating Oil for Crushing Mills

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Circulating Oil

Typical Properties	
ISO Grade	150
Specific Gravity @ 60°F	0.878
Density, lbs/gal @ 60°F	7.31
Color, ASTM D1500	2.0
Flash Point, COC, °C (°F)	277 (531)
Pour Point, °C (°F)	-15 (5)
Viscosity	
cSt @ 40°C	153
cSt @ 100°C	14.7
SUS @ 100°F	805
SUS @ 210°F	78.5
Viscosity Index	95
Acid Number, ASTM D874, mg KOH/g	0.05
Demulsibility, ASTM D1401, minutes to pass	5
Foam Test, ASTM D892, Seq. I, mL	0/0
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

CP Oil

Phillips 66® CP Oil is a low-viscosity, rust and corrosion-preventive oil developed for the lubrication of air tools and other pneumatic equipment lubricated through air line lubricators, especially where the compressed air has high moisture content.

CP Oil is formulated to provide excellent rust and corrosion protection and good wear protection for pneumatic tools, resulting in extended tool life. It has excellent metal-wetting ability to displace moisture from metal surfaces, and may be used as a rust preventive oil for metal parts stored indoors.

Applications

- Air tools and other pneumatic equipment lubricated through air line lubricators
- Rust and corrosion preventive oil for metal parts stored indoors
- Lightly loaded plain and rolling-element bearings exposed to moisture

Features/Benefits

- Excellent rust and corrosion protection
- Excellent metal-wetting ability
- Good oiliness properties for wear protection
- Does not form lacquer or gum on metal surfaces
- Emulsifiable for easy removal from metal parts

Corrosion- Preventive Air Tool Lubricant

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CP Oil

Typical Properties		
ISO Grade	22	32
Specific Gravity @ 60°F	0.856	0.865
Density, lbs/gal @ 60°F	7.13	7.20
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	230 (446)	233 (451)
Pour Point, °C (°F)	-29 (-20)	-27 (-17)
Viscosity		
cSt @ 40°C	22.0	32.1
cSt @ 100°C	4.4	5.4
SUS @ 100°F	115	166
SUS @ 210°F	41.1	44.4
Viscosity Index	109	102
Acid Number, ASTM D974, mg KOH/g	0.05	0.05
Ash Content, ASTM D482, wt %	Nil	Nil
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0
Rust Test, ASTM D665 A	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Diamond Class® Heat Transfer Fluids

Phillips 66® Diamond Class Heat Transfer Fluids are premium quality fluids specifically developed for use in liquid-phase heat transfer systems. They are available in two different formulations, designated “O/S” for use in open systems and “C/S” for use in closed systems.

Diamond Class Heat Transfer Fluids O/S and C/S are formulated with premium hydrocracked paraffinic base oils and advanced additive chemistry to provide outstanding thermal stability and low sludge-forming tendency for long service life and outstanding overall performance.

Applications

Diamond Class Heat Transfer Fluid O/S is optimized for use in pressure-relieved, liquid-phase heat transfer systems with expansion tanks, where there is the possibility of contact between the heat transfer fluid and air in the expansion tank. It is fortified with oxidation and corrosion inhibitors to prevent fluid degradation and deposit buildup in the system. The O/S fluid is recommended for use in systems operating with continuous maximum bulk oil temperatures up to 550°F (290°C), intermittent maximum temperatures as high as 650°F (343°C), and a maximum skin film temperature of 600°F (316°C).

Diamond Class Heat Transfer Fluid C/S is optimized for use in pressure-relieved, expansion tank-equipped liquid-phase heat transfer systems that are closed to the atmosphere and potential air contamination. The system must be equipped with a cold-oil seal pot on the expansion tank vent, or operated with low-pressure nitrogen blanketing of the oil so there is no possibility of air contacting the oil during operation. The C/S fluid is fortified with special additives to prevent thermal degradation. It is recommended for use in systems operating with continuous maximum bulk oil temperatures up to 620°F (327°C) and maximum skin film temperatures up to 650°F (343°C).

Some common applications include:

- Liquid-phase heat transfer systems ⁽¹⁾
- Heat transfer medium for industrial manufacturing processes
- Heat transfer equipment used in the manufacture of resins and coatings
- Asphalt heating
- Die casting
- Plastic injection molding and extrusion
- Wax coating equipment

⁽¹⁾ **Caution:** These fluids are **not** to be used in “vapor-phase” heat transfer units, nor should they come into contact with water, which can cause steam and pressure to build up in the system and create the potential for an explosion. Also, under no circumstances should the bulk oil be exposed to continuous high temperatures without the presence of an expansion tank, as the fluid will degrade quickly.

**Premium Heat
Transfer Fluids
for Open And
Closed Systems**

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SMOOTHLY.**





LUBRICANTS

Features/Benefits

- Outstanding performance in closed or open systems
- Outstanding thermal stability to minimize deposits
- Long service life
- Less waste oil disposal
- Reduced operating costs

Diamond Class® Heat Transfer Fluids

Typical Properties			
Grade	O/S 32	O/S 46	C/S 32
ISO Grade	32	46	32
Specific Gravity			
@ 15.6°C (60°F)	0.865	0.866	0.862
@ 38°C (100°F)	0.744	0.746	0.742
@ 160°C (320°F)	0.709	0.710	0.706
@ 288°C (550°F)	0.673	0.674	0.670
Density, lbs/gal			
@ 15.6°C (60°F)	7.20	7.21	7.18
@ 38°C (100°F)	6.20	6.21	6.18
@ 160°C (320°F)	5.90	5.91	5.88
@ 288°C (550°F)	5.60	5.61	5.58
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	225 (437)	240 (464)	225 (437)
Autoignition Temperature, ASTM E659, °C (°F)	357 (675)	362 (684)	364 (687)
Pour Point, °C (°F)	-42 (-44)	-42 (-44)	-42 (-44)
Viscosity			
cSt @ 40°C (104°F)	32.0	46.0	32.0
cSt @ 100°C (212°F)	5.4	6.8	5.4
cSt @ 204°C (400°F)	1.35	1.56	1.35
cSt @ 260°C (500°F)	0.91	1.02	0.91
cSt @ 316°C (600°F)	0.69	0.75	0.69
Viscosity Index	102	102	102
Acid Number, ASTM D974, mg KOH/g	0.00	0.00	0.01
Carbon Residue, ASTM D524, wt %	<0.1	<0.1	<0.1
Copper Corrosion, ASTM D130	1a	1a	1a
Oxidation Stability, RPVOT, ASTM D2272, minutes	875	875	448

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LUBRICANTS

Diamond Class® Heat Transfer Fluids

Typical Thermal Properties			
Grade	O/S 32	O/S 46	C/S 32
Coefficient of Thermal Expansion, vol %/°C (vol%/°F)			
@ 15.6°C (60°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 38°C (100°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 160°C (320°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 288°C (550°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
Specific Heat Capacity, Cp, Btu/lb-°F			
@ 15.6°C (60°F)	0.450	0.450	0.450
@ 38°C (100°F)	0.621	0.619	0.621
@ 160°C (320°F)	0.665	0.663	0.665
@ 288°C (550°F)	0.700	0.700	0.700
Thermal Conductivity, Btu/hr-ft-°F			
@ 15.6°C (60°F)	0.081	0.081	0.081
@ 38°C (100°F)	0.079	0.079	0.079
@ 160°C (320°F)	0.074	0.074	0.074
@ 288°C (550°F)	0.067	0.067	0.067
Vapor Pressure, psia (kpa)			
@ 15.6°C (60°F)	0.004 (0.029)	0.003 (0.025)	0.004 (0.029)
@ 38°C (100°F)	0.102 (0.700)	0.087 (0.597)	0.102 (0.700)
@ 160°C (320°F)	0.415 (2.86)	0.349 (2.41)	0.415 (2.86)
@ 288°C (550°F)	1.882 (12.98)	1.561 (10.76)	1.882 (12.98)

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Food Machinery Oil

Phillips 66® Food Machinery Oil is a premium quality, ashless, food-grade lubricant specially developed for use in hydraulic systems, rotary air compressors, lightly to moderately loaded enclosed gear drives, and other machinery in food processing and beverage plants. All viscosity grades are registered by NSF International as H1 lubricants for use where incidental food contact may occur, and also as H2 lubricants for use in applications where there is no chance for incidental food contact. All viscosity grades are certified as meeting Canadian Food Inspection Agency requirements for use in federally registered food plants, and also certified Halal, Kosher, and Pareve.

Food Machinery Oil is manufactured with hydroprocessed base oils of the highest purity and fortified with an ashless, zinc-free, antiwear additive plus rust and oxidation inhibitors. It provides excellent wear protection, corrosion resistance, and deposit control to ensure long service life for hydraulic pumps and motors, and other equipment. It has good water-separating properties to minimize the formation of emulsions, and is resistant to excessive foaming.

Food Machinery Oil meets the performance requirements of all major hydraulic pump manufacturers, and is recommended for use in all types of high-pressure, high-speed hydraulic pumps.

Applications

- Food processing equipment in bakeries, canneries, meat packing plants, and bottling plants
- Hydraulic systems, circulating oil systems, and rotary air compressors (typically, ISO VG 68 and lighter)
- Lightly to moderately loaded enclosed industrial gear drives that do not require a compounded extreme-pressure (EP) gear oil (typically, ISO VG 100 and heavier)
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Chain drives
- Deep well water pumps
- Equipment on offshore oil platforms

Food Machinery Oil meets the requirements of the following government and industry specifications:

- Canadian Food Inspection Agency (CFIA) requirements for use in federally registered food plants (incidental food contact) (registered)
- FDA 21 CFR 178.3570 for incidental food contact
- NSF International H1 and former 1998 USDA H1 guidelines for incidental food contact (Registration Nos. 137567, 137568, 137569, 140092, and 140093)
- NSF International H2 and former 1998 USDA H2 guidelines for use with no chance of incidental food contact

**Premium
Food-Grade
Machinery Oil;
NSF H1 & H2
Registered**

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Features/Benefits

- Excellent wear protection for critical system components
- Good oxidation resistance to minimize sludge and varnish formation
- Protects against rust and corrosion
- Good water-separating properties to minimize the formation of emulsions
- Good foam resistance
- Certified Halal, Kosher, and Pareve

Food Machinery Oil

Typical Properties					
ISO Grade	32	46	68	100	220
Specific Gravity @ 60°F	0.865	0.868	0.871	0.877	0.876
Density, lbs/gal @ 60°F	7.20	7.23	7.25	7.30	7.29
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5
Color, Saybolt	+30	+30	+30	+30	+30
Flash Point (COC), °C (°F)	204 (400)	216 (420)	221 (430)	221 (430)	263 (505)
Pour Point, °C (°F)	-9 (15)	-9 (15)	-9 (15)	-9 (15)	-9 (15)
Viscosity					
cSt @ 40°C	32.0	46.0	68.0	100	220
cSt @ 100°C	5.5	7.0	9.1	11.9	22.0
SUS @ 100°F	165	237	351	520	1,151
SUS @ 210°F	45	50	57	67	110
Viscosity Index	108	109	109	109	121
Acid Number, ASTM D664, mg KOH/g	0.05	0.05	0.05	0.05	0.05
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	30	30	30	30	30
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.55	0.53	0.50	0.50	0.50
FZG Scuffing Test, ASTM D5182, Failure Load Stage	12	12	12	12	12
Oxidation Stability					
TOST, ASTM D943-04a, hours	3,000	3,000	3,000	3,000	3,000
RPVOT, ASTM D2272, minutes	480	480	480	480	450
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

05-10-17

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LUBRICANTS

Heat Transfer Oils

Phillips 66® Heat Transfer Oils are high-quality straight or inhibited mineral oils developed for use in open and/or closed liquid-phase heat transfer systems. They have excellent thermal stability and provide excellent resistance to cracking and sludge formation for long service life. They are **not** recommended for use in vapor-phase heat transfer systems.

Heat Transfer Oil 32/46 is a straight paraffinic mineral oil recommended for use in closed systems operating under relatively mild conditions. Heat Transfer Oils 32 and 46 are paraffinic mineral oils fortified with select additives that provide enhanced oxidation resistance for long service life, and detergency to help keep the system clean for maximum heat transfer efficiency. They are recommended for use in both open and closed systems operating under more severe conditions.

Applications

Heat Transfer Oil 32/46 is recommended for use in closed liquid-phase heat transfer systems equipped with a cold-oil seal pot on the expansion tank vent, or operating with low-pressure nitrogen blanketing of the oil so there is no possibility of air contacting the oil during operation. For best performance, the maximum bulk oil temperature should not exceed 550°F (288°C).

Heat Transfer Oils 32 and 46 are recommended for use in closed liquid-phase heat transfer systems equipped with expansion tanks and pressure relief valves, where the maximum bulk oil temperature does not exceed 550°F (288°C). Preventive measures should be taken to minimize oil oxidation by eliminating air from the system prior to bringing the oil up to operating temperature. The use of an inert gas, such as nitrogen, under positive pressure in the expansion tank is recommended at all times during operation. Under no circumstances should the hot oil come into contact with air.

Heat Transfer Oils 32 and 46 also are recommended for use in open liquid-phase heat transfer systems equipped with cold-oil sealed expansion tanks, where the maximum bulk oil temperature does not exceed 374°F (190°C).

Some common heat transfer applications include:

- Direct and indirect-fired hot oil heaters in asphalt plants
- Hot corrugation and gluing
- Dehydration
- Molding and extrusion equipment
- Plastic and wax coating equipment
- Organic synthesis hot oil systems

Note: Always follow the equipment manufacturer's recommendations on oil change intervals, and for recommended practices when switching over from another brand of heat transfer oil.

**High-Quality
Heat Transfer
Oils for Open &
Closed Systems**

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Features/Benefits

- Excellent resistance to thermal breakdown at high temperatures
- Excellent performance in both open and closed heat transfer systems
- Long service life
- Excellent deposit control
- Low odor
- Non-corrosive

Heat Transfer Oils

Typical Properties			
ISO Grade	32/46	32	46
Specific Gravity @ 60°F			
@ 15.6°C (60°F)	0.867	0.864	0.871
@ 38°C (100°F)	0.853	0.850	0.857
@ 160°C (320°F)	0.775	0.772	0.779
@ 288°C (550°F)	0.693	0.690	0.697
Density, lbs/gal @ 60°F			
@ 15.6°C (60°F)	7.22	7.19	7.25
@ 38°C (100°F)	7.10	7.08	7.13
@ 160°C (320°F)	6.45	6.43	6.48
@ 288°C (550°F)	5.77	5.74	5.80
Color, ASTM D1500	0.5	1.0	1.0
Flash Point (COC), °C (°F)	222 (432)	218 (424)	240 (464)
Auto-ignition Temperature, ASTM E659, °C (°F)	335 (635)	329 (625)	352 (665)
Pour Point, °C (°F)	-15 (5)	-42 (-44)	-39 (-38)
Viscosity			
cSt @ 40°C	40.0	31.7	46.0
cSt @ 100°C	6.3	5.5	6.8
SUS @ 100°F	206	163	237
SUS @ 210°F	47.3	44.7	49.0
Viscosity Index	105	110	102
Acid Number, ASTM D974, mg KOH/g	0.02	0.28	0.28
Carbon Residue, ASTM D524, wt %	0.04	0.17	0.17
Oxidation Stability, RPVOT, ASTM D2272, minutes	---	57	57

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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Heat Transfer Fluids

Typical Thermal Properties			
Grade	32/46	32	46
Coefficient of Thermal Expansion, vol %/°C (vol%/°F)			
@ 15.6°C (60°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 38°C (100°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 160°C (320°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
@ 288°C (550°F)	0.102 (0.056)	0.102 (0.056)	0.102 (0.056)
Specific Heat Capacity, Cp, Btu/lb-°F			
@ 15.6°C (60°F)	0.450	0.573	0.450
@ 38°C (100°F)	0.468	0.583	0.468
@ 160°C (320°F)	0.581	0.664	0.581
@ 288°C (550°F)	0.683	0.747	0.683
Thermal Conductivity, Btu/hr-ft-°F			
@ 15.6°C (60°F)	0.081	0.081	0.081
@ 38°C (100°F)	0.079	0.079	0.079
@ 160°C (320°F)	0.074	0.074	0.074
@ 288°C (550°F)	0.067	0.067	0.067
Vapor Pressure, psia (kpa)			
@ 15.6°C (60°F)	0.0036 (0.025)	0.004 (0.028)	0.0036 (0.025)
@ 38°C (100°F)	0.0043 (0.03)	0.005 (0.03)	0.0043 (0.03)
@ 160°C (320°F)	0.032 (0.22)	0.036 (0.25)	0.032 (0.22)
@ 288°C (550°F)	0.730 (5.03)	0.860 (5.93)	0.730 (5.03)

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-27-16

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LUBRICANTS

High Pressure Machine Oil

Phillips 66® High Pressure Machine Oil is a high-quality, anti-wear lubricating oil developed for use in the fabrication of high-strength aluminum and aluminum alloy plates and sheets, such as those used in commercial and military aircraft, the aerospace industry, and in custom industrial applications. It is specially formulated to protect against distortion and provide excellent surface finish.

High Pressure Machine Oil is formulated to provide excellent wear protection and surface finish during aluminum stretching operations. It has excellent anti-wear properties and high load-carrying capacity to protect against distortion. It has excellent oxidation resistance at high temperatures to provide long service life and protect against deposit formation and staining. It has excellent water-separating properties to minimize the formation of emulsions, protects hydraulic system components against rust and corrosion, and is resistant to excessive foam buildup. It also has good low-temperature properties for cold start-ups. It is non-staining to aluminum, bronze, and brass.

High Pressure Machine Oil meets the stringent minimum requirement for load-carrying capacity for hydraulic oils as measured by the Brugger Test.

Applications

- Fabrication of high-strength aluminum and aluminum alloy plates and sheets
- Rolling and stretching of aluminum
- Chain drives

Features/Benefits

- High load-carrying capacity to protect against metal distortion
- Excellent surface finish
- Non-staining
- Excellent wear protection
- Protects against rust and corrosion
- Excellent water-separating properties
- Good foam resistance
- Good low-temperature performance

Anti-Wear Machine Oil for Fabrication of Aluminum Products





High Pressure Machine Oil

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.868
Density, lbs/gal @ 60°F	7.23
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	215 (419)
Pour Point, °C (°F)	-36 (-33)
Viscosity	
cSt @ 40°C	46.0
cSt @ 100°C	6.9
SUS @ 100°F	214
SUS @ 210°F	48.8
Viscosity Index	105
Acid Number, ASTM D974, mg KOH/g	1.00
Brugger Load-Carrying Capacity, DIN 51347-2, N/mm ²	30.2
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Demulsibility, ASTM D1401, minutes to pass	<0
Foam Test, ASTM D892, Seq. I, mL	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.52
Oxidation Stability, RPVOT, ASTM D2272, minutes	234
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-07-16

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LUBRICANTS

Industrial Oil

Phillips 66® Industrial Oil is a highly refined, non-compounded (no additives) paraffinic mineral oil recommended for use as a high-quality process oil, diluent oil, flush oil, or blending component for other lubricants. It also is recommended for general-purpose lubrication in applications that do not require a compounded oil.

Industrial Oil is available in seven grades for use in a wide range of applications. It is highly refined from select paraffinic stocks to be uniform in quality and chemical composition and have carefully controlled physical and chemical properties. It has high natural oxidation stability, low volatility, and good viscosity-temperature characteristics for use over a wide temperature range. It has a high flash point relative to its viscosity, good solvency properties, and very light color.

Industrial Oil 580 is registered with NSF International as an H2 lubricant for use in applications where there is no food contact.

Applications

- Process oil
- Compounding oil for rubber products and adhesives
- Blending component for other lubricants
- Flush oil for gas and steam turbines
- Mineral seal oil
- Chain drives and other “once-through” applications
- General-purpose lubrication in applications that do not require a compounded oil

Industrial Oil 580 meets the requirements of:

- NSF International H2 and former 1998 USDA H2 guidelines for no incidental food contact
- U.S. FDA Code of Federal Regulations 21 CFR 178.3620 (b) for non-food applications

Features/Benefits

- Uniform quality and chemical composition
- High natural oxidation stability
- Good viscosity-temperature characteristics
- Low volatility
- High flash point
- Good solvency
- Very light color (except 2500 grade)
- Non-staining
- Quick foam release

Highly Refined Paraffinic Mineral Oil

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Industrial Oil

Typical Properties								
Grade	70	100	110	115	150	250	580	2500
ISO Grade	10/15	22	22	22	32	46	100	460
Gravity, °API @ 60°F	33.8	34.1	34.4	33.9	32.4	31.7	29.5	27.4
Specific Gravity @ 60°F	0.856	0.855	0.8529	0.856	0.863	0.867	0.879	0.890
Density, lbs/gal @ 60°F	7.13	7.12	7.1	7.12	7.19	7.22	7.32	7.41
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5.0
Flash Point (COC), °C (°F)	196 (385)	209 (408)	207(405)	210 (410)	216 (421)	238 (460)	266 (511)	312 (594)
Pour Point, °C (°F)	-34 (-29)	-14 (7)	-15(5)	-18 (0)	-18 (0)	-18 (0)	-13 (9)	-12 (10)
Viscosity								
cSt @ 40°C	12.6	20.3	20.3	22.0	32.0	46.0	109	460
cSt @ 100°C	3.0	4.1	4.16	4.4	5.5	6.9	11.9	30.7
SUS @ 100°F	72.0	107	107	115	165	237	569	2,464
SUS @ 210°F	36.4	40.1	40.1	41.1	44.7	49.3	67.3	151
Viscosity Index	87	101	106	109	108	105	98	95
Acid Number, ASTM D664, mg KOH/g	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aniline Point, ASTM D611, °C (°F)	96 (205)	107 (225)	107(225)	108 (226)	112 (234)	116 (241)	126 (259)	132 (270)

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

3-9-2018

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LUBRICANTS

Marok®

Phillips 66® Marok® is a high-quality, adhesive, extreme-pressure (EP) lubricant specially developed to lubricate in the presence of moisture or where oil leakage is a problem. It is recommended for the lubrication of marine, mining, and industrial equipment operating in wet environments, and for the lubrication of air-powered tools, such as rock drills and jackhammers.

Marok is formulated with naphthenic base oils and a specially tailored additive package to provide excellent protection for pneumatic percussion tools and marine and industrial equipment operating under wet conditions. It has good load-carrying capacity to protect against wear and seizure of sliding metal surfaces under heavy or shock-load conditions. It has excellent adhesion to metal surfaces in the presence of moisture, and protects against rust and corrosion. It resists dripping and leakage, which is especially useful in applications where bearing clearances are large or seals are inadequate.

