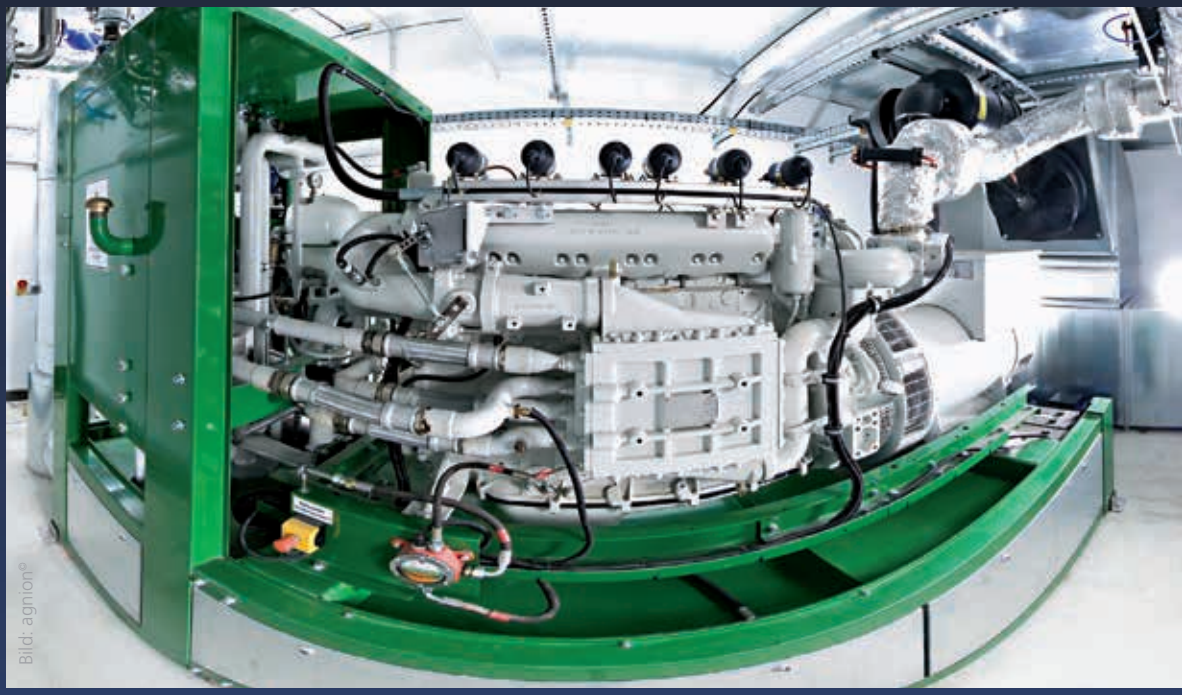
FUCHS Automotive Lubricants

TITAN

Outstanding economy and long life



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Lubricants for stationary gas engines

LUBRICANTS.
TECHNOLOGY.
PEOPLE.

FUCHS

OUR LUBRICANTS KEEP THE WORLD MOVING

For more than 80 years, we have been concentrating all our activities and research efforts on the development of innovative lubricants. This specialization means that we are enjoying continuous growth – geographically, technically and in the number of application areas.

Today, FUCHS is a company that offers powerful lubricants and associated specialties worldwide in practically all areas of application and industries.






What makes our products more valuable.

We develop lubricants on an application-specific basis and tailored to our partners' processes. Together, we look for the best lubricant for our customers. This type of collaboration is unique in its form, scope and intensity. We call it a development partnership. This ability is based on one key feature: As a true lubricant specialist with its headquarters in Mannheim/Germany, we are the largest independent lubricant specialist, and this independence makes all the difference. We are open to new methods and visionary approaches – a prerequisite for innovations. And innovations are a FUCHS trademark.

Together, we move more.

FUCHS Automotive Lubricants

It all depends on the right lubricant.

The specialist for gas engine oils.

