CATERPILLAR®

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Supplement

Caterpillar Commercial Diesel Engine Fluids Recommendations For Lubricants, Diesel Fuel, and Coolants

Includes Electrical Power Generation, Industrial, Marine, Petroleum, and Locomotive Engine Applications.
For All Commercial Diesel Engines Except 3600 Series Engines.

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Introduction

The information provided in this publication is the latest fluids recommendations for Caterpillar commercial diesel engines. This information supersedes all other recommendations which have been published for Caterpillar commercial diesel engines and Caterpillar marine transmissions.

Other Caterpillar fluids recommendations publications are:

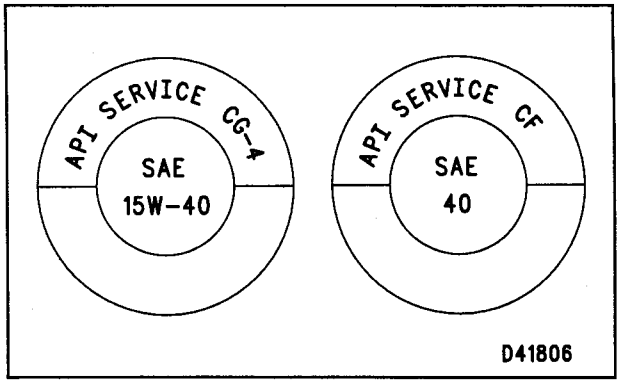
- SEBU6250, Caterpillar Built Machine Fluids Recommendations
- SEBU6385, Caterpillar On-Highway Diesel Truck Engine Fluids Recommendations
- SEBU6400, Lubrication Recommendations for Caterpillar Gaseous Fueled Spark Ignited Engines
- SEBU7003, Caterpillar 3600 Series Diesel Engine Fluids Recommendations

Lubricant Specifications

General Information

API Licensed Oils

Caterpillar recognizes and supports the American Petroleum Institute (API) "Engine Oil Licensing and Certification System" for engine oils. The API publication No. 1509, 13th edition, contains the detailed information concerning this system. Engine oils bearing the API symbol are licensed by the API.



Examples of the API symbol.

Diesel engine oil classifications CD, CD-2, and CE are obsolete API categories. Caterpillar will only reference those categories that are currently licensed by the API. The following chart summarizes the status of the categories.

Oil Classification Status	
Current	**Obsolete**
CF	CC, CD
CF-2[1]	CD-2[1]
CF-4, CG-4	CE

[1]CD-2 and CF-2 are oil categories for two cycle diesel engines. Caterpillar does not sell engines that utilize CD-2 and CF-2 category oils.

NOTE: CF is NOT the same as CF-4. API CF oils are only recommended for Caterpillar engines with precombustion chamber (PC) fuel systems.

In previous lubricant specifications, Caterpillar referred to U.S. Military oil specifications (MIL) and to European Comite des Constructeurs d'Automobile Marche Commun (CCMC) diesel engine oil specifications. Those specifications do not provide identical performance to API CF, CF-4 or API CG-4 engine oils. Therefore, Caterpillar will not make reference to MIL or to CCMC specifications in this publication.

Oil Viscosity

Lubricant viscosity charts are included in this publication for Caterpillar direct injection (DI) diesel engines, for Caterpillar precombustion chamber (PC) diesel engines, and for Caterpillar marine transmissions.

Grease

The National Lubricating Grease Institute (NLGI) classifies grease, based on the American Society for Testing and Materials (ASTM) D217-68 Worked Penetration characteristics. Grease characteristics are given a defined consistency number.

Terminology

Some abbreviations follow the Society of Automotive Engineers (SAE) J754 nomenclature. Some classifications follow the SAE J183 abbreviations. The definitions other than Caterpillar's will be of assistance in selecting lubricants.

Transmission/Drive Train Oil

Transmission and drive train oils are classified by the Caterpillar TO-4 specification developed by Caterpillar for use in Caterpillar transmissions and final drives.

Caterpillar Diesel Engine Oil (DEO)

Caterpillar Oils have been developed, tested, and approved by Caterpillar to provide the full performance and service life that has been designed and built into Caterpillar diesel engines. Caterpillar oils are currently used for factory fill in diesel engines. These oils are offered by Caterpillar dealers for continued refill use. Consult with your Caterpillar dealer for more information on these oils.

Due to significant variations in the quality and in the performance of commercially available oils, Caterpillar recommends:

Caterpillar Diesel Engine Oil (DEO) 15W40
Caterpillar Diesel Engine Oil (DEO) 10W30

Caterpillar multi-grade DEO is formulated with detergents, dispersants, and sufficient alkalinity to provide superior performance in Caterpillar diesel engines. Multi-grade DEO is blended in two viscosity grades: SAE 15W40 and SAE 10W30. Refer to the Lubricant Viscosities For Ambient Temperatures chart to choose the correct viscosity grade based on ambient temperatures. Multi-grade oils provide the correct viscosity for a broad range of operating temperatures and for cold engine starts. Multi-grade oils are also effective in maintaining low oil consumption and low levels of piston deposits.

Caterpillar multi-grade DEO is recommended for use in the 3000, 3100, 3200, 3300, 3400, and 3500 Series Caterpillar engines.

Caterpillar multi-grade DEO is also qualified for use in other diesel engines and in gasoline engines. Refer to the engine manufacturer's guide for the recommended specifications. Compare the recommendations to the specifications of Caterpillar multi-grade DEO. The current Caterpillar multi-grade DEO industry specifications are listed on the product labels and on the product data sheets.

Contact your Caterpillar dealer for part numbers and available container sizes.

Commercial Diesel Engine Oils

The performance of commercial diesel engine oils is based on API categories. API categories are developed to provide commercial lubricants for a wide variety of diesel engines that operate in various conditions.

If Caterpillar multi-grade DEO is not used, the following commercial oils are recommended.

- API CG-4 (multi-grade)
- API CF-4 (multi-grade)

The following explanations of these API categories can be used to make the proper choice of a commercial oil.

