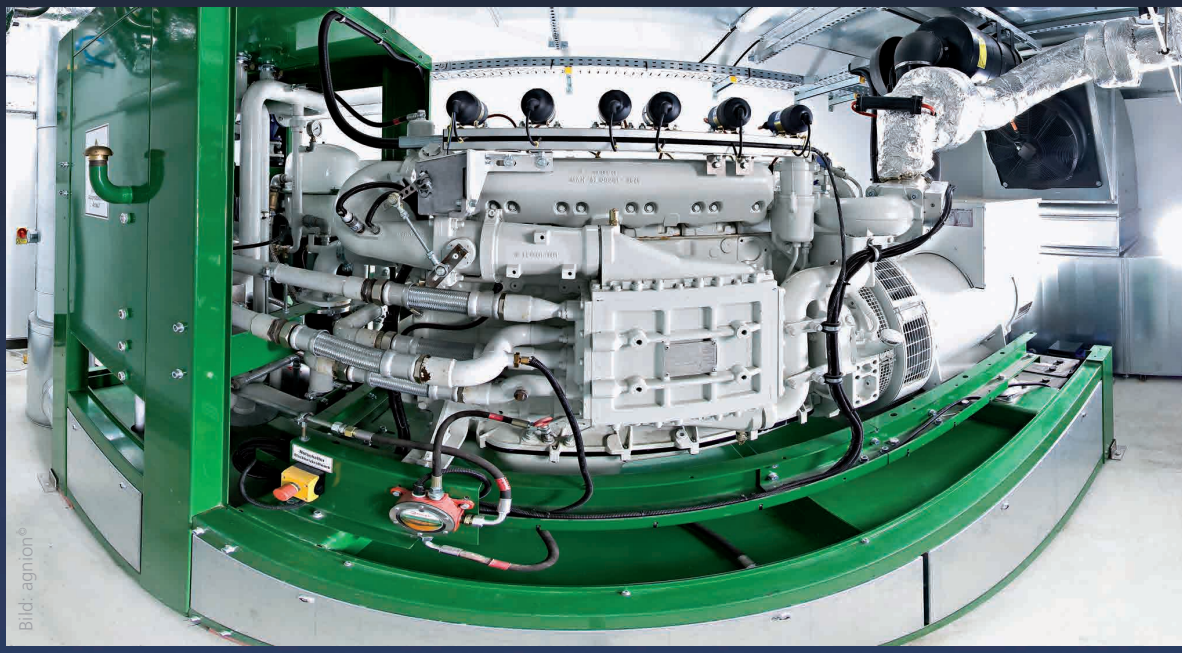
TITAN

## Outstanding economy and long life




# Lubricants for stationary gas engines

LUBRICANTS.
TECHNOLOGY.
PEOPLE.

FUCHS


FUCHS has more than 140 years' experience of manufacturing and supplying lubricants within the UK. We believe that the perfect lubricant partner should not only supply high performance lubricants, but also provide service and support to customers. Our experienced team work closely with customers, from choosing the right lubricant to fluid condition monitoring, ensuring they receive the most from their lubricants.

We research, develop and manufacture bespoke lubricants; technology that is approved for use by leading manufacturers and available globally via the FUCHS organisation. Our innovative lubricants can help reduce maintenance costs, protect your assets and minimise downtime.

# IN **PARTNERSHIP** WITH INDUSTRY

## THE **FUCHS GROUP**

FUCHS is the world's largest independent lubricant manufacturer. The Group comprises 55 operating companies with 34 production plants worldwide.

In addition to products developed for industry in the UK, we have access to more than 2,500 industrial FUCHS products from within the Group. Customers can make use of FUCHS' technical expertise and product availability on a global scale, providing access to international fluid technology.


## **UK GROUP** PROFILE

The headquarters of the UK subsidiary is located at our modern, highly automated production plant in Stoke-on-Trent. Our UK manufacturing site carries all the necessary approvals required: BSI AS 9100, ISO 9001, ISO 14001, ISO/TS 16949 and OHSAS 18001.

FUCHS is a full line supplier of lubricants and provides customers with local manufacturing, first-class logistics and specialist technical support.

## RESEARCH & **DEVELOPMENT**

The FUCHS Group has a very strong focus on R&D with more than 400 chemists, engineers and specialists in more than 40 laboratories worldwide. The UK labs are extremely well equipped and audited to the highest levels, having state-of-the-art equipment and highly trained staff with extensive technology and application knowledge.

Regular dialogue with OEMs, other industry bodies and component suppliers maintains technical advantages. Our continued investment in R&D ensures that we are at the forefront of lubricant technology, which is demonstrated by the fact that products developed within the last 5 years generate 70% of sales.