Applications

- Pneumatic percussion tools such as jackhammers, pavement breakers, and rock drills
- Mining equipment such as demolition hammers, chipping hammers, and drifters
- Marine applications such as stern tube bearings, oil-lubricated tunnel bearings, and cylinder lubricant for steam engines and crosshead engines
- Drive chains and overhead conveyors where a non-drip lubricant is required
- Enclosed industrial gear drives where oil leakage is a problem

Features/Benefits

- Good extreme-pressure properties
- Protects against wear and seizure
- Excellent adhesion to metal surfaces in the presence of moisture
- Resists dripping and leakage
- Protects against rust and corrosion
- Low odor

**Adhesive,
Extreme-
Pressure
Lubricant for Air
Tools & Marine
Equipment**

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LUBRICANTS

Marok®

Typical Properties				
ISO Grade	68	100	150	220
Specific Gravity @ 60°F	0.916	0.922	0.926	0.932
Density, lbs/gal @ 60°F	7.63	7.68	7.71	7.76
Color, ASTM D1500	3.5	3.5	4.0	5.0
Flash Point (COC), °C (°F)	186 (367)	192 (378)	204 (399)	204 (399)
Pour Point, °C (°F)	-24 (-11)	-21 (-6)	-21 (-6)	-15 (5)
Viscosity				
cSt @ 40°C	68.0	100	150	220
cSt @ 100°C	7.7	9.2	11.4	14.2
SUS @ 100°F	356	530	803	1,189
SUS @ 210°F	52.1	57.4	65.6	76.7
Viscosity Index	68	51	41	38
Acid Number, ASTM D664, mg KOH/g	0.60	0.60	0.60	0.60
Carbon Residue, ASTM D524, wt %	0.12	0.10	0.16	0.19
Falex EP Load, ASTM D3233, lbf	900	900	900	900
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.32	0.32	0.32	0.32
Four-Ball Weld Load, ASTM D2783, kgf	250	250	250	250
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0	10/0

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Paper Machine Oil

Phillips 66® Paper Machine Oil is a high-quality, circulating oil developed for use in modern papermaking machines. It is recommended for use in paper machines manufactured by all leading OEMs. It is specially formulated to provide excellent detergency for system cleanliness while still maintaining excellent water-separating properties.

Paper Machine Oil is formulated with an additive package specially tailored for papermaking machines. It has good oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has excellent detergency to help maintain system cleanliness. It has excellent water-separating properties to minimize the formation of emulsions, and passes the Pall Filterability Test for both new oil and “aged” oil contaminated with water. It has good load-carrying capacity for wear protection, protects system components against rust and corrosion, and has good foam resistance.

Applications

- Circulating systems of paper machines, including wet-end systems, dryer sections, and calender stacks
- Circulating systems for heavily loaded bearings where moisture contamination is a problem and operating temperatures are high
- Reduction gears and gear-head motors
- Vacuum pumps and water pumps

Features/Benefits

- Excellent detergency
- Excellent water-separating properties
- Excellent filterability for use with fine porosity filters
- Good oxidation resistance and thermal stability
- High load-carrying capacity
- Protects against rust and corrosion
- Good foam resistance

Paper Machine Circulating Oil

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Paper Machine Oil

Typical Properties			
ISO Grade	150	220	320
Specific Gravity @ 60°F	0.876	0.882	0.887
Density, lbs/gal @ 60°F	7.30	7.34	7.39
Color, ASTM D1500	2.5	4.0	4.5
Flash Point (COC), °C (°F)	260 (500)	270 (518)	270 (518)
Pour Point, °C (°F)	-12 (10)	-12 (10)	-12 (10)
Viscosity			
cSt @ 40°C	150	220	320
cSt @ 100°C	15.0	18.9	24.4
SUS @ 100°F	695	1,019	1,483
SUS @ 210°F	77.9	93.8	118
Viscosity Index	100	95	97
Acid Number, ASTM D974, mg KOH/g	0.70	0.70	0.70
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10	10
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0
Rust Test, ASTM D665A&B	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	30	30	30

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-07-16

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LUBRICANTS

Pump Oil

Phillips 66® Pump Oil is a highly refined paraffinic mineral oil developed for drip-feed lubrication of deep-well turbine water pumps.

Pump Oil is a highly refined, non-compounded paraffinic mineral oil. It contains no hazardous additives that can affect water quality, and has negligible odor.

Applications

- Deep-well water pumps for domestic and agricultural use
- Vacuum pumps
- Industrial applications that require a non-compounded, ISO VG 46 mineral oil

Features/Benefits

- Contains no hazardous additives
- Low odor
- Good low-temperature properties

Lubricating Oil for Deep-Well Water Pumps

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Pump Oil

Typical Properties	
ISO Grade	46
Specific Gravity @ 60°F	0.856
Density, lbs/gal @ 60°F	7.13
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	232 (450)
Pour Point, °C (°F)	-13 (9)
Viscosity	
cSt @ 40°C	41.3
cSt @ 100°C	6.4
SUS @ 100°F	213
SUS @ 210°F	47.7
Viscosity Index	103

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Quench Oils

Quench Oils are high-quality oils developed for heat treatment of ferrous metals in a wide variety of quenching operations. They are formulated to provide deep and uniform hardening with minimum distortion and cracking for a smooth surface finish.

Quench Oils are available in four grades: 15, 22, 22HS and 32HS. The 22 grade is a highly refined, straight (non-additized) paraffinic mineral oil recommended for conventional quenching of ferrous metals at bath temperatures up to 150°F (66°C). It has a slower quench speed than the other grades, and provides minimum hardening power. The other three grades are fortified with select additives to provide enhanced oxidation resistance and metal-wetting ability for use in fast quench operations where it is important to develop maximum hardness while minimizing distortion. The 15 and 22HS grades are high-speed quench oils with moderate-to-high hardening power. The 32HS grade is a higher viscosity, high-speed quench oil that provides the highest hardening power.

Quench Oils provide a high initial cooling rate to induce maximum hardness. After the critical transformation temperature is passed, the cooling rate gradually decreases to a much slower rate to minimize the possibility of stress and metal distortion, thereby ensuring a smooth surface finish. These oils are highly stable throughout the hardening temperature range to provide long service life with minimal sludge formation. They have a high viscosity index for minimum viscosity change during the entire quenching operation, and have high flash and fire points to minimize fire hazards.

Applications

- Conventional and fast quenching of ferrous metals, such as carbon steel, gray iron and high-alloy steel

Caution: Quench Oils must not be mixed with competitive quench oils, unless tested for compatibility. They are not recommended for marquenching or martempering operations, where oil temperatures can reach 150°C to 232°C (302°F to 450°F).

Features/Benefits

- Controlled cooling rate to minimize cracking and distortion
- Good surface finish
- Excellent oxidation resistance and thermal stability
- High flash point for fire safety

Note: Agitation, filtration and periodic product sweetening are essential to successful quenching operations. The quench tanks must be periodically cleaned and the quench oil filtered to remove scale, metal shavings and contaminants. A 50-micron double-bag filter is recommended for proper maintenance. The quench oil must be continuously agitated to provide uniform surface microstructure. Condition monitoring by oil analysis is essential in maintaining optimum performance and the desired quenching qualities of these oils.

Metal Quenching Oils





Quench Oils

Typical Properties				
Grade	15	22	22HS	32HS
ISO Grade	15	22	22	32
Specific Gravity @ 60°F	0.861	0.854	0.855	0.864
Density, lbs/gal @ 60°F	7.17	7.11	7.12	7.19
Color, ASTM D1500	5.0	0.0	L 2.0	2.0
Flash Point (COC), °C (°F)	185 (365)	205 (401)	207 (405)	218 (424)
Pour Point, °C (°F)	-15 (5)	-13 (9)	-15 (5)	-15 (5)
Viscosity				
cSt @ 40°C	16.1	22.0	23.1	32.9
cSt @ 100°C	3.5	4.5	4.5	5.5
SUS @ 100°F	87.3	115	120	170
SUS @ 210°F	38.1	41.4	41.4	44.7
Viscosity Index	90	118	107	103
Acid Number, ASTM D974, mg KOH/g	0.35	0.01	0.12	0.05
Cooling Characteristics ⁽¹⁾ , ASTM D6200				
Maximum Cooling Rate, °C/sec	71-88	29-40	74-85	76-87
Maximum Cooling Rate, °F/sec	160-190	85-105	165-185	169-189
Time to Cool to 600°C (1,112°F), seconds	8-10	12-15	9-10	9-10

⁽¹⁾ **Note:** Values for cooling rates and quench speeds are typical for new oil. For used oil, values will vary due to aging and contamination.

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

05-18-2017

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LUBRICANTS

Rock Drill Oil

Phillips 66® Rock Drill Oil is an adhesive, extreme-pressure (EP) lubricant specially developed for the lubrication of air-powered tools such as rock drills, jackhammers, pavement breakers and drifters. It also is recommended for the lubrication of mining and industrial equipment operating in wet environments. It is formulated with an ashless, chlorine-free additive package for reduced environmental impact.

Rock Drill Oil is formulated with high-quality paraffinic base oils and a specially tailored non-chlorinated additive package to provide excellent protection for pneumatic percussion tools. It has high load-carrying capacity to protect against wear and seizure of sliding metal surfaces under heavy or shock-load conditions. The emulsion and metal surface adhesion properties allow a maintained lubricant film in the presence of moisture. It also provides protection against rust and corrosion. It also has good oxidation resistance and thermal stability at high temperatures for long service life. The non-chlorinated additive package helps reduce environmental impact in case of leaks or stray mist, and facilitates waste oil disposal.

Applications

- Pneumatic percussion tools such as jackhammers, pavement breakers and rock drills
- Mining equipment such as demolition hammers, chipping hammers and drifters
- Enclosed industrial gearboxes where leakage is a problem

Features/Benefits

- Non-chlorinated additive package for reduced environmental impact
- Excellent extreme-pressure properties
- Protects against wear and seizure
- Good adhesion to metal surfaces in the presence of moisture
- Resists dripping and leakage and low fogging tendency
- Good oxidation resistance and thermal stability
- Low odor
- Good foam resistance
- Eight viscosity grades for use over a wide range of temperature

**Adhesive,
Extreme-
Pressure Air
Tool Lubricant**

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LUBRICANTS

Rock Drill Oil

Typical Properties								
ISO Grade	32	46	68	100	150	220	320	460
Specific Gravity @ 60°F	0.863	0.868	0.872	0.876	0.881	0.886	0.890	0.895
Density, lbs/gal @ 60°F	7.19	7.22	7.26	7.30	7.34	7.38	7.41	7.45
Color, ASTM D1500	1.5	1.5	2.5	2.5	3.0	3.5	4.0	4.5
Flash Point (COC), °C (°F)	198 (388)	215 (419)	222 (432)	222 (432)	228 (442)	234 (453)	243 (469)	243 (469)
Pour Point, °C (°F)	-37 (-35)	-37 (-35)	-27 (-17)	-27 (-17)	-21 (-6)	-18 (0)	-18 (0)	-11 (12)
Viscosity								
cSt @ 40°C	32.0	46.0	68.0	100	150	220	320	460
cSt @ 100°C	5.7	7.2	9.2	12.3	15.7	20.2	25.2	31.7
SUS @ 100°F	165	236	351	518	784	1,158	1,698	2,385
SUS @ 210°F	45.3	50.3	57.3	68.8	82.6	102	125	155
Viscosity Index	119	117	112	115	108	106	102	102
Acid Number, ASTM D664, mg KOH/g	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Falex EP Load, ASTM D3233, lbf	4,225	4,225	4,225	4,225	4,225	4,225	4,225	4,225
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Four-Ball Weld Load, ASTM D2783, kgf	315	315	315	315	315	315	315	315
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Timken OK Load, ASTM D2782, lb	70	70	70	70	70	70	70	70

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Rolling Oil

Phillips 66® Rolling Oil is a high-quality, multipurpose rolling oil developed for rolling non-ferrous metals, such as aluminum, brass, copper, and copper alloys. It also is recommended for use as a bearing lubricant, hydraulic oil, and roll-coating oil in many mill applications.

Rolling Oil is formulated to provide excellent oxidation resistance, wear protection, protection against rust and corrosion, and resistance to foaming. It has excellent water-separating properties to minimize the formation of emulsions. It is non-staining to aluminum and yellow metals.

Applications

- Hot rolling of non-ferrous metals
- Circulating oil for plain and rolling-element bearings in mill applications
- Hydraulic oil in mill applications
- Roll-coating oil in many mill applications

Rolling Oil meets the requirements of the following industry and OEM specifications:

- U.S. Steel 127, 136
- Vickers (Eaton) I-286-S

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Excellent wear protection for gears and bearings
- Protects against rust and corrosion
- Non-staining to non-ferrous metals
- Excellent water-separating properties
- Good foam resistance

Multipurpose Rolling Oil

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Rolling Oil

Typical Properties							
ISO Grade	10	15	46	68	150	320	460
Specific Gravity @ 60°F	0.857	0.854	0.868	0.873	0.882	0.890	0.892
Density, lbs/gal @ 60°F	7.14	7.11	7.23	7.27	7.34	7.41	7.43
Color, ASTM D1500	0.5	0.5	0.5	0.5	1.5	2.5	6.0
Flash Point (COC), °C (°F)	174 (345)	182 (360)	224 (435)	243 (469)	260 (500)	304 (579)	304 (579)
Pour Point, °C (°F)	-46 (-51)	-43 (-45)	-42 (-44)	-39 (-38)	-32 (-26)	-15 (5)	-15 (5)
Viscosity							
cSt @ 40°C	12.0	16.8	46.0	67.8	149	310	460
cSt @ 100°C	2.9	3.6	6.7	8.6	14.8	23.7	30.1
SUS @ 100°F	69.5	90.5	238	352	782	1,649	2,468
SUS @ 210°F	36.0	38.5	48.7	55.2	78.9	118	148
Viscosity Index	84	92	97	97	98	96	94
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	5	5	10	10	10	10	20
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.48	0.45	0.42	0.42	0.42	0.42	0.42
FZG Scuffing Test, ASTM D5182, Failure Stage	---	10	>12	>12	>12	>12	>12
Oxidation Stability							
TOST, ASTM D943-04a, hours	12,000	12,000	12,000	12,000	5,000	5,000	5,000
RPVOT, ASTM D2272, minutes	750	750	750	750	600	600	600
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Health & Safety Information

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LUBRICANTS

Special Bar & Chain Oil

Phillips 66® Special Bar & Chain Oil is an adhesive lubricant developed to lubricate the chain, bar guide, and drive sprocket on chain saws used in the logging industry. It is suitable for use with all types of chain saws equipped with either hand-operated or automatic oilers.

Special Bar & Chain Oil is formulated to provide good wear protection and resistance to foaming. It protects the chain, bar guide, and drive sprocket against wear. A tackiness agent minimizes sling-off during chain saw operation.

Special Bar & Chain Oil is dyed red for easy visibility on the chain.

Applications

- Chain saws (bar guide, chain, and drive sprocket)
- Industrial chain drives
- Machine tool guides and slideways

Features/Benefits

- Protects against wear
- Resists sling-off
- Good foam resistance
- Dyed red for easy visibility on the chain

Adhesive Chain Saw Lubricant

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Special Bar & Chain Oil

Typical Properties			
ISO Grade	68	150	220
Specific Gravity @ 60°F	0.877	0.878	0.904
Density, lbs/gal @ 60°F	7.30	7.31	7.53
Color, Visual	Red	Red	Red
Flash Point (COC), °C (°F)	220 (428)	228 (442)	235 (455)
Pour Point, °C (°F)	-12 (10)	-10 (14)	-10 (14)
Viscosity			
cSt @ 40°C	68.0	142	205
cSt @ 100°C	9.3	15.5	21.0
SUS @ 100°F	351	740	1,071
SUS @ 210°F	57.6	81.7	105
Viscosity Index	114	112	121
Foam Test, ASTM D892, Seq. I, mL	10/0	10/0	10/0

Health & Safety Information

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LUBRICANTS

Spindle Oil

Phillips 66® Spindle Oil is a high-quality spindle bearing oil developed for the lubrication of high-speed spindle bearings in machine tools and textile machinery.

Spindle Oil is formulated with an oiliness agent and/or an ashless anti-wear additive plus select inhibitors to provide excellent lubricity and wear protection, protection against rust and corrosion, and resistance to foaming. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposits and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup. It is non-staining for use in textile equipment.

Spindle Oils ISO VG 2, 6, 10, & 22 are recommended primarily for use in high-speed CNC milling machines, precision grinders, and other machine tools. They meet the performance requirements of leading manufacturers of high-speed CNC milling machines. They also may be used in low-pressure hydraulic systems that require a low viscosity oil.

Spindle Oil ISO VG 15 is recommended for lubrication of high-speed needle and spindle bearings in agricultural and textile machinery, such as spinning machines.

Applications

- Horizontal, vertical, bed-type, knee-type, and turret-type CNC milling machines
- High-speed needle and spindle bearings in industrial, agricultural, and textile machinery
- Low-pressure hydraulic systems that require a low-viscosity oil

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Long service life for reduced operating and maintenance costs
- Protects against wear
- Excellent oiliness characteristics (ISO VG 2 & 15)
- Protects against rust and corrosion
- Excellent water-separating properties
- Excellent low-temperature performance
- Clear color
- Non-staining
- Quick foam release

Spindle Bearing Oil





Spindle Oil

Typical Properties					
ISO Grade	2	6	10	15	22
Specific Gravity @ 60°F	0.806	0.833	0.848	0.852	0.856
Density, lbs/gal @ 60°F	6.71	6.94	7.06	7.09	7.13
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	99 (210)	150 (302)	171 (340)	168 (335)	188 (370)
Pour Point, °C (°F)	-40 (-40)	-40 (-40)	-36 (-33)	-36 (-33)	-37 (-35)
Viscosity					
cSt @ 40°C	2.1	5.1	10.0	15.1	22.1
cSt @ 100°C	1.0	1.7	2.6	3.4	4.4
SUS @ 100°F	33	44	61	83	115
SUS @ 210°F	29	32	35	38	41
Acid Number, ASTM D664, mg KOH/g	0.04	0.04	0.03	0.01	0.03
Copper Corrosion, ASTM D130	1a	1a	1a	1a	1a
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.52	0.49	0.42	-	0.41
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Spindle Wet

Phillips 66® Spindle Wet is a highly refined paraffinic mineral oil developed to lubricate the rubber doffers on mechanical cotton picking machines.

Spindle Wet is highly refined from select paraffinic stocks to have high natural oxidation stability, low volatility, and very light color to minimize staining.

Applications

- Rubber doffers on mechanical cotton picking machines

Features/Benefits

- High natural oxidation stability
- Low volatility
- Very light color to minimize staining

Cotton Picker Doffer Oil

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Spindle Wet

Typical Properties	
ISO Grade	22
Specific Gravity @ 60°F	0.852
Density, lbs/gal @ 60°F	7.10
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	209 (408)
Pour Point, °C (°F)	-14 (7)
Viscosity	
cSt @ 40°C	20.4
cSt @ 100°C	4.1
SUS @ 100°F	107
SUS @ 210°F	40.1
Viscosity Index	100
Acid Number, ASTM D664, mg KOH/g	<0.05

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Steaval D-150

Phillips 66® Steaval D-150 is a heavy, non-compounded paraffinic mineral oil developed for steam cylinder and valve lubrication in applications that require a non-emulsifying oil, or where the steam is superheated. It also may be used in applications where an ISO VG 460 or SAE 140 straight mineral gear oil is required.

Steaval D-150 is manufactured from highly refined, high-viscosity paraffinic base stocks and contains no additives. It forms a tough film on metal surfaces to protect against wear.

Applications

- Steam cylinders and valves in applications that require a non-compounded oil, or where the steam is superheated
- Paper mill calender roll bearings
- Steel mill roll neck bearings
- Rack and pinion gears and heavy mill gears
- Applications that require an ISO 460 or SAE 140 straight mineral gear oil

Features/Benefits

- High film strength
- Good retention on metal surfaces
- Non-corrosive to bronze or brass

**Non-
Compounded
Steam Cylinder
Lubricant**

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Steaval D-150

Typical Properties	
ISO Grade	460
Specific Gravity @ 60°F	0.890
Density, lbs/gal @ 60°F	7.41
Color, ASTM D1500	5.0
Flash Point (COC), °C (°F)	312 (594)
Pour Point, °C (°F)	-12 (10)
Viscosity	
cSt @ 40°C	493
cSt @ 100°C	32.0
SUS @ 100°F	2,645
SUS @ 210°F	157
Viscosity Index	96
Acid Number, ASTM D974, mg KOH/g	0.02
Carbon Residue, ASTM D524, wt %	0.51
Copper Corrosion, ASTM D130	1a

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syncon® Barrier Oil

Phillips 66® Syncon® Barrier Oil is a premium quality, non-reactive, synthetic, low-viscosity process oil developed for use as a barrier oil in seal applications where the manufacturer calls for a light mineral seal oil. Typical applications include seal service in refineries, gas plants, steel mills, power plants and chemical plants.

Syncon Barrier Oil is manufactured with synthetic polyalphaolefin (PAO) base oils and select additives to provide excellent oxidation inhibition and lubricity over a wide temperature range. It is free of impurities that can cause catalyst poisoning in process applications, and is compatible with most commonly used seal materials.⁽¹⁾ It complies with FDA 21 CFR 178.3570 regulations for use in food processing plants where there is the possibility of incidental food contact.

Applications

- Seal applications in gas processing and pumping
- Barrier fluid in dual mechanical seals used in refineries, power plants, and chemical plants, where the manufacturer calls for a premium quality light mineral seal oil

Features/Benefits

- Premium quality seal oil
- Outstanding oxidation resistance and thermal stability at high temperatures
- Superior heat transfer properties
- Excellent low-temperature fluidity
- Resistant to chemical contamination
- Helps keep the face of the seal cool and free of deposits
- Low odor

⁽¹⁾ **Note:** For information on compatibility with elastomers, paints, and plastics, please call our Technical Support Hotline.

Synthetic PAO-Based Fluid for Seal Service

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Syncon® Barrier Oil

Typical Properties	
ISO Grade	5
Specific Gravity @ 60°F	0.797
Density, lbs/gal @ 60°F	6.64
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	149 (300)
Pour Point, °C (°F)	-60 (-76)
Viscosity	
cSt @ 40°C	5.10
cSt @ 100°C	1.70
SUS @ 100°F	43.7
SUS @ 210°F	31.9
Viscosity Index	N/A
Acid Number, ASTM D974, mg KOH/g	0.17
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a
Demulsibility, ASTM D1401, minutes to pass	10
Foam Test, ASTM D892, Seq. I, mL	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.55
Oxidation Stability, RPVOT, ASTM D2272, minutes	2,400
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

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LUBRICANTS

Transformer Oil

Phillips 66® Transformer Oil is a highly refined electrical insulating oil developed for use in oil-immersed transformers, capacitors, tap changers, and circuit breakers where the equipment manufacturer specifies a Type II inhibited oil meeting ANSI/ASTM D3487-09 requirements.

Transformer Oil is formulated with hydrotreated naphthenic base oils and an oxidation inhibitor to control sludge and deposit formation and provide extended service life compared with non-inhibited Type I transformer oils. It has a high dielectric strength and low power factor to provide excellent insulating properties. It has excellent low-temperature properties and is noncorrosive to copper and copper alloys. This product does **not** contain any PCBs.

Applications

- Oil-immersed transformers
- Circuit breakers & switches
- Fuses
- Tap changers
- Other oil-immersed electrical equipment

Transformer Oil meets the requirements of the following industry and OEM specifications:

- ANSI/ASTM D3487-09 Type II Inhibited Oil
- British Standard BS 148, Class 1A
- Federal VV-I-530A, Class II Specification
- GE A13A3A2 (10CA)
- IEEE
- International Standard IEC 60296
- NEMA Type II (obsolete)
- Westinghouse Specification PDS 55822AG

Features/Benefits

- Excellent insulating properties
- High dielectric strength ⁽¹⁾
- Low power factor
- Resists oxidation and deposit formation
- Excellent low-temperature properties
- Compatible with materials used in transformers
- Does not contain any PCBs

⁽¹⁾**Note:** *In order to maintain its high dielectric strength for use as an insulating oil, the oil must be kept clean and dry. Contamination with even a small amount of water will significantly decrease the dielectric strength. The drums are sealed at the terminal with a blanket of dry air to keep moisture out. The drums should be stored indoors and covered to protect them from dust and debris. If stored outdoors, they should be positioned on their sides or upside down and covered to protect them from exposure to the elements. Every effort should be made to use the entire drum once the seal is broken to help prevent contamination. If contamination is suspected, always inspect the drum and test the oil for dielectric strength before use.*

**Inhibited
Electrical
Insulating Oil**

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Transformer Oil

Typical Properties	
ISO Grade	10
Specific Gravity @ 60°F	0.887
Density, lbs/gal @ 60°F	7.39
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	160 (320)
Pour Point, °C (°F)	-60 (-76)
Viscosity	
cSt @ 40°C	9.6
cSt @ 100°C	2.3
SUS @ 100°F	60.3
SUS @ 210°F	34.0
Viscosity Index	19
Acid Number, ASTM D974, mg KOH/g	<0.01
Aniline Point, ASTM D611, °C (°F)	75 (167)
Corrosive Sulfur, ASTM D1275B	Non-corrosive
Dielectric Breakdown Voltage ⁽²⁾	
Disc Electrodes, 60 Hz, ASTM D877, kV	40
Oxidation Stability, RPVOT, ASTM D2272, minutes	280
PCB Content, ASTM D4059, wt %	None
Power Factor @ 60 Hz, ASTM D924	
@ 25°C (77°F), %	0.003
@ 100°C (212°F), %	0.074
Water, ASTM D1533, wt %	0.0015

⁽²⁾ At the point of manufacture

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Ultra-Clean Spindle Oil

Phillips 66® Ultra-Clean Spindle Oil is a premium quality spindle bearing oil developed primarily for use in high-speed CNC milling machines and other machine tools that require an ultra-clean spindle oil. It meets the performance requirements of leading manufacturers of high-speed CNC milling machines. It is also recommended for use in textile machinery.