CG-4: CG-4 is the newest heavy duty diesel oil category. CG-4 oils can be used in Caterpillar diesel engines where CF-4 oils are recommended. Compared to CF-4 oils, CG-4 oils provide improved piston cleanliness, improved viscosity control, and improved crankcase cleanliness, especially in applications where oil soot is a problem. Although CG-4 oils were primarily developed for diesel engines operating on 0.05 percent sulfur diesel fuel, CG-4 oils can be used with higher sulfur fuels. The new oil TBN determines the maximum fuel sulfur level for CG-4 and CF-4 oils. Refer to the TBN and Fuel Sulfur topics in this publication.

CG-4 oils are the first oils to pass industry tests for foam control and viscosity shear loss. CG-4 oils must also pass recently developed tests for metals corrosion and wear.

CF-4 oils service a wide variety of modern diesel engines. This oil classification was developed with 0.40 percent sulfur diesel fuel. The fuel used in the CF-4 category represents the type of diesel fuels commonly available world wide. CF-4 oils provide improved piston deposit control and improved oil control when compared to the CE category oils. CF-4 oils also provide improved oil soot dispersancy compared to CD or CF category oils.

Some commercial oils meeting these API specifications may require shortened oil change intervals as determined by close monitoring of oil condition and wear metals (Caterpillar's S•O•S Oil Analysis Program preferred).

NOTICE
Failure to follow these oil recommendations can cause shortened engine service life due to deposits and/or excessive wear.

Synthetic Base Stock Oils

Synthetic base stock oils are acceptable for use in Caterpillar engines if these oils meet the performance requirements specified by Caterpillar.

Synthetic base stock oils generally outperform non-synthetic oils in two areas:
- Improved low temperature viscosity characteristics, especially in Arctic conditions
- Improved oxidation stability, especially at high operating temperatures

Some synthetic base stock oils have performance characteristics that enhance the useful service life of the oil. However, Caterpillar does NOT recommend the "automatic" extension of oil change intervals for any oil, including synthetic base stock oils. For Caterpillar diesel engines, oil change intervals can only be adjusted through an oil analysis program that contains the following elements: oil condition and wear metals (Caterpillar's S•O•S Oil Analysis preferred), trend analysis, fuel consumption, and oil consumption.

Re-Refined Base Stock Oils

Re-refined base stock oils are acceptable for use in Caterpillar engines if these oils meet the performance requirements specified by Caterpillar. Re-refined oils can be used exclusively in a finished oil or in combination with new base stocks. The U.S. Military and other heavy equipment manufacturers have also accepted the use of re-refined base stock oils with the same criteria.

The re-refining process should be adequate to remove all wear metals and oil additives that were present in the used oil. This type of re-refining is generally accomplished by vacuum distillation and hydrotreating the used oil. Filtering alone is inadequate for producing a high quality re-refined base stock from used oil.

Arctic Lubricants

For starting and operating engines in ambient temperatures below −20°C (−4°F), use a multi-grade oil with a 0W or 5W low temperature viscosity grade.

For starting and operating engines with ambient temperatures below −30°C (−22°F), use a synthetic base stock multi-grade oil with a 0W or 5W low temperature viscosity grade and a pour point of −50°C (−58°F) or lower.

Because the number of lubricants acceptable for use in Arctic conditions is limited, Caterpillar has special recommendations for these situations. Caterpillar recommends the following engine oils, in order of preference, for use in Arctic conditions:

- First Choice: API CG-4 or CF-4 oils with an SAE 0W20, 0W30, 5W30, or 5W40 viscosity grade
- Second Choice: Oils with a CG-4 or CF-4 type additive package and an SAE 0W20, 0W30, 5W30, or 5W40 viscosity grade

NOTICE
Shortened engine service life could result if second choice oils are used.

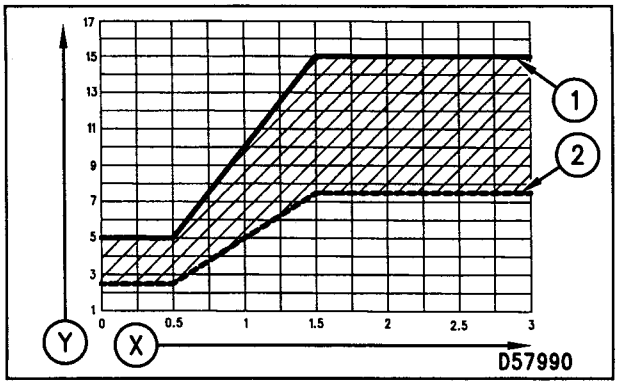
After-Market Oil Additives

Caterpillar does NOT recommend the use of after-market oil additives. After-market oil additives are not necessary to achieve service life predictions or to achieve rated performance. Fully formulated finished oils are made up of base stocks and commercial additive packages. The additive packages are blended into the base stocks at precise percentages to produce finished oils with performance characteristics that meet lubricant industry standards.

Lubricant industry standard tests do not exist to evaluate the performance of after-market oil additives. There are no lubricant industry standard tests to evaluate the compatibility of after-market additives in a finished oil. After-market additives could be incompatible with the finished oil additive package, reducing the performance of the finished oil. The after-market additives could fail to mix with the finished oil, producing a sludge in the crankcase. Caterpillar discourages the use of after-market additives in finished oils.

Total Base Number (TBN) and Fuel Sulfur Levels For Caterpillar DI Diesel Engines

The TBN required in a new oil depends on the sulfur level of the fuel used. For direct injection engines running on distillate diesel fuel, the minimum new oil TBN (by ASTM D2896) should be 10 times the fuel sulfur level, and the minimum TBN is 5 regardless of a low fuel sulfur level- refer to the following graph.



Y = oil TBN shown by ASTM D2896.
X = percent of fuel sulfur by weight.
New oil TBN (1).
Change oil when the used oil TBN limit (2) is reached.

In areas where the fuel sulfur exceeds 1.5 percent, choose an oil with the highest TBN that is within the API CF-4 or CG-4 categories, and shorten the oil change interval based on oil analysis. The oil analysis should evaluate oil condition and wear metals. High TBN oils that are not within the API CF-4 or CG-4 categories can produce excessive piston deposits, leading to a loss of oil control and bore polishing.

NOTICE

Operating DI diesel engines with fuel sulfur levels over 1.0 percent may require shortened oil change intervals in order to maintain adequate wear protection.

