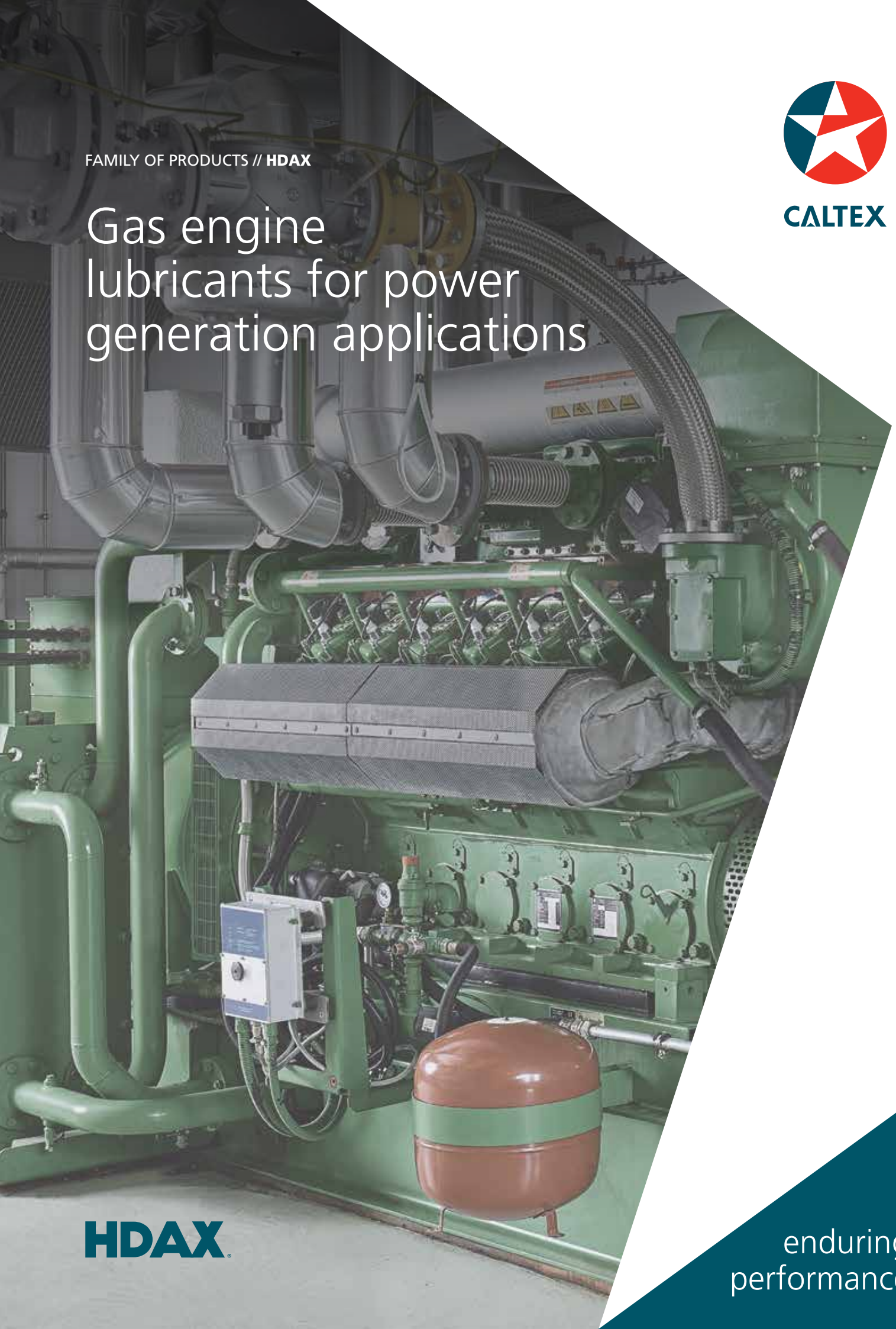
FAMILY OF PRODUCTS // **HDAX**

Gas engine lubricants for power generation applications



CALTEX

HDAX®

enduring performance

Keep the heart of your operation healthy

We know what you're up against. Gas engines are critical to keep your operation running. Yet today's engine designs and operating conditions mean higher temperatures and loads, more stress on components and lubricants, and more potential for costly failures. We developed the HDAX® family of stationary gas engine oils to help you fight back.