## **ENVIRONMENTAL** FOCUS

We are proud to have been awarded the latest environmental standard, designed to ensure that we choose the best materials for our formulations, minimising their impact on the environment and people whilst providing the highest performance.

FUCHS is at the leading edge of lubricant design to provide products based on renewable sources. Our bio-degradable PLANTO range is the most developed and extensive worldwide. FUCHS also offers innovative eco-friendly packaging options such as our recyclable Lube Cube.

# 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 lubricant specialist 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, calorific 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 characteristics 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 accompanying elements which arrange for a reliable operation.

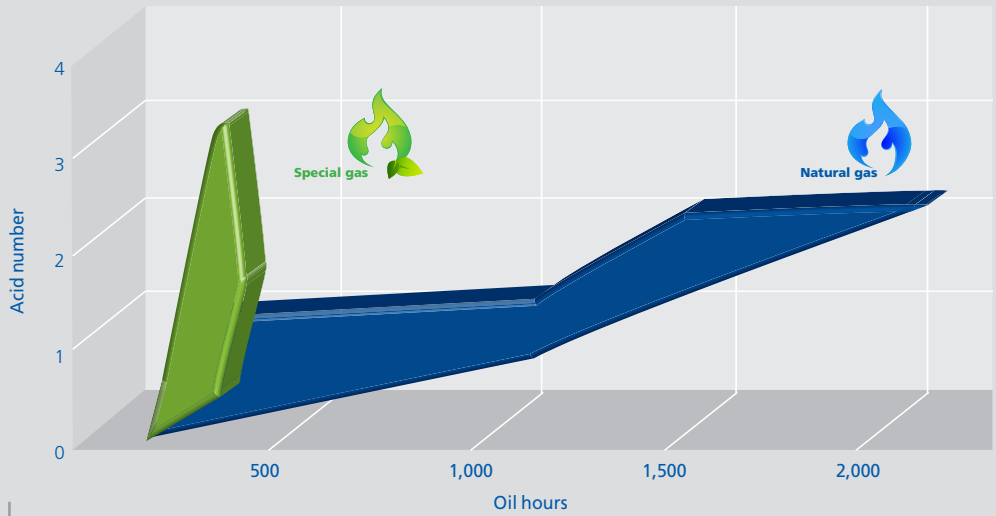
The main components define the most important characteristics (e.g. knock resistance, calorific value, combustion temperature, flame propagation speed and ignition properties) involved in the engine operation and combustion process. The main important components are Methane ($MH_4$), the main contributor to the calorific value and energy content of the combustion gas, Hydrogen ($H_2$) and chained hydrocarbons such as Propane ($C_3H_8$) and Butane ($C_4H_{10}$) as well as inert gases like Nitrogen ($N_2$) and carbon dioxide ($CO_2$).

The most usual accompanying elements found in the different gas types are Sulphur compounds (S) or hydrogen sulphide ($H_2S$), Chlorine (Cl), Fluoride (F), Silicon compounds (Si) or dust.

The effects of these impurities are proportional to the amount present in the engine during operation. The lower the calorific value of the combustion gas, the higher the amount of gas being used in the combustion process. With more gas being used a higher amount of impurities come along. 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 must be referenced to the calorific 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 | • inexistent<br>• very clean | • Danger of knocking with MZ <75.<br>• It leads to construction unit damages 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<br>• Reduction of the alkaline oil reserve<br>• Silicious combustion chamber and exhaust valve deposition<br>• Abrasive wear |
| **Sewage gas** Special gas | MN: 100–150 | Sulphur- and silicon compounds | • Corrosive wear<br>• Reduction of the alkaline oil reserve<br>• Silicious combustion chamber and exhaust valve deposition<br>• Abrasive wear |
| **Mine gas (CSM)**** Special gas | MN: 95–100 | Sulphur- and silicon compounds | • Corrosive wear<br>• Silicious combustion chamber<br>• 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 (CSM – Coal Seam Methane)

# 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 power. 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 customised. 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 against 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 conventional 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 which are deposited 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 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 so called 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 reflecting 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 higher the proportion of detergents and calcium compounds, the greater the engine cleanliness and the TBN – but also the proportion of sulphated ash formed.**

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 impossible to develop a universal product for all gas engines. As engine manufacturers recommend or prescribe various sulphated ash thresholds 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 in question.

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.