Lubricant Viscosity Recommendations For Caterpillar DI Engines

The proper SAE viscosity grade oil is determined by the minimum outside temperature at cold engine start up, and the maximum outside temperature during engine operation. Use the minimum temperature column on the chart to determine the oil viscosity required for starting a "cold soaked" engine. Use the maximum temperature column on the chart to select the viscosity for operation at the highest temperature anticipated. In general, use the highest viscosity oil available that still meets the start up temperature requirements.

Engine Oil Viscosity Protection		
Caterpillar DEO API CG-4 & CF-4 Viscosity Grade	Ambient Temperature	
	Minimum °C (°F)	Maximum °C (°F)
SAE 0W20	-40 (-40)	10 (50)
SAE 5W30	-30 (-22)	30 (86)
SAE5W40	-30 (-22)	40 (104)
SAE 10W30	-20 (-4)	40 (104)
SAE 15W40	-15 (5)	50 (122)

Precombustion Chamber (PC) Engines

Caterpillar Oil

Due to significant variations in the quality and in the performance of commercially available oils, Caterpillar recommends:

Caterpillar Diesel Engine Oil (DEO)

Caterpillar DEO is formulated with detergents, dispersants, and sufficient alkalinity to provide superior performance in Caterpillar precombustion chamber (PC) diesel engines. Multi-grade DEO is blended in two viscosity grades: SAE 10W30 and SAE 15W40. Single-grade DEO is blended in three viscosity grades: SAE 10W, SAE 30, and SAE 40. Refer to the Lubricant Viscosity Recommendations for Caterpillar Precombustion Chamber Diesel Engines chart to choose the correct viscosity grade based on ambient temperatures. Compared to single-grade oils, multi-grade oils provide the correct viscosity for a broad range of operating temperatures and for cold engine starts. Multi-grade oils are also effective in maintaining low oil consumption and low levels of piston deposits.

Commercial Diesel Engine Oils

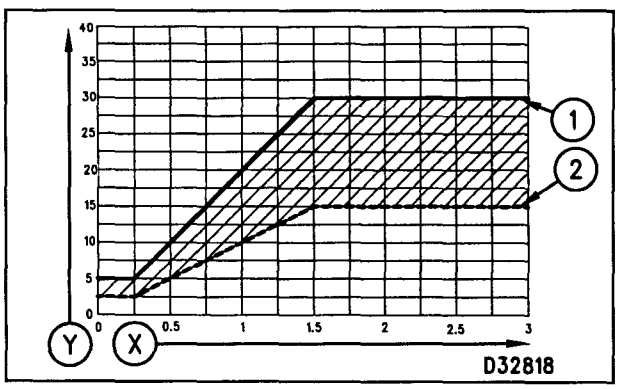
If Caterpillar DEO is not used, the following commercial oils are recommended for Caterpillar PC engines:

- API CG-4
- API CF-4
- API CF

CF oils are developed to service diesel engines that utilize a PC fuel system and those diesel engines designed to use single-grade oils.

Total Base Number (TBN) and Fuel Sulfur Levels For Caterpillar PC Diesel Engines

The TBN for a new oil depends on the sulfur level of the fuel used. For PC engines running on distillate fuel, the minimum new oil TBN (by ASTM D2896) should be 20 times the fuel sulfur level. The minimum TBN of new oil is 5, regardless of a low fuel sulfur level- refer to the following graph.



Y = oil TBN shown by ASTM D2896.
X = percent of fuel sulfur by weight.
New oil TBN (1).
Change oil when the used oil TBN limit (2) is reached.

In areas where the fuel sulfur exceeds 1.5 percent, choose an oil with the highest TBN that is within the API CF-4 or CG-4 or CF categories, and shorten the oil change interval based on oil analysis. The oil analysis should evaluate oil condition and wear metals.

NOTICE

Operating PC engines at fuel sulfur levels over 1.0 percent may require shortened oil change intervals to maintain adequate wear protection.

Lubricant Viscosity Recommendations for Caterpillar PC Engines

The proper SAE viscosity grade oil is determined by the minimum outside temperature at cold engine start up, and the maximum outside temperature during engine operation. Use the minimum temperature column on the chart to determine the oil viscosity required for starting a "cold soaked" engine. Use the maximum temperature column on the chart to select the viscosity for operation at the highest temperature anticipated. In general, use the highest viscosity oil available that still meets the start up temperature requirements.

Engine Oil Viscosity Protection		
Caterpillar DEO API CG-4, CF-4 & CF Viscosity Grade	Ambient Temperature	
	Minimum °C (°F)	Maximum °C (°F)
SAE 0W20	-40 (-40)	10 (50)
SAE 0W30	-40 (-40)	30 (86)
SAE 5W30	-30 (-22)	30 (86)
SAE5W40	-30 (-22)	40 (104)
SAE 10W	-20 (-4)	10 (50)
SAE 10W30	-20 (-4)	40 (104)
SAE 15W40	-15 (5)	50 (122)
SAE 20W40	-10 (14)	50 (122)
SAE 30	0 (32)	40 (104)
SAE 40	5 (41)	50 (122)

Caterpillar Marine Transmissions

Caterpillar Transmission/Drive Train Oil (TDTO) is balanced to give maximum frictional material service life in Caterpillar transmissions. TDTO has passed the requirements for the Caterpillar TO-4 oil specification which includes the frictional requirements and gear wear requirements. TDTO is offered in different viscosity grades, including SAE 50, for maximum component service life at high ambient temperatures and heavy duty cycles.

For maximum transmission service life and performance, Caterpillar recommends:

Caterpillar Transmission/Drive Train Oil (TDTO)

Caterpillar TDTO Lubricant Viscosities For Operating Temperatures

Compartment or System	Oil Viscositites	Minimum °C (°F)	Maximum °C (°F)
Transmission Raw/Sea Water Cooled	SAE 30	−15 (5)	80 (176)
	SAE 50	−5 (23)	95 (203)
Transmission Jacket Water Cooled	SAE 50	−5 (23)	95 (203)

Contact your Caterpillar dealer for part numbers and available container sizes.

NOTICE

This oil is formulated for transmissions and drive trains only, and should not be used in engines. Shortened engine service life will result.

Do not use Caterpillar Gear Oil (GO) in marine transmissions. Gear Oil can cause seal material to fail and possibly leak. Gear Oil also may not be compatible with friction materials and can reduce transmission efficiency.

