

4.04. Fuel specification for DAF diesel engines

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All DAF engines

@ The growing interest in alternative diesel fuel is reason to publish this SEI. It describes the obligatory diesel fuel specification for DAF engines. A number of specifications, including diesel fuel, are mentioned in the "driver" and "oil and grease specification" manuals which can be found via the Service Rapido button on the Dealernet website.

● Fuel specification for DAF diesel engines

Based on the present status of DAF engine development, the fuel (compositions) used must meet certain international standards to be assured of the required engine performance, durability and emission goals. Therefore DAF prescribes for all its engines that:

- Any diesel or diesel fuel mixture must comply with European Fuel Standard EN 590
- 100% Bio diesel must comply with European Bio diesel Standard EN14214*

* check applicability of this fuel on following pages.

@ Note that DAF as standard will comply with the latest effectuated EN590 Fuel Standard. Any other fuel standard must be quoted in this section to be accepted.

● Why alternative fuels?

@ The world-wide demand for less pollutant (diesel) engines, to decarbonise the environment by cutting CO₂ emissions and the growing interest to use renewable energy are the major reasons why alternative fuels are being developed. Additionally and to extend the favourable effects of these alternative fuels, special catalytic (Continuously Regenerating Trap) exhaust systems are being developed to 'clean' the engine emission a step further. Some of the alternative fuels developed are:

- **Bio-diesel/FAME:** is fuel extracted from agricultural products such as rapeseed oil, soybean oil, sugar beet, sun flower oil and palm oil. The more widely used are Rape Methyl Ester (RME) in Europe and Soybean Methyl ester (SME) in the US and collectively known as Fatty Acid Methyl Esters (FAME). The fatty oils are chemically modified by reaction with mostly methanol (esterification), during which the long tri-glycerides molecules are split into short fatty acid methyl ester molecules, producing a common diesel-like product with glycerine as a (waste) by-product. The Bio-fuel can be blended with fossil diesel fuel demanding only minor or no engine modification but intensified maintenance when a high concentration of bio-diesel is applied.
- **Pure Plant Oil (PPO):** is fuel that can be extracted from a range of agricultural products of which rapeseed oil is most commonly used. In contrast to Bio-diesel fuel the PPO fuel types do not receive the esterification treatment. As a result they remain a very viscous liquid even at normal temperatures what makes a preheated engine fuel supply system indispensable to improve or even to make a cold engine start possible. At operation temperature however engines will run smoothly but affected by the fuel composition (i.e. higher density and lower cetane value) not with the optimal combustion characteristic. Required to optimize the combustion process and to safeguard the targeted life-time expectancy of the fuel injection components new settings and redesign of equipment will be necessary. The quickened degradation of lubrication oil stability also demands appropriate countermeasures.

Important: Without official effectuated ISO/DIN standard for PPO fuel there is for DAF no basis to verify any performance, durability or emission results and therefore this type of fuel or any blends of it are **not allowed** in any of the DAF engines.

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- **City-diesel:** is fuel, like the current everyday diesel fuel refined from fossil raw material, but improved in composition during the refinery process. Sulphur reduction and lower aromatic content are common for all City-diesel fuels which, together with possible other chemicals changes during the refinery process, finally results in a virtually sulphur-free emission with reduced particles (PM) and nitrogen oxide (NOx) content. City-diesel is also referred to as ULSD (Ultra Low Sulphur Diesel).

Note however that by (voluntary) reduction of sulphur content in West European diesel fuels (< 10 ppm) there is no further difference between city and normal diesel. From 2008 this will be part of EN590 (today <50 ppm Sulphur)

Note: this SEI is limited to some information on Bio- and City-diesel fuel in relation to the earlier mentioned fuel specifications.

@ ● **Characteristic of Bio-diesel/FAME**

Some advantages are:

- neat Bio-diesel /FAME contains almost zero sulphur and no aromatics, giving rise to generally lower particulate exhaust emissions
- It is biodegradable and non-toxic; however, its biodegradability is nearly lost when blended with standard diesel.

Some disadvantages are:

- reduced cold start performance at low ambient temperatures
- less evaporating effect when heated, resulting in a negative effect on the oil change interval
- due to its high oxygen content, it produces relatively high NOx levels during combustion
- it has lower volumetric energy density than diesel leading to higher fuel consumption ($\pm 10\%$) and power losses (6-8%)
- bio fuel is hygroscopic leading to water absorption during a storage period. Bacteria and fungi will grow on interface of water and biodiesel leading to corrosion and filter blocking
- bio fuel is a good solvent and can affect lacquer and elastomers
- Bio fuel has a high pour point
- Phosphorous can attack catalyst in new SCR systems
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@ ● **Effects sorted by fuel composition**

Each variant of the refined diesel fuel has a different and unique 'physical' quality. Qualities, such as specific mass, differentiation of the aromatic and other components, which inevitably determine the 'behaviour' of the fuel during the combustion process and the amount of energy delivered.

The fuel itself and the engine combustion efficiency are responsible for the output performance, fuel consumption and composition of emitted gasses. Besides limited predictions based on the fuel composition, only actual engine tests can clarify the 'full' effect of these fuels blends on the engine on the long term.

Some results from engine tests are:

- the absence of sulphur as such has no significant effect on the engine fuel consumption
- blends with standard diesel with higher 'Bio-diesel/FAME' concentration than 5% (by volume) can cause a number of problems to parts of the fuel injection system such as:
 - corrosion of (FIE) components
 - pump seizure due to high fuel viscosity at low ambient temperatures
 - fuel injector spray hole blockage
 - elastomeric seal failures
 - increased injection pressure
 - increased dilution and polymerisation of engine sump oil

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Ongoing engine and fuel system developments will improve the component resistibility against the influences of Bio-diesel/FAME type of fuels. Check the conditions and guidelines involved on the next page.