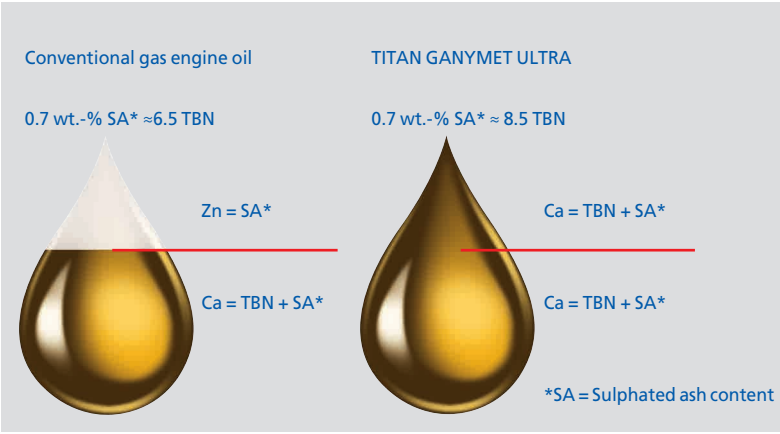
# Zinc-free technology clearly superior.

### 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 technology 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 formulation. To enable a comparison between the two formulation technologies, the ash forming potential 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 technologies 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.-%.

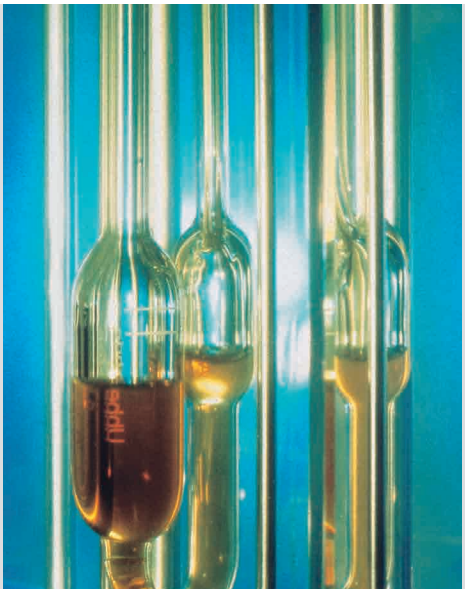
In addition, the increase in calcium components has a positive effect on the oil's neutralisation capacity which could be enhanced about 25%. To give the new formulation the necessary anti-wear, anti-corrosion and anti-oxidation properties which were previously provided by zinc, completely new, ash-free additives were used. The major advantage 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 differences 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 formulations 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.

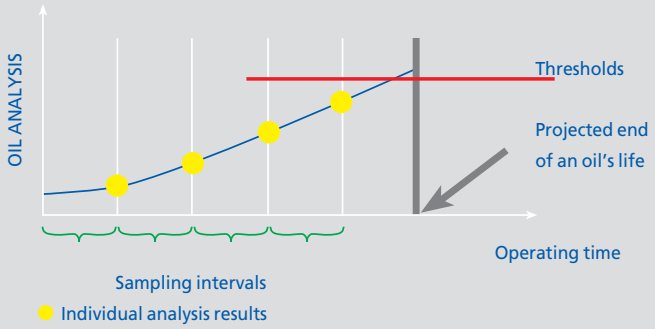
### All advantages at a glance

- **Due to the higher neutralisation capacity (approx. 30% higher TBN) at constant 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 additives 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 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 compensated 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.

# High performance gas engine oils.


| Product name | Description | Approvals / FUCHS Recommendations |
|---|---|---|
| **TITAN GANYMET ULTRA**<br>Natural gas Special gas<br>**TBN: 8.5 mg KOH/g**<br>**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 optimised 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. | AGROGEN<br>JENBACHER TA 1000-1109<br>(BR 2, 3, 4 und 6, A / BR 2, 3 – B, CAT)<br>MAN M 3271-4<br>MDE/MTU Onsite Energy<br>(Natural gas, Propane gas, Special gas)<br>MWM (Deutz Power Systems)<br>SPANNER RE²<br>SEVA |
| **TITAN GANYMET PLUS**<br>Special gas<br>**TBN: 9.2 mg KOH/g**<br>**SA: 0.8 %** | Zinc-free high-performance engine oil for stationary Otto and pilot injection gas engines. The highest corrosion prevention together with the optimised 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). | MWM (Deutz Power Systems)<br>DREYER & BOSSE<br>MDE/MTU Onsite Energy<br>SEVA<br>JENBACHER TA 1000-1109 (BR 2, 3 – B)<br>SCHNELL Motoren bis BJ 12/2005 |
| **TITAN GANYMET PLUS LA**<br>Natural gas<br>**TBN: 6.6 mg KOH/g**<br>**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. | MWM (Deutz Power Systems)<br>TEDOM 263.2-1P<br>SEVA<br><br>CATERPILLAR<br>CUMMINS<br>WAUKESHA |
| **TITAN GANYMET**<br>Special gas<br>**TBN: 8.1 mg KOH/g**<br>**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. | JENBACHER TA 1000-1109 (BR 2, 3 – C)<br>MAN M 3271-4<br>MDE/MTU Onsite Energy (Special gas)<br>SEVA |
| **TITAN GANYMET LA**<br>Natural gas<br>**TBN: 5.5 mg KOH/g**<br>**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. | MWM (Deutz Power Systems)<br>MDE/MTU Onsite Energy<br>(Natural gas, Propane gas)<br>MAN M 3271-2<br>JENBACHER TA -1109 (BR 2, 3 - A, CAT)<br>SEVA<br><br>CATERPILLAR<br>CUMMINS<br>WAUKESHA |