HDAX® lubricants are formulated to handle the tighter equipment tolerances, extreme temperatures and dirty conditions your operation faces every day. They help you control nitration, oxidation acids and other deposits that attack pistons, cylinders and valves and cause poor performance and even catastrophic shutdowns. HDAX® oils help keep you protected, so you can reach higher levels of efficiency and achieve the full potential of your engine.

HDAX®

Caltex® HDAX applications

Engine (natural gas)

HDAX® 9300	Power Generation	4-Cycle
HDAX® 9200	Power Generation	4-Cycle
HDAX® 5200	Power Generation and Oil & Gas	4-Cycle

Cooling system

Delo® ELC Premixed 50/50

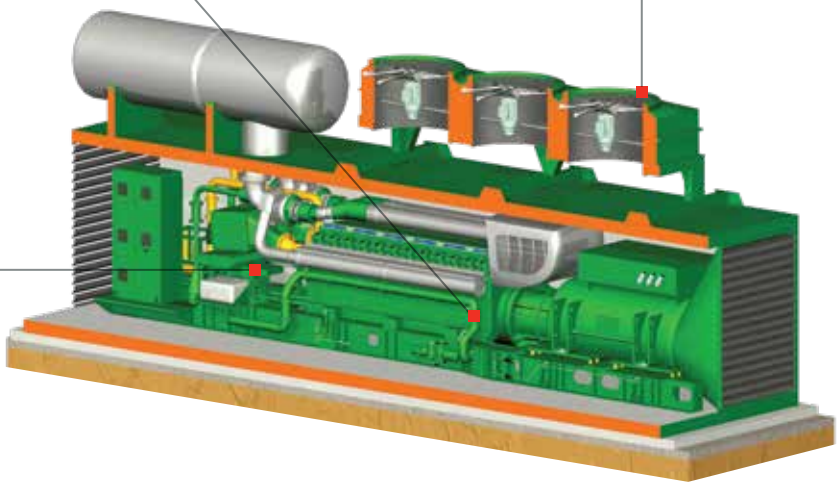
Delo® XLC Premixed 40/60

Delo® XLI Corrosion Inhibitor

Delo® ELI Corrosion Inhibitor

Cooling fans

SRI Grease NLGI 2



Always confirm that the product selected is consistent with the Original Equipment Manufacturer's recommendation for the equipment operating conditions and customer's maintenance practices.

SPECIFICATIONS	PRODUCT LINE		
	HDAX® 9300	HDAX® 9200	HDAX® 5200
ENGINE TYPE	4-Cycle	4-Cycle	4-Cycle
VISCOSITY	SAE 40	SAE 40	SAE 40
TBN, D2896, mgKOH/g	6.2	4.2	4.2
ASH LEVEL SULFATED ASH, wt%	Medium Ash 0.7	Low Ash 0.5	Low Ash 0.5
APPLICATION	High BMEP Steel Pistol Gas Engines	Natural Gas Gathering Power Generation	Natural Gas Gathering Power Generation
GAS TYPE	Natural Gas Well Head Gas	Natural Gas Well Head Gas	Natural Gas Well Head Gas
BENEFITS			
TOTAL PROTECTION	✓✓✓	✓✓✓	✓✓
WEAR PROTECTION	✓✓✓	✓✓✓	✓✓
EXTENDED DRAIN CAPABILITY	✓✓✓	✓✓✓	✓✓
CATALYST COMPATIBILITY	✓✓✓	✓✓✓	✓✓✓
VALVE RECESSION CONTROL	✓✓✓	✓✓✓	✓✓✓
DEPOSIT CONTROL	✓✓✓	✓✓	✓✓

HDAX® 9300 provides excellent control of carbonaceous deposits on pistons, ensuring correct piston ring operation and providing scuffing protection to cylinder liners.

