Internal combustion engines

Basic knowledge

Internal combustion engines are thermal fluid energy machines: they generate mechanical energy by burning a mixture of fuel and air. All work processes take place inside a working area: the cylinder. Since the force/energy within the cylinder is transferred by means of a variable volume, internal combustion engines are part of the group of positive displacement machines.

Motors or engines are often used to power motor vehicles, ships or locomotives. They are also used for drives that must be reliable and independent of the electrical power supply, such as emergency backup generators, construction machines or agricultural machinery.

Small single-cylinder engines are perfect for demonstrating the fundamentals of engine technology. GUNT offers various internal combustion engines with capacities of up to 75kW, including real car engines with a volumetric displacement of up to two litres. Among these engines are four-stroke diesel and petrol engines, petrol engines with variable compression and two-stroke petrol engines.

Comparison of engines: 2-stroke petrol engine, 4-stroke petrol engine, 4-stroke diesel engine

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2-stroke engine: one work cycle = one crank revolution

1st stroke: compression/intake
The piston moves upward: from bottom dead centre to top dead centre
Processes above the piston: The precompressed mixture is further compressed above the piston. The precompressed mixture under the piston pushes the accumulated exhaust fumes out and fills the cylinder.
Processes below the piston: The transfer port is closed as the piston travels upwards. Due to the resulting negative pressure the intake valve opens: The fuel and air mixture is drawn in.

2nd stroke: power / precompression
Downward motion of the piston: from top dead centre to bottom dead centre
Processes above the piston: The resulting pressure forces the piston downward and opens first the outlet channel and then the transfer port. The precompressed mixture under the piston pushes the accumulated exhaust fumes out and fills the cylinder.
Processes below the piston: The mixture that was sucked in is precompressed by the upward motion of the piston and pressed into the transfer port. The positive pressure closes the inlet valve.

4-stroke engine: one work cycle = two crank revolutions

1st stroke: intake
The piston moves from the top to the bottom dead centre. As it does, the fuel and air mixture is sucked in.

2nd stroke: compression
The piston moves from the bottom to the top dead centre. As it does, the fuel and air mixture is compressed.

3rd stroke: power – ignition and expansion
The compressed fuel and air mixture is ignited shortly before the top dead centre is reached. The resulting pressure presses the piston downwards.

4th stroke: exhaust
The piston moves from the bottom to the top dead centre. As it does, the exhaust gases are discharged.

Indicator diagram of a 2-stroke engine

Indicator diagram of a 4-stroke engine

1st stroke (0-1): the cylinder is charged with the fuel / air mixture, compression of the mixture,
2nd stroke (1-2): ignition and combustion of the mixture, expansion of the combustion gases,
3rd stroke (2-3): expulsion of the remaining combustion gases
4th stroke (3-4): the remaining exhaust gases are expelled.