Ultra-Clean Spindle Oil is formulated to provide excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has excellent oxidation resistance and thermal stability at high temperatures to minimize deposits and provide long service life. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup. It has the added advantage of fine filtration to a typical ISO Cleanliness Code of 17/15/11 for use in hydraulic systems with tight tolerances where particle contamination can cause operational problems.

Applications

- Horizontal, vertical, bed-type, knee-type, and turret-type CNC milling machines, especially where particle contamination can cause operational problems
- High-speed needle and spindle bearings in industrial, agricultural, and textile machinery
- Low-pressure hydraulic systems that require a low-viscosity oil

Features/Benefits

- Excellent oxidation resistance and thermal stability
- Long service life for reduced operating and maintenance costs
- Protects against wear
- Excellent oiliness characteristics (ISO VG 2)
- Protects against rust and corrosion
- Excellent water-separating properties
- Excellent low-temperature performance
- Clear color
- Non-staining
- Quick foam release
- Meets ISO Cleanliness Code rating of 17/15/11⁽¹⁾

⁽¹⁾ **Note:** Applies only to unopened packaged containers as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

**Premium
Spindle Bearing
Oil; Meets ISO
Cleanliness
Code 17/15/11**

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Ultra-Clean Spindle Oil

Typical Properties			
ISO Grade	2	10	22
Specific Gravity @ 60°F	0.806	0.848	0.856
Density, lbs/gal @ 60°F	6.71	7.06	7.13
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	99 (210)	171 (340)	188 (370)
Pour Point, °C (°F)	-40 (-40)	-36 (-33)	-37 (-35)
Viscosity			
cSt @ 40°C	2.1	10.0	22.1
cSt @ 100°C	1.0	2.6	4.4
SUS @ 100°F	33	61	115
SUS @ 210°F	29	35	41
Acid Number, ASTM D664, mg KOH/g	0.04	0.03	0.03
Copper Corrosion, ASTM D130	1a	1a	1a
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.52	0.42	0.41
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Cleanliness Code, ISO 4406:1999	17/15/11	17/15/11	17/15/11

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Uniguide II

Phillips 66® Uniguide II is a premium quality oil specially developed to provide optimum lubrication of saw guides and saw blades in sawmills. It is particularly recommended for the lubrication of arbor bearings and saw guide systems that utilize “thin kerf” technology in cutting lumber.

Uniguide II is formulated with unique ashless additive technology to provide wear protection, tackiness, enhanced metal-wetting ability, and protection against rust and corrosion. Oiliness and tackiness agents provide a strong oil film that reduces friction and resists sling-off during operation, resulting in extended saw guide life and reduced water usage for cooling. An extreme-pressure additive provides extra protection against saw guide wear.

Uniguide II homogenizes with water to form fine droplets to provide effective saw guide lubrication. It has excellent filterability and does not contain any chlorine or heavy metal compounds.

Uniguide II is non-toxic to Rainbow Trout, Daphnia, Algae, and Mysid Shrimp as per OECD 201, 202, and 203 procedures.

Applications

- Saw guides and blades
- Arbor bearings
- Saw system ways and gears

Uniguide II is recommended for use in saw guide systems from all leading manufacturers, including:

- Coe Newnes/McGehee
- Salem
- USNR (Schurman, Ukiah)

Features/Benefits

- Good metal-wetting ability
- Homogenizes into fine droplets in the presence of water
- Extreme-pressure properties for wear protection
- Resists sling-off
- Excellent filterability
- Protects against rust and corrosion
- Ashless formulation; does not contain heavy metals or chlorine
- Environmentally friendly and non-toxic to both freshwater and saltwater organisms

Premium Ashless Saw Guide Oil





Uniguide II

Typical Properties				
ISO Grade	32	46	100	150
Specific Gravity @ 60°F	0.861	0.871	0.875	0.880
Density, lbs/gal @ 60°F	7.17	7.25	7.29	7.32
Color, ASTM D1500	1.0	1.0	2.0	2.5
Flash Point (COC), °C (°F)	216 (420)	225 (437)	268 (514)	282 (540)
Pour Point, °C (°F)	-24 (-11)	-24 (-11)	-29 (-20)	-18 (0)
Viscosity				
cSt @ 40°C	32.0	46.0	100	150
cSt @ 100°C	5.6	7.1	12.4	16.0
SUS @ 100°F	165	237	518	783
SUS @ 210°F	45.0	50.0	69.2	83.8
Viscosity Index	114	113	117	111
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

White Oil

Phillips 66® White Oil is a highly refined, premium quality mineral oil developed for use in food processing plants, consumer products, and in other applications that require an exceptionally pure white mineral oil. It meets or exceeds the highest industry standards for purity and stability. All viscosity grades are registered by NSF International as H1 lubricants for use where incidental food contact may occur, and are certified Kosher and Pareve. They also are certified as meeting Canadian Food Inspection Agency requirements for use in federally registered food plants.

White Oil is manufactured with hydroprocessed base oils of the highest purity. It contains Vitamin E as a natural oxidation inhibitor and remains colorless, odorless, and tasteless during normal storage and service life. It is non-toxic and has outstanding storage stability.

White Oil meets FDA requirements for use in applications where direct, indirect, or incidental contact with food may occur. It may be used to lubricate machinery, protect against moisture, or control dust on grains and animal feed. It also is used as a component in certain consumer products such as cosmetics and pharmaceuticals. The 340/365 grade also is registered as NSF 3H for use as a release agent to prevent sticking on grills, ovens, chopping boards, and other hard surfaces in contact with meat and poultry.

Applications

- Food processing, bottling and canning equipment
- Protective coating for raw fruits and vegetables
- Egg shell sealant in facilities operating under the USDA voluntary shell egg grading program
- Non-stick release agent in meat and poultry plants
- Dust suppressant for grain or animal feed
- Drip oil for deep well water pumps
- Process oil or diluent in adhesives, sealants, caulks, cosmetics, pharmaceuticals, rubber extender oils and plastics
- Smoke oil for air shows
- Textile lubricants
- Household cleaners and polishes

White Oil meets the requirements of the following government and industry specifications:

- Canadian Food Inspection Agency (CFIA) requirements for use in federally registered food plants (incidental food contact)
- Cosmetic, Toiletry, and Fragrance Association (CTFA)
- FDA Code of Federal Regulations:
 - 21 CFR 172.878 for direct food contact
 - 21 CFR 178.3620 for indirect food contact

Premium Food-Grade Mineral Oil; NSF H1 Registered

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- National Formulary (NF) (Grades 50/60, 65/75, 80/90)
- NSF International H1 and former 1998 USDA H1 guidelines for incidental food contact (Registration Nos. 137240, 137241, 137242, 137243, 137244)
- USDA voluntary shell egg grading program, for protective coating (Grades 50/60, 65/75 and 80/90)
- United States Pharmacopoeia (USP) (Grades 200/215, 340/365)

Features/Benefits

- Colorless, odorless and tasteless
- Excellent color stability
- Contains Vitamin E for oxidation inhibition
- Non-staining
- Certified Kosher and Pareve

White Oil

Typical Properties					
Grade	50/60	65/75	80/90	200/215	340/365
ISO Grade	7/10	10/15	15	32/46	68
Specific Gravity @ 60°F	0.842	0.853	0.853	0.865	0.876
Density, lbs/gal @ 60°F	7.01	7.10	7.10	7.20	7.29
Color, Saybolt	+30	+30	+30	+30	+30
Flash Point (COC), °C (°F)	174 (345)	177 (351)	183 (361)	210 (410)	225 (437)
Pour Point, °C (°F)	-9 (16)	-15 (5)	-15 (5)	-15 (5)	-15 (5)
Viscosity					
cSt @ 40°C	8.3	12.5	16.1	41.0	68.5
cSt @ 100°C	2.3	2.9	3.4	6.1	8.0
SUS @ 100°F	55.0	71.7	87.5	212	358
SUS @ 210°F	34.0	36.0	37.7	46.7	53.1
Viscosity Index	83	68	72	91	78

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

05-10-17

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LUBRICANTS

Wireline

Phillips 66® Wireline is a high-quality, tacky, viscous, high viscosity index lubricant specifically developed for lubrication and sealing of braided wirelines and cables used in oil and gas wells for cased-hole logging, pipe recovery service, tubing conveyed perforating, production logging and reservoir analysis.

Wireline is applied in once-through operation. It maintains a seal around the moving wireline in high-pressure environments to prevent the escape of wellbore corrosive fluids and gases between the wireline outer diameter and the flow tube inner diameter. It provides excellent protection against corrosion, including saltwater corrosion, as well as rust preventive properties for storage of logging cables. It also has excellent low-temperature fluidity to prevent wireline seizure and breakage in cold weather.

Wireline passes the visual “no sheen” requirements of the U.S. EPA/U.S. Coast Guard Static Sheen Test (Federal Register Vol. 58, No.41). It also meets the criteria of OECD Test Method 302D for classification as “inherently biodegradable.”

Applications

- Braided wirelines and cables used in oil & gas wells
- Cased-hole logging operations
- Pipe recovery service
- Tubing-conveyed perforating
- Production logging
- Reservoir analysis

Note: This product is not designed for and should not be used in wire rope applications.

Features/Benefits

- Clear color
- Easy to apply in warm and cold weather
- Tacky; stays put and does not drip
- Excellent corrosion protection
- Excellent low-temperature fluidity
- High viscosity index
- Easily pumpable in wireline injection units
- Inherently biodegradable

**High-Quality
Wireline
Lubricant
& Sealant;
Inherently
Biodegradable**

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Wireline

Typical Properties					
ISO Grade	46	68	220	460	680
Specific Gravity @ 60°F	0.866	0.865	0.863	0.862	0.860
Density, lbs/gal @ 60°F	7.22	7.21	7.19	7.17	7.16
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	172 (342)	225 (437)	225 (437)	225 (437)	225 (437)
Pour Point, °C (°F)	-52 (-62)	-39 (-38)	-39 (-38)	-36 (-33)	-36 (-33)
Viscosity					
cSt @ 40°C	46.0	68.0	220	460	680
cSt @ 100°C	9.2	10	28	55	76
Viscosity Index	187	131	164	187	193
Rust Test, ASTM D665 B	Pass	Pass	Pass	Pass	Pass
Usable Temperature Range					
°C	-40 to -15	-34 to -7	-26 to 4	-18 to 16	-12 to 24
°F	-40 to 5	-30 to 20	-15 to 40	0 to 60	10 to 75
ISO Grade	1500	5000	7500	10000	12000
Specific Gravity @ 60°F	0.859	0.855	0.855	0.853	0.852
Density, lbs/gal @ 60°F	7.15	7.12	7.12	7.10	7.10
Color, ASTM D1500	0.5	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	225 (437)	225 (437)	225 (437)	225 (437)	225 (437)
Pour Point, °C (°F)	-36 (-33)	-30 (-22)	-27 (-17)	-24 (-11)	-24 (-11)
Viscosity					
cSt @ 40°C	1,500	5,000	7,500	9,500	12,000
cSt @ 100°C	154	500	660	850	990
Viscosity Index	218	283	286	303	303
Rust Test, ASTM D665 B	Pass	Pass	Pass	Pass	Pass
Usable Temperature Range					
°C	-4 to 38	13 to 38+	18 to 38+	24 to 38+	29 to 38+
°F	25 to 100	55 to 100+	65 to 100+	75 to 100+	85 to 100+

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Wool Processing Oil

Phillips 66® Wool Processing Oil is a high-quality, low-viscosity mineral oil developed for use as a wool processing oil. It improves cohesion of the wool fibers and helps protect them during processing and spinning the wool into yarn. It also helps reduce static during processing.

Wool Processing Oil has very light color and is non-staining. It is inhibited against oxidation to maintain color stability.

Applications

- Wool Processing Oil

Features/Benefits

- Very light color
- Non-staining
- Good color stability

Light Mineral Oil for Processing & Spinning Wool

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Wool Processing Oil

Typical Properties	
ISO Grade	22
Specific Gravity @ 60°F	0.853
Density, lbs/gal @ 60°F	7.10
Color, ASTM D1500	0.5
Flash Point (COC), °C (°F)	209 (408)
Pour Point, °C (°F)	-15 (5)
Viscosity	
cSt @ 40°C	22.5
cSt @ 100°C	4.4
SUS @ 100°F	108.5
SUS @ 210°F	40.8
Viscosity Index	102

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

XD Bearing Oil

Phillips 66® XD Bearing Oil is a high-performance anti-wear circulating oil specifically developed for use in Morgan Construction No-Twist® rod mills. It provides excellent wear protection and rapid water separation for use in rod and bar mill rolling applications.

XD Bearing Oil is formulated to provide good oxidation resistance, excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has good oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It has excellent anti-wear properties to help protect the gears, shafts, bearings and adjusting screws during the extrusion process. It has excellent water-separating properties to minimize the formation of emulsions in circulating systems subject to contamination with large quantities of water. It protects system components against rust and corrosion, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Applications

- Morgan, Danieli, Demag and Pomini rod and bar mills
- Circulating oil for ferrous and non-ferrous rolling mills
- Circulating systems where water contamination is a problem
- Large, slow-speed gears in mixers and mills
- Hot and cold strip mills

XD Bearing Oil meets the requirements of the following OEM specification:

- Morgan MMC40003 (ISO VG 100)

Features/Benefits

- Excellent wear protection
- Excellent water-separating properties
- Good oxidation resistance and thermal stability
- Protects against rust and corrosion
- Good foam resistance

**High-
Performance
Circulating Oil
for Morgan
High-Speed
No-Twist® Rod
Mills**

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XD Bearing Oil

Typical Properties				
ISO Grade	100	150	320	460
Specific Gravity @ 60°F	0.876	0.883	0.891	0.894
Density, lbs/gal @ 60°F	7.24	7.35	7.42	7.45
Color, ASTM D1500	0.5	3.0	5.0	5.0
Flash Point (COC), °C (°F)	262 (504)	273 (523)	282 (540)	270 (518)
Pour Point, °C (°F)	-25 (-13)	-19 (-2)	-15 (5)	-12 (10)
Viscosity				
cSt @ 40°C	100	150	320	460
cSt @ 100°C	11.8	14.7	24.3	30.4
SUS @ 100°F	463	695	1,483	2,132
SUS @ 210°F	65.7	76.8	117	144
Viscosity Index	107	96	96	94
Acid Number, ASTM D974, mg KOH/g	0.65	0.65	0.65	0.65
Copper Corrosion, ASTM D130	1b	1b	1b	1b
Demulsibility, ASTM D1401, minutes to pass	5	5	15	20
Demulsibility, ASTM D2711				
Free Water @ 82°C, mL	39.5	35.2	36	36
Emulsion @ 82°C, mL	0.2	0	0	0
Water in Oil @ 82°C, %	0	0.4	0.4	0.4
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172				
Scar Diameter, mm	0.36	0.35	0.33	0.33
FZG Scuffing Test, ASTM D5182				
Failure Load Stage	12	12	12	12
Oxidation Stability				
RPVOT, ASTM D2272, minutes	>250	>250	>250	>250
Rust Test, ASTM D665 A	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

12-07-16

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LUBRICANTS

TURBINE OILS



LUBRICANTS

Diamond Class® AW Turbine Oil

Phillips 66® Diamond Class AW Turbine Oil is a premium quality, rust and oxidation (R&O)-inhibited, anti-wear turbine oil developed for use in geared and direct-drive gas turbines and steam turbines in severe service.

Diamond Class AW Turbine Oil is formulated with premium hydrocracked base oils and select additives to provide outstanding oxidation resistance, excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions and is resistant to excessive foam buildup that can interfere with proper lubrication. An ashless (non-zinc) antiwear additive provides wear protection for gears and bearings.

Diamond Class AW Turbine Oil is filtered to an ISO Cleanliness Code of 18/16/13 for use in circulating systems with tight tolerances where particle contamination can cause operational problems. The bulk oil is filtered at the blending terminal prior to filling any package containers, and is filtered again upon delivery in bulk to the customer's bulk tank.

Applications

- Combined-cycle and co-generation gas turbines
- Gas turbines and steam turbines with gear drives

Diamond Class AW Turbine Oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- Alstom Power HTGD 90 117, for turbines without gear drives
- ASTM D4304-06a, Type II Turbine Oil
- British Standard 489
- Cincinnati Machine P-38 (ISO VG 32)
- DIN 51515 Part 1, Lubricating Oils, Type L-TD
- DIN 51515 Part 2, Lubricating Oils, Type L-TG
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- DIN 51524 Part 2, Anti-wear Hydraulic Oils, Type HLP
- Elliott ring-oiled turbines, where mineral-based turbine oil is specified
- General Electric GEK 101941a, GEK 107395a, GEK 32568f, GEK 46506e, GEK 27070 (obsolete), GEK 28143a (obsolete)
- Siemens Power Generation TLV 9013 04 (approved), TLV 9013 05
- Siemens Westinghouse 21T0591 (obsolete), 55125Z3 (obsolete)
- Solar Turbines ES9-224, Rev. W, Class II Turbine Oil
- U.S. Military MIL-PRF-17672D, Symbol 2075 T-H (ISO VG 32), 2110 T-H (ISO VG 46), 2135 T-H (ISO VG 68)
- U.S. Steel 126

**Premium Rust
& Oxidation-
Inhibited, Anti-
Wear Turbine
Oil; Bulk Oil
Meets ISO
Cleanliness
Code 18/16/13**

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Features/Benefits

- Outstanding oxidation resistance and thermal stability for long service life
- Protects against sludge and varnish formation
- Excellent wear protection for gears and bearings
- Protects against rust and corrosion
- Excellent water-separating properties
- Resists the formation of emulsions and bacteria buildup
- Good foam resistance
- Meets ISO Cleanliness Code rating of 18/16/13 ⁽¹⁾

⁽¹⁾Note: Applies only to bulk product as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

Diamond Class® AW Turbine Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.862	0.868	0.872
Density, lbs/gal @ 60°F	7.18	7.23	7.26
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	220 (428)	231 (448)	243 (469)
Pour Point, °C (°F)	-39 (-38)	-36 (-33)	-30 (-22)
Viscosity			
cSt @ 40°C	32.0	46.0	68.0
cSt @ 100°C	5.4	6.8	8.8
SUS @ 100°F	165	237	352
SUS @ 210°F	44.4	49.0	55.9
Viscosity Index	102	102	102
Acid Number, ASTM D974, mg KOH/g	0.14	0.14	0.10
Air Release, ASTM D3427, minutes	2.2	2.2	2.2
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15	15
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Four-Ball Wear, ASTM D4172, Scar Diameter, mm	0.50	0.50	0.50
FZG Scuffing Test, ASTM D5182, Failure Load Stage	10	10	10
Oxidation Stability			
TOST, ASTM D943-04a, hours	>24,000	>24,000	>24,000
RPVOT, ASTM D2272, minutes	>1,700	>1,700	>1,700
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Cleanliness Code, ISO 4406:1999	18/16/13	18/16/13	18/16/13

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

03-06-17

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LUBRICANTS

Diamond Class® Turbine Oil

Phillips 66® Diamond Class Turbine Oil is a premium quality, rust and oxidation (R&O)-inhibited turbine oil developed for use in gas turbines and steam turbines in severe service. It is specially formulated to protect against sludge and varnish formation in new-generation gas turbines.

Diamond Class Turbine Oil is formulated with premium hydrocracked base oils and specially tailored additives to provide outstanding oxidation resistance and deposit control, resulting in long service life and significant cost savings to power generation customers. It minimizes the formation of harmful sludge and varnish deposits, especially in servo valves and IGV valves where oil flow rate is low and the oil is subjected to cyclic temperatures common in peaking gas turbines. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions and bacteria buildup, and is resistant to excessive foam buildup that can interfere with proper lubrication and lead to premature bearing wear.

Diamond Class Turbine Oil is filtered to an ISO Cleanliness Code of 18/16/13 for use in circulating systems with tight tolerances where particle contamination can cause operational problems. The bulk oil is filtered at the blending terminal prior to filling any package containers, and is filtered again upon delivery in bulk to the customer's bulk tank.

Applications

- Direct-drive, combined-cycle and co-generation gas turbines ⁽¹⁾
- Direct-drive steam turbines ⁽¹⁾

⁽¹⁾**Note:** For turbines with gear drives, use Diamond Class AW Turbine Oil.

Diamond Class Turbine Oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- Alstom Power HTGD 90 117, for turbines without gear drives
- ASTM D4304-06a, Type I Turbine Oil
- ASTM D4304-06a, Type III Turbine Oil
- British Standard 489
- Cincinnati Machine P-38 (ISO VG 32)
- DIN 51515 Part 1, Lubricating Oils, Type L-TD
- DIN 51515 Part 2, Lubricating Oils, Type L-TG
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- Elliott ring-oiled turbines, where mineral-based turbine oil is specified
- General Electric GEK 101941a, GEK 107395a, GEK 32568j, GEK 46506e, GEK 27070 (obsolete), GEK 28143b (obsolete)
- ISO 8068, Type L-TGB, Type L-TGSB
- Siemens Power Generation TLV 9013 04 (approved), TLV 9013 05
- Siemens Westinghouse 21T0591 (obsolete), 55125Z3 (obsolete)
- U.S. Military MIL-PRF-17672D, Symbol 2075 T-H (ISO VG 32), 2110 T-H (ISO VG 46), 2135 T-H (ISO VG 68)
- U.S. Steel 126

Premium Long-Life, Rust & Oxidation-Inhibited Turbine Oil; Bulk Oil Meets ISO Cleanliness Code 18/16/13

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Features/Benefits

- Outstanding oxidation resistance and thermal stability for long service life
- Outstanding control of sludge and varnish formation in base-loaded and peaking turbines
- Protects against rust and corrosion
- Excellent water-separating properties
- Resists the formation of emulsions and bacteria buildup
- Good foam resistance
- Meets ISO Cleanliness Code rating of 18/16/13⁽²⁾

⁽²⁾**Note:** Applies only to bulk product as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

Diamond Class® Turbine Oil

Typical Properties			
ISO Grade	32	46	68
Specific Gravity @ 60°F	0.862	0.868	0.872
Density, lbs/gal @ 60°F	7.18	7.23	7.26
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	220 (428)	234 (453)	243 (469)
Pour Point, °C (°F)	-40 (-40)	-36 (-33)	-30 (-22)
Viscosity			
cSt @ 40°C	31.7	46.0	68.0
cSt @ 100°C	5.4	6.8	8.8
SUS @ 100°F	163	237	352
SUS @ 210°F	44.4	49.0	55.9
Viscosity Index	104	102	102
Acid Number, ASTM D974, mg KOH/g	0.10	0.10	0.10
Air Release, ASTM D3427, minutes	0.8	1.7	1.7
Copper Corrosion, ASTM D130	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	15	15	15
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Oxidation Stability			
TOST, ASTM D943-04a, hours	>35,000	>35,000	>35,000
RPVOT, ASTM D2272, minutes	>1,700	>1,700	>1,700
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Cleanliness Code, ISO 4406:1999	18/16/13	18/16/13	18/16/13

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Syncon® Turbine Oil

Phillips 66® Syncon Turbine Oil is a premium quality, synthetic lubricant developed for use in land-based gas turbines operating over a wide temperature range, where the manufacturer calls for a synthesized hydrocarbon (SHC) or PAO based turbine oil.