Few people understand engines better than FUCHS. As the world's largest independent manufacturer of lubricants we focus exclusively on the development and manufacturing of lubricants. Ongoing investments in our worldwide R&D centres as well as close cooperation with the German automotive industry have made us what we are today: A lubricantspecialist with a full line of products and a multitude of special solutions. Particularly for stationary gas engines, the selection of the right engine oil is of critical importance. For reliable operation, high efficiency and long life.

Gases and their composition.

In different applications of cogeneration units, different fuel gases can be used. Fuel gas is defined as an appropriate gas mixture for gas engines, which vary in composition, fuel value and knock resistance. The methane number of natural gas is for example 70 – 90 and decreases the knock resistance in comparison to gases like biogas, sewage or landfill gas with a methane number of 100 – 160. The gas quality and composition can vary during operation which can be compensated by using an adjusted facility and engine management. If the characteristcs of the gas quality change or if dangerous substances increase, the lifetime, the reliability and the efficiency of the engine can be shortened.

Fuel gases consist of components which provide the needed energy for the combustion process and impurities which influence reliable operation.

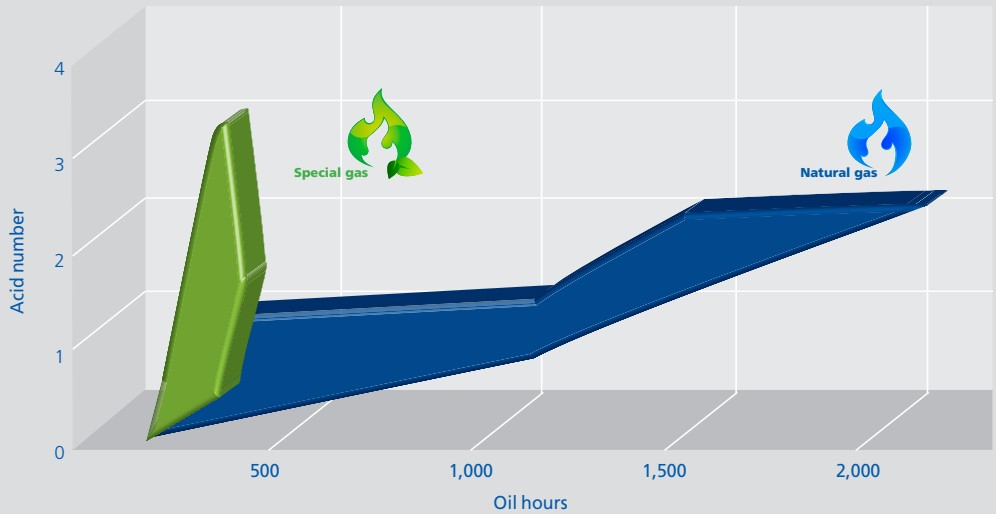
The main components define the most important ful characteristics (e.g. knock resistance, fuel value, combustion temperature, flame propagation speed and ignition properties) involved in the engine operation and combustion process. The main important components are methane, the main contributor to the fuel value and energy content of the combustion gas, hydrogen and chained hydrocarbons such as propane and butane as well as inert gases like nitrogen and carbon dioxide.

The most usual impurities found in the different gas types are sulphur compounds or hydrogen sulphide, chlorine, fluoride, silicon compounds or dust.

The effects of these impurities are proportional to the amount present in the engine during operation. The lower the fuel value of the combustion gas, the higher the amount of gas being used in the combustion process. With more gas being used there is a higher amount of impurities.
In order to be able to evaluate and compare different gases even with identical concentrations of pollutant elements but with different energy content, the concentration of trace elements must be referenced to the fuel value of the combustion gases.

Impurities such as sulphur compounds occur primarily on special gases so that the oxidation and the acidification proceed faster. Another difficulty of these gases is the varying composition and quality which can change continuously during operation. The engine and engine oils therefore have to meet different challenges depending on the gas type.

