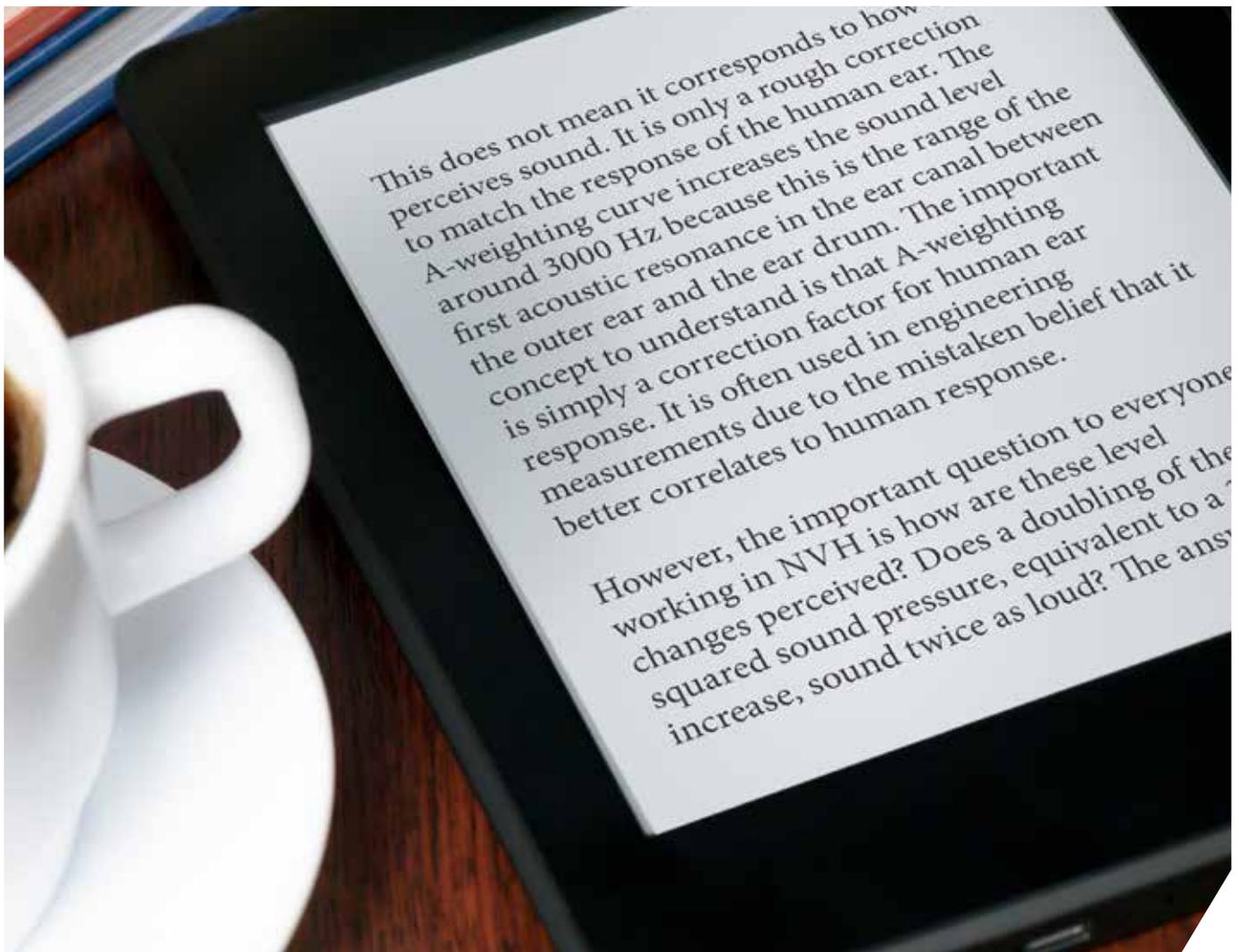


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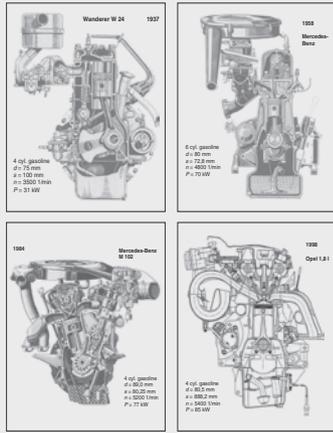


Figure 4.3 Various supercharging methods (after [2-3]).