NOTE: Multi-grade oils are not currently blended by Caterpillar for use in transmissions. Multi-grade oils which use high molecular weight polymers as viscosity index improvers lose their viscosity effectiveness by permanent and temporary shear of the viscosity index improver. Therefore, multi-grade oils are not recommended for transmissions. The Caterpillar TO-4 specification does include a test for multi-grade oil shear stability. Multi-grade oils with adequate shear stability may be available in the future.

Commercial Transmission/Drive Train Oils

If Caterpillar Transmission/Drive Train Oil is not used, commercial oils meeting the Caterpillar TO-4 specification must be used in Caterpillar marine transmissions:

- TO-4 Specification Oils, single grade only

Commercial Marine Transmissions

For marine transmissions which are not manufactured by Caterpillar, refer to the marine transmission or vessel OEM lubrication recommendations.

S•O•S Oil Analysis

Caterpillar's Scheduled Oil Sampling (S•O•S) Oil Analysis should be a part of an engine's overall maintenance program. The S•O•S program monitors the engine and transmission through used oil analysis. The oil analysis measures wear metals and oil condition. Deviations from established limits or trend lines can diagnose an impending problem before the problem becomes apparent, costly, and destructive.

See your Caterpillar dealer for more information regarding S•O•S Oil Analysis and how the program can help you manage your engine and transmission.

Engine Lubricant Recommendations Summary

To achieve all the performance that was built into a Caterpillar engine, follow these guidelines:

- Select the proper Caterpillar oil or commercial oil that meets the API specifications
- Select the proper oil viscosity based on the applicable Lubricant Viscosities chart
- Replace the engine oil and oil filter(s) at the intervals specified in the Operation and Maintenance Manual
- Perform maintenance according to the Operation and Maintenance Manual

Caterpillar Lubricating Grease

Caterpillar provides grease for a variety of applications and extreme temperature conditions. The descriptions of these products follow.

Contact your Caterpillar dealer for part numbers and available container sizes.

NOTE: One grease may be incompatible with another grease. When using commercial grease, make sure the grease is compatible with the grease used in your system, or make sure to purge the system. Contact your supplier regarding grease compatibility questions.

Multipurpose Grease

Multipurpose Lithium Complex Grease (MPG)

MPG is a NLGI No.2 general purpose lithium complex grease for light to medium duty applications. MPG has good high temperature characteristics, with a minimum dropping point of 260°C (500°F). MPG contains unleaded extreme pressure additives and anti-wear and corrosion inhibitors to provide extra protection in a variety of construction, agricultural and automotive applications.

MPG meets the requirements for extended service intervals of automotive chassis points and wheel bearings with disc brakes, particularly in passenger cars, vans, light trucks and taxi fleets. MPG meets NLGI GC-LB certification. MPG normal operating temperatures range from −28 to 149°C (−18 to 300°F). MPG is also available as a white lithium complex grease.

Multipurpose Lithium Complex Grease With Molybdenum (MPGM)

MPGM is a NLGI No.2 general purpose lithium complex grease for light to medium duty applications. MPGM is fortified with molybdenum disulfide and polymer for extra lubricity and protection. MPGM contains unleaded additives and anti-wear and oxidation/corrosion inhibitors for protection and lubrication in many environments. MPGM is formulated with a high viscosity base fluid and contains polymer additive to help protect against water washout, enhance retention, and withstand heavy loads.

MPGM is recommended for heavily loaded pin joints, journal bearings, heavy duty automotive, agricultural, industrial, steel mill, mining, and off road equipment. MPGM meets NLGI GC-LB certification. MPGM normal operating temperatures range from −28 to 149°C (−18 to 300°F).

NOTE: If MPGM is not available, use a multipurpose type grease that contains three to five percent molybdenum.

Special Purpose Grease

Bearing Lubricant

Bearing Lubricant is a NLGI No.2 lubricating grease with a polyurea thickener. Bearing Lubricant is recommended for high temperature anti-friction bearings in applications such as electric motors, alternators, fan drives, starters, and generators. Bearing Lubricant has an effective operating range from −29 to 177°C (−20 to 350°F).

Water and Temperature Resistant Grease (WTR)

WTR grease is designed for applications where water washout, sever corrosion, or higher operating temperatures are a concern. WTR is an environmentally friendly grease that provides extreme pressure, anti-wear, oxidation and corrosion protection without using barium, zinc, antimony, phosphorous, lead, or sulfur additives. WTR is very shear stable and resists breakdown in the presence of water.

WTR grease performs extremely well in marine, automotive, agricultural, and industrial applications, in construction equipment, and in washer equipment bearings. WTR meets NLGI GC-LB certification. WTR normal operating temperatures range from −40° to 204°C (−40 to 400°F).

Caterpillar Premium Grease

Desert Gold

Desert Gold is a heavy duty premium synthetic extreme pressure lubricating grease developed for the most harsh operating environments. Desert Gold is formulated with a high viscosity synthetic base fluid, polymers, and molybdenum disulfide. Desert Gold has a high viscosity index and a high dropping point. Desert Gold has excellent adhesion and stability characteristics, and provides longer protection than other greases. Desert Gold is an environmentally friendly grease which does not contain antimony, sulfur, barium, zinc, lead, or phosphorous.

Desert Gold will lubricate and protect equipment against heavy shock loads and corrosion in extremely hot, moist, or dusty conditions. Desert Gold operating temperatures range from −6 to 230°C (20 to 450°F). Desert Gold can operate at higher temperatures for short time periods and has additional extreme pressure protection for heavily loaded pin joints.

Arctic Platinum

Arctic Platinum is a super-premium extreme pressure synthetic lubricating grease developed for lubrication in sub-zero to moderate operating temperatures. Arctic Platinum has a high drop point and contains five percent molybdenum disulfide for protection against extra heavy loads. Arctic Platinum provides excellent protection against corrosion and oxidation. Arctic Platinum is an environmentally friendly grease which does not contain antimony, sulfur, barium, zinc, or phosphorous.

Arctic Platinum is designed for lubrication of horizontal pivot and lower link bearings, steering cylinders, king pin/king bolt bearings, upper hitch link bearings, and ejector carrier roller bearings. Arctic Platinum is extra tacky for retention on excavator car-body bearings and has additional extreme pressure protection for heavily loaded pin joints. Arctic Platinum is available in NLGI grades No.000, No.00, No.0, No.1 and No.2 to assure pumpability in central lube systems in a variety of ambient temperatures, ranging from −60 to 18°C (−76 to 65°F).