Change of the acidification of different fuel gas types – the same oil, same engine model



Fuel gas types

Fuel gas	Methane number (MN)*	Impurities/pollutants	Effects on engine operating/ lubricating oil
Natural gas Natural gas	MN: 70–90	• non-existent • very clean	• Danger of knocking with MN <75. • It leads to damages of engine components and reduces the oil service life
Biogas Special gas	MN: ≥ 100	Sulphur- and silicon compounds	• Reduction of the alkaline oil reserve (abrasive wear)
Landfill gas Special gas	MN: 100–160	Chlorine-, Fluorine-, Sulphur- and Silicon compounds	• Corrosive wear • Reduction of the alkaline oil reserve • Silicious combustion chamber and exhaust valve deposition • Abrasive wear
Sewage gas Special gas	MN: 100–150	Sulphur- and silicon compounds	• Corrosive wear • Reduction of the alkaline oil reserve • Silicious combustion chamber and exhaust valve deposition • Abrasive wear
Mine gas (CSM)** Special gas	MN: 95–100	Sulphur- and silicon compounds	• Corrosive wear • Silicious combustion chamber • Abrasive wear
Wood gas Special gas	MN: 120–140	Tar, pyroligneous acid	• Gas is cleaned prior to combustion chamber, so that no impurities come into contact with the lubricant

*MN >100, by inert gases which do not participate in combustion **Gas from active mines (CMM – Coal Mine Methane)

FUCHS Automotive Lubricants

It all depends on the right lubricant.

Requirements of gas engine oils.

Gas engines used in power stations, landfill sites, sewage plants and biogas plants are characterised by continuous operation at full load. The good anti-knock properties of fuel gas causes high effective pressures in gas engines which again lead to very high combustion temperatures.

The result is an increased formation of NO_x which reacts with the used engine oil and causes oxidation and nitration along with an increase in viscosity. The formation of acids (organic and inorganic) pose the danger of oil acidification and corrosive wear in the oil circuit.

Consequently, gas engine oils have to meet the following demands:

- high thermal stability
- high ageing resistance and
- good neutralisation properties.

Depending on the application, the characteristics of engine oils have to be customized. It can be differentiated for example between applications with natural gas or cleaned biogas (reduced sulphur content) and applications with special gases.

The high performance engine oils of the TITAN GANYMET series.

TITAN GANYMET engine oils from FUCHS were specially developed for stationary Otto and pilot injection gas engines and offer a broad spectrum of applications.

Special high-performance additives with a high resistance to oxidation and nitration guarantee reliability even under extreme operating conditions. Our special formulations offer a maximum degree of wear protection and work a-gainst the formation of sludge, deposits, acids and corrosion.

Technical background.

In an engine oil, the sulphated ash (SA) is formed from certain additive (functional metallic) components in the oil. These ash-forming agents affect engine cleanliness, neutralisation capacity, ageing resistance and the anti-wear properties of the oil. The element zinc is one of these ash-forming agents and is usually found in conven-tional engine oils as a metalorganic compound in the form of ZnDTP (zinc dialkyldithiophosphates). This compound offers high protection against wear and corrosion as well as good anti-oxidation properties. However, this additive gets into the combustion chamber of the engine by passing the piston rings. When burnt, ash components are formed and build deposits on the pistons, cylinder head, valves and catalytic converter. These deposits cause wear of engine components and lead to a drop in performance and premature engine failure.

The following applies: The higher the proportion of ZnDTP, the greater the wear protection and anti-oxidation characteristics – but also the amount of sulphated ash.

Additives which contain calcium compounds are the principal constituent of socalled detergents. These play a significant role in avoiding coking deposits on the piston crown, rings and ring grooves. The deposits again have a grinding effect on the cylinder liners and lead to polished surfaces. The detergents are also responsible for the neutralisation capacity and alkaline reserve (expressed as the Total Base Number, TBN) of an engine oil and thus reduces acidity increase and thereby protects against corrosion.

The following applies: The higher the proportion of detergents and calcium com-pounds, the greater the engine cleanliness and the TBN – but also the proportion of sulphated ash formed.

