Particularly essential preconditions for running a diesel engine are the availability and quality of the diesel fuel. Fuels and engines must be compatible with each other in technical terms in order to ensure trouble-free operation. At any given time and place the fuel should be available at low cost and easy to access.
Mercedes-Benz diesel engines are designed for diesel fuel, which complies with respective national and international requirements (EN 590 in Europe).

Conventional diesel fuels

Conventional diesel fuels, such as have been used for many years now worldwide for high-speed diesel engines, are hydrocarbons that occur in the range between 180 °C and 360 °C during the fractionating crude oil distillation process in the refineries. These hydrocarbons can have extremely different molecular structures, which naturally exhibit different characteristics.

Chemical structure of diesel fuel

The quadrivalent carbon C and the monovalent hydrogen H have numerous bonding capabilities. There are linear and various branched chains as well as assorted ring-type systems, which can be saturated or unsaturated, and the number of multiple bonds is also different.

Alcanes are chain-shaped saturated hydrocarbons with the total formula CnH2n+2, which, also named paraffins, are very important for diesel fuel. Regular paraffins (linear chains, non-branched) have an excellent ignition quality and favorable smoke behavior, the low-temperature flowability however is poor, and because of the low density the volumetric calorific value is low. Compared with this iso-paraffins (branched chains) exhibit an unfavorable ignition quality and a better low-temperature behavior.

Alcenes are chain-shaped (straight-chained or branched) unsaturated hydrocarbons with a double bond; they have the total formula CnH2n. These products which are also known as olefins, are similar to the iso-paraffins, but they have a less favorable smoke characteristic.

Cycloalcanes are ring shaped, saturated hydrocarbons with the total formula CnH2n. These products known as cycloparaffins, or better still naphthenes, exhibit a moderate ignition quality, but have a more favorable low-temperature characteristic, and they have a smoke characteristic similar to that of the olefines. Density and volumetric calorific value are average.

Aromatics, ring-shaped hydrocarbons with double bonds, have a lower ignition quality, poor smoke characteristic and a moderate low-temperature behavior. Density and volumetric calorific values are high.

Requirements, characteristics, parameters (DIN EN 590)

The diesel fuel characteristics that are necessary for running a diesel engine can either be described or, with the aid of parameters, specified in more detail. Although these parameters, which as a rule are based on standardized test procedures, are indeed useful, they do not always fully satisfy the need to define important quality criteria for handling diesel fuel and for its combustion in the engine. A certain number of such specifications, for which limit values have been defined, are called on to compile standards for minimum requirements.

In our view diesel fuel additives are absolutely essential for improving quality. This lies within the remit of the supplier as it bears the overall responsibility for its product (see here also the section on Additives).

Ignition quality

The ignition quality represents one of the essential features of diesel fuel. With regard to its significance for the anti-knock rating of the benzines however only a limited comparison can be drawn. Looked at technically the ignition quality represents the opposite of the anti-knock property.

The ignition quality is expressed as the cetane number and in fact measured in accor

The ignition delay, in other words the time span between the injection point and spontaneous ignition, represents a measure of ignition quality. An excellent ignition quality, i.e. a high cetane number, signifies a low ignition delay. This is particularly important when starting off, especially when the engine is cold. The engine sound, the smoothness, is also dependent on the ignition quality. DIN EN 590 specifies a minimum cetane number of 51; good commercial fuels however lie higher than this.

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Boiling characteristics

The diesel fuel's boiling characteristics lies between approx. 180 °C and 360 °C, whereby there are considerable differences around the world. A diesel engine howe

The DIN standard recognizes three limit values only, namely:

up to 250 °C max. 65 Vol. % vaporized

up to 350 °C min. 85 Vol. % vaporized

95 Vol. % point at max. 360 °C

Suitable commercial diesel fuels are however subject to much more stringent specifications.

The sulfur content in diesel fuel is essentially dependent upon the origin of the crude oil, the refinery's desulfurization capabilities and is governed by standards and/or regulations.
It represents one of the most significant application-engineering parameters for diesel fuel and for this reason it is dealt with in its own Sheet 136.0 "Sulfur in diesel fuels". In general the sulfur content should be as low as is possible.
The reduction in sulfur content discussed here which over the past few years has not

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Low-temperature behavior

The hydrocarbon compounds generally looked on favorably for operation in diesel engines have a certain disadvantage, they have no resistance to cold, i.e. even at a fe

Depending upon the method of fuel production and the vehicle configuration it was possible in practice to master these problems more or less successfully. Today

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Apart from a certain drop in performance, this has no negative effect on the engine

Now that there are several suppliers who offer diesel fuel with a guaranteed low-temperature resistance, it is advisable to use such fuels only. See Sheets 137.0 and 137.1

Density
Density is not specified in every country's standard. DIN EN 590 specifies that the density of the diesel fuel must be between 820 and 845 kg/m3 at 15 °C. In the European and suppliers place value on having as wide a range of permissible densities as possible. It is not possible to achieve the necessary performance with the given injection-pump settings and an ultralight fuel nor to comply with the specified emission-control levels with a very heavy fuel.

Viscosity
Viscosity, in other words the internal friction, the fuel's tenacity, is responsible for the flow processes and the wear resistance in the injection system and influences the pulverization capability in the combustion chamber. In accordance with the DIN standard it can be between 2.0 and 4.5 mm2/s, measured at 40 °C; as a general rule this large tolerance band is not fully exploited.

