Mixture Preparation

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An engine should operate satisfactorily under all operating conditions and ensure the energy it receives is utilized to a maximum. The fuel-air mixture must be optimally prepared for this purpose. Only in this way can effective combustion take place and provide the corresponding engine power output. Added to this, effective combustion also ensures that pollutant emissions are kept within acceptable limits.

Adaptation makes it possible for the engine control unit to learn certain values from components and equipment variants thus making it possible to compensate for certain component tolerances. A fault is indicated if adaptation exceeds certain limits.

Lambda adaptation

Lambda adaptation serves the purpose of compensating for component tolerances that influence the mixture and ageing effects.

Factors such as secondary air and fuel pressure also have an effect on lambda adaptation and are, in part, also compensated.

For this reason, exact intervention limits in the case of fault cannot be specified.

Lambda adaptation differentiates between idle (additive) and partial load (multiplicative) mixture adaptation:

- Idle adaptation is effective at idle speed and in the range close to idle speed. Its influence decreases as the engine speed increases (an important factor is secondary air for instance).

- Partial load adaptation is effective over the entire characteristic map range (an important factor is the fuel pressure for instance)

Fuel-air mixture

A petrol engine requires a certain air-fuel ratio (lambda) in order to operate effectively. The theoretical air-fuel ratio is 14.7 : 1.

Different operating conditions (cold, warm, acceleration, etc.), however, render necessary an air-fuel mixture that deviates from the ideal value. Mixture correction must take place with the aid of various facilities.

A rich mixture is necessary during full throttle operation in order to develop the required power output.

There is insufficient air if lambda is < 1. The fuel-air mixture is rich. The engine develops its maximum power output at lambda = 0.85 to 0.95.

There is surplus air if lambda is > 1. The air-fuel mixture is lean. As a result, fuel consumption and power output are reduced.

If lambda is > 1.3, the air-fuel mixture no longer readily ignites, the engine no longer runs, the operating limit is exceeded.

A lambda value of 0.9 to 1.1 has proven to be the most favourable in practical applications. If, however, it is necessary to operate the engine about a lambda value = 1, a fuel injection with emission (lambda) control will be necessary for the purpose of mixture preparation.

The electronic fuel injection system measures the air drawn in by the engine and converts the measured value into an electrical signal that is evaluated by the DME control unit. The control unit calculates the fuel requirement on the basis of the electronic signal and other parameters. The control unit correspondingly activates electromagnetic fuel injectors. These fuel injectors intermittently inject fuel ahead of the inlet valves of the cylinders.