Therefore carefully balanced formulations are required to enable the use of these additives: A higher proportion of detergents and ZnDTP in the oil results in greater neutralisation capacity, better wear protection and improved ageing resistance but also causes increased formation of sulphated ash. It is hence impossible to develop a universal product for all gas engines. As engine manufacturers recommend or prescribe various sulphated ash limits for different types of fuel gas, the possibilities of optimising single characteristics of an oil are limited. Therefore it is important to select the most suitable gas engine oil for the specific application.

Engine manufacturers generally recommend low-ash (SA <0.5% wt) oils for engines running on relatively clean gases (e.g. natural gas) because they allocate greater importance to engine cleanliness than to high neutralisation capacity. Engine oils with a higher sulphated ash content (max. 1% wt) however, are usually accepted when using gases with a higher degree of noxious components such as sulphur, chlorine and fluorine as an increased neutralisation capacity is required to achieve longer oil change intervals.

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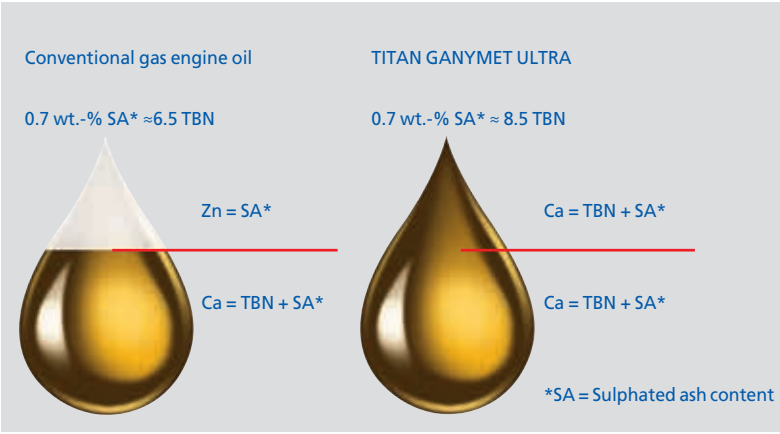
Zinc-free technology clearly superior.

Why zinc-free?

Two different formulation technologies are illustrated in the highly-simplified drop diagram on the right. The left drop represents the conventional formulation tech-nology whereas the right drop shows the zinc free Low SAPS technology developed by FUCHS – both in relation to ash-forming components and TBN. The volume of each drop demonstrates the sulphated ash potential of each formula-tion. To en-able a comparison between the two formulation technologies, the ash forming po-tential is defined with wt.-0.7% for both technologies and thus the volume of both drops is the same.

The principal difference between the two additive techno-logies is that in the zinc-free formulation the zinc has been replaced by specially-adapted calcium compounds. The amount though, was only increased as long as the desired sulphated ash content did not exceed 0.7 wt.-%.

In addition, the increase in calcium components has a posi-tive effect on the oil's neutralisation capacity which could be enhanced about 25%. To give the new for-mulation the necessary anti-wear, anti-corrosion and anti-oxidation properties which were previously provided by zinc, com-pletely new, ash-free additives were used. The major advan-tage of these new additives is that they do not influence the formation of sulphated ash and can thus be used in almost unlimited quantities. As a result, the anti-wear and anti-oxidation properties of the new formulation were not just maintained but significantly improved.



Advantages of zinc-free sulphated ash deposits.

Experiences have shown that there are significant differ-ences in the morphology (structure) of the ash compounds. Ash deposits formed by the combustion of calcium are noticeably softer than those formed by the combustion of both calcium and zinc.

Zinc-free sulphated ash deposits lead to considerably less abrasive wear and are less tenacious, a factor which ultimately influences the cleanliness of the combustion chamber.

Minimal losses of phosphorus.