Figure 4.36 Start of preinjection control (DI-TCI diesel engine).

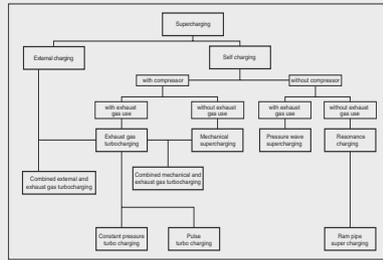


Figure 4.36 Start of preinjection control (DI-TCI diesel engine).

There are many possible combinations for the cylinder arrangement, some of which are identified in a self-explanatory manner by letters. Figure 2.4 shows a selection of possible cylinder arrangements and configurations.

The following are possibly of significance:

- The inline engine (two bank of cylinders and one crankshaft): Two connecting rods are coupled to each crank pin. Common V-engines are 45°, 60°, 90°, and 180°. The V8 engine [2-14] has a V-angle of 15°, the crankshaft having a separate crank pin for each connecting rod.
- The V-engine (two banks of cylinders and one crankshaft): Three connecting rods are connected in each case to one crank pin. A V-engine consisting of two V8 banks is referred to as a V16 engine, or also as a W-engine [2-14].
- The boxer (flat-opposed) engine: Unlike the 180° V-engine, each connecting rod is connected to a separate crank pin.

The crank mechanism has proven its value in engine design. Trunk piston engines and crosshead engines may be differentiated as variants. Slider crank mechanisms and cam engines are also described in the relevant literature, as are crankshaftless engines (curved-plate, curved-track, and crankless engines) [2-16].

Single- and double-acting engines can be differentiated according to their manner of action, depending on whether the combustion gases act on only one side or on both sides of the piston. The double-piston engine has two pistons to each

combustion chamber; the pistons being arranged either opposed (opposed-piston engine) or concurrent (I-piston engine). Vertical, horizontal, and overhead engines are differentiated on the basis of the location of the cylinder axis, and overhead and side-actuated engines by the location of the timing mechanism.

**2.2.2 Ignition**  
The fuel-air mixture may be ignited by means of supplied ignition or compression ignition:

- Supplied ignition (gasoline engine): An electrical spark ignites the mixture in the cylinder (spark ignition).
- Autogenous (diesel engine): The fuel injected ignites spontaneously in the air heated by compression in the cylinder (compression ignition).

**2.2.3 Cooling**  
In view of the high temperatures that occur, the combustion engine needs to be cooled, to protect its components and the lubricating oil. It is necessary to differentiate between direct and indirect engine cooling.

Direct cooling is accomplished using air (air cooling) either with or without the assistance of a fan.  
In the case of indirect cooling, the engine is cooled with a mixture of water, antifreeze, and corrosion inhibitors, or with oil (liquid cooling). Removal of heat to the environment is accomplished via a heat exchanger arrangement. One

reduce the NO<sub>x</sub> emissions described above. In the map area without preinjection, on the other hand, the main injection is shifted earlier.

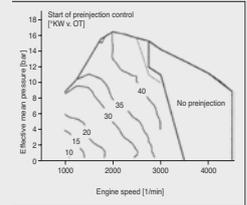


Figure 4.36 Start of preinjection control (DI-TCI diesel engine).

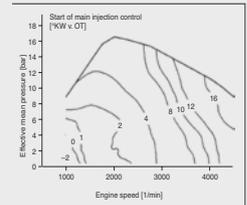


Figure 4.37 Start of main injection control (DI-TCI diesel engine).

#### 4.4 Exhaust Gas Temperature

The behavior of the exhaust gas temperature is shown in Figure 4.18. The sharp increase in temperature to high loads necessitates specific protection of the exhaust gas catalytic converter from even destruction.

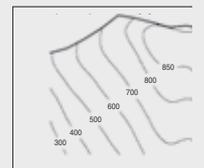


Figure 4.18 Exhaust gas temperature map at the entry to converter (MPI 3 engine).

Both design measures and the calibration operating parameters are employed here. For exhaust gas turbocharging, the gas temperature inlet is also critical for component protection. An enrichment of the fuel-air mixture is there as an effective component protection measure.

For operation with low load points, on the other hand, an excessively low exhaust gas temperature must be avoided. A relatively retarded ignition timing varies. In addition to these measures, recognition maps, deviating control parameters for the ignition system are normally calibrated after the engine so that the catalytic converter quickly reaches the temperature necessary for conversion of the exhaust gases into harmless components.

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