Syncon Turbine Oil is formulated with synthetic polyalphaolefin (PAO) base oils and select additives to provide outstanding performance and protection in gas turbines. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has high load-carrying capacity to protect against wear. It protects system components against rust and corrosion, and is resistant to excessive foam buildup that can interfere with proper lubrication. It has a high viscosity index and a very low pour point for use over a wide temperature range.

Applications

- Land-based gas turbines

Syncon Turbine Oil meets the requirements of the following OEM specification:

- Solar Turbines ES 9-224, Revision Y, Class I (Synthesized Hydrocarbon) Turbine Oil⁽¹⁾

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent low-temperature fluidity
- High viscosity index and very low pour point for use over a wide temperature range
- Low volatility for lower oil consumption and less makeup oil
- Protects against wear
- Protects against rust and corrosion
- Good foam resistance
- Extended service intervals compared with conventional mineral oil-based lubricants

⁽¹⁾ In order to meet the ES 9-224 cleanliness specification, the fluid may need to be filtered prior to reservoir introduction

Note: For information on compatibility with seals, paints and plastics, please call our Technical Support Hotline.

Synthetic PAO-Based Turbine Oil





Syncon® Turbine Oil

Typical Properties		
ISO Grade	32	46
Specific Gravity @ 60°F	0.841	0.846
Density, lbs/gal @ 60°F	7.00	7.04
Color, ASTM D1500	0.5	0.5
Flash Point (COC), °C (°F)	254 (489)	260 (500)
Pour Point, °C (°F)	-57 (-71)	-42 (-44)
Viscosity		
cSt @ 40°C	32.0	42.4
cSt @ 100°C	6.0	7.5
SUS @ 100°F	164	197.7
SUS @ 210°F	46.3	50.8
Viscosity Index	136	145
Acid Number, ASTM D974, mg KOH/g	0.36	0.42
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a
Demulsibility, ASTM D1401, minutes to pass	10	10
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0
Four-Ball Wear Test, ASTM D4172, Scar Diameter, mm	0.40	0.40
FZG Scuffing Test, ASTM D5182, Failure Load Stage	8	8
Oxidation Stability, RPVOT, ASTM D2272, minutes	1,600	1,600
Rust Test, ASTM D665 A&B	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Syndustrial® Turbine Oil

Phillips 66® Syndustrial Turbine Oil is a premium quality synthetic lubricant developed to meet the severe lubrication requirements of aero-derivative stationary and marine gas turbines.

Syndustrial Turbine Oil is formulated with synthetic polyol ester (POE) base oils and select ashless additives to provide outstanding performance and protection in gas turbines. It has outstanding oxidation resistance and thermal stability at high temperatures to minimize deposit formation and provide long service life. It has high load-carrying capacity and excellent affinity for metal surfaces to protect against wear. It has natural detergency for improved cleanliness, and protects against rust and corrosion. It also has excellent low-temperature properties for use over a wide temperature range.

Applications

- Aero-derivative gas turbines

Syndustrial Turbine Oil meets the requirements of the following industry and OEM specification:

- Allison 501-k, 571-k
- General Electric GEK 97310, LM Series 500 to 6000
- Rolls-Royce RB211, Avon, Olympus, Spey and Tyne turbines
- Solar Turbines ES9-224, Revision W, Class III (Synthesized Ester) Turbine Oil
- U.S. Military MIL-PRF-23699F, Class STD Synthetic Turbine Oil

Features/Benefits

- Outstanding oxidation resistance and thermal stability at high temperatures
- Excellent low-temperature fluidity
- High load-carrying capacity
- Protects against rust and corrosion
- Natural detergency
- High flash point for reduced fire/explosion hazard
- Extended service intervals compared with conventional mineral-oil based lubricants

Note: Syndustrial Turbine Oil can be used as top-off for existing competitive polyol ester turbine oils of the same quality. For information on compatibility with seals, paints and plastics, please call our Technical Support Hot Line.

**Synthetic Polyol
Ester Lubricant
for Land-Based
Industrial &
Marine Gas
Turbines**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Syndustrial® Turbine Oil

Typical Properties	
ISO Grade	22/32
Specific Gravity @ 60°F	0.994
Density, lbs/gal @ 60°F	8.28
Color, ASTM D1500	4.0
Flash Point (COC), °C (°F)	266 (511)
Pour Point, °C (°F)	-60 (-76)
Viscosity	
cSt @ 40°C	25.5
cSt @ 100°C	5.1
SUS @ 100°F	132
SUS @ 210°F	43
Viscosity Index	132
Acid Number, SAE ARP 5088, mg KOH/g	0.18
Copper Corrosion, ASTM D130	1a
Foam Test, ASTM D892	
Sequence I, mL	5/0
Sequence II, mL	5/0
Sequence III, mL	10/0
Particle Contamination, NAS 1639, max	6
Rust Test, ASTM D665 A&B	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

Turbine Oil

Phillips 66® Turbine Oil is a very high quality, rust and oxidation (R&O)-inhibited circulating oil developed for use in industrial steam turbines, rotary air compressors, and many other industrial applications. It is specially formulated to provide a very high level of oxidation resistance for long service life.

Turbine Oil is formulated to provide excellent protection against rust, corrosion, and deposit formation. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Applications

- Direct-drive steam turbines and hydroelectric turbines
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Centrifugal and rotary air compressors
- Lightly loaded enclosed gear drives where the OEM specifies a R&O type oil (ISO VG 68, 100)
- Electric motor bearings, fan bearings, and blower bearings
- Vacuum pumps, deep-well water pumps, and machine tools

Turbine Oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- Alstom Power HTGD 90 117, for turbines without gear drives
- Ansaldo Energia AE94.3A & AE94.2 without gear drives (ISO VG 46) (approved)
- ANSI/AGMA Standard 9005-E02, R&O Inhibited Oils
- ASTM D4304-06a, Type I Turbine Oil
- British Standard 489
- China National Standard GB 11120-2011 L-TSA (ISO VG 32 & 68) (approved)
- Denison Hydraulics HF-1
- DIN 51515 Part 1, Lubricating Oils, Type L-TD
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- General Electric GEK 46506e, GEK 32568j, GEK 27070 (obsolete), GEK 28143b (obsolete)
- Siemens Power Generation TLV 9013 04, TLV 9013 05
- U.S. Military MIL-PRF-17672D, Symbol 2075 T-H (ISO VG 32), 2110 T-H (ISO VG 46), 2135 T-H (ISO VG 68)
- U.S. Steel 126

**Long-Life, Rust
& Oxidation-
Inhibited
Circulating Oil**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Features/Benefits

- Excellent oxidation resistance and thermal stability for long service life
- Protects against sludge and varnish formation
- Protects against rust and corrosion
- Excellent water-separating properties
- Low carbon-forming tendency for use in air compressors
- Good foam resistance

Turbine Oil

Typical Properties				
ISO Grade	32	46	68	100
AGMA Grade	0	1	2	3
Specific Gravity @ 60°F	0.862	0.868	0.873	0.870
Density, lbs/gal @ 60°F	7.18	7.23	7.27	7.24
Color, ASTM D1500	0.5	0.5	0.5	0.5
Flash Point (COC), °C (°F)	220 (428)	232 (450)	243 (469)	277 (531)
Pour Point, °C (°F)	-37 (-35)	-33 (-27)	-27 (-17)	-24 (-11)
Viscosity				
cSt @ 40°C	31.8	46.0	68.0	100
cSt @ 100°C	5.4	6.7	8.8	11.3
SUS @ 100°F	164	238	352	522
SUS @ 210°F	44.4	48.7	55.9	65.0
Viscosity Index	103	97	102	99
Acid Number, ASTM D974, mg KOH/g	0.08	0.08	0.08	0.08
Air Release, ASTM D3427, minutes	0.8	2.0	2.0	2.0
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	20	20	25
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0	0/0
Oxidation Stability				
TOST, ASTM D943-04a, hours	>15,000	>15,000	>15,000	>15,000
RPVOT, ASTM D2272, minutes	>1,200	>1,200	>1,200	>1,200
Rust Test, ASTM D665 A&B	Pass	Pass	Pass	Pass

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Ultra-Clean Turbine Oil

Phillips 66® Ultra-Clean Turbine Oil is a very high quality, rust and oxidation (R&O)-inhibited circulating oil developed for use in industrial gas turbines and steam turbines, and in many other industrial applications. It provides the same performance features and long service life as Turbine Oil plus the added benefit of filtration to a typical ISO Cleanliness Code of 18/16/13, for use in circulating systems with tight tolerances where particle contamination can cause operational problems.

Ultra-Clean Turbine Oil is formulated to provide excellent protection against rust, corrosion and deposit formation. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It protects system components against rust and corrosion. It has excellent water-separating properties to minimize the formation of emulsions, and is resistant to excessive foam buildup that can interfere with proper lubrication.

Applications

- Direct-drive steam turbines and hydroelectric turbines
- Air tools and other pneumatic equipment lubricated through air line lubricators
- Centrifugal and rotary air compressors
- Lightly loaded enclosed gear drives where the OEM specifies a R&O type oil (ISO VG 68)
- Electric motor bearings, fan bearings, and blower bearings
- Vacuum pumps, deep-well water pumps, and machine tools

Ultra-Clean Turbine Oil meets the requirements of the following industry and OEM specifications:

- ABB G12106
- Alstom Power HTGD 90 117, for turbines without gear drives
- Ansaldo Energia AE94.3A & AE94.2 without gear drives (ISO VG 46)
- ANSI/AGMA Standard 9005-E02, R&O Inhibited Oils
- ASTM D4304-06a, Type I Turbine Oil
- British Standard 489
- China National Standard GB 11120-2011 L-TSA (ISO VG 32 & 68) (approved)
- Denison Hydraulics HF-1
- DIN 51515 Part 1, Lubricating Oils, Type L-TD
- DIN 51517 Part 2, Lubricating Oils, Type CL
- DIN 51524 Part 1, Hydraulic Oils, Type HL
- General Electric GEK 46506e, GEK 32568j, GEK 27070 (obsolete), GEK 28143b (obsolete)
- Siemens Power Generation TLV 9013 04, TLV 9013 05
- U.S. Military MIL-PRF-17672D, Symbol 2075 T-H (ISO VG 32), 2110 T-H (ISO VG 46), 2135 T-H (ISO VG 68)
- U.S. Steel 126

**Long-Life, Rust
& Oxidation-
Inhibited
Circulating
Oil; Meets ISO
Cleanliness
Code 18/16/13**

**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**





Features/Benefits

- Excellent oxidation resistance and thermal stability for long service life
- Protects against sludge and varnish formation
- Protects against rust and corrosion
- Excellent water-separating properties
- Low carbon-forming tendency for use in air compressors
- Good foam resistance
- Meets ISO Cleanliness Code rating of 18/16/13⁽¹⁾

⁽¹⁾**Note:** Applies only to unopened packaged containers as delivered from Phillips 66® manufacturing plants. Particle counts may vary from lab to lab.

Ultra-Clean Turbine Oil

Typical Properties			
ISO Grade	32	46	68
AGMA Grade	0	1	2
Specific Gravity @ 60°F	0.862	0.868	0.873
Density, lbs/gal @ 60°F	7.18	7.23	7.27
Color, ASTM D1500	0.5	0.5	0.5
Flash Point (COC), °C (°F)	220 (428)	232 (450)	243 (469)
Pour Point, °C (°F)	-37 (-35)	-33 (-27)	-27 (-17)
Viscosity			
cSt @ 40°C	31.8	46.0	68.0
cSt @ 100°C	5.4	6.7	8.8
SUS @ 100°F	164	238	352
SUS @ 210°F	44.4	48.7	55.9
Viscosity Index	103	97	102
Acid Number, ASTM D974, mg KOH/g	0.08	0.08	0.08
Air Release, ASTM D3427, minutes	0.8	2.0	2.0
Copper Corrosion, ASTM D130, 48 hrs @ 80°C	1a	1a	1a
Demulsibility, ASTM D1401, minutes to pass	20	20	20
Foam Test, ASTM D892, Seq. I, mL	0/0	0/0	0/0
Oxidation Stability			
TOST, ASTM D943-04a, hours	>15,000	>15,000	>15,000
RPVOT, ASTM D2272, minutes	>1,200	>1,200	>1,200
Rust Test, ASTM D665 A&B	Pass	Pass	Pass
Cleanliness Code, ISO 4406:1999	18/16/13	18/16/13	18/16/13

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

07-12-16

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LUBRICANTS

POWER TRANSMISSION FLUIDS



LUBRICANTS

CVT Fluid

Phillips 66® CVT Fluid is a premium quality, full-synthetic transmission fluid specifically designed for use in passenger cars with belt-driven continuously variable transmissions. It has been specifically engineered to have the unique frictional properties required for use in this type transmission.

CVT Fluid has carefully balanced frictional properties to protect against belt slippage and wear while also providing excellent anti-shudder performance. It has high shear stability and excellent oxidation resistance for long service life. It helps protect against sludge and varnish formation, and has excellent low-temperature properties for easier shifting in cold weather. The synthetic formulation provides enhanced performance benefits at extreme temperatures compared with conventional, all-mineral transmission fluids.

CVT Fluid is recommended for most Honda, Jeep, Mitsubishi, Nissan (except Altima hybrid) and Suzuki vehicles with CVT transmissions. It is not recommended for eCVT or most chain-driven CVT transmissions, or in any non-CVT transmission. Please refer to the owner's manual for correct transmission fluid recommendation.

Applications

- Passenger cars with belt-driven continuously variable transmissions (CVTs)

Features/Benefits

- Meets performance requirements for nearly all vehicles with belt-type continuously variable transmissions
- High steel-on-steel friction to prevent belt slippage, which can result in high or even catastrophic wear
- Low steel-on-paper friction to prevent torque converter clutch slippage, which can result in shudder
- Excellent oxidation resistance and thermal stability for long fluid life
- Protects against sludge and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Excellent low-temperature properties for easier shifting in cold weather
- Good seal compatibility
- Good foam resistance

**Full-Synthetic
Automatic
Transmission
Fluid for
Belt-Driven
Continuously
Variable
Transmissions**

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SMOOTHLY. 



CVT Fluid

Typical Properties	
Specific Gravity @ 60°F	0.864
Density, lbs/gal @ 60°F	7.20
Color, Visual	Amber
Flash Point (COC), °C (°F)	196 (385)
Pour Point, °C (°F)	<-45 (<-49)
Viscosity, Brookfield	
cP @ -40°C	10,300
Viscosity, Kinematic	
cSt @ 40°C	33.9
cSt @ 100°C	7.3
Viscosity Index	189
Zinc, wt %	<0.001

Health Safety Information

For recommendations on safe handling and use of this product, please refer to the Material Safety Data Sheet via <http://3apps.phillips66.com/NetMSDS>.



LUBRICANTS

PowerDrive® Fluid

Phillips 66® PowerDrive Fluid is a high-performance multi-functional fluid developed for use in transmissions, final drives and hydraulic systems of off-highway equipment where a fluid meeting Caterpillar TO-4 performance requirements is specified. It provides substantially improved friction and antiwear performance compared with older API CD/TO-2 quality fluids, resulting in longer equipment life and reduced risk of field failure. The SAE 10W and 30 viscosity grades also are recommended for use in Allison off-highway heavy-duty automatic transmissions where a C-4 quality fluid is specified.

PowerDrive Fluid is formulated with state-of-the-art additive technology that provides improved deposit control, corrosion protection and load-carrying capacity for better equipment protection and more reliable operation. Its carefully optimized frictional properties prevent clutch slippage for smoother, more consistent transmission operation and also provide improved wet brake performance.

Applications

- Powershift transmissions, hydrostatic transmissions, torque converters, final drives and hydraulic systems of Caterpillar, Euclid, Komatsu and other off-highway construction and mining equipment
- Heavy-duty automatic transmissions where the OEM specifies an Allison C-4 quality fluid
- Heavy-duty manual and semi-automatic transmissions in trucks and buses where the OEM specifies a Caterpillar TO-4 quality fluid or a heavy-duty engine oil

Note: Typically, the SAE 10W and 30 viscosity grades are recommended for hydraulic systems and transmissions, and the SAE 50 viscosity grade is recommended for differentials, final drives and heavy-duty manual transmissions. Refer to the OEM recommendations for selection of the proper viscosity grade.

PowerDrive Fluid SAE 30 is OEM-approved for service fill in the following applications:

- Allison TES-439, for off-highway applications (approval no. 439-33372012)

PowerDrive Fluid meets or exceeds the requirements of:

- Caterpillar TO-4, TO-2⁽¹⁾
- Vickers (Eaton) M-2950-S

⁽¹⁾Obsolete specification.

Caterpillar TO-4 Fluid for Off-Highway Equipment

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PowerDrive Fluid is recommended for service fill in:

- ZF torque converter transmissions in off-highway equipment where the OEM specifies a TE-ML 03C quality lubricant (SAE 10W, 30)

Features/Benefits

- Well-balanced frictional properties for efficient clutch operation and improved wet brake performance
- Excellent oxidation resistance and thermal stability for long fluid life
- High load-carrying capacity for protection of final drive gear sets
- Excellent deposit control and wear protection
- Protects yellow metals against corrosion
- High shear stability
- Compatible with a wide variety of seals and friction materials
- Good low-temperature properties
- Good foam resistance

PowerDrive® Fluid

Typical Properties				
SAE Grade	10W	30	50	60
Specific Gravity @ 60°F	0.875	0.857	0.861	0.896
Density, lbs/gal @ 60°F	7.29	7.34	7.43	7.46
Color, ASTM D1500	2.5	3.0	4.0	5.5
Flash Point (COC), °C (°F)	213 (415)	233 (451)	242 (468)	281 (538)
Pour Point, °C (°F)	-39 (-38)	-33 (-27)	-28 (-18)	-12 (10)
Viscosity, Brookfield				
cP @ -35°C	45,500	---	---	---
Viscosity, Kinematic				
cSt @ 40°C	43.0	96.0	227	318
cSt @ 100°C	6.6	11.1	19.1	24.0
Viscosity Index	105	101	95	96
Total Base Number (TBN), ASTM D2896	7.6	7.6	7.6	7.6
Zinc, wt %	0.110	0.110	0.110	0.110

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

PowerDrive® Fluid 6000

Phillips 66® PowerDrive Fluid 6000 is a high-performance lubricant specially designed for use in the final drives and axles of Caterpillar off-highway equipment. It is formulated with advanced additive technology to provide improved gear and bearing life in final drives and axles. It meets the performance requirements of the Caterpillar FD-1 specification for Final Drive and Axle Oil (FDAO).

PowerDrive Fluid 6000 provides significantly improved wear protection and oxidation control compared with Caterpillar TO-4 fluids, allowing extension of drain intervals under normal operating conditions. It may be used as a direct replacement for the original Caterpillar FDAO fill fluid.

Applications

PowerDrive Fluid 6000 is recommended for use in certain highly loaded Caterpillar final drives and axles that do not contain friction materials. It is not recommended for use in engines, transmissions or hydraulic systems, and should not be used in compartments with friction materials unless Caterpillar FDAO or FD-1 quality oil is specified.

PowerDrive Fluid 6000 meets or exceeds the requirements of:

- Caterpillar FD-1

Note: Follow Caterpillar recommendations for preferred viscosity grade and ambient temperature ranges. At very low ambient temperatures, warm-up is required prior to equipment operation.

Features/Benefits

- Improved bearing life and gear life compared with TO-4 fluids
- Excellent oxidation resistance and thermal stability for long fluid life
- Protects against pitting, scuffing and wear
- Protects against rust and copper corrosion
- Compatible with a wide variety of seals
- Good foam resistance

**Final Drive &
Axle Oil for
Caterpillar
Off-Highway
Equipment**

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SMOOTHLY. 



LUBRICANTS

PowerDrive® Fluid 6000

Typical Properties	
SAE Grade	60
Specific Gravity @ 60°F	0.897
Density, lbs/gal @ 60°F	7.47
Color, ASTM D1500	5
Flash Point (COC), °C (°F)	190 (374)
Pour Point, °C (°F)	-18 (0)
Viscosity, Kinematic	
cSt @ 40°C	344
cSt @ 100°C	25.8
Viscosity Index	98
High-Temp/High-Shear Viscosity, cP @ 150°C	6.6
Copper Corrosion, ASTM D130	1a
Sulfated Ash, ASTM D874, wt %	0.126
Total Base Number (TBN), ASTM D2896	3.2
Zinc, wt %	Nil

Health & Safety Information

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LUBRICANTS

PowerDrive® Synthetic All Season TO-4 Fluid

Phillips 66® PowerDrive Synthetic All Season TO-4 Fluid is a premium quality, synthetic, multi-functional fluid developed for use in transmissions, final drives and hydraulic systems of off-highway equipment where a fluid meeting Caterpillar TO-4 performance requirements is specified. It is a multigrade fluid particularly recommended for equipment operating in very cold temperatures as well as year-round service in most climates.

PowerDrive Synthetic All Season TO-4 Fluid is formulated with synthetic polyalphaolefin (PAO) base stocks and state-of-the-art additive technology that reduces deposits on critical parts, provides improved yellow metal protection, and increases load-carrying capacity for enhanced performance and more reliable operation. Its carefully optimized frictional properties prevent clutch slippage for smoother, more consistent transmission operation and also provide improved wet brake performance. The synthetic base stocks provide improved low-temperature performance for easier starting in frigid climates and better thermal stability at high temperatures for extended lubricant life under severe operating conditions.

Applications

- Powershift transmissions, hydrostatic transmissions, torque converters, final drives and hydraulic systems of Caterpillar, Euclid, Komatsu and other off-highway construction and mining equipment
- Heavy-duty automatic transmissions where the OEM specifies an Allison C-4 quality fluid
- Heavy-duty manual and semi-automatic transmissions in trucks and buses where the OEM specifies a Caterpillar TO-4 quality fluid or a heavy-duty engine oil

CAUTION: Refer to the OEM recommendations for recommended temperature ranges.

PowerDrive Synthetic All Season TO-4 Fluid meets or exceeds the requirements of:

- Caterpillar TO-4

**Synthetic
Multigrade
Caterpillar
TO-4 Fluid for
Off-Highway
Equipment**

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Features/Benefits

- Synthetic formulation for enhanced performance in arctic temperatures
- Well-balanced frictional properties for smooth and efficient clutch operation
- Outstanding oxidation resistance and thermal stability for long fluid life
- High load-carrying capacity for protection of final drive gear sets
- Excellent deposit control and wear protection
- Protects yellow metals against corrosion
- High shear stability
- Compatible with a wide variety of seals and friction materials
- Excellent low-temperature properties for easier starting at low ambient temperatures
- Good foam resistance
- Suitable for year-round use in most climates

PowerDrive® Synthetic All Season TO-4 Fluid

Typical Properties	
SAE Grade	5W-30
Specific Gravity @ 60°F	0.854
Density, lbs/gal @ 60°F	7.11
Color, ASTM D1500	2.0
Flash Point (COC), °C (°F)	260 (500)
Pour Point, °C (°F)	-53 (-63)
Viscosity, Brookfield	
cP @ -40°C	27,700
Viscosity, Kinematic	
cSt @ 40°C	59.7
cSt @ 100°C	10.3
Viscosity Index	162
Total Base Number (TBN), ASTM D2896	7.6
Zinc, wt %	0.110

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

PowerDrive® Synthetic Arctic TO-4 Fluid

Phillips 66® PowerDrive Synthetic Arctic TO-4 Fluid is a premium quality, synthetic, multigrade fluid specially developed for use in off-highway equipment operating in arctic climates where a fluid meeting Caterpillar TO-4 performance requirements is specified. It is a multi-functional fluid for use in transmissions, final drives, hydraulic systems and wet brakes. It is not for use in engines.

