

AUMET OY

The Z⁺-motor company

Z combustion



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The features of Z engine

- Z engine is a new type of a 2/4 stroke internal combustion engine. Each cylinder produces a complete 4-stroke work cycle at every crankshaft revolution.
- A part of combustion air compression is done externally from the work cylinder by 2-stage compressor consisting of a turbocharger and a piston compressor.
- A turbocharged Z engine having 2 work cylinders and one compressor cylinder is equal to turbocharged 4-cylinder 4-stroke engine.

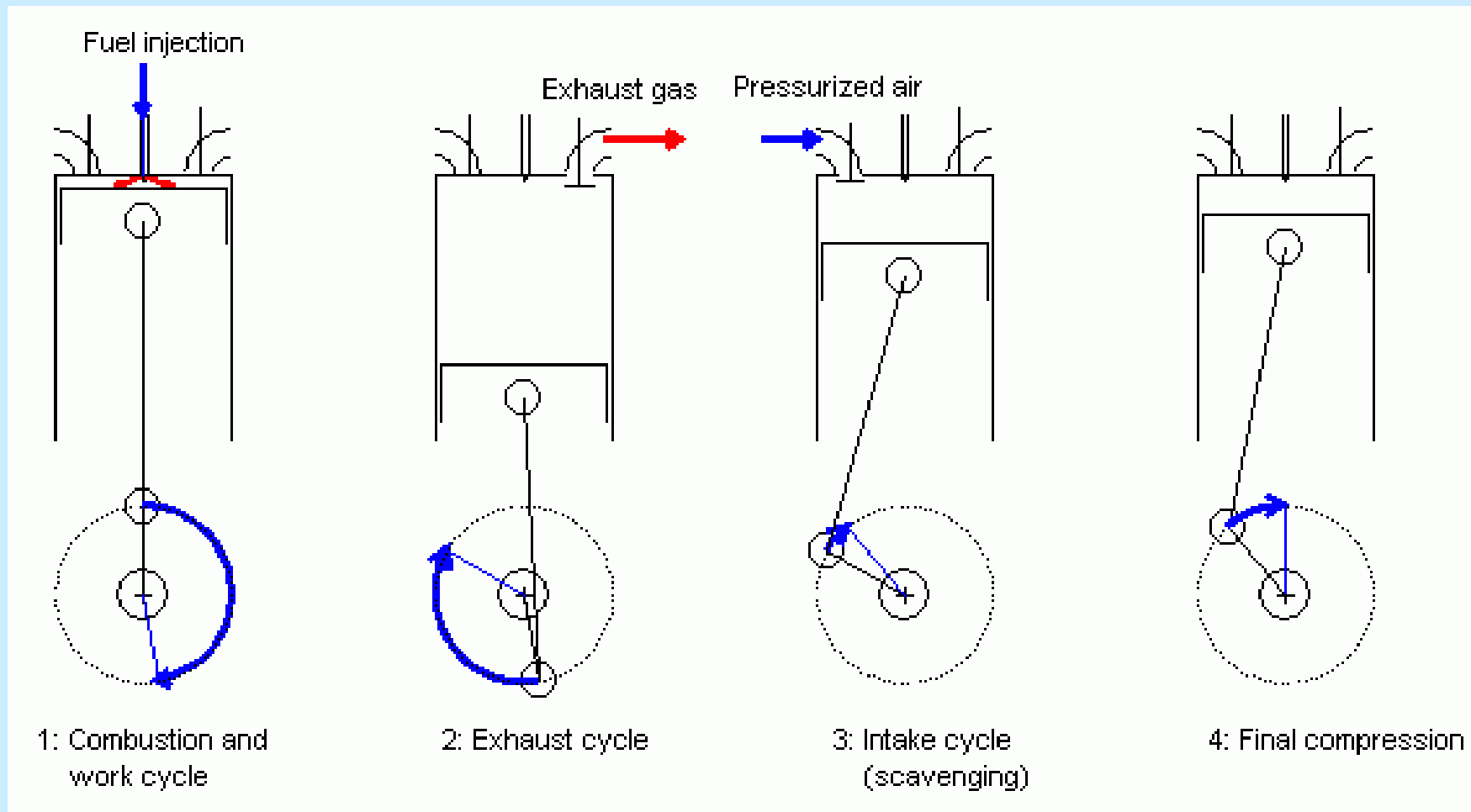


A possible construction of Z engine

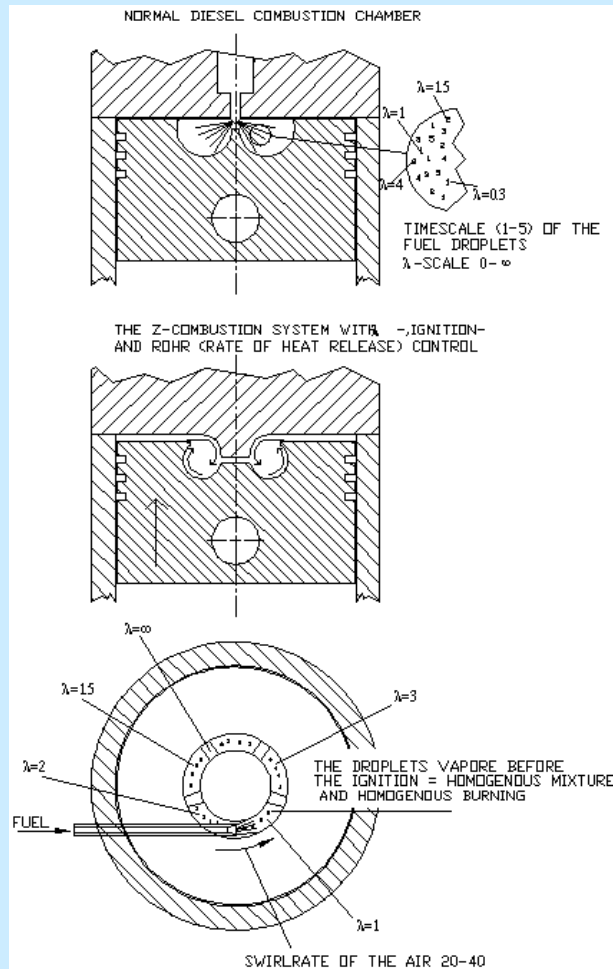


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In cylinder work cycle of the Z engine