Performance Attribute:

- Extended drain capability and low oil consumption
- Promotes engine cleanliness
- Long component life
- Optimized ash level
- Catalyst compatible

Performance Claims*:

- INNIO Jenbacher Type 9 (all versions) Fuel Class A
- INNIO Jenbacher Type 4 (Version C), Type 6 (Version F)
- Waukesha**

HDAX® 9300 SAE 40

HDAX® 9300 is a premium performance medium ash, dispersant/ detergent type gas engine oil formulated specifically for natural gas applications even under heavily loaded conditions, including high output engines in the 10 MWe class. The optimized ash level provides protection against valve recession, while avoiding the formation of ash deposits in the combustion chamber that could lead to pre-ignition. It's low phosphorus additive design allows for use with catalyst systems.

HDAX® 9300 is formulated with premium base oils which contain extremely low sulphur, nitrogen and aromatics. The combination of excellent base number retention and oxidation/nitration resistance allows HDAX® 9300 to deliver extended drain capability – even in applications where the oil feed rate is deliberately kept low, placing extra stresses on the lubricant. HDAX® 9300 prevents sludge formation on cylinder liners, which could interfere with oil flow and lead to higher oil consumption.

HDAX® 9300 is approved for INNIO Jenbacher Type 9 (all versions) gas engines burning clean natural gas (Class A). This oil is recommended for four-stroke gas fueled engines by Waukesha, and for Jenbacher Type 4 and 6 natural gas engines.

* Refer to product data sheet for most updated product claims/ approvals.

** Pending approval from OEM, field trial demonstration completed.

Performance Attribute:

- HDAX® 9300 is designed to achieve 4000 hour extended drain period on Jenbacher Type 9 engines
- HDAX® 9300 with it's optimized ash level is formulated for reliable valve recession control and to help prevent potential pre-ignition.

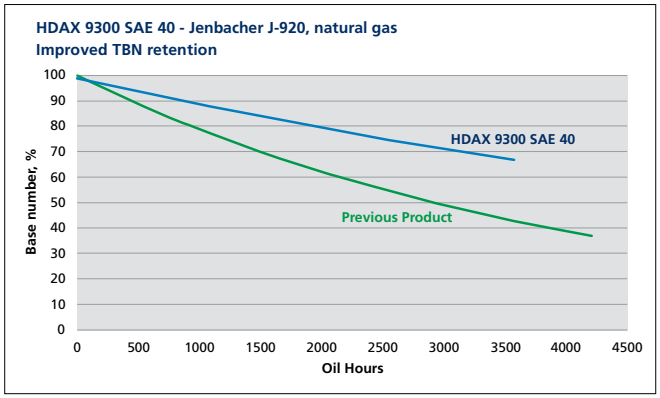
Field Trial Performance

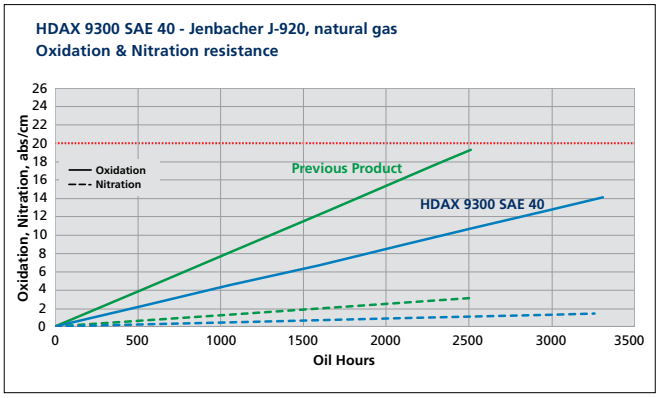
At a cogeneration facility, HDAX® 9300 was tested on a Jenbacher J920 engine burning natural gas with an average oil consumption of 0.15 g/kWh.

For the duration of the trial, HDAX® 9300 provided outstanding piston deposit control and scuffing protection to the cylinder liners. It also protected against abrasive wear.