PowerDrive Synthetic Arctic TO-4 Fluid is formulated with synthetic polyalphaolefin (PAO) base stocks and state-of-the-art additive technology that reduces deposits on critical parts, provides improved yellow metal protection, and increases load-carrying capacity for enhanced performance and more reliable operation. Its carefully optimized frictional properties prevent clutch slippage for smoother, more consistent transmission operation and also provide improved wet brake performance. The synthetic base stocks provide improved low-temperature performance for easier starting in frigid climates and better thermal stability at high temperatures for extended lubricant life under severe operating conditions.

Applications

- Powershift transmissions, hydrostatic transmissions, torque converters, final drives and hydraulic systems of Caterpillar, Euclid, Komatsu and other off-highway construction and mining equipment operating in arctic climates

CAUTION: Refer to the OEM recommendations for recommended temperature ranges.

PowerDrive Synthetic Arctic TO-4 Fluid meets or exceeds the requirements of:

- Caterpillar TO-4

**Synthetic
Multigrade
Caterpillar TO-4
Fluid for Arctic
Climates**

KEEPING THE
WORLD
RUNNING
SMOOTHLY. 



Features/Benefits

- Synthetic formulation for enhanced performance in arctic temperatures
- Well-balanced frictional properties for smooth and efficient clutch operation
- Outstanding oxidation resistance and thermal stability for long fluid life
- High load-carrying capacity for protection of final drive gear sets
- Excellent deposit control and wear protection
- Protects yellow metals against corrosion
- High shear stability
- Compatible with a wide variety of seals and friction materials
- Excellent low-temperature properties for easier starting at low ambient temperatures
- Good foam resistance

PowerDrive® Synthetic Arctic TO-4 Fluid

Typical Properties	
SAE Grade	0W-20
Specific Gravity @ 60°F	0.851
Density, lbs/gal @ 60°F	7.09
Color, ASTM D1500	2.0
Flash Point (COC), °C (°F)	260 (500)
Pour Point, °C (°F)	-53 (-63)
Viscosity, Brookfield	
cP @ -40°C	12,700
Viscosity, Kinematic	
cSt @ 40°C	40.5
cSt @ 100°C	7.9
Viscosity Index	171
Total Base Number (TBN), ASTM D2896	7.6
Zinc, wt %	0.110

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

PowerTran™ Fluid

Phillips 66® PowerTran Fluid is a multi-functional fluid specially formulated for use in farm tractors and other off-highway equipment requiring one lubricant for the transmission, final drive, wet brakes and hydraulic systems. It meets the performance requirements of all major brands of farm tractors and other farm equipment that utilize a common fluid reservoir.

PowerTran Fluid is formulated to provide excellent oxidation resistance, excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has carefully balanced frictional properties to ensure proper operation of wet brakes and transmission clutches.

PowerTran Fluid is available in two viscosity grades for use over a wide range of temperatures. The heavier viscosity grade is suitable for year-round use in most climates, whereas the "Low Viscosity" grade is recommended for use in cold climates where a John Deere J20D fluid is specified.

Applications

PowerTran Fluid is recommended for use where the equipment manufacturer specifies:

- AGCO Power Fluid 821XL, Q-1826, Q-1802 (Type 55 Fluid), Q-1766B
- Case IH MS1210, MS1209, MS1207, MS1206
- Case New Holland (CNH) MAT3525 (134-D Fluid), MAT3506, MAT3505
- Caterpillar TO-2 (obsolete)
- Denison Hydraulics HF-0, HF-1, HF-2
- Ford ESN-M2C134-D, ESN-M2C86-C, ESN-M2C86-B, ESN-M2C41-B
- Ford-New Holland FNHA-2-C-201.00
- John Deere JDM J20C, J20D ("Low Viscosity" grade), J14C (Type 303 Fluid)
- Kubota UDT Fluid
- Landini Tractor II Hydraulic Fluid
- Massey Ferguson CMS M1145/M1143, M1141, M1135, M1129A
- Sundstrand Hydrostatic Transmission Fluid
- Vickers (Eaton) M-2950-S, I-286-S
- Volvo VME WB 101 (VCE 1273.03)
- ZF TE-ML 03E, 05F, 17E, 21F

PowerTran Fluid also meets API GL-4 performance requirements.

**Multipurpose
Hydraulic/
Transmission/
Final Drive
Fluid for Farm
Tractors**

KEEPING THE
WORLD
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SMOOTHLY. 



Features/Benefits

- Excellent oxidation resistance and thermal stability
- Excellent wear protection for clutches, gears and hydraulic pumps
- Prevents brake chatter and grabbing
- Protects against rust and corrosion
- Excellent seal compatibility
- Good foam resistance
- Two viscosity grades for use in most climates

PowerTran™ Fluid

Typical Properties		
SAE Grade		Low Vis
Specific Gravity @ 60°F	0.879	0.864
Density, lbs/gal @ 60°F	7.32	7.19
Color, ASTM D1500	3.5	3.5
Flash Point (COC), °C (°F)	210 (410)	190 (374)
Pour Point, °C (°F)	-43 (-45)	-51 (-60)
Viscosity, Brookfield		
cP @ -20°C	2,800	---
cP @ -35°C	26,700	---
cP @ -40°C	---	11,500
Viscosity, Kinematic		
cSt @ 40°C	61.0	34.3
cSt @ 100°C	9.4	7.4
Viscosity Index	135	190
Sulfated Ash, ASTM D874, wt %	1.41	1.41
Total Base Number (TBN), ASTM D2896	9.6	9.6
Zinc, wt %	0.149	0.149

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-14-2016

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LUBRICANTS

PowerTran™ XP

Phillips 66® PowerTran XP is a multi-functional fluid specially formulated for use in farm tractors and other off-highway equipment requiring one lubricant for the transmission, final drive, wet brakes and hydraulic systems. It meets the performance requirements of all major brands of farm tractors and other farm equipment that utilize a common fluid reservoir.

PowerTran XP is formulated to provide excellent oxidation resistance, excellent wear protection, protection against rust and corrosion, and resistance to foaming. It has carefully balanced frictional properties to ensure proper operation of wet brakes and transmission clutches.

PowerTran XP has increased shear stability for use in continuously variable transmissions used in agriculture tractors and machinery. Meets increased shear stability requirements by many OEMs to accommodate for higher power densities.

Applications

PowerTran XP is recommended for use where the equipment manufacturer specifies:

- AGCO Power Fluid 821XL, Q-1826, Q-1802 (Type 55 Fluid), Q-1766B
- Case IH MS1210, MS1209, MS1207, MS1206
- Case New Holland (CNH) MAT3525 (134-D Fluid), MAT3506, MAT3505, MAT3540
- Denison Hydraulics HF-0, HF-1, HF-2
- Ford ESN-M2C134-D, ESN-M2C86-C, ESN-M2C86-B, ESN-M2C41-B
- Ford-New Holland FNHA-2-C-201.00
- John Deere JDM J20C, J14C (Type 303 Fluid)
- Kubota UDT Fluid, Super UDT 2
- Landini Tractor II Hydraulic Fluid
- Massey Ferguson CMS M1145/M1143, M1141, M1135, M1129A
- Sundstrand Hydrostatic Transmission Fluid
- Vickers (Eaton) M-2950-S, I-286-S
- Volvo VME WB 101 (VCE 1273.03)
- ZF TE-ML 03E, 05F, 17E, 21F

PowerTran XP also meets API GL-4 performance requirements.

**Multipurpose
Hydraulic/
Transmission/
Final Drive
Fluid for Farm
Tractors**

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Features/Benefits

- Excellent oxidation resistance and thermal stability
- Excellent wear protection for clutches, gears and hydraulic pumps
- Prevents brake chatter and grabbing
- Protects against rust and corrosion
- Excellent seal compatibility
- Good foam resistance
- Improved shear stability

PowerTran™ XP

Typical Properties	
SAE Grade	
Specific Gravity @ 60°F	0.8776
Density, lbs/gal @ 60°F	7.31
Color, ASTM D1500	2
Flash Point (COC), °C (°F)	210 (410)
Pour Point, °C (°F)	-43 (-45)
Viscosity, Brookfield	
cP @ -20°C	4000
cP @ -35°C	26,694
Viscosity, Kinematic	
cSt @ 40°C	61.0
cSt @ 100°C	9.8
Viscosity Index	146
Sulfated Ash, ASTM D874, wt %	1.48
Total Base Number (TBN), ASTM D2896	9.6
Zinc, wt %	0.150

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

Super ATF

Phillips 66® Super ATF is a high-quality transmission fluid recommended for use in all domestic and import vehicles no longer under warranty where the OEM previously specified a GM DEXRON®-III H or Ford MERCON® fluid.

Super ATF is formulated to provide the proper frictional characteristics for smooth, quiet shifting in electronically controlled automatic transmissions. It has excellent oxidation resistance for long fluid life, excellent low-temperature properties for easy shifting in cold weather, protects against wear and helps minimize the formation of sludge and varnish.

Applications

- GM and Ford automatic transmissions in 2005 and earlier model-year vehicles that are no longer under warranty, where the OEM previously specified DEXRON®-III H, DEXRON®-II, DEXRON® or MERCON® ATF
- Import vehicles where DEXRON®-III H⁽¹⁾ or an earlier-generation DEXRON® fluid⁽¹⁾ is specified
- Allison heavy-duty off-highway automatic transmissions that require a C-4 quality fluid
- Hydraulic systems on industrial and mobile equipment operating over a wide temperature range

⁽¹⁾obsolete service category

Note: Super ATF is not recommended for use in newer automatic transmissions that require a GM DEXRON®-VI, Ford MERCON®LV, Ford MERCON®SP or Ford MERCON®V fluid for warranty coverage, or in continuously variable transmissions (CVTs).

Features/Benefits

- Proper frictional properties for smooth shifting and excellent anti-shudder performance
- Excellent thermal stability and oxidation resistance for long fluid life
- Excellent low-temperature properties
- Protects against wear
- Minimizes sludge and varnish deposits
- Protects against rust and corrosion
- Good seal compatibility
- Suitable for both automotive and industrial applications

Transmission Fluid for Older GM & Ford Automatic Transmissions

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Super ATF

Typical Properties	
Specific Gravity @ 60°F	0.861
Density, lbs/gal @ 60°F	7.17
Color, ASTM D1500	Red
Flash Point (COC), °C (°F)	212 (414)
Pour Point, °C (°F)	<-40 (<-40)
Viscosity, Brookfield	
cP @ -40°C	14,000
Viscosity, Kinematic	
cSt @ 40°C	32.1
cSt @ 100°C	7.0
Viscosity Index	188
Zinc, wt %	<0.003

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

09-14-16

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LUBRICANTS

Triton® Heavy Duty ATF

Phillips 66® Triton Heavy Duty ATF is a full-synthetic, heavy-duty automatic transmission fluid designed for use in truck and bus transmissions operating under severe service conditions or in extended drain intervals. It is particularly recommended by Phillips 66 Company for use in applications where the OEM specifies a fluid providing performance capability comparable to the Allison TES-295 specification.

Triton Heavy Duty ATF has excellent shear stability and high load-carrying ability to protect against viscosity breakdown and wear. It has excellent oxidation resistance and thermal stability to minimize the formation of sludge and varnish, and excellent friction durability to ensure smooth shifting and proper transmission performance for the life of the fluid. It also has outstanding low-temperature properties for year-round use, and protects against rust and corrosion.

Triton Heavy Duty ATF can provide extended drains up to 4 times the normal interval for a conventional all-mineral automatic transmission fluid. It was field-tested for over 100,000 miles in a fleet of city transit buses operating in severe stop-and-go service. During this test, it provided outstanding protection against wear, glazing and sludge and deposit formation, while maintaining excellent shift quality throughout the duration of the field test.

Applications

- Heavy-duty automatic transmissions in trucks and buses in extended drain or severe service, such as in intracity transit buses, intercity tour coaches, school buses, emergency vehicles, recreational vehicles, refuse vehicles and commercial utility vehicles

Triton Heavy Duty ATF is OEM-approved for service fill in:

- Allison automatic transmissions in off-highway applications where a C-4 fluid is specified (approval no. C4-32612008)

Triton Heavy Duty ATF is recommended for service fill in:

- Allison automatic transmissions in on-highway applications where a TES-295 quality fluid is specified
- Voith DIWA transmissions
- ZF Ecomat transmissions

Note: Triton Heavy Duty ATF is not OEM-approved by Allison under TES-295 certification, nor is it OEM-approved by Voith or ZF. Recommendations are based on demonstrated field test performance and testing against Allison C-4, Ford MERCON®V and GM DEXRON®-IIIH transmission fluid specification requirements.

**Premium
Synthetic,
Heavy-Duty,
Extended Drain
Automatic
Transmission
Fluid**

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Features/Benefits

- Excellent friction durability for smooth shifting throughout the service interval
- Outstanding oxidation resistance and thermal stability for long fluid life
- Protects against sludge and varnish formation
- Protects against wear
- High shear stability
- Protects against rust and corrosion
- Outstanding low-temperature properties for easier shifting in cold weather
- Good seal compatibility
- Good foam resistance

Triton[®] Heavy Duty ATF

Typical Properties	
Specific Gravity @ 60°F	0.846
Density, lbs/gal @ 60°F	7.04
Color, Visual	Red
Flash Point (COC), °C (°F)	230 (446)
Pour Point, °C (°F)	-55 (-67)
Viscosity, Brookfield	
cP @ -40°C	7,000
Viscosity, Kinematic	
cSt @ 40°C	34.0
cSt @ 100°C	7.4
Viscosity Index	193
Zinc, wt %	<0.003

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Triton® Synthetic MTF

Phillips 66® Triton Synthetic MTF (Manual Transmission Fluid) is a full-synthetic, fuel-efficient transmission lubricant designed for use in heavy-duty commercial manual transmissions operating in extreme temperatures and/or extended service intervals. It combines outstanding low-temperature properties with outstanding oxidation resistance and thermal stability at high temperatures to provide excellent all-climate, year-round performance. It provides improved fuel efficiency of up to 1.5% compared with previous-generation SAE 50 manual transmission fluids.

Triton Synthetic MTF has excellent shear stability and antiwear properties to protect synchronizers, reduce component wear and promote longer transmission life. It is particularly recommended for use in newer, higher torque manual transmissions coupled with increased horsepower engines. It is recommended for extended drain service in most heavy-duty manual transmissions, and is fully approved under the new Eaton PS-386 specification for extended drain service (up to 500,000 miles in linehaul service) in Eaton Roadranger® transmissions.

Applications

- Heavy-duty manual and semi-automatic transmissions in commercial vehicles where the OEM specifies a non-EP SAE 40 or SAE 50 API MT-1 transmission fluid, an API GL-1 SAE 90 gear oil, or an SAE 40 or SAE 50 heavy-duty engine oil

Triton Synthetic MTF meets or exceeds the requirements of:

- API Service MT-1
- Navistar MPAPS TMS 6816
- Mack TO-A Plus
- Meritor O-81

Triton Synthetic MTF is approved for service fill under the following OEM specification:

- Eaton PS-386 (supercedes Eaton PS-164 Rev 7)

Premium Full-Synthetic, Fuel-Efficient Heavy-Duty Manual Transmission Fluid, API MT-1; Eaton PS-386

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Features/Benefits

- Extended drain, all-season performance
- Outstanding oxidation resistance and thermal stability to minimize sludge and varnish formation
- Improved low-temperature properties for easier shifting in cold weather
- Improved fuel efficiency
- High shear stability
- High load-carrying capacity
- Protects against component wear and gear micropitting
- Protects against rust and corrosion
- Good foam resistance
- Excellent seal compatibility

Triton® Synthetic MTF

Typical Properties	
SAE Grade	40
Specific Gravity @ 60°F	0.850
Density, lbs/gal @ 60°F	7.08
Color, Visual	Amber
Flash Point (COC), °C (°F)	238 (460)
Pour Point, °C (°F)	-42 (-44)
Viscosity, Brookfield	7,000
cP @ -40°C	51,900
Viscosity, Kinematic	34.0
cSt @ 40°C	95.1
cSt @ 100°C	14.8
Viscosity Index	163

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.



LUBRICANTS

Type F ATF

Phillips 66® Type F ATF is specifically designed for use in automatic transmissions in passenger cars and light trucks manufactured by Ford Motor Company prior to 1977, and in many 1977-1981 models. It also is recommended for use in many Borg-Warner automatic transmissions and older Ford power steering units, as well as in the hydrostatic drive systems and hydraulic systems on certain farm equipment.

Type F ATF is formulated to provide the proper frictional characteristics for positive shifting with little or no slippage. It has excellent oxidation resistance and thermal stability at high temperatures to minimize sludge and varnish formation, and provide long service life. It provides good wear protection, protects against rust and corrosion, and has good foam resistance. It also has good low-temperature properties for easier shifting in cold weather.

Applications

- Service fill in all automatic transmissions and power steering units that require a fluid meeting the requirements of Ford specification ESW-M2C33-F
- Hydrostatic drive systems and hydraulic systems on certain farm equipment

Note: Type F ATF is not recommended for use in transmissions that require any other type of automatic transmission fluid besides Type F.

Type F ATF meets the requirements of:

- Ford ESW-M2C33-F (obsolete specification)

Features/Benefits

- Proper frictional properties for transmissions that require a fluid with high static friction
- Excellent oxidation resistance and thermal stability
- Protects against sludge and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Good low-temperature properties
- Good seal compatibility
- Good foam resistance

Ford Type F Automatic Transmission Fluid

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Type F ATF

Typical Properties	
Specific Gravity @ 60°F	0.864
Density, lbs/gal @ 60°F	7.20
Color, Visual	Red
Flash Point (COC), °C (°F)	210 (410)
Pour Point, °C (°F)	<-40 (<-40)
Viscosity, Brookfield	
cP @ -18°C	1,100
cP @ -40°C	21,300
Viscosity, Kinematic	
cSt @ 40°C	43.0
cSt @ 100°C	7.6
Viscosity Index	146
Zinc, wt %	0.048

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

VersaTrans® ATF

Phillips 66® VersaTrans® ATF is a premium quality, part-synthetic transmission fluid specially designed for use in automatic transmissions in most passenger cars and light trucks. It has been extensively field tested for use in most North American vehicles and in a wide variety of European and Japanese vehicles.

VersaTrans ATF has carefully balanced frictional properties for smooth shifting and excellent anti-shudder performance. It has high shear stability and excellent oxidation resistance for long service life. It provides excellent wear protection, helps protect against sludge and varnish formation, and has excellent low-temperature properties for easier shifting in cold weather. The part-synthetic formulation provides enhanced performance benefits at extreme temperatures compared with conventional, all-mineral transmission fluids.

VersaTrans ATF meets the requirements of the JASO M315, Class 1A performance standard developed by Japanese automakers for service fill automatic transmission fluids.

Applications

- Chrysler automatic transmissions, except continuously variable transmissions (CVTs)
- Ford automatic transmissions where MERCON® V or an earlier-generation MERCON fluid (obsolete) is specified
- GM automatic transmissions in 2005 and earlier vehicles, except those that require DEXRON®-VI for warranty coverage, or a CVT fluid
- Many import vehicles, including Acura, Audi, BMW, Honda, Hyundai, Infiniti, Kia, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Porsche, Saab, Saturn, Toyota, Volkswagen and Volvo⁽¹⁾
- Heavy-duty automatic and powershift transmissions in trucks and buses
- Hydraulic systems on industrial and mobile equipment operating over a wide temperature range

⁽¹⁾**Note:** VersaTrans ATF is not recommended for use in continuously variable transmissions (CVTs) or in most 6-speed or 7-speed automatic transmissions. For questions about a specific application, please call our Technical Support Hotline.

VersaTrans ATF is OEM-approved for service fill in the following applications:

- Ford MERCON V (License Nos. M5091007, M5091008, M5091009)
- Voith DIWA transmissions

**Synthetic Blend
Multi-Vehicle
Automatic
Transmission
Fluid**

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VersaTrans ATF is recommended for service fill in the following applications:

- Allison automatic transmissions in off-highway applications where a C-4 quality fluid is specified
- ZF Ecomat transmissions

VersaTrans ATF is recommended for service fill in:

- ZF torque converter transmissions in off-highway equipment where the OEM specifies a TE-ML-03C quality lubricant (SAE 10W, 30)

Features/Benefits

- Extensively field tested in a wide variety of domestic and import automatic transmissions
- Proper frictional properties for smooth shifting and excellent anti-shudder performance
- Excellent oxidation resistance and thermal stability for long fluid life
- Protects against sludge and varnish formation
- Protects against wear
- Protects against rust and corrosion
- Excellent low-temperature properties for easier shifting in cold weather
- Good seal compatibility
- Good foam resistance

VersaTrans® ATF

Typical Properties	
Specific Gravity @ 60°F	0.857
Density, lbs/gal @ 60°F	7.14
Color, Visual	Red
Flash Point (COC), °C (°F)	196 (385)
Pour Point, °C (°F)	<-45 (<-49)
Viscosity, Brookfield	
cP @ -40°C	10,200
Viscosity, Kinematic	
cSt @ 40°C	34.0
cSt @ 100°C	7.6
Viscosity Index	202
Zinc, wt %	<0.001

Health & Safety Information

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LUBRICANTS

VersaTrans® LV ATF

Phillips 66® VersaTrans® LV ATF is a full-synthetic, low-viscosity (LV) transmission fluid approved for use in passenger car and light truck automatic transmissions that require a Ford MERCON® LV or GM DEXRON®-VI fluid. It also is recommended for use in Toyota vehicles where a Type WS fluid is specified, and in many newer import vehicles.

VersaTrans LV ATF is specifically engineered to help ensure long service life and to provide consistent shift performance for the life of the fluid, as well as better shift performance under extreme operating conditions. It is highly shear stable and has excellent oxidation resistance for long fluid life. It provides excellent anti-shudder performance and has excellent low-temperature properties for easier shifting in cold weather. The low-viscosity fluid results in less frictional drag (churning loss) for improved transmission efficiency, thereby offering the potential for improved fuel economy performance.

VersaTrans LV ATF is recommended for use in many newer Ford, GM and Japanese vehicles where the manufacturer recommends MERCON LV, DEXRON-VI, AW-1, DW-1, SP-IV, Type T-IV or Type WS fluids. It is not recommended for use in dual clutch transmissions (DCTs), belt or chain-driven continuously variable transmissions (CVTs), or older transmissions that require a higher-viscosity fluid. Please refer to the owner's manual for correct fluid recommendation.