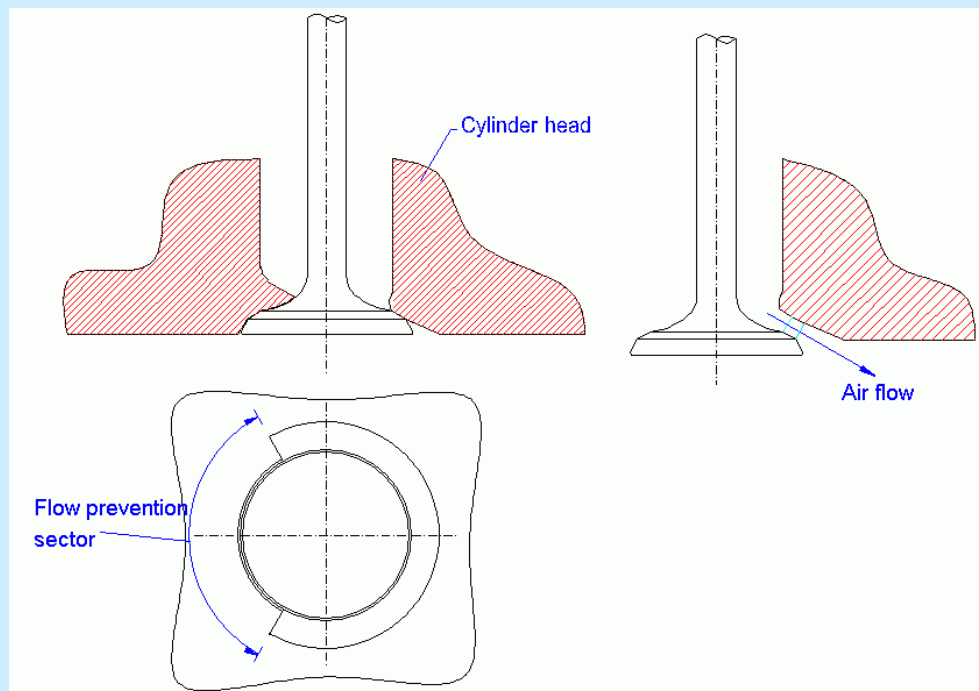


The principle of Z combustion



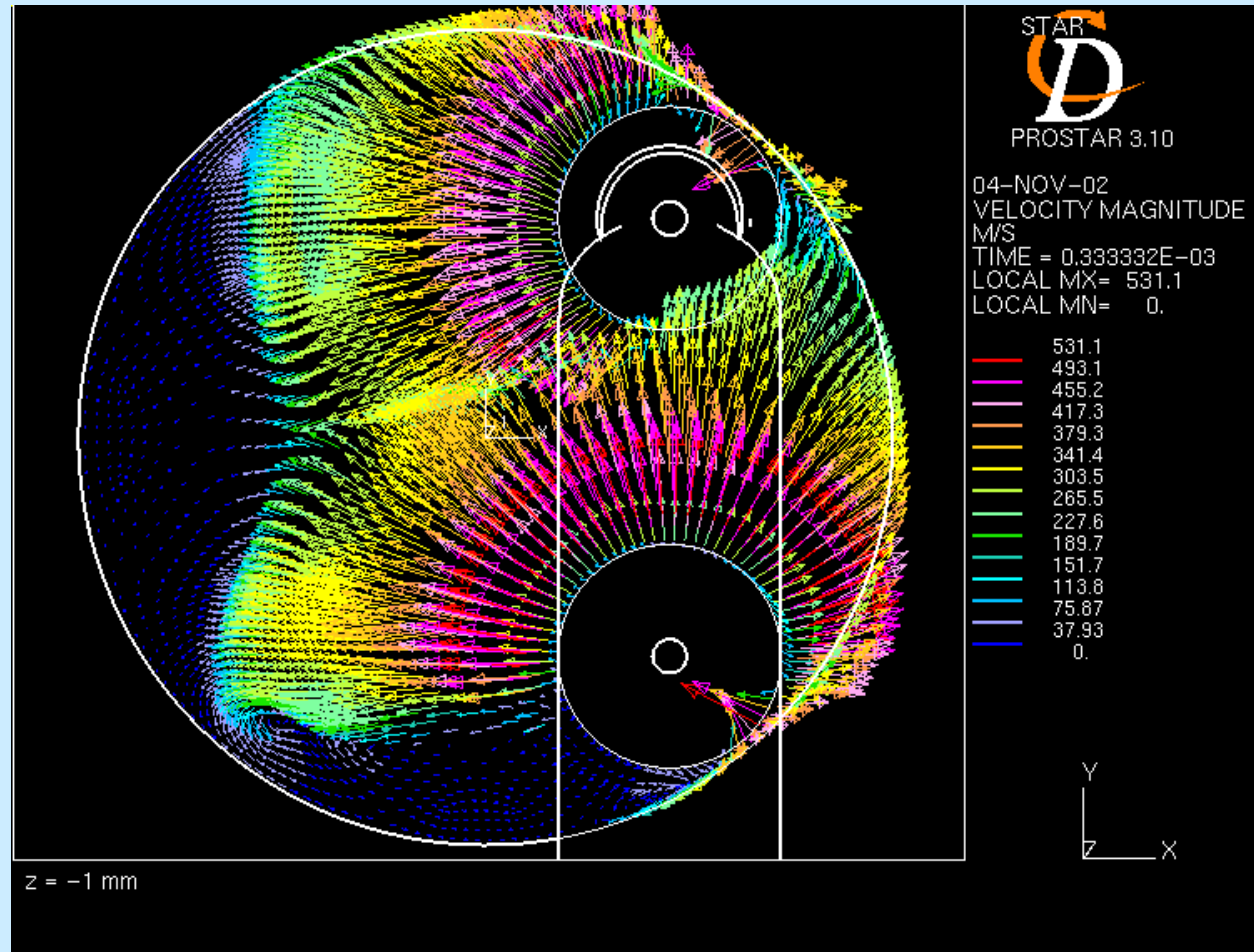
- The high pressure difference over intake valves and therefore possibility to have high swirl rate makes Z combustion possible.
- The combustion chamber is a circular groove on the piston crown.
- The high swirl combustion air flows in the combustion chamber at top dead center. The fuel is injected down stream into the highly turbulent air flow. The air flow transports the fuel droplets.
- Because the fuel droplets are transported within the rotating air there is no injection directly into the flame.