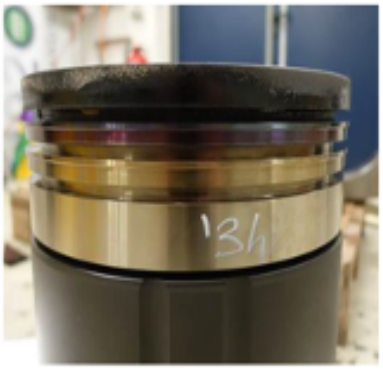
Despite a very low oil consumption for the engine, HDAX® 9300's robust oxidation/nitration resistance and base number retention characteristics enabled extended drain. It minimized oil thickening and sludge formation; and resulted in low deposition in ring grooves.

HDAX® 9300 Field Trial Results





Cylinder 4 inspection after 3000+ hours



Performance Attribute:

- Exceptional Engine Performance
- Long Oil Life
- Valve Recession Protection
- Low Wear
- Clean Pistons

Performance Claims:

- INNIO Jenbacher Fuel Class A, engine Type 2, 3, 4 (all versions) Type 6 (C, E, F onwards)
- Caterpillar Energy Solutions GmbH (former MWM) for CG132, CG170 and CG260 series
- Waukesha VGF, VGP series
- RMB/ Energie
- Caterpillar 3500 series

HDAX® 9200 Low Ash Gas Engine Oil SAE 40

HDAX® 9200 is a premium performance, long-drain, heavy-duty, low ash crankcase oil specifically designed to lubricate a wide range of latest generation high output, turbocharged, low emission four-stroke natural gas and dual-fuel engines where low ash oils are recommended.

Formulated with premium base oils and additive technology to provide deposit control, exceptional oxidation and nitration resistance, extended oil and filter life, outstanding protection against ring and liner scuffing and wear, and excellent piston and ring belt deposit control to effectively protect against the formation and build-up of engine sludge.

Protects across the high-load to low-load spectrum.

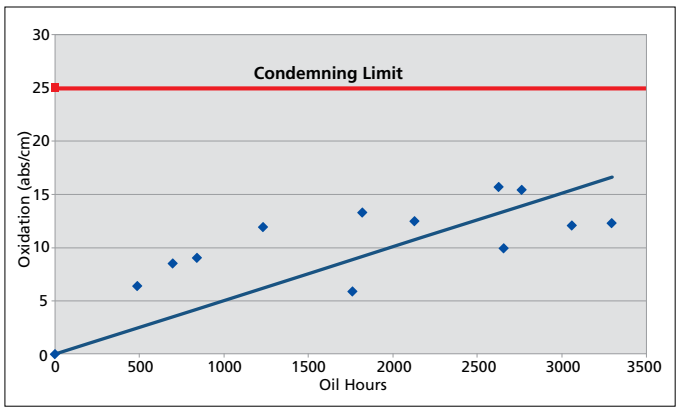
While a number of OEMs recommend operating their engines with a minimum 83% to 100% load, customers often de-rate their engines below these recommendations to as low as 50%. Operating at these levels can cause inadequate cylinder pressures and interferes with the engine's ability to provide a full, continuous flow of oil to sufficiently lubricate critical engine parts. This also may allow oil to leak past the piston rings into the combustion chamber, which can cause deposits.

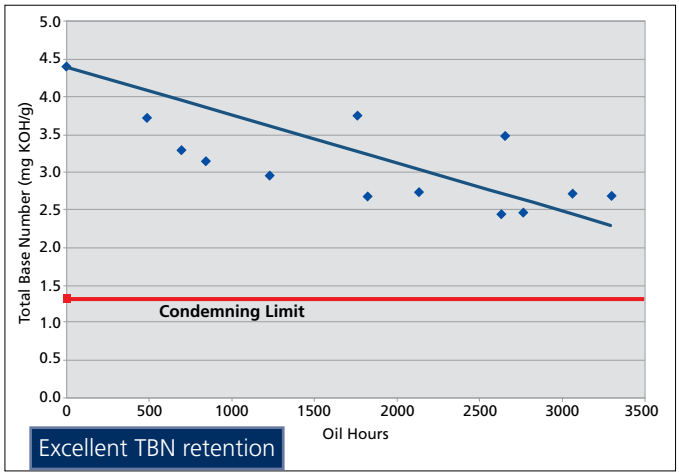
HDAX® 9200 Low Ash Gas Engine Oil contains robust additive chemistry that helps minimize deposits

Slower depletion means greater corrosion prevention.