Applications

- Ford automatic transmissions and transaxles where a MERCON LV fluid is specified
- GM automatic transmissions where a DEXRON-VI, earlier-generation DEXRON or AW-1 fluid is specified
- Acura and Honda automatic transmissions where a Z1 or DW-1 fluid is specified
- Hyundai, Kia and Mitsubishi automatic transmissions where a SP-III or SP-IV type fluid is specified
- Toyota automatic transmissions where a Type T-IV (JWS 3309) or Type WS (JWS 3324) fluid is specified
- Hybrid vehicles with electronic continuously variable transmissions (eCVTs) where the OEM specifies a MERCON LV or Toyota Type WS fluid
- Hydraulic systems on industrial and mobile equipment operating over a wide temperature range

**Full-Synthetic,
Low-Viscosity
Automatic
Transmission
Fluid; Ford
MERCON® LV &
GM DEXRON®-VI
Approved**

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VersaTrans LV ATF is OEM-approved for service fill in applications where the OEM specifies:

- Ford MERCON® LV (License Nos. MLV140201, MLV140202, MLV140203)
- GM DEXRON®-VI (License No. J-60175)

Note: VersaTrans LV ATF is not recommended for use in Ford automatic transmissions that require a MERCON® SP, MERCON® V or Type F fluid.

Features/Benefits

- Outstanding friction durability for consistent shift performance for the life of the fluid
- Excellent oxidation resistance and thermal stability for long fluid life
- Protects against sludge and varnish formation
- Protects against rust, corrosion and wear
- High shear stability
- Excellent low-temperature properties for easier shifting in cold weather
- Good seal compatibility
- Good foam resistance
- Low viscosity for improved fuel economy performance

VersaTrans® LV ATF

Typical Properties	
Specific Gravity @ 60°F	0.845
Density, lbs/gal @ 60°F	7.03
Color, Visual	Red
Flash Point (COC), °C (°F)	220 (428)
Pour Point, °C (°F)	<-40 (<-40)
Viscosity, Brookfield	
cP @ -40°C	10,200
Viscosity, Kinematic	
cSt @ 40°C	29.2
cSt @ 100°C	5.9
Viscosity Index	152
Zinc, wt %	<0.001

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

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LUBRICANTS

AUTOMOTIVE COOLANTS



LUBRICANTS

Shield Coolant/Antifreeze

Phillips 66® Shield Coolant/Antifreeze provides extended life protection up to 5 years or 150,000 miles (when flushed and filled according to directions) and is compatible with any antifreeze/coolant used in any vehicle. Concentrate and prediluted 50/50 formulations are available.

**Universal Coolant/
Antifreeze FOR
USE IN ALL
VEHICLES**

Concentrate		
Composition	Typical Values	
Antifreeze Glycols	95.0%	
Corrosion Inhibitors	2.2%	
Total Water	2.8%	
Flash Point	250°F	
Weight per gallon at 60°F	9.35-9.45 lbs	
Silicates	<250 ppm	
Properties	Typical Values	ASTM Method
Chloride	25 ppm	D3634
Specific Gravity at 60°F	1.110-1.145	D1122
Ash Content	2.5%	D1119
pH	7.5-11.0	D1287
Reserve Alkalinity	6	D1121
Water mass %	2.8%	D1123
Freeze Point	-34°F	D1177
Boiling Point	265°F	D1120
Foam Test	150 mL vol., max 5 sec. break, max	D1881

50/50 Prediluted		
Composition	Typical Values	
Antifreeze Glycols	48.0%	
Corrosion Inhibitors	1.1%	
Total Water	49.0%	
Flash Point	-	
Weight per gallon at 60°F	8.8 lbs	
Silicates	<250 ppm	
Properties	Typical Values	ASTM Method
Chloride	33 ppm	D3634
Specific Gravity at 60°F	1.065	D1122
Ash Content	2.5%	D1119
pH	7.5-11.0	D1287
Reserve Alkalinity	3	D1121
Water mass %	49.0%	D1123
Freeze Point	-34°F	D1177
Boiling Point	265°F	D1120
Foam Test	150 mL vol., max 5 sec. break, max	D1881

Protection	Freeze-Up Protection	Boil-Over Protection*	Corrosion Protection
Minimum 50% Antifreeze 50% Water	-34°F	265°F	Meets or exceeds ASTM D3306 ASTM D4985
Maximum 70% Antifreeze 30% Water	-84°F	276°F	

*Using a 15lb. pressure cap in good condition

Protection	Freeze-Up Protection	Boil-Over Protection*	Corrosion Protection
Minimum 50% Antifreeze 50% Water	-34°F	265°F	Meets or exceeds ASTM D3306 ASTM D4985

*Using a 15lb. pressure cap in good condition

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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**KEEPING THE
WORLD
RUNNING
SMOOTHLY.**



10-12-2017

Phillips66Lubricants.com

U.S. Customer Service:
1-800-368-7128

Technical Hotline:
1-877-445-9198

International Customer Service:
1-832-765-2500

E-mail address:
phillips66lubricants@p66.com



LUBRICANTS

HEAVY DUTY COOLANTS



LUBRICANTS

Guardol OAT HD Coolant/Antifreeze

Phillips 66® Guardol OAT HD Coolant/Antifreeze is an Organic Acid Technology (OAT) that is intended for use and compatible with any OAT extended life heavy duty coolant/antifreeze in any diesel commercial vehicle engine or stationary engine with aluminum and other various engine metals. The advanced formulation is based on a concentrated blend of long-lasting inhibitors designed to provide up to 600,000 miles/12,000 hours* of protection against temperature extremes, corrosion, scale, rust and premature water pump failure. Guardol OAT HD Coolant/Antifreeze is available in both concentrate and prediluted 50/50 formulas.

*TOP OFF: Will maintain extended life protection when added to any OAT extended life antifreeze/coolant. FLUSH AND FILL: Receive protection for up to 600,000 miles or 12,000 hours with a complete flush and fill using Guardol OAT HD Coolant/Antifreeze.

Applications

Check engine coolant level frequently and top off with Guardol OAT HD Coolant/Antifreeze when necessary. Guardol OAT HD Coolant/Antifreeze can also be used for flush and fill. To ensure best performance, the system should be drained and flushed thoroughly. A 50/50 mix of Guardol OAT HD Coolant/Antifreeze is recommended to ensure proper freezing/boilover protection. To provide the proper concentration level of inhibitors, never exceed 70%. Always check the specific maintenance and change-out intervals, coolant/antifreeze to water ratio, cooling system capacity, and service instructions recommended for your vehicle.

Meets or exceeds the following performance requirements:

- ASTM D3306, D4985, D6210, D7583
- TMC RP329, RP338
- Cummins Bulletin 3666132
- Cummins CES 14603
- Navistar
- Detroit Diesel 93K217
- Freightliner 48-25878
- CAT EC-1
- Volvo 128603
- SAE J1941

Features/Benefits

- Nitrite free, Organic Acid Technology (OAT)
- Compatible with all heavy duty OAT formulations
- Requires no initial Supplemental Coolant Additive (SCA) or Extender
- Complete liner pitting and corrosion protection for aluminum and all other engine metals
- When used as directed, Guardol OAT HD Coolant/Antifreeze provides long-lasting inhibition and corrosion protection

**Heavy Duty
Nitrite Free
OAT Extended
Life Coolant/
Antifreeze**

KEEPING THE
WORLD
RUNNING
SMOOTHLY. 



LUBRICANTS

Guardol OAT HD Coolant/Antifreeze		
Composition	Typical Values	
Ethylene Glycol and Inhibitors: Concentrate 50 vol %	97.9% 51%	
Water: Concentrate 50 vol %	2.1% 49%	
Dyes	Trace	
Color	Yellow	
Odor	Characteristic	
Average Fluid Weight/Unit at 68°F (20°C): Concentrate 50 vol %	9.3 lb (4.2 kg) / gal (3.78 L) 8.9 lb (4.0 kg) / gal (3.78 L)	
Properties	Typical Values	ASTM Method
Ash, Mass: Concentrate 50 vol %	1.20% 0.60%	D1119
pH, 50 vol %	8.6	D1287
Reserve Alkalinity: Concentrate 50 vol %	10.0 mL 5.0 mL	D1121
Specific Gravity at 20°C: Concentrate 50 vol %	1.118 1.070	D1122
Flash Point, 50 vol %	None	Tag Open Cup
Foam Test	70 mL / 2.0 sec	D1881

Protection	Freeze-Up Protection	Boil-Over Protection*
40% 60% Water	-12°F (-24°C)	221°F (105°C)
50% 50% Water	-34°F (-37°C)	265°F (129°C)
60% 40% Water	-62°F (-52°C)	270°F (132°C)
70% 30% Water	-84°F (-64°C)	276°F (136°C)

*Using a 15lb pressure cap in good condition.

Health & Safety Information

For recommendations on safe handling and use of this product, please refer to the Safety Data Sheet via <http://www.phillips66.com/EN/products/Pages/MSDS.aspx>.

02-13-2018

Typical properties are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product formulations are subject to change without notification.

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LUBRICANTS

TECHNICAL HANDBOOK



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LUBRICANTS

Phillips 66 Lubricants Customer Support

Lubricants Product Support

To better serve our customers, Phillips 66 Lubricants operates several toll-free "Hotlines." These numbers are available during regular business hours in the United States to assist customers with placing orders, answering technical lubrication questions and/or addressing their specific complaints. Phillips 66 Lubricants customers are encouraged to use these services.

To place orders or to report specific complaints, call the Customer Service Center Hotline, 7:00 a.m. to 6:00 p.m. Central Standard Time, for the appropriate brand at one of the numbers listed below:

U.S. Customer Service: 1-800-368-7128

International Customer Service: 1-832-765-2500

E-mail address: phillips66lubricants@p66.com

For technical services inquiries or lubricant product recommendations, call the Technical Support Hotline, 7:00 a.m. to 6:00 p.m. Central Standard Time, at the number listed below:

Phillips 66 Lubricants: 1-877-445-9198

Phillips 66 Lubricants Web Site:

<http://www.phillips66lubricants.com>

Phillips 66 Aviation Web Site:

<http://www.phillips66aviation.com>



LUBRICANTS

How to Obtain Safety Data Sheet (SDS)

To comply with OSHA's Worker's Right-To-Know regulation, Phillips 66 maintains a comprehensive file of OSHA Safety Data Sheets (SDS) for all Phillips 66 lubricants. To obtain an SDS on a Phillips lubricant, contact:

Phillips 66 Lubricants SDS

SDS Web Site:

<http://www.phillips66.com/EN/products/Pages/MSDS.aspx>

SDS Hot Line:

1-800-762-0942

Phillips 66 Lubricants:

1-877-445-9198



API Engine Oil Service Categories for Automotive Diesel Engines

The following descriptions of the categories in the API Engine Service Classification System are intended as guides to aid in the selection of proper engine oils for significantly different engine service conditions. The performance requirements for these categories are technically described in SAE J183 MAR2006 Standard, Engine Oil Performance and Engine Service Classification (other than “Energy Conserving”).

“C” – COMMERCIAL (Fleets, Contractors, Farmers, etc.)

CF-4 – 1990 Diesel Engine Service (Obsolete)

Service typical of high-speed, 4-stroke cycle diesel engines. API CF-4 oils exceed the requirements for the API CE category, providing improved control of oil consumption and piston deposits. These oils should be used in place of API CE oils. They are particularly suited for on-highway, heavy-duty truck applications. When combined with the appropriate “S” category, they also can be used in gasoline and diesel powered personal vehicles – i.e., passenger cars, light trucks and vans – when recommended by the vehicle or engine manufacturer.

CF-2 – 2-Stroke Cycle Diesel Engine Service (Obsolete)

Service typical of 2-stroke cycle diesel engines requiring highly effective control of wear and deposits. Oils designed for this service have been in existence since 1994 and also may be used when API Service Category CD-II is recommended. These oils do not necessarily meet the requirements of API CF or CF-4, unless these oils have specifically met the performance requirements of these categories.



CF – For Off-Road Indirect Injected Diesel Engine Service (Obsolete)

Service typical of off-road indirect injected diesel engines and other diesel engines that use a broad range of fuel types, including those using fuel with higher sulfur content ($>0.5\%$ by weight). Effective control of piston deposits, wear and corrosion of copper containing bearings is essential for these engines, which may be naturally aspirated, turbocharged or supercharged. Oils designated for this service have been in existence since 1994. Oils designated for this service also may be used when API Service Category CD is recommended.

CH-4 – For 1998 Severe Duty Diesel Engine Service (Current)

API Service Category CH-4 oils are suitable for high-speed, 4-stroke diesel engines designed to meet 1998 exhaust emissions standards. CH-4 oils are specifically compounded for use with diesel fuels ranging in sulfur content up to 0.5% by weight. CH-4 oils are superior in performance to those meeting API CF-4 and API CG-4 and can effectively lubricate engines calling for those API Service Categories.

CI-4 – 2002 Severe-Duty Diesel Engine Service (Current)

The API CI-4 Service Category describes oils for use in those high-speed, 4-stroke cycle diesel engines designed to meet 2004 exhaust emission standards, to be implemented October 2002. These oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 0.05% by weight. These oils are especially effective at sustaining engine durability where Exhaust Gas Recirculation (EGR) and other exhaust emission componentry may be used. Optimum protection is provided for control of corrosive wear tendencies, low- and high-temperature stability, soot-handling properties, piston deposit control, valvetrain wear, oxidative thickening, foaming and viscosity loss due to shear. API CI-4 oils are superior in performance to those meeting API CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories.



CI-4 PLUS – 2004 Severe-Duty Diesel Engine Service

API Service Category CI-4 engine oils that also carry the classification CI-4 PLUS are formulated to provide a higher level of protection against soot-related viscosity increase and viscosity loss due to shear in vehicles powered by diesel engines. Starting Sept. 1, 2004, oils that meet the requirements of CI-4 PLUS and are properly licensed may display “CI-4 PLUS” in the lower portion of the API Service Symbol in conjunction with API Service Category CI-4 in the upper portion. Oils that meet CI-4 PLUS requirements are superior in performance to those meeting API CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories.

CJ-4 – 2007 Severe-Duty Diesel Engine Service

API Service Category CJ-4 describes oils for use in high-speed, 4-stroke cycle diesel engines designed to meet 2007 model-year on-highway exhaust emission standards, as well as for previous model years. These 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 after treatment system durability and/or oil drain interval. These 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 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.

CK-4 (Most Current)

API CK-4 oils are especially effective at sustaining emission control system durability where particulate filters and other advanced after treatment systems are used. API CK-4 oils are designed to



provide enhanced protection against oil oxidation, viscosity loss due to shear, and oil aeration as well as protection against catalyst poisoning, particulate filter blocking, engine wear, piston deposits, degradation of low- and high-temperature properties, and soot-related viscosity increase.

API CK-4 oils exceed the performance criteria of API CJ-4, CI-4 with CI-4 PLUS, CI-4, and CH-4 and can effectively lubricate engines calling for those API Service Categories. When using CK-4 oil with higher than 15 ppm sulfur fuel, consult the engine manufacturer for service interval recommendations.

FA-4 (Most Current)

API FA-4 oils are blended to a high temperature high shear (HTHS) viscosity range of 2.9cP-3.2cP to assist in reducing GHG emissions. These oils are especially effective at sustaining emission control system durability where particulate filters and other advanced after treatment systems are used. API FA-4 oils are designed to provide enhanced protection against oil oxidation, viscosity loss due to shear, and oil aeration as well as protection against catalyst poisoning, particulate filter blocking, engine wear, piston deposits, degradation of low- and high-temperature properties, and soot' related viscosity increase.

API FA-4 oils are neither interchangeable nor backward compatible with API CK-4, CJ-4, CI-4 with CI-4 PLUS, CI-4, and CH-4 oils. Refer to engine manufacturer recommendations to determine if API FA-4 oils are suitable for use. API FA-4 oils are not recommended for use with fuels having greater than 15 ppm sulfur. For fuels with sulfur contents greater than 15 ppm, refer to engine manufacturer recommendations.



API Engine Oil Service Categories for Automotive Gasoline Engines

The following descriptions of the categories in the API Engine Service Classification System are intended as guides to aid in the selection of proper engine oils for significantly different engine service conditions. The performance requirements for these categories are technically described in the SAE J183 (Rev. MAR2006) Standard, *Engine Oil Performance and Engine Service Classification (other than "Energy Conserving")*.

"S" – SERVICE STATION

(Service Stations, Garages, New Car Dealers, etc.)

SL – 2001 Gasoline Engine Warranty Maintenance Service (Active)

API Service Category SL was adopted to describe engine oils for use in 2001. These oils are for use in service typical of gasoline engines in present and earlier passenger cars, sport utility vehicles, vans and light trucks operating under vehicle manufacturers' recommended maintenance procedures. Oils meeting API Service Category SL requirements have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. These oils may be used where API Service Category SJ and earlier categories are recommended.

SM – 2005 Gasoline Engine Warranty Maintenance Service (Current)

API Service Category SM was adopted to describe engine oils available for use in 2004. These oils are for use in service typical of gasoline engines in current and earlier passenger cars, sport utility vehicles, vans and light trucks operating under vehicle manufacturers' recommended maintenance procedures. Oils meeting API Service Category SM requirements have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. These oils may be used where API Service Category SL and earlier S categories are recommended.



SN – 2011 Gasoline Engine Warranty Maintenance Service (Most Current)

API Service Category SN was adopted to describe engine oils available for use in 2011. These oils are for use in service typical of gasoline engines in current and earlier passenger cars, sport utility vehicles, vans and light trucks operating under vehicle manufacturers' recommended maintenance procedures. Oils meeting API Service Category SN requirements have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. These oils may be used where API Service Category SM and earlier S categories have been recommended.

ILSAC GF Categories

The International Lubricant Standardization and Approval Committee (ILSAC) is a joint activity of the American Automobile Manufacturers Association (AAMA) and the Japan Automobile Manufacturers Association Inc. (JAMA). ILSAC issued its first minimum performance standard for gasoline-fueled passenger cars, ILSAC GF-1, in 1990. This standard listed the performance requirements and chemical and physical properties deemed necessary by vehicle manufacturers for satisfactory equipment life and performance. This standard has been upgraded as OEM requirements change: ILSAC GF-2 was issued in November 1995; ILSAC GF-3, coinciding with the introduction of API Service Category SL, became effective July 1, 2001; ILSAC GF-4, coinciding with the introduction of API Service Category SM, became official July 31, 2004; and ILSAC GF-5, coinciding with API Service Category SN, became official October 1, 2010.



API License Marks

API licenses two types of Marks: the API Service Symbol, or “donut” logo (Figure 1), and the API Certification Mark, or “starburst” symbol (Figure 2). The API Service Symbol indicates a licensed oil’s performance properties based on the alphanumeric system of API Service Categories and, if applicable, the Energy Conserving designation. The API Certification Mark identifies oils meeting ILSAC minimum performance standards. The API Certification Mark does not change as improvements are made to oil performance standards. Annual licenses for the API Certification Mark are issued only for engine oils that meet the current ILSAC performance requirements.



Figure 1 — API Service Symbol



Figure 2 — API Certification Symbol

Oils designated as energy conserving are formulated to improve the fuel economy of passenger cars, sport utility vehicles, vans and light trucks powered by gasoline engines. These oils have produced a fuel economy improvement in the Sequence VIB (current) test when compared with the standard reference oil. The fuel economy obtained by individual vehicle operators using these oils may differ because of many factors, including the type of vehicle and engine, the mechanical condition and maintenance of the engine, operating conditions, and driving habits.



SAE Viscosity Classifications for Engine Oils and Automotive Gear Lubricants

SAE VISCOSITY GRADES FOR ENGINE OILS ⁽¹⁾⁽²⁾

(SAE J300 JANUARY 2015)

SAE Viscosity Grade	Low-Temperature (°C) Cranking Viscosity ⁽³⁾ , cP Max.	Low-Temperature (°C) Pumping Viscosity ⁽⁴⁾ , cP Max. With No Yield Stress ⁽⁵⁾	Low-Shear-Rate Kinematic Viscosity ⁽⁶⁾ , cSt at 100°C Min.	Low-Shear-Rate Kinematic Viscosity ⁽⁶⁾ , cSt at 100°C Max.	High-Shear-Rate Viscosity ⁽⁶⁾ , (cP) at 150°C 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	—	—
16	—	—	6.1	<8.2	2.3
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, 40 grades)
50	—	—	16.3	<21.9	3.7
60	—	—	21.9	<26.1	3.7

⁽¹⁾ Note: 1 cP = 1 mPa.s; 1 cSt = 1 mm²/s.

⁽²⁾ All values, with the exception of the low-temperature cranking viscosity, are critical specifications as defined by ASTM D3244 (see text, Section 3).

⁽³⁾ ASTM D5293: Cranking viscosity - The non-critical specification protocol in ASTM D3244 shall be applied with a P value of 0.95.

⁽⁴⁾ ASTM D4684. Note that the presence of any yield stress detectable by this method constitutes a failure regardless of viscosity.

⁽⁵⁾ ASTM D445.

⁽⁶⁾ ASTM D4683, CEC L-36-A-90 (ASTM D4741), or ASTM D5481.

AUTOMOTIVE GEAR LUBRICANT VISCOSITY CLASSIFICATION

(SAE J306 JUNE 2005)

SAE Viscosity Grade	Maximum Temperature (°C) for Viscosity of 150,000 cP ⁽¹⁾⁽²⁾	Kinematic Viscosity at 100°C, cSt ⁽³⁾	
		Minimum ⁽⁴⁾	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	—

Notes: 1 cP=1mPa.s; 1 cSt=1 mm²/s

⁽¹⁾ Using ASTM D2983

⁽²⁾ Additional low-temperature viscosity requirements may be appropriate for fluids intended for use in light-duty synchronized manual transmission.

⁽³⁾ Using ASTM D445.

⁽⁴⁾ Limit also must be met after testing in CEC L-45-T-93. Method C (20 hours).

⁽⁵⁾ The precision of ASTM 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.

SAE Standard J306 is intended for use by equipment manufacturers in defining and recommending automotive gear, axle and manual transmission lubricants. The SAE viscosity grades shown in the Table constitute a classification in rheological terms only. This classification is based on the lubricant viscosity measured at both high and low temperatures.

Automotive gear lubricant SAE viscosity grades should not be confused with engine oil SAE viscosity grades. A gear lubricant and an engine oil having the same viscosity will have widely different SAE viscosity grade designations as defined by SAE J306 and SAE J300, respectively. For example, an SAE 90 gear lubricant viscosity can be similar to that of an SAE 40 or SAE 50 engine oil (see Chart on Page 3).