Caterpillar Reference Materials for Lubricants

PEHP5026, Data Sheet- Caterpillar Diesel Engine Oils (DEO) (CG4/CF-4) (North America and selected International)
PEHP1026, Data Sheet- Caterpillar Diesel Engine Oil (DEO) (CF-4) (International only)
PEHP0003, Data Sheet- Multipurpose Lithium Complex Grease (MPG)
PEHP0002, Data Sheet- Multipurpose Lithium Complex Grease with Molybdenum (MPGM)
PEHP0017, Data Sheet- Special Purpose Grease (SPG) Bearing Lubricant
PECP4025, One Safe Source
SEBD0640, Oil and Your Engine
SEBU5898, Cold Weather Recommendations

Additional Reference Material

EMA Lubricating Oils Data Book

Engine Manufacturers Association
401 N. Michigan Ave.
Chicago, Illinois, USA 60611
Phone (312) 644-6610

Society of Automotive Engineers (SAE) Specifications can be found in your SAE handbook or can be obtained from your local technological society, library, or college, or contact

SAE International
400 Commonwealth Drive
Warrendale, PA USA 15096-0001

American Society for Testing and Materials (ASTM) Specifications can normally be obtained from your local technological society, library, or college, or contact:

American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

Fuel Specifications

Distillate Diesel Fuel

Diesel fuels that meet the specifications in the chart below will provide rated engine performance and full component service life. In North America, diesel fuel identified as No.1-D and No.2-D in ASTM D975 generally meet these specifications. This chart is for diesel fuels that are distilled from crude oil. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

Caterpillar Distillate Diesel Fuel Specifications	
Specifications (ASTM Test)	**Requirements**
Aromatics (D1319)	35% maximum
Ash (D482)	0.02% weight maximum
Carbon Residue On 10% Bottoms (D524)	1.05% weight maximum
Cetane Number (D613)	35 minimum (PC engines) 40 minimum (DI engines)
Cloud Point (D97)	maximum not above lowest expected ambient temperature
Copper Strip Corrosion (D130)	No. 3 maximum
Distillation (D86)	10% at 282°C (540°F) maximum 90% at 360°C (680°F) maximum
Flash Point (D93)	legal minimum
API Gravity (D287)	30 minimum/45 maximum
Pour Point (D97)	6°C (10°F) minimum below ambient temperature
Sulfur[1] (D3605 or D1552)	3% maximum
Viscosity[2] (D445) Kinematic at 40°C (104°F)	1.4 cSt minimum 20.0 cSt maximum
Water and Sediment (D1796)	0.1% maximum
Water (D1744)	0.1% maximum
Sediment (D473)	0.05% weight maximum
Gums & Resins (D381)	10 mg/100 ml maximum (5.8 grains/US gal) maximum

[1] Caterpillar fuel systems and engine components can operate on high sulfur fuels. However, fuel sulfur levels effect exhaust particulate emissions. High sulfur fuels increase the potential for internal component corrosion. Fuel sulfur levels above 1.0 percent may SIGNIFICANTLY shorten the oil change interval. Refer to the TBN and Fuel Sulfur topic for additional information.

[2] The Viscosity limits are for the fuel as delivered to the fuel injection pump. If low viscosity fuels such as JP-8 or No.1D diesel are used, fuel cooling may be required to maintain 1.4 cSt at the fuel injection pump. Conversely, when using high viscosity fuels or when operating in low temperature conditions, fuel heaters may be required in order to reduce viscosity to 20 cSt. Refer to SEBD0717, Diesel Fuel And Your Engine, for additional information.

There are many other diesel fuel specifications published by governments and technical societies. Those diesel fuel specifications usually do not contain all of the parameters addressed by Caterpillar in this specification. To assure optimum engine performance, a complete fuel analysis should be obtained prior to engine operation. The fuel analysis should include all of the properties listed in the Distillate Fuel Recommendations chart. If a particular fuel does not meet the minimum Caterpillar requirements, the engine could exhibit excessive fuel system wear, fuel system failure, or excessive engine wear caused by deposits or corrosion.

0.05 Percent Sulfur Diesel Fuel

In the U.S.A., 0.05 percent sulfur diesel fuel has been used in all on-highway diesel truck engines since January 1, 1994. This low sulfur fuel was mandated as a means of directly reducing particulate emissions from diesel truck engines. This low sulfur fuel will also be used in Caterpillar commercial diesel engines where low emissions are required and where supply sources provide this type of fuel. Caterpillar has not seen any detrimental effects with 0.05 percent sulfur fuel in Caterpillar commercial diesel engines.

NOTICE

Heavy Fuel Oil (HFO), Residual fuel, or Blended fuel must NOT be used in Caterpillar diesel engines (except in certain 3600 Series HFO engines). Severe component wear and component failures will result if HFO type fuels are used.

Caterpillar Reference Materials for Fuels

SEBD0717, Diesel Fuels and Your Engine

Additional Reference Material

American Society for Testing and Materials (ASTM) Specifications can normally be obtained from your local technological society, library, or college, or contact:

American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

Coolant Specifications

General Coolant Information

Many engine failures are related to the cooling system. Problems such as overheating, water pump leaking, plugged radiators, and cylinder liner pitting can be avoided with proper cooling system maintenance. Cooling system maintenance is as important as fuel and lubricating system maintenance. Coolant quality is as important as the quality of fuel and lubricating oil.

Coolant is normally composed of three elements:

- Water
- Additives
- Glycol

Water

NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate anti-freeze or anti-boil protection.

Distilled or deionized water is recommended for use in engine cooling systems. DO NOT use hard tap water or salt softened tap water in engine cooling systems. If distilled or deionized water is not available, use water that meets the minimum acceptable requirements listed in the following chart.

Caterpillar Water Quality Limits	
Water Property (ASTM Test)	**mg/L (grains/US gal)**
Chloride (D512b or D512d or D4327)	40 (2.4) Maximum
Sulfate (D516b or D516d)	100 (5.9) Maximum
Total Hardness (D1126)	170 (10) Maximum
Total Solids (D1888a)	340 (20) Maximum
pH (D1293)	5.5 to 9.0

Contact your Caterpillar dealer, your local water department, agricultural agent, or an independent laboratory for water analysis.

