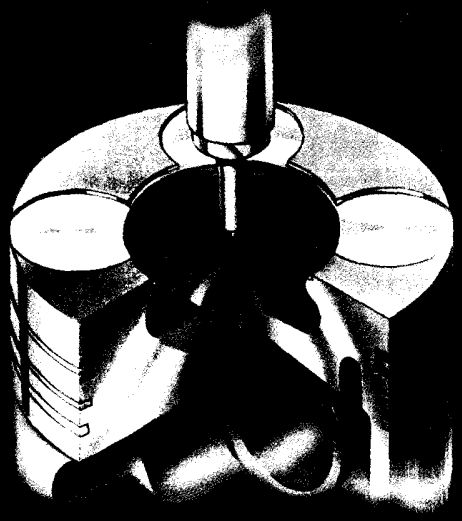
Automotive Technology

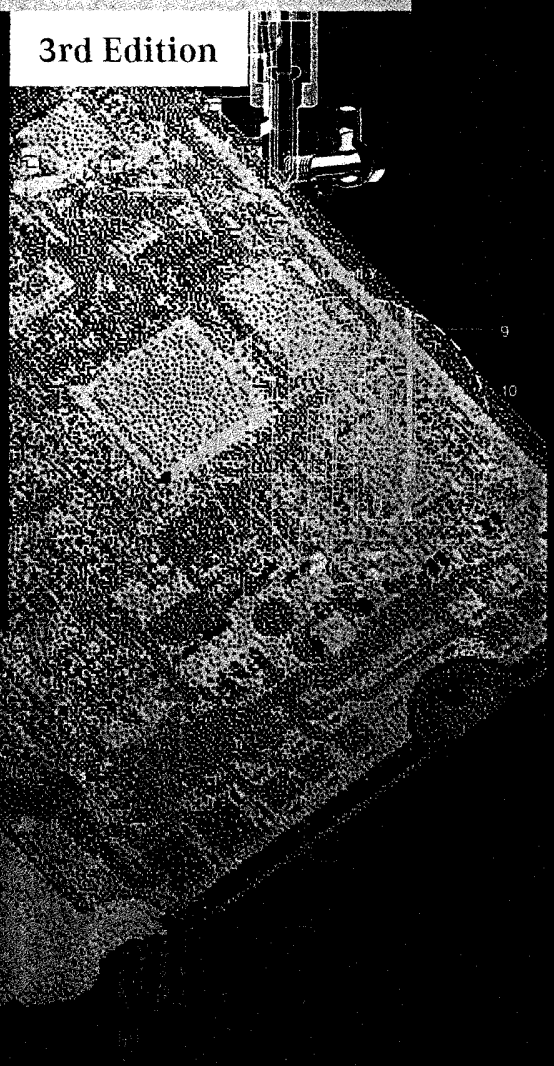
Diesel-Engine Management

Systems and Components

New: Unit Pump/Unit Injector

3rd Edition





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The cetane number is tested using a standardized single-cylinder testing engine. The ignition lag is set for the fuel under test by means of a variable compression ratio. The engine is then run on a reference fuel made up of a mixture of cetane and α-methylnaphthalene (Figure 1) using the same compression ratio. The proportion of cetane in the mixture is altered until the same ignition lag is obtained. The proportion of cetane then gives the cetane number (for example, a mixture of 52 % cetane and 48 % α-methylnaphthalene has a cetane number of 52).

Paraffin fuel components have a high cetane number while aromatic compounds (chiefly cracking products) have a low cetane number; i-paraffins, olefins and naphthenes have a medium cetane number.

Ignition accelerators can be added to the fuel to improve its cetane number. All types of emission, particularly NO_x, diminish as the cetane number increases, as does the combustion noise.

Density
The energy content of diesel fuel per unit of volume increases with density. Fuels are sold by volume and delivered to the combustion chamber by fuel-injection systems on the same basis. If an engine is designed for use with a "medium-density" fuel, then if it is run on higher-density fuel (based on fuel grade), engine performance and soot emission increase; they diminish if a lower-density fuel is used. Temperature-dependent variations in fuel density are compensated for by the EDC system.

The requirement of diesel fuel is therefore "narrow grade-based density spread". A density sensor could also provide a solution to the problem. There is a greater density spread found in fuels around the world than permitted by EN 590.

Viscosity
If the viscosity of a fuel is too low, it will lead to leakage losses in the fuel-injection system at low engine speeds in particular and therefore also to power deficiencies and hot-start problems. If the viscosity is too high, it will impair pump function and result in poor fuel atomization. Therefore, EN 590 specifies narrow tolerance limits for diesel-fuel viscosity.

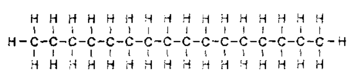
Boiling range
The boiling range is the temperature range within which the fuel boils.

A low initial boiling point makes a fuel suitable for use in cold weather but also means a lower cetane number and poor lubricant properties. A high upper boiling limit gives long-chained paraffins poor cold-starting properties but a higher cetane number.

Polyaromatic compounds with three or more rings also have a high boiling point but a low cetane number. As the polyaromatic-compound content of diesel fuel increases, more soot is produced as a by-product of combustion.

Reference fuels for testing cetane number

Cetane (n-hexadecane $C_{16}H_{34}$)
highly combustible (CZ 100)



α-methylnaphthaline ($C_{11}H_{10}$)
non-combustible (CZ 0)

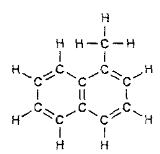


Fig. 1
C Carbon
H Hydrogen
— Chemical bond