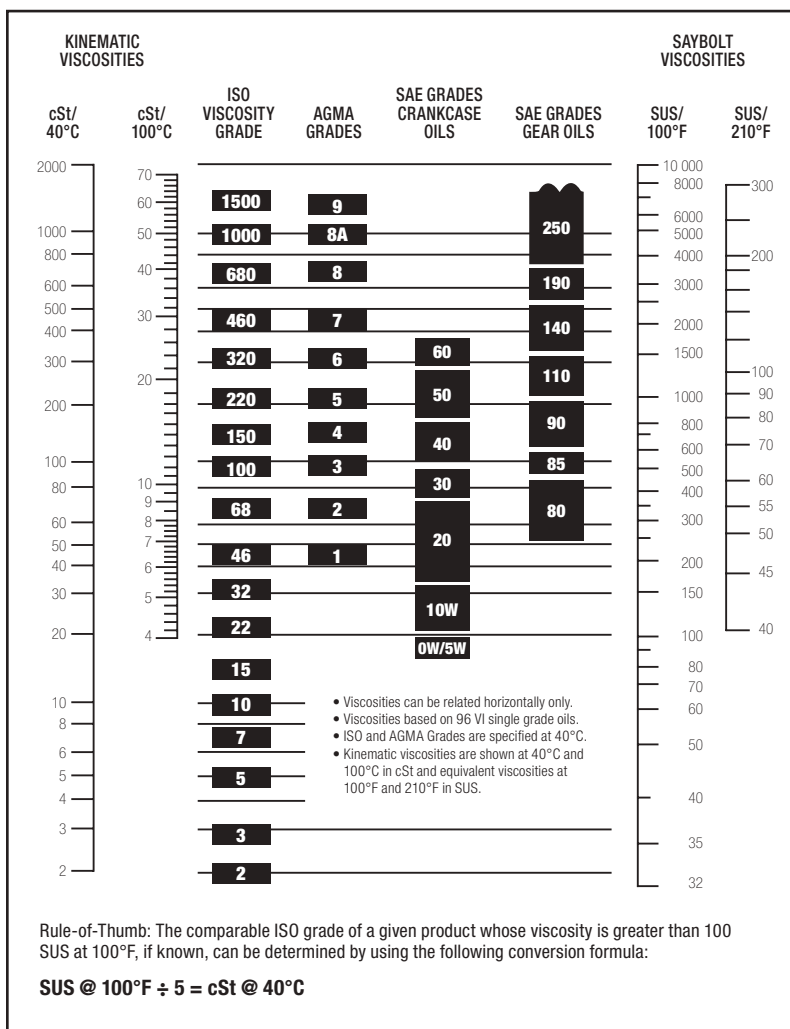
API Service Classifications for Automotive Gear Oils

Classifications	Type	Typical Application
GL-1 (Inactive)	Straight mineral oil	Some manual transmissions (tractors and trucks)
GL-2 (Inactive)	Usually contains fatty materials	Worm gear drives, industrial gear oils
GL-3 (Inactive)	Contains mild EP additive	Manual transmissions and spiral bevel final drives (GL-3 not widely used)
GL-4 (Current) (See Footnote)	Equivalent to obsolete MIL-L-2105 Specification. Usually satisfied by 50% GL-5 additives level	Manual transmissions, spiral bevel and hypoid gears where moderate service prevails
GL-5 (Current)	Equivalent to present MIL-L-2105D Specification. Primary field service recommendation of most passenger car and truck builders worldwide	Used for moderate and severe service in hypoid and all other types of gears. Also may be used in manual transmissions
GL-6 (Obsolete)	Technically obsolete. Same performance as Ford M2C105A (still in use for Ford light trucks)	Typically recommended in service conditions where more antiscoring protection is required than provided by GL-5 lubes
MT-1 (Most Current)	Addresses thermal degradation, component wear and oil seal deterioration, which is not provided by lubricants meeting only the requirements of API GL-1 through GL-5	Non-synchronized manual transmissions in buses and heavy-duty trucks

**While the GL-4 service designation still is used commercially to describe lubricants, some test equipment used for performance verification is no longer available. SAE is reviewing the performance requirements of this category.*



Viscosity Grading Systems





ISO/ASTM Viscosity Classifications for Industrial Oils

Viscosity Ranges for ISO and ASTM Systems

ISO Viscosity Grade	Mid-Point Kinematic Viscosity	Kinematic Viscosity Limits cSt at 40°C (104°F)		ASTM, Saybolt Viscosity Number	Saybolt Viscosity SUS 100°F (37.8°C)	
		Min.	Max.		Min.	Max.
2	2.2	1.98	2.42	32	34.0	35.5
3	3.2	2.88	3.52	36	36.5	38.2
5	4.6	4.14	5.06	40	39.9	42.7
7	6.8	6.12	7.48	50	45.7	50.3
10	10	9.00	11.0	60	55.5	62.8
15	15	13.5	16.5	75	72	83
22	22	19.8	24.2	105	96	115
32	32	28.8	35.2	150	135	164
46	46	41.4	50.6	215	191	234
68	68	61.2	74.8	315	280	345
100	100	90.0	110	465	410	500
150	150	135	165	700	615	750
220	220	198	242	1000	900	1110
320	320	288	352	1500	1310	1600
460	460	414	506	2150	1880	2300
680	680	612	748	3150	2800	3400
1000	1000	900	1100	4650	4100	5000
1500	1500	1350	1650	7000	6100	7500



NLGI Grades for Greases/Grease Mixture Compatibility Chart

NLGI ⁽¹⁾ Grade No.	Penetration, ASTM ⁽²⁾	Description and Typical Use
000	445-475	Semifluid; Centralized Systems
00	400-430	Semifluid; Centralized Systems
0	355-385	Semifluid; Centralized Systems
1	310-340	Very Soft; Grease Guns or Centralized Systems
2	265-295	Soft; Grease Guns or Centralized Systems
3	220-250	Light; Grease Guns
4	175-205	Medium; Pressure Guns
5	130-160	Heavy; Grease Cups
6	85-115	Block; Open Grease Cellars

⁽¹⁾ National Lubricating Grease Institute

⁽²⁾ Worked Penetration at 25°C (77°F), 60 strokes, ASTM D217

Grease Mixture Compatibility Chart

	Aluminum Complex	Barium	Bentonite Clay	Calcium 12-Hyd.	Calcium Complex	Calcium Sulfonate	Lithium 12-Hyd.	Lithium Complex	Polyurea	Polyurea EP	Silica Gel	Sodium
Aluminum Complex	C	I	I	C	I	I	I	I	I	I	I	I
Barium	I	C	I	C	I	I	I	I	I	I	I	I
Bentonite Clay	I	I	C	C	I	I	I	I	I	I	I	I
Calcium 12-Hydroxy	C	C	C	C	I	C	C	C	I	I	I	I
Calcium Complex	I	I	I	I	C	C	I	C	C	I	I	I
Calcium Sulfonate	I	I	I	C	C	C	C	C	C	I	I	I
Lithium 12-Hydroxy	I	I	I	C	I	C	C	C	I	I	I	I
Lithium Complex	I	I	I	C	C	C	C	C	I	I	I	I
Polyurea	I	I	I	I	C	C	I	I	C	C	I	I
Polyurea EP	I	I	I	I	I	I	I	I	C	C	I	I
Silica Gel	I	I	I	I	I	I	I	I	I	I	C	I
Sodium	I	I	I	I	I	I	I	I	I	I	I	C

I = Incompatible

C = Compatible

Note: This chart is meant only to serve as a guideline for determining compatibility. For the purpose of changing products in the field, the compatibility of the greases in question should be determined by laboratory testing.



NLGI Service Classification for Automotive Grease

SERVICE CATEGORY “L” CHASSIS GREASES

LA Mild duty

For the lubrication of chassis components and universal joints operating under mild conditions with frequent relubrication (2,000 miles or less).

LB Mild-to-severe duty

For the lubrication of chassis components and universal joints subject to heavy loads or water exposure, and operating at temperatures ranging from -40°F to 248°F with relubrication intervals greater than 2,000 miles.

SERVICE CATEGORY “G” WHEEL BEARING GREASES

GA Mild duty

For the lubrication of wheel bearings over a limited temperature range.

GB Moderate duty

For the lubrication of wheel bearings over a wide temperature range, where bearing temperatures may range down to -40°F, with frequent excursions to 248°F and occasional excursions to 320°F. Typical of vehicles operated under normal highway service.

GC Severe duty

For the lubrication of wheel bearings over a wide temperature range, where bearing temperatures may range down to -40°F, with frequent excursions to 320°F and occasional excursions to 392°F. Typical of vehicles operated under frequent stop-and-go service (buses, taxis, etc.) or under severe braking service (trailer towing, mountain driving, etc.)

Greases tested in accordance with ASTM D4950.



ISO 4406:1999 Oil Cleanliness Standard

Range Number	Number of Particles per ml Greater Than	Number of Particles per ml Up to and Including
30	5,000,000	10,000,000
29	2,500,000	5,000,000
28	1,300,000	2,500,000
27	640,000	1,300,000
26	320,000	640,000
25	160,000	320,000
24	80,000	160,000
23	40,000	80,000
22	20,000	40,000
21	10,000	20,000
20	5,000	10,000
19	2,500	5,000
18	1,300	2,500
17	840	1,300
16	320	840
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

The ISO 4406:1999 Cleanliness Code references the number of particles greater than 4, 6 and 14 microns in each milliliter of fluid. A corresponding cleanliness code, such as 18/15/13, is then given to the fluid. For particle concentration that fall between two adjacent particle concentration, the higher range is used.



NSF International Registration for Food-Grade Lubricants

(Formerly USDA/FDA Food Safety Inspection Service)

As of Sept. 30, 1998, the U.S. Department of Agriculture (USDA) Food Safety Inspection Service (FSIS) discontinued listing and certification of food-grade lubricants for use in the food processing industry. The absence of this listing created a void in the industry which necessitated action by inspectors who manage the risk of chemical hazards.

In 1999, NSF International (www.nsf.org/usda) initiated the NSF Nonfood Compounds Registration and Listing Program to fill the void created by the USDA. Those products that were formally approved prior to that date and are listed in the USDA's 1998 publication, "List of Proprietary Substances and Nonfood Compounds," can now be registered with NSF and listed under "H1, H2 or H3 Approved Grades."

For further information on which Phillips 66 products are listed with NSF International, please contact your Hot Line consultant.



Weight-Volume Conversions – API Gravity vs. Specific Gravity

ASTM D287/ANSI Z11.31*

$$\text{Conversion Formula: API} = \frac{141.5}{\text{SG}} - 131.5$$

Table Showing Gravity Conversions, Weights and Heating Values of Oils Used for Fuels

Degrees API at 60°F	Specific Gravity at 60°F	Pounds Per Gallon at 60°F	Gallons Per Pound at 60°F	BTU Per Pound	BTU Per Gallon
0	1.0760	8.962	.1116		
1	1.0679	8.895	.1124		
2	1.0599	8.828	.1133		
3	1.0520	8.762	.1141	18,190	159,300
4	1.0443	8.698	.1150	18,240	158,500
5	1.0366	8.634	.1158	18,290	157,800
6	1.0291	8.571	.1167	18,340	157,100
7	1.0217	8.509	.1175	18,390	156,300
8	1.0143	8.448	.1184	18,440	155,300
9	1.0071	8.388	.1192	18,490	155,100
10	1.0000	8.328	.1201	18,540	154,600
11	.9930	8.270	.1209	18,590	153,900
12	.9861	8.212	.1218	18,640	153,300
13	.9792	8.155	.1226	18,690	152,600
14	.9725	8.099	.1235	18,740	152,000
15	.9659	8.044	.1243	18,790	151,300
16	.9593	7.989	.1252	18,840	150,700
17	.9529	7.935	.1260	18,890	150,000
18	.9465	7.882	.1269	18,930	149,400
19	.9402	7.830	.1277	18,980	148,800
20	.9340	7.778	.1286	19,020	148,100
21	.9279	7.727	.1294	19,060	147,500
22	.9218	7.676	.1303	19,110	146,800
23	.9159	7.627	.1311	19,150	146,200
24	.9100	7.578	.1320	19,190	145,600
25	.9042	7.529	.1328	19,230	145,000
26	.8984	7.481	.1337	19,270	144,300
27	.8927	7.434	.1345	19,310	143,700
28	.8871	7.387	.1354	19,350	143,100
29	.8816	7.341	.1362	19,380	142,500
30	.8762	7.296	.1371	19,420	141,800
31	.8708	7.251	.1379	19,450	141,200
32	.8654	7.206	.1388	19,490	140,600
33	.8602	7.163	.1396	19,520	140,000
34	.8550	7.119	.1405	19,560	139,400
35	.8498	7.076	.1413	19,590	138,800
36	.8448	7.034	.1422	19,620	138,200
37	.8398	6.993	.1430	19,650	137,600
38	.8348	6.951	.1439	19,680	137,000
39	.8299	6.910	.1447	19,720	136,400
40	.8251	6.870	.1456	19,750	135,800
41	.8203	6.830	.1464	19,780	135,200
42	.8155	6.790	.1473	19,810	134,700
43	.8109	6.752	.1481	19,830	134,100
44	.8063	6.713	.1490	19,860	133,500
45	.8017	6.675	.1498	19,890	132,900

*ASTM D1298 and ASTM D287 are the international versions, similar to ASTM D287, but they include non-petroleum products, too. International tables are employed to convert from one system to another.



Product Loading Compatibility Matrix

Instructions: Find the column across the top of the chart for the product to be loaded next (bulk transports, tanks & vessels) and then read down to the row for the previous product loaded as listed in the left-hand column. A "Yes" in the box indicates that the product can be loaded without cleaning. A "No" indicates that the compartment must be cleaned with a compatible material prior to loading (typically clear diesel, but not biodiesel). Please consider all footnotes indicated. **Transports must be completely drained prior to loading regardless of the compatibility classification. Special instructions or procedures must be adopted at all times in handling respective products through the entire supply chain, including product receiving, storing/packaging and delivering to the end customer.**

Previous Product ⁽⁶⁾	Product To Be Loaded Next →												
	Base Oil	Engine Oil, SAE 0W-20	Engine Oil, All Other Grades	ATF	Off-Road Trans Fluid	Ashless Engine Oil (zinc-free)	Automotive Gear Oil	Industrial Gear Oil	Ashless Hydraulic Oil & R&O Oil	AW Oil (w/zinc)	Turbine Oil (except Diamond Class® & Ultra-Clean Oil)	Diamond Class® & Ultra-Clean Oil	Emulsifiable / EP Oil
Ethanol	No	No	No	No	No	No	No	No	No	No	No	No ⁽⁵⁾	No
Clear Diesel	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No ⁽⁵⁾	Yes
Dyed Diesel (not Biodiesel)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No ⁽⁵⁾	Yes
Biodiesel	No	No	No	No	No	No	No	No	No	No	No	No ⁽⁵⁾	No
Base Oil	Yes	Yes	Yes	Yes ⁽¹⁾	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No ⁽⁵⁾	Yes
Engine Oil, SAE 0W-20	No	Yes	Yes ⁽²⁾	No	Yes	No	No	No	No	No	No	No ⁽⁵⁾	No
Engine Oil, All Other Grades	No	Yes ⁽⁷⁾	Yes ⁽²⁾	No	Yes	No	No	No	No	No	No	No ⁽⁵⁾	No
ATF	No	No	No	Yes ⁽²⁾	No	No	No	No	No	No	No	No ⁽⁵⁾	No
Off-Road Trans Fluid	No	Yes ⁽⁷⁾	Yes	No	Yes	No	No	No	No	No	No	No ⁽⁵⁾	No
Ashless Engine Oil (zinc-free)	No	Yes ⁽⁷⁾	Yes	Yes	Yes	Yes	No	No	No	No	No	No ⁽⁵⁾	Yes
Automotive Gear Oil	No	No	No	No	No	No	Yes	No	No	No	No	No ⁽⁵⁾	Yes
Industrial Gear Oil	No	No	No	No	No	No	Yes	Yes	No	No	No	No ⁽⁵⁾	Yes
Ashless Hydraulic Oil & R&O Oil	No	Yes ⁽⁷⁾	Yes	Yes ⁽¹⁾	Yes	Yes ⁽⁴⁾	Yes	Yes	Yes	No	Yes	No ⁽⁵⁾	Yes
AW Oil (w/zinc)	No	Yes ⁽⁷⁾	Yes	No	Yes	No	No	No	No	Yes	No	No ⁽⁵⁾	No
Turbine Oil (except Diamond Class® & Ultra-Clean Oil)	No	Yes ⁽⁷⁾	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No ⁽⁵⁾	No
Diamond Class® & Ultra-Clean Oil	No	Yes ⁽⁷⁾	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Emulsifiable / EP Oil	No	No	No	No	No	No	No	No	No	No	No	No ⁽⁵⁾	Yes
Incompatible	No	No	No	No	No	No	No	No	No	No	No	No ⁽⁵⁾	No

Notes:

⁽¹⁾ "Yes" permitted only if the ISO grade of the previous product is 32 or lower.

⁽²⁾ Except if previous product is Type F ATF.

⁽³⁾ Any SAE 5W-XX or 10W-XX grade or tractor fluid should not be loaded after an SAE 40, 50, 60 or 20W-50 grade engine oil.

⁽⁴⁾ "Yes" permitted only if the ISO grade of the previous product is 100 or lower.

⁽⁵⁾ Bulk transport of Diamond Class® Turbine Oils requires either (a) a dedicated trailer or (b) a tanker and hoses processed through a wash bay and thoroughly dried.

⁽⁶⁾ Certificate of Cleanliness/Wash or evidence of previous haul presented prior to loading. Additional requirements may apply:

>Full-synthetic industrial oils should not be loaded after any other product

>Full-synthetic and synthetic blend engine oils can be loaded after engine oils

>No products may be loaded behind or on top of biodiesel product

⁽⁷⁾ SAE 0W-20 engine oil should be loaded only through a cleaned transfer system. SAE 0W-20 engine oil may be loaded subsequent to SAE 5W-20 or 5W-30 engine oil only if the line is first flushed with one times (1x) the line volume with either the SAE 0W-20 oil or 100N oil. For loading the SAE 0W-20 oil subsequent to any other products in the compatible engine oil group, the line must be flushed with three times (3x) the line volume.



Glossary

A

absolute viscosity — The ratio of shear stress to shear rate. It is a fluid's internal resistance to flow. The common unit of absolute viscosity is the poise (see *viscosity*). Absolute viscosity divided by the fluid's density equals *kinematic viscosity*.

absorption — The taking up, assimilation or incorporation of one material into another.

acid — A chemical substance that can react with metals to form salts and with bases or alkalies to form salts plus water. Acids contain hydrogen, and they form hydrogen ions (H^+) in water. They are considered strong or weak depending on the hydrogen ion concentration in the solution.

acid number — See *neutralization number*.

additive — A chemical added in small quantities to a petroleum product to impart or improve certain properties.

AGMA — American Gear Manufacturers Association, which as one of its activities establishes and promotes standards for gears and lubricants.

alkaline — The property of a substance, product, or mixture that gives it the chemical character of a base or alkali, as contrasted to an acid.

aniline point — Lowest temperature at which a specified quantity of aniline (a benzene derivative) is soluble in a specified quantity of a petroleum product, as determined by test method ASTM D611 or D1012; hence, an empirical measure of the solvent power of a hydrocarbon.

antifoam agent — One of two types of *additives* used to reduce foaming in petroleum products: silicone oil to break up large surface bubbles; and various kinds of *polymers* that decrease the amount of small bubbles entrained in the oils.

anti-friction bearing — A rolling contact type bearing in which the rotating or moving member is supported or guided by means of ball or roller elements. Does not mean without friction.

antioxidant — See *oxidation inhibitor*.

antiwear agent — An additive that minimizes wear caused by metal-to-metal contact during conditions of mild boundary lubrication (e.g., stops and starts, oscillating motion). The additive reacts chemically with, and forms a film on, metal surfaces under normal operating conditions.

API (American Petroleum Institute) — Trade association of petroleum producers, refiners, marketers and transporters; organized for the advancement of the petroleum industry by conducting research, gathering



and disseminating information, and maintaining cooperation between government and the industry on all matters of mutual interest.

API Engine Service Categories — Gasoline and diesel engine oil quality levels established jointly by *API*, *SAE* and *ASTM*, and sometimes called *SAE* or *API/SAE* categories; formerly called *API Engine Service Classifications*.

API Gravity — A gravity scale established by the *API* and in general use in the petroleum industry, the unity being called the “*API degree*.” This unit is defined in terms of specific gravity as follows:

$^{\circ}\text{API} = (141.5 \div \text{sp. gr. @60}^{\circ}/60^{\circ}\text{F}) - 131.5$

apparent viscosity — A measure of the resistance to flow of a grease whose viscosity varies with shear rate. It is defined as the ratio of the shear stress to the shear rate calculated from Poiseuille’s equation at a given rate of shear and is expressed in poises.

aromatic — *Unsaturated hydrocarbon* identified by one or more *benzene* rings or by chemical behavior similar to benzene.

ash content — Noncombustible residue of a lubricating oil or fuel, determined in accordance with *ASTM D582* and *D874 (sulfated ash)*.

ashless dispersant — Cleanliness additive for crankcase oils. It is widely used in lubricants for aviation piston engines. Unlike conventional crankcase oil detergents, ashless dispersants do not contain metallic compounds. See *dispersant*.

ASLE (American Society of Lubrication Engineers) — Organization intended to advance the knowledge and application of lubrication and related sciences.

ASTM (American Society for Testing and Materials) — Organization devoted to “the promotion of knowledge of the materials of engineering, and the standardization of specifications and methods of testing.” A preponderance of the data used to describe, identify, or specify petroleum products is determined in accordance with *ASTM* test methods.

auto-ignition temperature — Minimum temperature at which a combustible fluid will burst into flame without an extraneous ignition source.

axial load bearing — A bearing in which the load acts in the direction of the axis of rotation.

B

babbitt — A soft, white, nonferrous alloy bearing material composed principally of copper, antimony, tin and lead.

ball bearing — An antifriction bearing comprising rolling elements in the form of balls.

barrel — Standard unit of measurement in the petroleum industry, equivalent to 42 standard U.S. gallons, or approximately 35 Imperial gallons.



base — One of a broad class of compounds that react with acids to form salts plus water.

base number — See *neutralization number*.

base oils — Base stocks and base stock blends used as an inert ingredient or diluent in the manufacture of automotive and industrial lubricants, and some industrial, agricultural and consumer chemicals.

base stock — A primary refined petroleum fraction, usually a lube oil, into which *additives* and other oils are blended to produce finished products.

bearing — A support or guide by means of which a moving part, such as a shaft or axle, is positioned with respect to the other parts of a mechanism.

BIA — Boating Industry Association. See *NMMA*.

bleeding — The tendency of a liquid component to separate from a solid or semisolid mixture as an oil from a grease.

block grease — Generally, a grease of high soap content which under normal temperatures is firm to the touch and can be handled in block or stick form.

bloom — A sheen or fluorescence evident in some petroleum oils when viewed by reflected light.

boundary lubrication — A condition of lubrication in which the bulk viscosity characteristics of the lubricant do not apply or in which partial contact takes place between the mating surfaces. Also refers to a thin film, imperfect, or nonviscous lubrication.

bright stock — High-viscosity oils, highly refined and dewaxed to make clear products of good color, produced from residual stocks, or *bottoms*; used for blending with lower viscosity oils.

Brookfield viscosity — *Apparent viscosity* of an oil, as determined under test method ASTM D 2983.

bulk modulus — Measure of a fluid's resistance to compressibility; the reciprocal of compressibility.

C

°C (Celsius) — See *temperature scales*.

carbon — A nonmetallic element — No. 6 in the periodic table. Diamonds and graphite are the two pure forms of carbon. Carbon is a constituent of all organic compounds.

carbon dioxide — CO_2 . A colorless, odorless gas produced by complete combustion of a hydrocarbon fuel-air mixture.



carbon monoxide (CO) — Colorless, odorless, poisonous gas, formed by the incomplete combustion of any carbonaceous material (e.g., gasoline, wood, coal).

carbon residue — Percent of coked material remaining after a sample of lubricating oil has been exposed to high temperatures under ASTM Method D189 (Conradson) or D524 (Ramsbottom). Results of these tests are reported as a percentage of the weight of the original sample.

catalyst — Substance that contributes to a chemical reaction without, itself, undergoing any change.

Celsius (°C) — See *temperature scales*.

centigrade — See *temperature scales*.

centipoise — See *viscosity*.

centistoke — See *viscosity*.

centralized lubrication — System under which grease or oil is dispensed automatically from a reservoir directly to the lubricated parts of one or more machines. Flow is maintained by a pump or battery of pumps operating on a common rail, and the amount of lubricant supplied to each point can be regulated by metering devices at each point.

cetane number — Measure of the ignition quality of a *diesel fuel*, expressed as the percentage of cetane that must be mixed with liquid methylnaphthalene to produce the same ignition performance as the diesel fuel being rated, as determined by test method ASTM D613.

channel point — A measure of the lowest temperature at which a gear lubricant may be used safely.