Additives

Additives must be added to all coolant mixtures. Additives help prevent the formation of rust, scale, and mineral deposits. Additives protect metals from corrosion, prevent liner cavitation, and contain anti-foaming agents. Additives deplete during engine operation and need to be replenished. This can be done by treating conventional coolants with Supplemental Coolant Additives (SCA) or by treating Extended Life Coolant (ELC) with Extender.

Additives must be added at the proper concentration. Over-concentration of additives can cause the inhibitors to drop out of the solution and form a gel in the radiator. An over-concentration of additives produces excessive deposits on water pump seals that can cause the water pump seal to leak. Under-concentration of additives can produce pitting, cavitation, erosion, rust, scale, and foaming.

Glycol

Glycol in the coolant provides anti-boil and freeze protection, prevents water pump cavitation, and reduces cylinder liner pitting. **For optimum performance, Caterpillar recommends a 50/50 glycol/water coolant mixture.**

NOTE: All Caterpillar engines equipped with air-to-air aftercooling (ATAAC) require a MINIMUM of 30 percent glycol to prevent water pump cavitation.

Ethylene glycol is used in most conventional heavy duty (HD) coolant/antifreezes. However, propylene glycol may also be used. Both ethylene glycol and propylene glycol have similar fluid properties in a 50/50 glycol/water mixture. Both ethylene glycol and propylene glycol provide similar heat transfer, freeze protection, corrosion control, and seal compatibility. The following charts define the temperature protection provided by the two types of glycol.

Ethylene Glycol		
	Protection	
Concentration % Glycol/% Water	Anti-Freeze °C (°F)	Anti-Boil °C (°F)
50/50	−36 (−33)	106 (223)
60/40	−51 (−60)	108 (226)

NOTICE
Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional anti-boil or anti-freeze protection.

Propylene Glycol		
	Protection	
Concentration % Glycol/% Water	Anti-Freeze °C (°F)	Anti-Boil °C (°F)
50/50	−37 (−35)	106 (222)

Caterpillar recommends the use of a refractometer for checking the glycol concentration. Use the 1U-7298 Coolant Tester (°C) or use the 1U-7297 Coolant Tester (°F). The testers give immediate, accurate readings and can be used with ethylene or propylene glycol.

Coolant Recommendations

NOTICE
DO NOT use a commercial coolant/antifreeze that ONLY meets the ASTM D3306 or D4656 specification. This type of coolant/antifreeze is made for light duty automotive applications.

The primary types of coolant used in Caterpillar commercial diesel engines are:

- Preferred – Caterpillar Extended Life Coolant (ELC), or...

  a commercial ELC meeting the Caterpillar EC-1 specification

- Acceptable – Caterpillar Diesel Engine Antifreeze/Coolant (DEAC), or...

  a commercial heavy duty (HD) coolant/antifreeze meeting ASTM D5345 or D4985 specifications, or ...

  a mixture of Caterpillar SCA and distilled or deionized water, or ...

  a mixture of commercial SCA and distilled or deionized water

Caterpillar ELC will provide the best coolant service life, corrosion protection, water pump seal service life, and radiator service life.

Caterpillar recommends a 50/50 glycol/water mixture for optimum ELC performance and for optimum conventional HD coolant/antifreeze performance.

NOTE: Caterpillar DEAC does not require SCA treatment at initial fill. Commercial HD coolant/antifreezes meeting the ASTM D5345 or D4985 specification DO REQUIRE SCA treatment at initial fill.

In those stationary and marine engine applications **that do not require anti-boil or anti-freeze protection,** a mixture of SCA and water is acceptable. Caterpillar recommends a six to eight percent concentration of SCA in those cooling systems. Distilled or deionized water is preferred. Water which has the properties listed in the Caterpillar Water Quality Limits chart may be used.

Coolant Service Life	
Coolant Type	**Service Life**
Caterpillar ELC	6000 Hours or Four Years
Caterpillar DEAC	3000 Hours or Two Years
Commercial heavy duty coolant/antifreeze meeting ASTM D5345	3000 Hours or Two Years
Commercial heavy duty coolant/antifreeze meeting ASTM D4985	3000 Hours or One Year
Caterpillar SCA and Water	3000 Hours or Two Years
Commercial SCA and Water	3000 Hours or One Year

Caterpillar Extended Life Coolant (ELC)

Caterpillar provides Extended Life Coolant (ELC) for use in heavy duty diesel engines, natural gas engines, and automotive engines. The Caterpillar ELC anti-corrosion package is totally different from conventional coolants. Caterpillar ELC is an ethylene glycol based coolant which contains organic acid corrosion inhibitors and anti-foaming agents. Caterpillar ELC has fewer nitrites than other coolants. Caterpillar ELC has been formulated with the correct levels of additives to provide superior corrosion protection for all metals in diesel engine cooling systems.

Caterpillar ELC extends coolant service life to 6000 service hours or Four years. Caterpillar ELC does not require frequent additions of SCA. A "one time only" coolant Extender is the only maintenance addition required. The Extender should be added to the cooling system at 3000 service hours or Two Years.

Caterpillar ELC is available Premixed with distilled water in a 50/50 concentration. The Premixed ELC provides anti-freeze protection to −36°C (−33°F). The Premixed ELC is recommended for initial fill and for topping off the cooling system. ELC Concentrate is available to lower the freezing point to −51°C (−60°F) for Arctic conditions. ELC Concentrate should be used to adjust the coolant freeze point as required where Caterpillar ELC Premixed freeze protection is not acceptable.

Contact your Caterpillar dealer for part numbers and available container sizes.

NOTE: The Caterpillar EC-1 Specification is an industry standard developed by Caterpillar. The EC-1 specification defines all of the performance requirements that an engine coolant must meet in order to be sold as an extended life coolant for Caterpillar engines. Caterpillar ELC can be used in most OEM diesel, gasoline, and natural gas engines. Caterpillar ELC meets the industry performance requirements of ASTM D4985 and D5345 for heavy duty low silicate coolant/antifreezes. Caterpillar ELC also meets the industry performance requirements of ASTM D3306 and D4656 for automotive applications.

Caterpillar ELC Cooling System Maintenance

Caterpillar ELC Extender

Caterpillar ELC Extender is added to the cooling system halfway through the ELC service life. The cooling system should be treated with Extender at 3000 service hours or one half of the coolant service life. Use the chart below to determine the proper amount of Caterpillar Extender required.