The high swirl intake valves of Z combustion



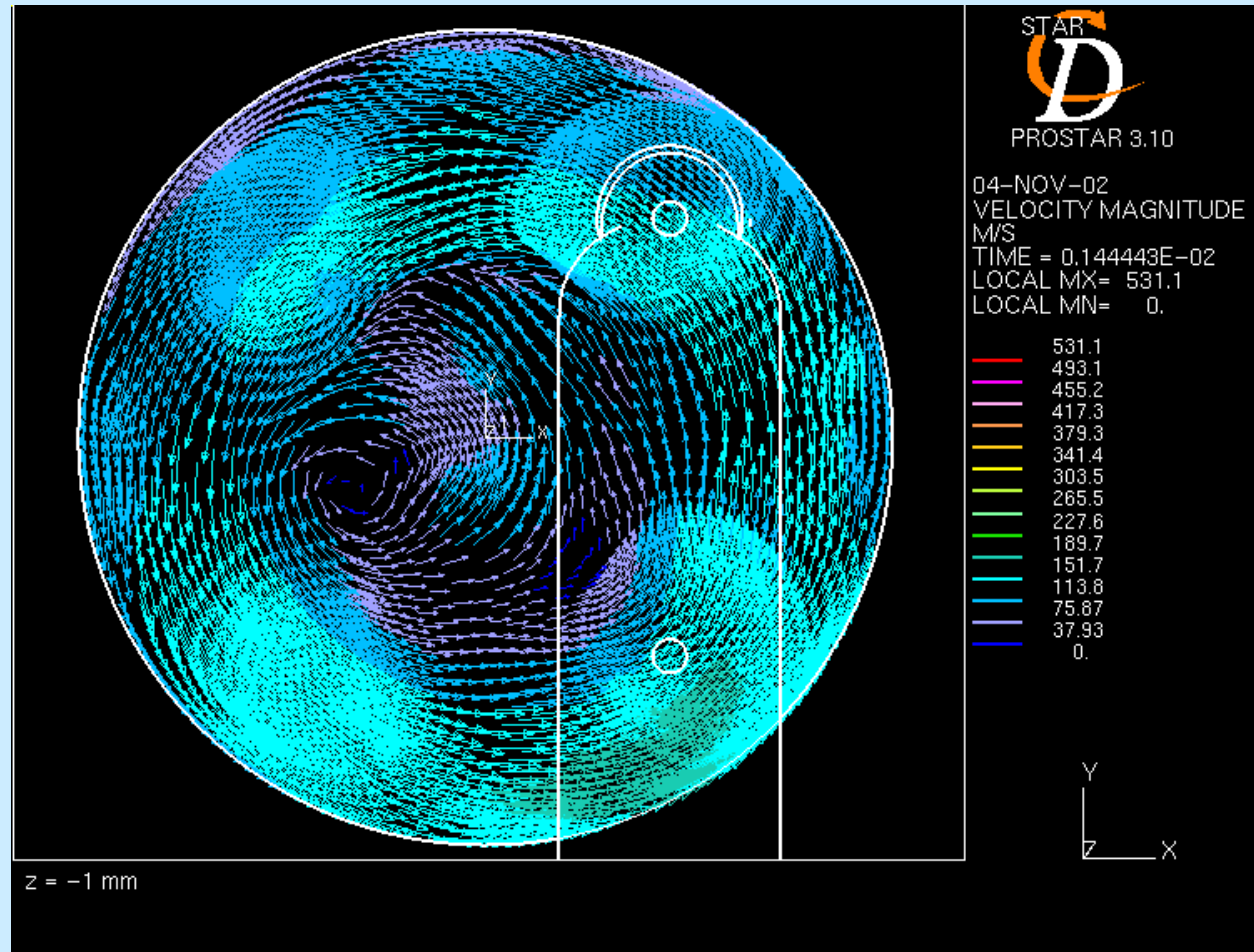
- The valves form a narrowing / widening nozzle that allows supersonic flow speed.
- The flow is prevented on certain sector to direct the combustion air tangentially into the cylinder to make a high swirl.