When fuel is burned, the combustion process creates acids that aggressively attack metal surfaces. The best defense against these acids is the alkaline reserve in the engine oil. Thus, it is very important to formulate engine oils with sufficient alkaline reserve to neutralize acids before they can cause corrosion. Base Number (BN) is used to indicate an engine oil's alkaline reserve. Many OEMs have established an engine oil condemning limitation of 50% of new oil BN or Total Base Number (TBN), based on ASTM D 2896. An engine oil with a high initial BN does not necessarily predict the actual longevity of the alkaline reserve or the rate of depletion.

Many competitive engine oils advertise high BN numbers, but the alkalinity reserve actually deplete rapidly. HDAX® 9200 is formulated with a typical BN of 4.2 mgKOH/g, which may be lower than some of our competitors' top engine oils. However, it consistently depletes at a slower rate, remaining active to help prevent harmful acids from damaging your engine.





Field Trial Performance

At a gas gathering facility, HDAX® 9200 was tested in a Waukesha 7044GSI engine burning natural gas. The oil successfully delivered an oil drain interval of 3000+ hours with high resistance to oxidation and nitration; and showing excellent Base Number (TBN) retention.

HDAX® 9200 exhibited excellent piston deposit control, very low combustion chamber and piston top deposits; and excellent valve recession wear rates. The power assemblies showed very good cylinder liner and bearing anti-wear performance.

Piston Thrust & Anti-Thrust

Valves

Cylinder Liners Thrust / Anti-Thrust

Performance Attribute:

> Maximizes Oil Service Life
> Lowers Operating Costs
> Minimizes maintenance costs
> Extends engine life to overhaul

Performance Claims:

> INNIO Jenbacher Type 2, 3, 4, and 6 (C, E, F versions)
> MAN Energy Solutions
> Wartsila Gas and Duel Fuel Engines
> Waukesha
> Caterpillar CG and G series
> Waukesha
> MWM
> Duetz

Quote from user:

> "Even after 60,000 hours of operation, still honing marks on cylinder liners were in excellent condition, and piston rings were in free floating conditions. Similarly, bearings, cam rollers and inlet/out lets valve were in very good condition with no valve guttering or recession"

Total Base Number:

> TBN is formulated into the finished lubricants to counteract the by-products of combustion/acids. Formulators desire a relatively slower TBN depletion rate, which is a function of a balanced additive package, base oil quality, and formulation experience

HDAX® 5200 Low Ash Gas Engine Oil SAE 40

HDAX® 5200 is a premium performance monograde, low ash detergent/dispersant gas engine oil recommended for four-stroke stationary engines fueled by natural or synthetic gas. It is also suited for duel fuel four-stroke engines and meets all catalyst compatibility requirements.

HDAX® 5200 offers superior oxidation and nitration resistance, valve protection, wear control and high temperature deposit protection as proven through field trials. The synergy between hydrocracked base oils, oxidation inhibitor package and dispersant extends oil drain capability so that the engine can remain in service longer, generating more revenue.

HDAX® 5200 is approved for INNIO Jenbacher types 2, 3, 4 and 6 gas engines burning clean natural gas (Class A), Waukesha gas engines that burn pipeline quality gas and cogeneration applications, Wartsila for gas engines and dual fuel engines with natural gas as the main fuel, all MWM (now Caterpillar Energy Solutions) gas engines, MAN gas and dual fuel engines in operation on natural gas and Duetz 913/914 series engines.