● Fuel feature control via Fuel Standard and Lubricity norm

- @ Key topics are lowering engine pollution by reducing the sulphur quantity in the fuel and chemically control the final exhaust gas composition. Realisation of these goals demand that all fuel products available have to meet with the requirements set by the European Fuel Standard and Lubricity norm.

European Fuel Standard EN590 and Lubricity Norm (ISO 12156)

The European Fuel Standard EN 590 specifies a large number of requirements for marketed and delivered automotive diesel fuel. It incorporates specific fuel properties, their values and test methods which have to be met.

- **Lubricity Norm** (integrated part of the Fuel Standard EN 590)
The problem raised by a reduced sulphur quantity is a partial or complete deletion of the lubricating effect of the fuel, an effect however that is required for 'fuel greased' mechanical installations like, for example, the diesel fuel injection pump. Obviously with a diminishing sulphur quantity in the fuel, a replacing additive is required to meet the sulphur functionality.

- @ To safeguard a minimum fuel lubricity the 'Lubricity norm' was introduced. At this moment the maximum lubricity norm test value is defined as 460 μm (standard value). Higher test values indicate a decreased fuel greasing performance and are not yet accepted. However, on request of the industry and as an ongoing process, the norm test value can be re-evaluated at any time in case technical innovations allow a change (lowering) of the fuel's lubricity.

● General guidelines for alternative fuel

Based on gathered knowledge concerning the effects of alternative fuels, DAF supports the following rule: Alternative fuels and possible mixtures of diesel fuel for the DAF LF45 up to and including the XF series are allowed, if all following conditions are met:

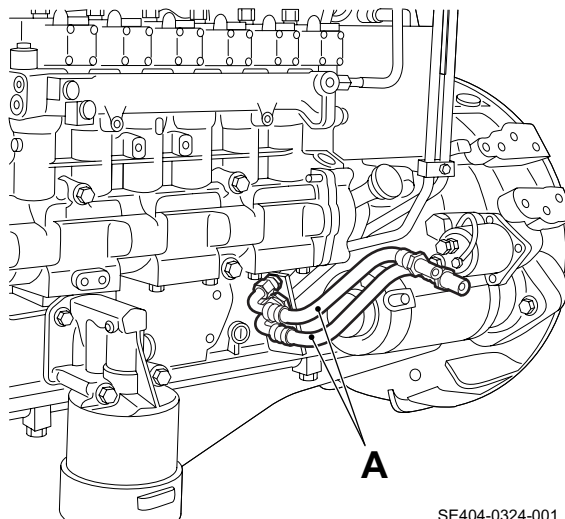
- @ **For LF** (BE or CE engine), **CF** (CE or PE engine) **and XF** (XE or MX engine) **Series**
- There may be no negative (destructive) chemical reaction of the fuel on any of the engine or fuel system components.
 - All EN590 Fuel Standard requirements must be met and for 100% Bio diesel standard EN14214.
 - Only official produced diesel or blends with alternative fuel up to 5% Bio-diesel is allowed for the LF, CF65 and 95XF series and the CF75/85 series with chassis numbers up to 0E552890. This diesel fuel mixture must comply with the Fuel standard EN 590.
- @
- Only official produced diesel or blends of standard diesel fuel with up to 5% Bio-diesel/FAME is allowed for use in the XF series with MX type engine.
 - Only official produced diesel or blends of standard diesel fuel with up to 100% Bio-diesel/FAME is allowed for use in the XF series with XE type engine and for the CF75/85 series with PE type engine from chassis number 0E552890 onwards.
 - Blends of standard diesel fuel with up to 100% Bio-diesel/FAME is allowed if following additional conditions are met:

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- the fuel hoses 'A' which run from the connection in the chassis member to the engine (see below) need to be checked for leakage each oil interval and replaced when necessary; the material is not resistant against bio-diesel. See instruction TI 4-051 at the DAF dealer.



- the sealing of the fuel filler cap may cause leakage; if so it needs timely replacement.
- the oil- and fuel filter change interval period must be diminished by half.
- extended oil service intervals are not allowed.
- under cold weather circumstances the fuel may cause problems in the fuel system; this can be prevented by heating the fuel; use a higher percentage of normal diesel or use of additives. Solutions to this have to be consulted with the supplier of bio-diesel.

Advised is the installation of a water separator unit to diminish possible growth of bacteria.

* The service intervals are related to the nature of the vehicle operation (urban and off-road, regional distribution and long distance); check for details the service maintenance schedule.

Important: Blends of diesel fuel with water are not allowed.

Note: there is no kit available to convert DAF engines to suit the use of BIO-diesel/FAME fuels.

● Additional information for (bio-diesel) fuel consumers

- Night heaters of the type D1LC compact and D3LC compact accept 100% bio-diesel/FAME fuel.
- @ - The Hydronic 10 and D2 and D4S Airtronic night heaters are released for blends of standard diesel with up to a maximum of 5% bio-diesel/FAME.

@ ● Storage and use of fuel

- 1) Users are reminded that fuel Standards apply to the fuel only to the point of delivery from the distribution network. From this point on it is the user's responsibility to protect the fuel in storage tanks, in supply systems and during use on the vehicle from free water and dirt contamination to enable engines to achieve the designed performance, emission, and durability targets.
- 2) Bio fuel is not stable and will deteriorate at higher temperatures. Storage time must therefore be limited.