In cylinder flow simulation, intake valves opened



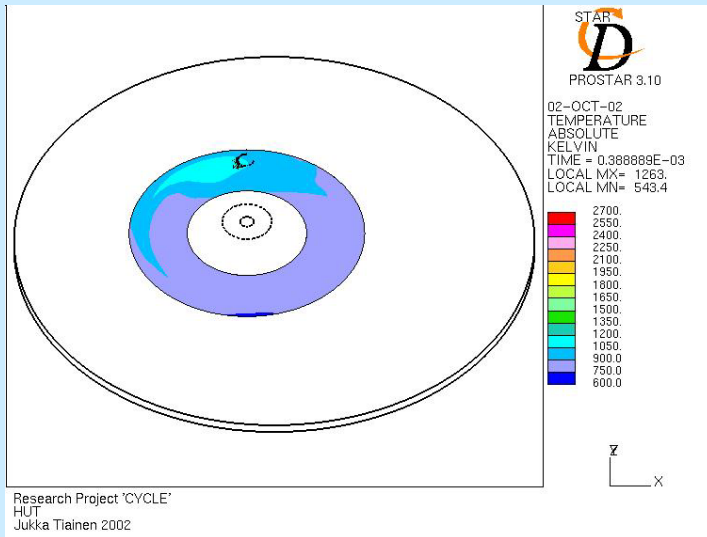
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In cylinder flow simulation, intake valves closed