Additives
With regard to the diesel fuel's service life and wear rates of the injection systems, the retention of favorable exhaust-emission values as well as the attainment of an overall positive operating behavior, the use of diesel fuel with high additivity levels represent a necessary measure which in the long term is also inexpensive.

In terms of the supply of such fuels, the individual customer must rely on the filling stations that he visits selling such fuels with additives; the opinion of large companies passed-on to us has shown that this is the case nationally, and is usually the case in respect of independent filling stations not tied to major suppliers. Large customers are generally in a position to enter into bilateral negotiations that guarantee the supply of products containing additives; we would recommend these customers to demand that they are provided with such fuels only.

We would expressly like to point out that according to our assessment the slight percentage increase in fuel costs is more than compensated for by the savings in terms of maintenance and servicing and the lower susceptibility for repair work. Typical complaints that can be prevented from occurring through the use of increased additives in the fuels are, e.g. coking of injection nozzles, wear and corrosive damages throughout the entire fuel system. Apart from this constantly improving exhaust-emission values help to take the burden off the environment.

The fuel additive gains greater significance when the problems associated with lubricity in sulfur-free fuels is entered into the equation (see section on "Lubricity"). Looked at in this way optimizing the additive process is no longer an option, but a necessity.

The additive process should be undertaken by the supplier as part of its quality assurance responsibility with regard to the fuels, the addition of secondary additives by the customer is not recommended.

Storage and transportation
The following instructions are of particular relevance to those of our customers who own their own filling station.

Diesel fuel is a valuable energy carrier. If it is to be used in the vehicle - in accordance with the customer's wishes - without any problems then certain basic technical rules must be observed.

Never operate the tanks alternately, in other words do not fill them alternately with diesel and gasoline, but if demand exists for both fuel types (minimum) then two dedicated tanks should be used. If this instruction is not followed then alternating contamination effects are inevitable.

In particular, customers who do not purchase diesel fuel often, should completely use up their stocks of summer-grade and transitional fuel before receiving a delivery of winter-grade quality.

The ground tank must not contain any water or other dirt (e.g. from contamination with microorganisms, see Sheet 138.0). This applies particularly prior to filling the tank with winter diesel fuel. If this should however occur, have the tank cleansed thoroughly. Check the bottom tanks at regular intervals!

If the fuel supply is changed from fuels without additives to fuels with additives then special care must be taken to ensure that the storage tanks are clean. The detergents present in the fuels containing additives, which serve to keep the vehicle fuel system clean, can also carry dirt particles from the storage tanks into the vehicle's fuel system and thus contribute to a faster blocking of the filter.

Nonobservance of this rule can lead to premature blockage of the fuel system filter and performance problems during the winter months.

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Ignition point/hazard class
The diesel fuel's ignition point, as measured by ISO 2719, must be higher than 55 °C. For combustion within the engine, this is in fact meaningless, but important so that the diesel fuel falls into hazard class A III (fluids which are not soluble in water with a flash point between 55 °C and 100 °C) (see also Sheet 112.0).

Even very small admixtures of gasoline will significantly lower the ignition point of diesel fuel. Although the ignition point of diesel fuel is higher than that of gasoline, the self-ignition temperature for diesel fuel is lower than that for gasoline.

Purity
Diesel fuel must be free of any organic acids and solid matter and be clear when at ambient temperature.

The water content must not be higher than 200 mg/kg in order to prevent corrosion from occurring. In order to ensure that the diesel fuel does not contain any organometallic, wear-enhancing compounds, the permissible ash content has been set at max. 0.01 percent by weight.

Diesel fuel components which tend to promote carbonization can cause considerable engine-related problems, e.g. nozzle coking and excessive combustion-chamber deposits. For this reason the coke residue is limited to 10 % petroleum stock (as measured by Conradson).

Lubricity
The reduction in sulfur content for environmental reasons which has taken place during the past few years has brought with it the problem of the diesel fuel's lubricity, because hydrogenation of the middle distillate which was required to gain the reduction, also caused the removal of the natural lubrication enhancers.

There is evidence that diesel fuels that comply with the European limit of max. 0.05 percent by weight, today
max. 0.035 % by weight of sulfur can cause wear in the injection equipment. This means that the addition of lubricant enhancing additives by the fuel producers is absolutely essential if our customers are to be protected against long-term damage.

EN 590 2/99 regulates this through specifications in the "HFRR test" ("High Frequency Reciprocating Rig Test"), in which a ball is put into forced oscillation under load on a plate, whereby the diesel fuel to be tested serves as lubricating medium. This test has been in existence since (9/99) both as a CEC specification (CEC F-06-A96) and an ISO testing technique (ISO 12156-1). The maximum permissible limit value for the lubricity in the HFRR test has been defined in EN 590 at 460 mm at 60 °C.
Although the method is largely accepted in the industry, point of criticisms regarding precision and meaningfulness (i.e. correlation with practice) of the test still exist. DaimlerChrysler has proposed normalization of a pump test at ACEA and CEC, and work has started on it.

Miscellaneous
Almost all previously mentioned characteristics or parameters are dependent on each other. This applies in particular to density, boiling characteristic, viscosity, ignition point, low-temperature behavior and ignition quality. If one of these characteristics is altered, the others inevitably change too.

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