Cleveland Open Cup (COC) — Test (ASTM D92) for determining the *flash point* and *fire point* of all petroleum products except fuel oil and products with flash points below 70°C (175°F).

cloud point — Temperature at which a cloud or haze of wax crystals appears at the bottom of a sample of lubricating oil in a test jar, when cooled under conditions prescribed by test method ASTM D2500.

Cold Cranking Simulator (CCS) — A high shear viscometer used to measure viscosity of crankcase oils at low temperature (0°F).

compatibility — The ability of petroleum products to form a homogeneous mixture that neither separates nor is altered by chemical interaction.

compounded oil — Special blend of petroleum oil with small amounts of fatty or synthetic fatty oils.

compounds — 1. Chemically, any substance formed by a combination of two or more elements. 2. In petroleum processing, compound or compounding means fatty oils and similar materials foreign to petroleum but added to lubricants to impart special properties to them.



compressor — Any of a wide variety of mechanisms designed to compress air or other gas to produce useful work.

corrosion — Chemical attack on a metal or other solid by contaminants in a lubricant.

corrosion inhibitor — *Additive* for protecting lubricated metal surfaces against chemical attack by water or other contaminants.

cutting fluid — Fluid, usually of petroleum origin, for cooling and lubricating the tool and work in machining and grinding.

D

demulsibility — Ability of an oil to separate from water, as determined by test method ASTM D1401 or D2711.

density — The mass of a unit volume of a substance. Its numerical value varies with the units used. See *specific gravity*.

deposits — See *engine deposits*.

detergent — An *additive* in *crankcase oils* generally combined with (and confused with) *dispersant* additives. A detergent chemically neutralizes acidic contaminants in the oil before they become insoluble and fall out of the oil, forming sludge.

detergent-dispersant — Engine oil *additive* that is a combination of a *detergent* and a *dispersant*; important in preventing the formation of *sludge* and other engine deposits.

dielectric strength (breakdown voltage) — Minimum voltage required to produce an electric arc through an oil sample, as measured by test method ASTM D877; hence, an indication of the insulating (arc preventive) properties of a transformer oil. A low dielectric strength may indicate contamination, especially by water.

dispersant — Engine oil *additive* that helps prevent *sludge*, varnish and other engine deposits by breaking up insoluble contaminant particles already formed. Particles are kept finely divided so that they can remain “dispersed” or colloiddally suspended in the oil.

drop feed lubrication — A system of lubrication in which the lubricant is applied to the bearing surfaces in the form of drops at regular intervals.

dropping point — Normally related to a *grease*. The temperature at which a grease passes from a semisolid to a liquid state under specified test conditions ASTM D556. It is an indication of whether a grease will flow from a bearing at operating temperature.

drum — A container with a capacity of 55 U.S. gallons.

dynamic viscosity — See *absolute viscosity*



E

emulsibility — The ability of an oil to emulsify with water. The oil becomes suspended in the water in minute particles in a more or less stable form.

emulsion — Intimate mixture of oil and water, generally of a milky or cloudy appearance.

energy conservation — Employment of less energy to accomplish the same amount of useful work; also, the reduction or elimination of any energy-consuming activity.

engine deposits — Hard or persistent accumulations of *sludge*, *varnish* and carbonaceous residues due to *blow-by* of unburned and partially burned (partially oxidized) fuel, or from partial breakdown of the crankcase lubricant.

EP additive — Lubricant *additive* that prevents sliding metal surfaces from seizing under conditions of extreme pressure (EP). At the high local temperatures associated with metal-to-metal contact, an EP additive combines chemically with the metal to form a surface film that prevents the welding of opposing *asperities*, and the consequent *scoring* that is destructive to sliding surfaces under high loads.

EPA (Environmental Protection Agency) — Agency of the federal executive branch, established in 1970 to abate and control pollution through monitoring, regulation, and enforcement, and to coordinate and support environmental research.

F

°F (Fahrenheit) — See *temperature scales*.

FDA (Food and Drug Administration) — Agency administered under the U.S. Department of Health and Human Services (formerly Health, Education and Welfare) “to enforce the Federal Food, Drug and Cosmetic Act and thereby carry out the purpose of Congress to ensure that foods are safe, pure, and wholesome, and made under sanitary conditions; drugs and therapeutic devices are safe and effective for their intended uses; cosmetics are safe and prepared from appropriate ingredients; and that all of these products are honestly and informatively labeled and packaged.”

film strength — Property of a lubricant which acts to prevent scuffing or scoring of bearing surfaces.

fire point — The minimum sample temperature at which vapor is produced at a sufficient rate to sustain combustion. Specifically, it is the lowest sample temperature at which the ignited vapor persists in burning for at least 5 seconds.

flash point — Minimum temperature of a petroleum product or other combustible fluid at which vapor is produced at a rate sufficient to yield a combustible mixture. Specifically, it is the lowest sample temperature at



which the air vapor mixture will “flash” in the presence of an ignition source (small flame).

floc point — Temperature at which waxy materials in a lubricating oil separate from a mixture of oil and FREON® R-12 refrigerant, giving a cloudy appearance to the mixture.

fluid friction — A liquid’s internal resistance to flow. See *friction*.

foam inhibitor — An additive which causes foam to dissipate more rapidly. It promotes the combination of small bubbles into large bubbles which burst more easily.

foaming — Occurrence of a frothy mixture of air and a petroleum product (e.g., lubricant, fuel oil) that can reduce the effectiveness of the product, and cause sluggish hydraulic operation, air binding of oil pumps, and overflow of tanks or sumps.

force feed lubrication — A system of lubrication in which the lubricant is supplied to the bearing surface under pressure.

freezing point — A specific temperature that can be defined in two ways, depending on the ASTM test used.

fretting corrosion — A process of mechanical attrition combined with chemical reaction taking place at the common boundary of loaded contact surfaces having small oscillatory relative motion.

friction — Resistance to the motion of one surface relative to another. The amount of friction is dependent on the smoothness of the contacting surfaces, as well as the force with which they are pressed together.

G

gallon (Imperial) — Unit of liquid volume used in Canada, England and other countries. Defined as the volume of 10 lb. of water at 68°F. One Imperial gallon equals 1.20095 U.S. gallons.

gallon (U.S.) — Unit of liquid volume equal to 231 cu. in.

gas — The vapor state of any substance that has neither independent shape nor volume.

gel — An elastic solid mixture of a *colloid* and a liquid, it possesses a yield point point and a jelly-like texture.

gram — A metric unit of mass and weight equal to 1/1000 kilogram and nearly equal to the mass (weight) of 1 cc of water at its maximum density.

graphite — A crystalline form of carbon either natural or synthetic in origin, which is used as a lubricant.



gravity — Weight-per-unit-volume relationship. With petroleum products, this relationship may be expressed as *specific gravity*, the ratio of the weight of a volume of the product at a designated temperature to the weight of an equal volume of water — also at a designated temperature.

grease — Mixture of a fluid lubricant (usually a petroleum oil) and a thickener (usually a soap) dispersed in the oil. Because greases do not flow readily, they are used where extended lubrication is required and where oil would not be retained.

gum — A rubber-like, sticky deposit black or dark brown in color, which results from oxidation of lubricating oils in service.

H

heat content — 1. *Gross*. Total heat evolved by complete combustion of a unit weight of substance usually expressed in BTU/lb. 2. *Net*. Gross heat of combustion less the latent heat of condensation of any water produced.

heat of combustion — Measure of the available energy content of a fuel, under controlled conditions specified by test method ASTM D240 or D2382.

heating value — See *heat of combustion*.

hydraulic oil — An oil specially suited for use as a power transmission medium in hydraulically operated equipment.

hydrocarbon — Chemical compound of hydrogen and carbon; also called an *organic compound*. Hydrogen and carbon atoms can be combined in virtually countless ways to make a diversity of products.

hydrodynamic lubrication — A system of lubrication in which the shape and relative motion of the sliding surfaces causes the formation of a fluid film having sufficient pressure to separate the surfaces.

hydrogenation — The chemical addition of hydrogen to a material. In non-destructive hydrogenation, hydrogen is added to a molecule only if, and where, unsaturation with respect to hydrogen exists. In destructive hydrogenation, the operation is carried out under conditions which result in rupture of some of the hydrocarbon chains (cracking); hydrogen is added where the chain breaks have occurred.

hydrolytic stability — Ability of additives and certain *synthetic lubricants* to resist chemical decomposition (hydrolysis) in the presence of water.

hydrotreating — A process which converts and removes undesirable components with the use of a catalyst.

hypoid gear lubricant — A gear lubricant having extreme pressure characteristics for use with a hypoid type of gear as in the differential of an automobile.



hypoid gears — Gears in which the pinion axis intersects the plane of the ring gear at a point below the ring-gear axle and above the outer edge of the ring gear, or above the ring-gear axle and below the outer edge of the ring gear.

HVI — High Viscosity Index, typically from 80 to 100 VI units.

I

inhibitor — Additive that improves the performance of a petroleum product through the control of undesirable chemical reactions. See *corrosion inhibitor*, *oxidation inhibitor*, *rust inhibitor*.

inorganic compound — Chemical compound, usually mineral, that does not include *hydrocarbons* and their derivatives.

insolubles — Test for contaminants in used lubricating oils, under conditions prescribed by test method ASTM D893.

ISO — International Standards Organization.

ISO viscosity classification system — International system, approved by the International Standards Organization (ISO), for classifying industrial lubricants according to *viscosity*. Each ISO viscosity grade number designation corresponds to the mid-point of a viscosity range expressed in centistokes (cSt) at 40°C.

J

journal bearing — A sliding type of bearing in conjunction with which a journal operates. In a full- or sleeve-type journal bearing, the bearing surface is 360° in extent. In a partial bearing, the bearing surface is less than 360° in extent.

K

ketones — These are organic compounds characterized by a carbonyl group joined to two hydrocarbon radicals. The ketones have very high diluent tolerance and good viscosity reduction power.

kinematic viscosity — *Absolute viscosity* of a fluid divided by its density at the same temperature of measurement. It is the measure of a fluid's resistance to flow under gravity, as determined by test method ASTM D445.

L

lacquer — An organic coating that dries by solvent evaporation.

latent heat — Quantity of heat absorbed or released by a substance undergoing a change of state (e.g., ice changing to liquid water, or water to steam) without change of temperature.



LC₅₀ — Lethal concentration, 50 percent mortality; a measure of inhalation toxicity. It is the concentration in air of a volatile chemical compound at which half the test population of an animal species dies when exposed to the compound. It is expressed as parts per million by volume of the toxicant per million parts of air for a given exposure period.

load wear index — Measure of the relative ability of a lubricant to prevent wear under applied loads; it is calculated from data obtained from the Four-Ball EP Method.

lubrication — Control of friction and wear by the introduction of a friction-reducing film between moving surfaces in contact. The lubricant used may be a fluid, solid or plastic substance.

lubricity — Ability of an oil or grease to lubricate; also called *film strength*. Lubricity can be enhanced by *additive* treatment.

M

melting point — The temperature at which a solid substance melts or becomes liquid. Grease melting point is determined by placing a small amount of the grease on the bulb of a thermometer and heating in hot air until the grease begins to run off. Also see *dropping point*.

mg — Milligrams.

mineral oil — Any petroleum oil, as contrasted to animal or vegetable oils. Also, a highly refined petroleum *distillate*, or *white oil*, used medicinally as a laxative.

miscible — Capable of being mixed in any concentration without separation of phases.

moly, moly sulfide — See *molybdenum disulfide*.

molybdenum disulfide — A black, lustrous powder (MoS₂) that serves as a dry-film lubricant in certain high-temperature and high-vacuum applications.

multigrade oil — Engine oil that meets the requirements of more than one SAE (Society of Automotive Engineers) viscosity grade classification (see *SAE viscosity grades*), and may therefore be suitable for use over a wider temperature range than a single-grade oil.

N

naphthene — Hydrocarbon characterized by saturated carbon atoms in a ring structure, and having the general formula C_nH_{2n}; also called *cycloparaffin* or *cycloalkane*. Naphthenic lubricating oils have *low pour points*, owing to their very low wax content, and good solvency properties.

naphthenic — See *naphthene*.



natural gas — Naturally occurring mixture of gaseous *saturated hydrocarbons*, consisting of 80 percent to 95 percent *methane* (CH_4), lesser amounts of *propane*, *ethane*, and *butane*, and small quantities of nonhydrocarbon gases (e.g., nitrogen, helium).

needle bearing — A bearing comprising rolling elements in the form of rollers which are relatively long compared to their diameter.

neutral oils — Lubricating oils of low or medium viscosity obtained in petroleum distillation and prepared by various methods. They derive their name from the fact that they have not been treated with either an acid or an alkali.

neutralization number — Also called *neut number*, an indication of the acidity or alkalinity of an oil; the number is the weight in milligrams of the amount of acid (hydrochloric acid $[\text{HCL}]$) or base (potassium hydroxide $[\text{KOH}]$) required to neutralize one gram of the oil, in accordance with test method ASTM D664 (potentiometric method) or ASTM D974 (colorimetric method).

Newtonian fluid — Fluid, such as a *straight mineral oil*, whose *viscosity* does not change with rate of flow.

NLGI (National Lubricating Grease Institute) — Trade association whose main interest is grease and grease technology.

NLGI consistency grades — Simplified system established by the National Lubricating Grease Institute (NLGI) for rating the consistency of grease.

NMMA — National Marine Manufacturers Association (formerly BIA).

O

octane number — Expression of the *antiknock* properties of a gasoline, relative to that of a standard reference fuel. There are two distinct types of octane number measured in the laboratory: *Research Octane Number (RON)* and *Motor Octane Number (MON)*, determined in accordance with ASTM D2699 and D2700, respectively.

oil — A greasy unctuous liquid of vegetable, animal, mineral or synthetic origin.

oil ring — A loose ring, the inner surface of which rides a shaft or journal and dips into a reservoir of lubricant from which it carries the lubricant to the top of a bearing by its rotation with the shaft.

organic compound — Chemical substance containing carbon and hydrogen; other elements, such as nitrogen or oxygen, may also be present.

oxidation — A form of chemical deterioration to which petroleum products —like most other organic materials — are subject. The resistance of many petroleum products to oxidation, however, is very high. Oxidation usually involves the addition of oxygen atoms, and the result is nearly always one of degradation.



oxidation inhibitor — Substance added in small quantities to a petroleum product to increase its oxidation resistance, thereby lengthening its service or storage life; also called an *antioxidant*.

oxidation stability — Resistance of a petroleum product to oxidation; hence a measure of its potential service or storage life. There are a number of ASTM tests to determine the oxidation stability of a lubricant or fuel, all of which are intended to simulate service conditions on an accelerated basis.

P

pad lubrication — A system of lubrication in which the lubricant is delivered to a bearing surface by a pad of felt or similar material.

pale oil — Straight naphthenic mineral oil, straw or pale yellow in color, used as a once-through lubricant and in the formulation of *process oils*.

paraffin — Hydrocarbon identified by saturated straight (normal) or branched (iso) carbon chains. Paraffins are relatively nonreactive and have excellent *oxidation stability*. In contrast to naphthenic (see *naphthene*) oils, paraffinic lube oils have relatively high wax content and *pour point*, and generally have a high *viscosity index* (V.I.).

paraffinic — See *paraffin*.

penetration (grease) — Measure of the consistency of a grease, utilizing a *penetrometer*. Penetration is reported as the tenths of a millimeter (penetration number) that a standard cone, acting under the influence of gravity, will penetrate the grease sample under test conditions prescribed by test method ASTM D217. Standard test temperature is 25°C (77°F). The higher the penetration number, the softer the grease.

petrolatum — A jelly-like product obtained from petroleum and having a microcrystalline structure. Often used in rust preventives.

plain bearing — Any simple sliding-type bearing as distinguished from tapered land, tilting pad, or antifriction bearings, etc.

poise — CGS unit of absolute viscosity; shear stress (in dynes per square centimeter) required to move one layer of fluid along another over a total layer thickness of one centimeter at a shear rate of one centimeter per second. Dimensions are dyne-sec/cm². The *centipoise* (cP) is 1/100 of a poise and is the unit of absolute viscosity most commonly used.

pour point — Is a widely used low-temperature flow indicator and is 5°F above the temperature to which a normally liquid petroleum product maintains fluidity.

pour point depressant — *Additive* used to lower the *pour point* of a petroleum product.

ppm — Parts per million.



pressure — Force per unit area, measured in kilopascals (kPa) or pounds per square inch (psi).

process oil — Oil that serves as a temporary or permanent component of a manufactured product.

psi — Pounds per square inch.

Q

quenching — Immersion of a heated manufactured steel part, such as a gear or axle, in a fluid to achieve rapid and uniform cooling. Petroleum oils are often used for this purpose. Quenching provides hardness superior to that possible if the heat-treated part were allowed to cool slowly in air.

R

R&O — Rust- and oxidation-inhibited term applied to highly refined industrial lubricating oils formulated for long service in circulating systems, compressors, hydraulic systems, bearing housings, gear cases, etc. The finest R&O oils are often referred to as *turbine oils*.

refining — Series of processes for converting crude oil and its fractions to finished petroleum products.

rheology — Study of the deformation and flow of matter in terms of stress, strain, temperature and time. The rheological properties of a grease are commonly measured by penetration and *apparent viscosity*.

ring lubrication — A system of lubrication in which the lubricant is supplied to the bearing surfaces by an oil ring.

roller bearing — An antifriction bearing comprising rolling elements in the form of rollers.

rust — See *compounds and additives, corrosion inhibitors*.

rust inhibitor — A lubricant additive for protecting ferrous (iron and steel) components from rusting caused by water contamination or other harmful materials from oil degradation.

Rust Prevention Test (Turbine Oils) — A test for determining the ability of an oil to aid in preventing the rusting of ferrous parts in the presence of water.

S

SAE (Society of Automotive Engineers) — Organization responsible for the establishment of many U.S. automotive and aviation standards, including the viscosity classifications of engine oils and gear oils.

SAE viscosity grades — Engine oil classification system developed by the Society of Automotive Engineers (SAE), based on the kinematic viscosities of the oil measured at 100°C under low-shear conditions and at 150°C



under high-shear conditions. Multigrade oils, designated with a “W” for “winter use” (e.g., SAE 10W-30), are further defined by their low-temperature cranking viscosity measured at -10°C to -35°C, and their low-temperature pumping viscosity measured at -15°C to -40°C.

Saybolt Furol Viscosity — The time in seconds required for 60 cubic centimeters of a fluid to flow through the orifice of a Saybolt Furol Viscometer at a given temperature under specified conditions. The orifice of the furol viscometer is larger than that of the universal viscometer, the former instrument being used for more viscous fluids.

Saybolt Universal Viscosity — The time in seconds required for 60 cubic centimeters of a fluid to flow through the orifice of the Standard Saybolt Universal Viscometer at a given temperature under specified conditions.

shear — Deformation which occurs when parallel planes of a body are displaced relative to each other in a direction parallel to themselves.

shear rate — Rate at which adjacent layers of a fluid move with respect to each other, usually expressed as reciprocal seconds.

shear stability — Mechanical stability.

shear stress — Frictional force overcome in sliding one “layer” of fluid along another, as in any fluid flow. The shear stress of a petroleum oil or other *Newtonian fluid* at a given temperature varies directly with *shear rate* (velocity). The ratio between shear stress and shear rate is constant; this ratio is termed *viscosity*.

sleeve bearing — A journal bearing, usually a full journal bearing.

sludge — In gasoline engines, a soft, black, mayonnaise-like emulsion of water, other combustion byproducts, and oil formed during low-temperature engine operation.

soap — The salt of an acid derived from animal or vegetable matter. Metallic soaps are used in the manufacture of grease.

specific gravity — For petroleum products, the ratio of the mass of a given volume of product and the mass of an equal volume of water, at the same temperature. The standard reference temperature is 15.6°C (60°F). Specific gravity is determined by test method ASTM D1298. The higher the specific gravity, the heavier the product.

splash lubrication — A system of lubrication in which parts of a mechanism dip into and splash lubricant onto themselves and/or other parts of the mechanism.

straight mineral oil — Petroleum oil containing no *additives*.

static friction — The friction between two surfaces not in relative motion but tending to slide over one another. The value of the static friction at the instant relative motion begins is termed break-away friction.



sulfated ash — The ash content of fresh, compounded lubricating oil as determined by ASTM Method D874. Indicates level of metallic additives in the oil.

synthetic lubricant — Lubricating fluid made by chemically reacting materials of a specific chemical composition to produce a compound with planned and predictable properties; the resulting *base stock* may be supplemented with additives to improve specific properties.

T

tackiness agent — Additive used to increase the adhesive properties of a lubricant, improve retention and prevent dripping and splattering.

temperature scales — Arbitrary thermometric calibrations that serve as convenient references for temperature determination. There are two thermometric scales based on the freezing and boiling point of water at a pressure of one atmosphere: the Fahrenheit (F) scale (32 degrees = freezing, 212 degrees = boiling) and the Celsius (C), or Centigrade, scale (0 degrees = freezing, 100 degrees = boiling).

texture — That property of a lubricating grease which is observed when a small portion of it is compressed and the pressure slowly released.

thermal stability — Ability to resist chemical degradation at high temperatures.

Timken EP Test — The Timken Extreme-Pressure Test is one of many laboratory machines used in determining the load-carrying capacities of oils and greases. In this test, a Timken bearing cup is rotated against a steel block. The highest load under which a lubricant prevents scoring of the steel block by the rotating cup is the reported value.

total acid number — See *neutralization number*.

total base number — See *neutralization number*.

tribology — Science of the interactions between surfaces moving relative to each other. Such interactions usually involve the interplay of two primary factors: the load, or force, perpendicular to the surfaces, and the frictional force that impedes movement.

U

unworked penetration — The penetration at 77°F of a sample of grease which has received only the minimum handling in transfer from a sample can to the test apparatus and which has not been subjected to the action of a grease worker.

USDA — United States Department of Agriculture.

USP (United States Pharmacopeia) — Compendium of drugs, drug



formulas, quality standards and tests published by the United States Pharmacopeial Convention, Inc., which also publishes the NF (National Formulary).

V

Varnish — When applied to lubrication, a deposit resulting from the oxidation and polymerization of fuels and lubricants. Similar to, but softer than, lacquer.

V.I. — See *viscosity index* (V.I.).

viscosity— Measurement of a fluid's resistance to flow. The common metric unit of *absolute viscosity* is the *poise*, which is defined as the force in dynes required to move a surface one square centimeter in area past a parallel surface at a speed of one centimeter per second, with the surfaces separated by a fluid film one centimeter thick.

viscosity index (V.I.)— Empirical, unitless number indicating the effect of temperature change on the *kinematic viscosity* of an oil. Liquids change *viscosity* with temperature, becoming less viscous when heated; the higher the V.I. of an oil, the lower its tendency to change viscosity with temperature.

viscosity index (V.I.) improver — Lubricant *additive*, usually a high molecular weight *polymer*, that reduces the tendency of an oil to change *viscosity* with temperature. *Multigrade oils*, which provide effective lubrication over a broad temperature range, usually contain V.I. improvers.

Volatility — Expression of evaporation tendency. The more volatile a petroleum liquid, the lower its boiling point and the greater its flammability.

W

wear — The attrition or rubbing away of the surface of a material as a result of mechanical action.

white oil — Highly refined *straight mineral oil*, essentially colorless, odorless, and tasteless. White oils have a high degree of chemical stability.

worked penetration — The penetration of a sample of lubricating grease immediately after it has been brought to 77°F +/- 1°F and then subject to 60 strokes in the ASTM standard grease worker.

Z

ZDDP (zinc dialkyl dithiophosphate or zinc diary dithiophosphate) — Widely used as an antiwear agent in motor oils to protect heavily loaded parts, particularly the valve train mechanisms (such as the camshaft and cam followers) from excessive wear. It also is used as an antiwear agent in *hydraulic fluids* and certain other products.