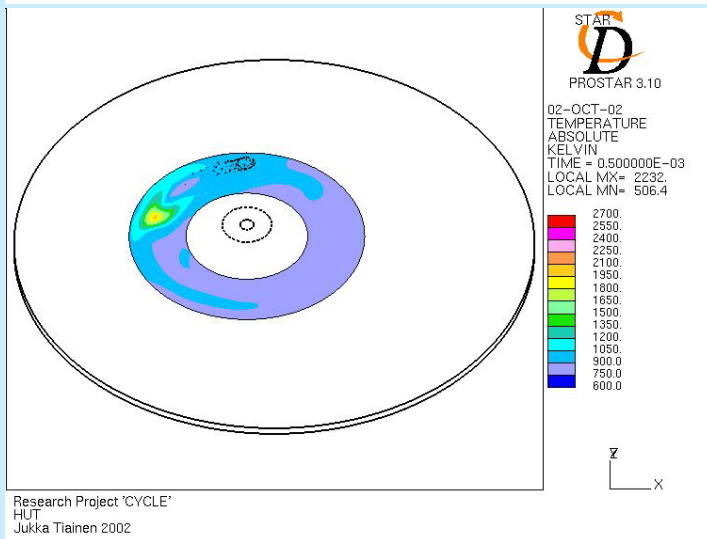


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Simulation of Z combustion



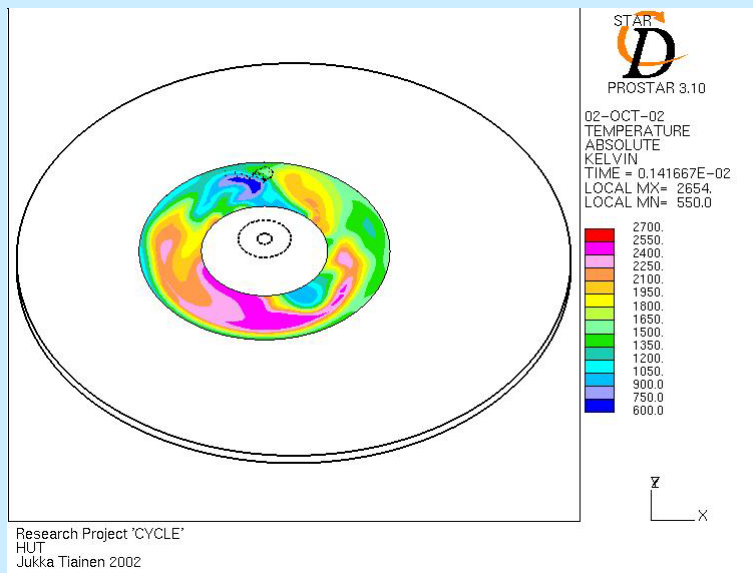
Start of injection



Start of ignition

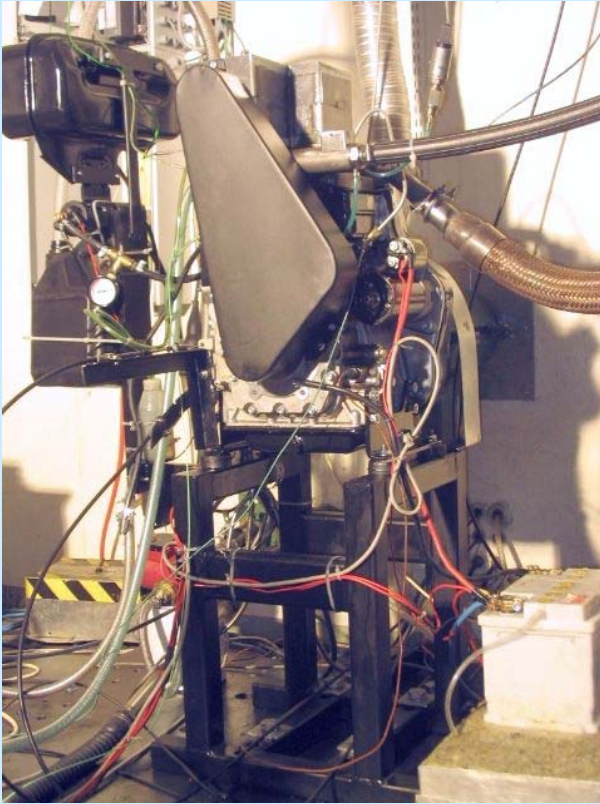
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Simulation of Z combustion



The burnt matter (exhaust gas) reaches the fuel nozzle and the injection is cut down.

The dynamometer tests of Z engine utilizing Z combustion



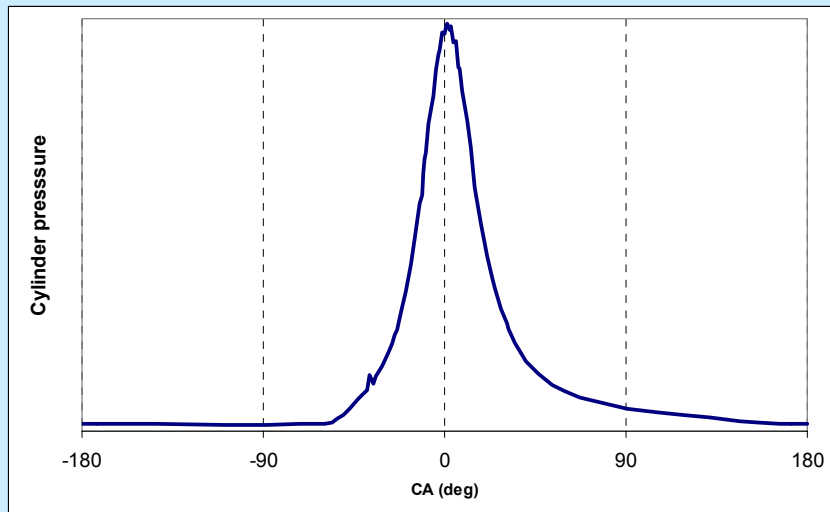
- The tests are carried out in the premises of VTT (Technical Research Centre of Finland).
- The test program is still going on.



The dynamometer tests of Z engine utilizing Z combustion



The heat insulated combustion chamber in the piston crown of prototype engine. The combustion chamber “lip” has a milling that increases turbulence of squish flow.



A measured cylinder pressure curve at low load.

The goals and features of Z combustion

- Homogenous combustion \Rightarrow low NO_x and particle emissions.
- Intention to have low air/fuel equivalence ratios (near 1).
- Internal exhaust gas recycling is possible.
- The Z combustion system has an analogy with the swirl chamber combustion. However, there aren't problems with HC-emissions because the combustion chamber is open. The Z combustion doesn't increase the pumping losses of a Z engine.
- The high geometrical compression ratio (20-30).
- It's possible to have 2-stage combustion.
- The injector doesn't need to have transport function because the air flow mixes and transports the fuel droplets. A low pressure but small droplets producing nozzle is suitable for Z combustion. Because of the low pressure the injection system is inexpensive to produce and the power dissipation of injection pump is low.
- Aim to low emissions:
 - No need for expensive active catalytic converters to fulfill future environmental legislation concerning NO_x emission.
 - No need to sacrifice efficiency to achieve lower NO_x emissions.
 - No need for particle filter.