Phosphorus is an important component in the oil's anti-wear additive system. During combustion, small amounts from the oil on the cylinder walls are burnt and reach the catalytic converter where the catalytic surfaces can be poisoned. The performance and life time of the catalytic converter is thus influenced by the amount of phosphorus in the exhaust gases.

Various tests have shown that there are significantly smaller losses of phosphorus in zinc-free technologies than in for-mulations containing zinc. Consequently the lubricant retains the desired wear protection and contributes in addition to maintain the performance and life time of the catalytic converter.

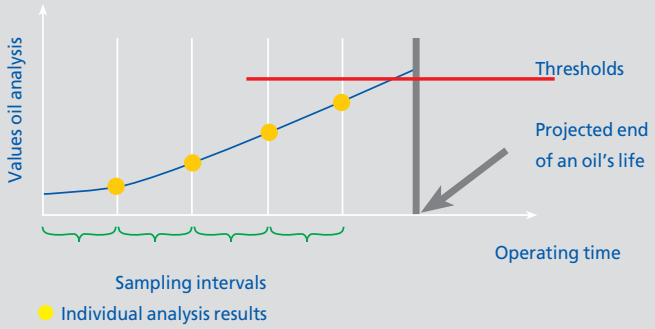
All advantages at a glance

- Due to the higher neutralisation capacity (approx. 30% higher TBN) at con-stant sulphated ash content, significantly longer oil change intervals can be implemented.
- Conversely, if the TBN value remains constant, the sulphated ash content falls and engine cleanliness visibly improves.
- Improved wear protection and higher oxidation stability due to novel addi-tives which do not form sulphated ash and can thus be used in greater concentrations.
- Noticeably less abrasive wear and greater engine cleanliness due to zinc-free sulphated ash deposits.
- Due to minimal losses of phosphorus, not only does the wear protection of the oil remain, but the longevity of the catalytic converters are not affected.

Monitoring and laboratory analysis.

When a gas engine is commissioned, the oil change intervals are initially determined by the recommendations of the engine manufacturer.

It is therefore necessary to monitor the condition of the engine oil with routine oil analyses (see chart) and then to set individual oil change intervals for every engine.



The lubricant's life and the optimum oil change intervals are however dependent on:

- gas quality
- lubricant quality
- ambient conditions
- mode of engine operation.

Regular analyses of used oil show the rate of degradation in all the measured parameters. So deviations in gas quality or different operating modes can be com-pensated quickly. This avoids potential engine damage and corresponding repair costs.

Make use of our fast, professional and complete service for oil analysis. Your engine will benefit.

FUCHS Automotive Lubricants

High performance gas engine oils.