This oil is recommended for four-stroke gas fueled engines made by Caterpillar.

Field Trial Performance

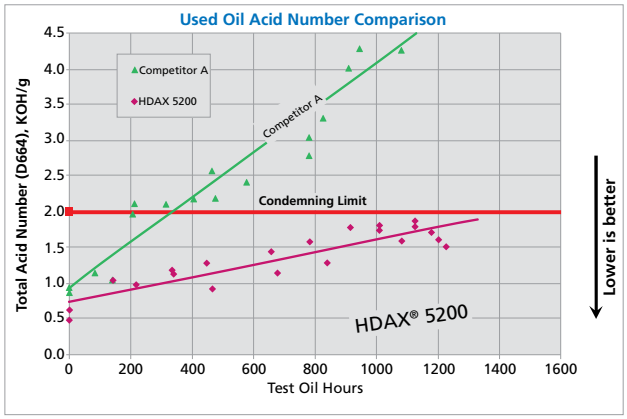
Caterpillar 3516TA

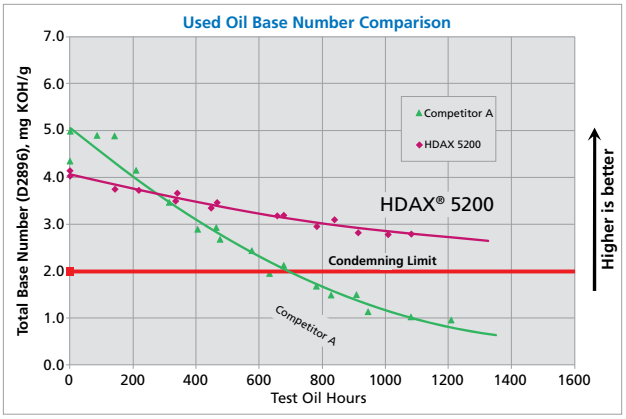
HDAX® 5200 was tested against an industry standard gas engine oil at a co-generation facility in an extended 15,000+ hour field trial on a Caterpillar 3516TA gas engine.

> The engines operated at 1200rpm and at 100% of rated load.

> HDAX® 5200 demonstrated superior performance showing excellent base number (BN) retention, better oxidation and nitration resistance and better viscosity control.

HDAX® 5200 : Caterpillar 3516TA Field Test





Another field test extending over 9000 hours was conducted on a Caterpillar 3516TA engine that was used for natural gas compression operation. The trial was specifically looking to compare deposits and cleanliness of the current product in use with HDAX® 5200.

With a load of >90% for the duration of the trial, HDAX® 5200 exhibited cleaner pistons, lower total piston deposits and a much cleaner piston under crown.

HDAX® 5200 : Caterpillar 3516TA Field Test

HDAX® 5200

Competitor B

*Caterpillar 3516TA Field Test Piston Comparison

HDAX® 5200

Competitor B

*Caterpillar 3516TA Field Test Piston Under-Crown Comparison

COOLANT / ANTIFREEZE

Delo® ELC Premixed 50/50 & Delo® ELI Corrosion Inhibitor

Performance Attribute:

- Silicate-free formula offers next-level heat transfer
- Helps reduce hard water and phosphate scale
- Offers up to 32,000 hours service life
- Contributes to long life pump seal and corrosion protection
- Designed for low maintenance operation

Delo® ELC Premixed 50/50 is a high-performance extended life coolant designed to offer optimum heat transfer performance and long-life protection to stationary gas engine coolant systems.

Delo® ELC Premixed 50/50 is formulated with our patented carboxylate corrosion inhibitor technology, designed to offer high performance system protection with maximum uptime across a wide rand of operating conditions.

Delo® ELI Corrosion Inhibitor is a water based extended life corrosion inhibitor based on aliphatic carboxylates that is recommended for use in a wide variety of cooling systems in industrial, on road and stationary applications. Delo® ELI Corrosion Inhibitor is recommended where complete cooling system protection is needed but where freeze protection is not required.