Contact your Caterpillar dealer for part numbers and available container sizes.

Caterpillar ELC Extender Additions By Cooling System Capacity	
Cooling System Capacity	**Extender Addition**
22 to 30 L (6 to 8 US gal)	0.57 L (20 fl oz)
31 to 38 L (9 to 10 US gal)	0.71 L (24 fl oz)
39 to 49 L (11 to 13 US gal)	0.95 L (32 fl oz)
50 to 64 L (14 to 17 US gal)	1.18 L (40 fl oz)
65 to 83 L (18 to 22 US gal)	1.60 L (54 fl oz)
84 to 114 L (23 to 30 US gal)	2.15 L (72 fl oz)
115 to 163 L (31 to 43 US gal)	3.00 L (100 fl oz)
164 to 242 L (44 to 64 US gal)	4.40 L (148 fl oz)

ELC Cooling System Cleaning

NOTE: CLEAN WATER is the only system cleaning/flushing agent required when ELC is drained from the cooling system.

ELC can be recycled. The drained coolant mixture can be "distilled" to remove the ethylene glycol and water for reuse. Contact your Caterpillar dealer for more information.

After draining and refilling the cooling system, operate the engine with the radiator filler cap removed until the coolant reaches normal operating temperature and the coolant level stabilizes. Add ELC mixture as necessary to fill the system to the proper level.

Changing to Caterpillar ELC

To switch the cooling system from conventional HD coolant/antifreeze to Caterpillar ELC, perform the following steps:

1. Drain the cooling system.

2. Flush the system with clean water to remove any debris.

3. Clean the cooling system with Caterpillar Cooling System Cleaner. Follow the instructions on the label.

4. Flush the cooling system with clean water. It is very important to remove all of the cleaning agent.

5. Fill the cooling system with clean water. Operate the engine until the cooling system temperature is 49° to 66°C (120° to 150°F).

6. Drain the cooling system. Flush the cooling system with clean water.

7. Repeat steps 5 and 6. Continue to flush the cooling system with clean water until the draining water is also clean.

8. Fill the cooling system with Caterpillar ELC.

9. Attach a label to the cooling system to indicate the system has been switched over to Caterpillar ELC.

ELC Cooling System Contamination

NOTICE

Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for premixed or concentrate coolants. Use only Caterpillar Extender with Caterpillar ELC. Failure to follow these recommendations can result in shortened cooling system component life.

ELC cooling systems can withstand contamination of up to ten percent of conventional HD coolant/antifreeze. If the contamination exceeds ten percent of the total system capacity, perform either one of the following two procedures:

- Drain the cooling system. Flush the system with clean water. Refill the system with ELC.
- Maintain the cooling system as if the system is filled with conventional HD coolant/antifreeze.

Commercial ELC

If Caterpillar extended life coolant is not used, select a commercial extended life coolant that meets the Caterpillar EC-1 specification. Do not use a product that is labeled as an extended life coolant but does not meet the Caterpillar EC-1 specification. Follow the coolant maintenance guidelines of the commercial ELC supplier. In all cases, use distilled or deionized water or use water that has the properties listed in the Caterpillar Water Quality Limits chart.

Caterpillar Diesel Engine Antifreeze/Coolant (DEAC)

Caterpillar recommends the use of Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) in conventional HD cooling systems. DEAC is an alkaline type, single-phase, ethylene glycol-based antifreeze/coolant. DEAC contains inorganic corrosion inhibitors and anti-foaming agents.

Contact your Caterpillar dealer for part numbers and available container sizes.

Caterpillar DEAC is available premixed with distilled water in a 50/50 concentration. If DEAC concentrate is used, Caterpillar recommends mixing the concentrate with distilled or deionized water. If distilled or deionized water is not available, use water that has the properties listed in the Caterpillar Water Quality Limits chart.

Caterpillar Supplemental Coolant Additive (SCA)

Caterpillar Supplemental Coolant Additive (SCA) is effective in preventing corrosion on all metals. Caterpillar SCA also prevents the formation of mineral deposits, prevents liner cavitation, and eliminates coolant foaming.

Caterpillar DEAC is formulated with the correct level of Caterpillar SCA. Additional SCA is NOT needed when the cooling system is initially filled with DEAC.

Contact your Caterpillar dealer for part numbers and available container sizes.

Commercial Heavy Duty (HD) Coolant/Antifreeze and SCA

If Caterpillar DEAC is not used, select a low silicate commercial HD coolant/antifreeze that meets ASTM D5345 or D4985 specifications.

When a commercial HD coolant/antifreeze is used, the cooling system should be treated with three to six percent Caterpillar SCA by volume. Refer to the Caterpillar SCA Requirements for Heavy Duty Coolant/Antifreeze chart. If Caterpillar SCA is not used, select a commercial SCA. The commercial SCA must provide a minimum of 1200 mg/L or 1200 ppm (70 grains/US gal) nitrites in the final coolant mixture. Follow the coolant maintenance guidelines of the commercial SCA supplier.

HD coolant/antifreezes that meet ASTM D5345 or D4985 specifications **DO require SCA treatment at initial fill, and on a maintenance basis.**

When mixing concentrated coolants, use distilled or deionized water or use water that has the properties listed in the Caterpillar Water Quality Limits chart.

Heavy Duty Coolant/Antifreeze Cooling System Maintenance

NOTICE

Never operate an engine without thermostats in the cooling system. Thermostats maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without thermostats.

Check the coolant/antifreeze solution (glycol content) frequently to ensure adequate anti-boil and anti-freeze protection. Caterpillar recommends the use of a refractometer for checking the glycol concentration. Use the 1U-7298 Coolant Tester (°C) or use the 1U-7297 Coolant Tester (°F). The testers give immediate, accurate readings and can be used with ethylene or propylene glycol.

Caterpillar commercial engine cooling systems should have the SCA concentration tested every 250 hours. Your Caterpillar dealer has test kits to evaluate SCA concentration. Test the SCA concentration or submit a coolant sample to your Caterpillar dealer every 250 hours (refer to the S•O•S Coolant Analysis topic).

SCA additions are based on the test results or based on the coolant analysis results. Liquid SCA or a SCA maintenance element (if equipped) may be needed every 250 service hours.