Premium-Quality

High-Quality

Basic-Quality

Product name	Description	Approvals	FUCHS Recommendations
TITAN GANYMET ULTRA Natural gas Special gas **TBN: 8,5 mg KOH/g** **SA: 0,7 %**	Premium synthetic zinc-free high-performance engine oil for stationary Otto and pilot injection gas engines. The highest corrosion protection together with the optimized zinc-free wear protection, excellent acid neutralisation properties and oxidation stability allow a safe and extended oil service in natural gas and especially aggressive gas operations (sewage gas, landfill gas and biogas) also with formaldehyde catalysts.	2G TA-003 agenitor series 2, 3 AGROGEN CAT CG132, CG170, CG260 JENBACHER TA 1000-1109 - A, CAT: series 2, 3, 4 (Version B), 6 (Version C and E) - B, CAT: series 2, 3 MAN M 3271-4 MTU Onsite Energy DK-BS-0001 (E, P, B) MTU Onsite Energy DK-BS-0002 (B) MWM TR 0199-99-02105 (DEUTZ POWER SYSTEMS) SEVA TRS-07 SPANNER RE2 TEDOM 61-0-0281.1/L, B, S	
TITAN GANYMET PLUS Special gas **TBN: 9,2 mg KOH/g** **SA: 0,8 %**	Zinc-free high-performance engine oil for stationary Otto and pilot injection gas engines. The highest corrosion prevention together with the optimized zinc-free wear protection and excellent acid neutralisation properties allow a safe and extended oil service in special aggressive gas operations (sewage gas, landfill gas and biogas).	CAT CG132, CG170, CG260 DREYER & BOSSE JENBACHER TA 1000-1109 - B: series 2, 3 MTU Onsite Energy DK-BS-0001 (B) MWM TR 0199-99-02105 (DEUTZ POWER SYSTEMS) SCHNELL MOTOREN bis BJ 12/2005 SEVA TRS-07	
TITAN GANYMET PLUS LA Natural gas **TBN: 6,6 mg KOH/g** **SA: 0,5 %**	Zinc-free, „Low Ash" high-performance engine oil for stationary gas engines. The highest corrosion prevention together with the excellent zinc-free wear protection and acid neutralisation properties allow a safe and extended oil service. Specially for gas engines fitted with exhaust catalyst and heat exchangers that specify an sulphate ash content of less than 0.5 weight %.	CAT CG132, CG170, CG260 DEUTZ TR 0199-99-01213 MWM TR 0199-99-02105 (DEUTZ POWER SYSTEMS) SEVA TRS-07 TEDOM 61-0-0281.1/G, P	CATERPILLAR CUMMINS WAUKESHA
TITAN GANYMET Special gas **TBN: 8,1 mg KOH/g** **SA: 0,99 %**	High-performance engine oil for stationary gas engines which run on all types of digester gases such as sewage gas, landfill gas and biogas.	ASJA AMBIENTE ITALIA JENBACHER TA 1000-1109 - C: series 2, 3 MAN M 3271-4 MTU Onsite Energy DK-BS-0001 (B,K) SEVA TRS-07	
TITAN GANYMET LA Natural gas **TBN: 5,5 mg KOH/g** **SA: 0,45 %**	„Low Ash" high-performance engine oil for stationary gas engines. Good corrosion prevention. Specially for gas engines fitted with exhaust catalyst and heat exchangers that specify a sulphate ash content of less than 0.5 weight %.	CAT CG132, CG170, CG260 DEUTZ TR 0199-99-01213 JENBACHER TA 1000-1109 - A, CAT: series 2, 3, 4 (Version B), 6 (Version C and E) MAN M 3271-2 MTU Onsite Energy DK-BS-0001 (E, P, K) MWM TR 0199-99-02105 (DEUTZ POWER SYSTEMS) SEVA TRS-07	CATERPILLAR CUMMINS WAUKESHA

Antifreeze coolants for gas engines.

Gas engines create large amounts of heat during the combustion process. As the engine and its components can only release heat slowly, additional coolants are necessary, so that the engine does not break down due to overheating. Our “ready-mixed” anti-freeze coolants are especially easy to use on stationary engines. No on-site mixing is needed.

Product name	Description	Specificationen	Approvals	FUCHS Recommendations
MAINTAIN FRICOFIN LL Concentrate	Premium Performance Coolant Additive based on monoethylene glycol. Free from nitrite, amine, phosphate and silicates.	ASTM D 3306 ASTM D 4985 BS 6580	DEUTZ DQC CB-14 MAN 324 SNF MWM TR 0199-99-2091	AFNOR NFR 15-601 CUMMINS (ISBe engines at DAF and Leyland) LIEBHERR MD 1-36-130
MAINTAIN FRICOFIN Concentrate	Super High Performance Coolant Additive based on monoethylene glycol. Free from nitrite, amine and phosphate.	AFNOR NF R 15-601 ASTM D 3306 ASTM D 4985 BS 6580:1992 SAE J1034	DEUTZ DQC CA-14 JENBACHER TA 1000-0201 MAN 324 NF MTU MTL 5048 MWM TR 0199-99-2091	LIEBHERR TLV 035/TLV 23009 A
MAINTAIN FRICOFIN -35 Ready-to-use Mix	Super High Performance Coolant Ready-Mix based on monoethylene glycol. Offers frost protection down to -35°C. Free from nitrite, amine and phosphate.	AFNOR NF R 15-601 ASTM D 3306-05 ASTM D 4985 BS 6580:1992	DEUTZ DQC CA-14	JENBACHER TA 1000-0201 LIEBHERR TLV 035/TLV 23009 A MAN 324 NF MTU MTL5048 MWM TR 0199-99-2091

Oil chooser.