ANTIFREEZE/COOLANT

Delo® XLC Antifreeze/Coolant & Delo® XLI Corrosion Inhibitor

Performance Attribute:

- Formulated for long, low maintenance service life
- Offers over 32,000 hours in stationary engines
- Promotes reliability and corrosion protection
- Contributes to reliable hard water stability
- Aids high temperature corrosion protection

Delo® XLC Antifreeze/Coolant is a high-performance long-life coolant formulated to protect engines from freezing and boiling while offering advanced cooling system corrosion protection, including high temperature corrosion resistance in modern aluminum engines.

Delo® XLC Antifreeze/Coolant is an ethylene glycol-based formulation in combination with an advanced non-depleting corrosion inhibitor technology. It is designed to offer long, low maintenance service life and is available as a concentrate, premix 50/50.

Delo® XLI Corrosion Inhibitor concentrate provides long life corrosion protection by using optimized and patented aliphatic carboxylate organic inhibitors that provide long lasting protection for cooling system metals and components including hard to protect aluminum. Delo® XLI helps maintain excellent heat transfer since it does not contain silicates and phosphates which can over time create deposits on heat transfer surfaces.

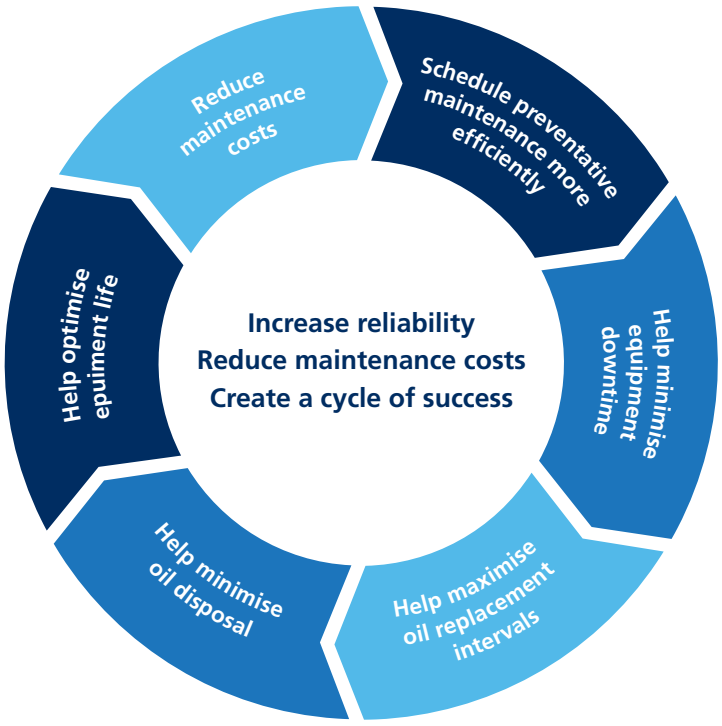
LubeWatch used oil analysis

LubeWatch oil analysis enables you to track the performance of equipment that is the lifeblood of your business. By analyzing oil samples on a regular basis, you can help optimize equipment life and oil replacement intervals, identify lubricant-related needs and understand the changing environment within a piece of equipment. This knowledge helps in the precise scheduling of maintenance work that can reduce downtime or even eliminate the risk of catastrophic failure.

The LubeWatch oil analysis programme provides:

- Accurate results on five basic test packages and aa wide variety of specialized testing procedures
- Reliable interpretation of test results and actionable recommendations based on the data
- 48-hour turnaround of tests and analyses indicating abnormal or critical steps, provided by email or accessible online
- Advanced technical services including component failure and/or wear particle analysis
- Expert training and in-field advice and support
- Added assurance of oil and system integrity when running on an extended oil drain interval programme.

LubeWatch®
Oil Analysis Program



For more information visit:
me.caltexlubricants.com/lubewatch

Advanced technology Caltex® gas engine lubricants & coolants.
Whatever the lubricant requirement – private and commercial vehicles through to industrial plant and machinery operating in some of the world's most challenging environments – customers trust caltex.

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