The following chart lists the amount of Caterpillar SCA needed at initial fill to treat commercial HD coolant/antifreeze.

The chart also lists SCA additions for liquid SCA and for SCA maintenance elements at 250 hours. The additions apply to both Caterpillar DEAC and commercial HD coolant/antifreezes.

Caterpillar SCA Requirements For Heavy Duty Coolant/Antifreeze

Cooling System Capacity L (US gal)	SCA At Initial Fill[1] ASTM D5345 ASTM D4985 HD Coolant L (fl oz)	SCA At 250 Hours For All HD Type Coolants[2] L (fl oz)	SCA Element At 250 Hours For All HD Type Coolants[3] Part No. (Qty)
22 to 30 (6 to 8)	0.95 (32)	0.24 (8)	111-2370 (1)
31 to 38 (9 to 10)	1.18 (40)	0.36 (12)	111-2369 (1)
39 to 49 (11 to 13)	1.42 (48)	0.36 (12)	111-2369 (1)
50 to 64 (14 to 17)	1.90 (64)	0.47 (16)	9N-3368 (1)
65 to 83 (18 to 22)	2.37 (80)	0.60 (20)	111-2371 (1)
84 to 114 (23 to 30)	3.32 (112)	0.95 (32)	9N-3718 (1)
115 to 163 (31 to 43)	4.75 (160)	1.18 (40)	111-2371 (2)
164 to 242 (44 to 64)	7.60 (256)	1.90 (64)	9N-3718 (2)

[1] SCA is NOT required for Caterpillar DEAC at initial fill.
[2] Do not exceed the six percent maximum concentration. Check the SCA concentration with a SCA test kit.
[3] Do not use both the SCA maintenance element and SCA liquid at the same time.

NOTE: Due to specific engine applications, maintenance practices may need periodic re-evaluation in order to properly maintain the engine's cooling system.

Heavy Duty Coolant/Antifreeze Cooling System Cleaning

Caterpillar Cooling System Cleaners are designed to clean the cooling system of harmful scale and corrosion. Caterpillar cleaners dissolve mineral scale, corrosion products, light oil contamination, and sludge.

Clean the cooling system:
- after draining used coolant and before filling the cooling system with new coolant
- whenever the coolant is dirty or foaming

SCA and Water Cooling Systems

NOTE: All Caterpillar engines equipped with air-to-air aftercooling (ATAAC) require a MINIMUM of 30 percent glycol to prevent water pump cavitation.

In stationary and marine engine cooling systems that use Supplemental Coolant Additive (SCA) and water alone, Caterpillar recommends the use of Caterpillar SCA to prevent corrosion, mineral deposition, liner cavitation, and coolant foaming. If Caterpillar SCA is not used, select a commercial SCA. The commercial SCA must provide a minimum of 2400 mg/L or 2400 ppm (140 grains/US gal) of nitrites in the final coolant mixture.

Water quality is a very important factor in this type of cooling system. Caterpillar recommends the use of distilled or deionized water. If distilled or deionized water is not available, use water that has the properties listed in the Caterpillar Water Quality Limits chart.

A cooling system using SCA and water only needs more SCA than a cooling system using a glycol/water mixture. The SCA concentration in a SCA and water cooling system should be six to eight percent by volume. Refer to the following chart for the amount of Caterpillar SCA required for various cooling system capacities.

Caterpillar SCA Requirements For SCA And Water Cooling Systems		
Cooling System Capacity L (US gal)	**Caterpillar SCA At Initial Fill L (fl oz)**	**Caterpillar SCA At 250 Hours L (fl oz)**
22 to 30 (6 to 8)	1.75 (64)	0.44 (15)
31 to 38 (9 to 10)	2.30 (80)	0.57 (20)
39 to 49 (11 to 13)	3.00 (100)	0.75 (25)
50 to 64 (14 to 17)	3.90 (128)	0.95 (32)
65 to 83 (18 to 22)	5.00 (168)	1.25 (42)
84 to 110 (23 to 29)	6.60 (224)	1.65 (56)
111 to 145 (30 to 38)	8.75 (296)	2.19 (74)
146 to 190 (39 to 50)	11.50 (392)	2.88 (98)
191 to 250 (51 to 66)	15.00 (512)	3.75 (128)

SCA and Water Cooling System Maintenance

Except for the amount of SCA additions, maintenance of a SCA and water system is the same as maintenance for a system using a HD coolant/antifreeze. See the Caterpillar SCA Requirements for SCA and Water Cooling Systems chart for the amount of SCA required.

NOTE: The 8T-5296 Conditioner Test Kit can be used to evaluate the SCA concentration in water and SCA cooling systems, with the following modifications to step 3 and step 5:

STEP 3 - Add tap water to the vial up to the 20 ml mark.

STEP 5 - With the defined procedure, the six to eight percent concentration will yield a 20 to 27 drop range. Fewer drops indicate under-concentration of SCA. More drops indicate over-concentration of SCA. Adjust SCA the concentration as needed.

S•O•S Coolant Analysis

Coolant testing is available at your Caterpillar dealer. S•O•S Coolant Analysis is the best way to monitor the condition of your coolant and your cooling system. S•O•S Coolant Analysis is a two-level program, based on periodic samples.

Level I: Basic Analysis

Recommended at every oil change or every 250 service hours. Level I tests for:

- glycol
- SCA concentration
- pH
- conductivity

Level I coolant analysis reports results and makes recommendations.

Level II: Comprehensive Analysis

Recommended semi-annually or every 1000 service hours or whenever indicated by Level I results.

- Performs full Level I analysis
- Inspects visual properties
- Identifies metal corrosion and contaminants
- Identifies built-up impurities that point to corrosion and scaling problems BEFORE they lead to costly repairs

Level II coolant analysis reports results and makes recommendations.

See your Caterpillar dealer for more information on coolant analysis and how it can help you manage your equipment.

Caterpillar Reference Materials for Coolants

PEHP4036, Data Sheet- Caterpillar Coolant
PEHP5033, S•O•S Coolant Analysis
PECP4025, One Safe Source
SEBD0518, Know Your Cooling System
SEBD0970, Coolant and Your Engine

Additional Reference Material

American Society for Testing and Materials (ASTM) Specifications can normally be obtained from your local technological society, library, or college, or contact:

American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

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