	Clean gas			Contaminated gas	
	natural gas	cleaned special gas w/o catalyst	with formaldehyd catalyst	biogas/ sewage gas	landfill gas
Approvals					
MWM	TITAN GANYMET PLUS LA TITAN GANYMET LA			TITAN GANYMET PLUS LA TITAN GANYMET LA TITAN GANYMET ULTRA TITAN GANYMET PLUS (in agreement with service partner)	
GE Jenbacher	TITAN GANYMET ULTRA (series 2, 3, 4 & 6A-E) TITAN GANYMET LA (series 2 & 3)			TITAN GANYMET ULTRA (series 2 & 3) TITAN GANYMET PLUS (series 2 & 3)	TITAN GANYMET (series 2 & 3)
MAN	TITAN GANYMET LA	TITAN GANYMET ULTRA TITAN GANYMET	TITAN GANYMET LA	TITAN GANYMET ULTRA TITAN GANYMET	
MTU Onsite Energy	TITAN GANYMET ULTRA (series 400) TITAN GANYMET LA (series 400)		TITAN GANYMET LA (series 400) TITAN GANYMET (series 400)	TITAN GANYMET ULTRA (series 400 & 4000) TITAN GANYMET PLUS (series 400) TITAN GANYMET (series 400)	
AGROGEN	TITAN GANYMET ULTRA			TITAN GANYMET ULTRA	
SPANNER RE²				TITAN GANYMET ULTRA (wood gas operation)	
Tedom	TITAN GANYMET PLUS LA			TITAN GANYMET ULTRA	
FUCHS Recommendations					
Caterpillar	TITAN GANYMET PLUS LA TITAN GANYMET LA			TITAN GANYMET PLUS LA TITAN GANYMET LA	
Cummins	TITAN GANYMET PLUS LA* TITAN GANYMET LA			TITAN GANYMET PLUS LA TITAN GANYMET LA	
Waukesha	TITAN GANYMET ULTRA** TITAN GANYMET PLUS LA TITAN GANYMET LA		TITAN GANYMET PLUS LA TITAN GANYMET LA	TITAN GANYMET ULTRA TITAN GANYMET PLUS LA TITAN GANYMET LA	

*approval procedure ongoing

**some engines require SA<0,5%

Check out the benefits of TITAN GANYMET engine oils!

This questionnaire will enable us to determine the most suitable lubricant for your gas engine.

Simply fill in and fax to: + 49 621 3701-7302 or mail to anwendungstechnik.automotive@fuchs-europede

*Necessary information

Your details

Company*

Address*

Department*

Customer no.

Telephone*

Fax

E-mail*

Engine details

Manufacturer*

Type*

Year of manufacture*

Total operating hours*

Catalytic converter* Yes ☐ No ☐

Running hours*

Engine power (KW)*

Power used in %*

Oil volume*

Oil temperature*

Gas details

Fuel gas type*

Gas analysis available* Yes ☐ No ☐
(If possible, please attach copy)

Gas purification* Yes ☐ No ☐

Details of current oil in use

Product name*

Manufacturer*

Oil drain interval*
(If possible, please attach oil analysis)

Required volume per month

Price/litre

Do you have any problems with your current oil?
If yes, please specify.

Would you like an appointment for further information?
Yes ☐ No ☐

Signature

Date

FUCHS Industrial Lubricants

Innovative lubricants need experienced application engineers

Every lubricant change should be preceded by expert consultation on the application in question. Only then the best lubricant system can be selected. Experienced FUCHS engineers will be glad to advise on products for the application in question and also on our full range of lubricants.

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