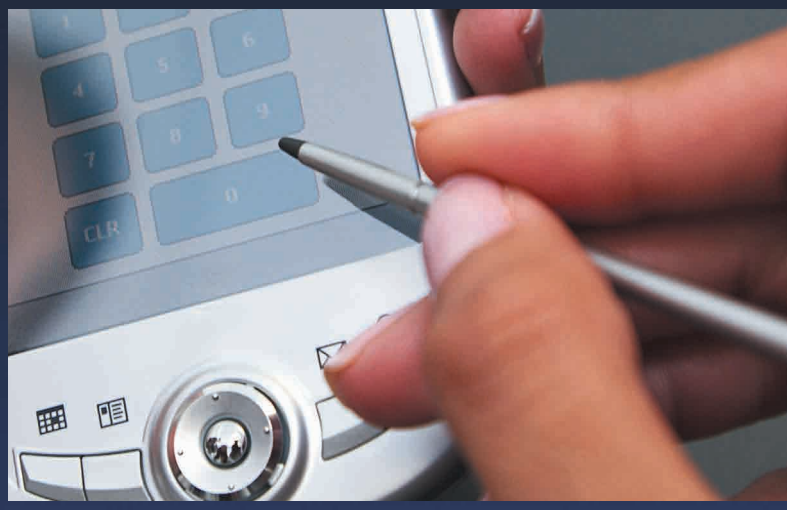
| | Clean gas | | | Contaminated gas | |
|---|---|---|---|---|---|
| | natural gas | cleaned special gas w/o catalyst | with formaldehyd catalyst | biogas/ sewage gas | landfill gas |
| **Approvals** | | | | | |
| **GE Jenbacher** | TITAN GANYMET LA (BR 2 & 3)<br>TITAN GANYMET ULTRA (BR 2, 3, 4 & 6) | | TITAN GANYMET ULTRA (BR 2 & 3)<br>TITAN GANYMET LA (BR 2 & 3) | TITAN GANYMET ULTRA (BR 2 & 3)<br>TITAN GANYMET PLUS (BR 2 & 3) | TITAN GANYMET (BR 2 & 3) |
| **MAN** | TITAN GANYMET LA | TITAN GANYMET ULTRA<br>TITAN GANYMET | TITAN GANYMET LA | TITAN GANYMET ULTRA<br>TITAN GANYMET | |
| **MWM/Deutz Power Systems** | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA<br>--> SA <0,5 % | | | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA<br>--> SA <0,5 % | |
| | | | | TITAN GANYMET ULTRA<br>TITAN GANYMET PLUS<br>--> 0,5 % <SA <1 % | |
| **MTU Onsite Energy/MDE** | TITAN GANYMET ULTRA<br>TITAN GANYMET LA | | | TITAN GANYMET ULTRA<br>TITAN GANYMET PLUS<br>TITAN GANYMET | |
| **AGROGEN** | TITAN GANYMET ULTRA | | | TITAN GANYMET ULTRA | |
| **Dreyer & Bosse** | | TITAN GANYMET PLUS | | TITAN GANYMET PLUS | |
| **Schnell Motoren** | | TITAN GANYMET PLUS bis BJ 12/2005 | | TITAN GANYMET PLUS bis BJ 12/2005 | |
| **SPANNER RE²** | | | | TITAN GANYMET ULTRA<br>(Holzgasbetrieb) | |
| **SEVA** | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA<br>--> SA <0,5 %** | | | TITAN GANYMET ULTRA<br>TITAN GANYMET PLUS<br>TITAN GANYMET<br>--> 0,5 % <SA <1 %** | |
| **Tedom** | TITAN GANYMET PLUS LA | | | | |
| **FUCHS Recommendations** | | | | | |
| **Caterpillar** | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | | | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | |
| **Cummins** | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | | | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | |
| **Waukesha** | TITAN GANYMET ULTRA*<br>TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | | TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | TITAN GANYMET ULTRA<br>TITAN GANYMET PLUS LA<br>TITAN GANYMET LA | |

*some engines require SA<0,5 %

**depending on engine series

# 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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