

# Effect of Intake Channel Design to Cylinder Charge and Initial Swirl

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## ABSTRACT

Two different medium-speed diesel engine cylinder head designs have been studied. The focus of the study has been the effect of intake channel design in the in-cylinder flow. The study has been carried out by CFD. The first cylinder head is a standard Wärtsilä 20 cylinder head and the second one is a specially designed head for a single cylinder research engine, called Extreme Value Engine (EVE). The CFD boundary conditions have been simulated by the help of a 1-d simulation code. In the full load cases the maximum cylinder pressure was 300 bar. Simulations have been done at lower load level too. One simulation with the new cylinder head was carried out with one intake valve closed in order to get an idea of the swirl to be generated by this approach. In the study the in-cylinder flow field, the cylinder charge and turbulence kinetic energy have been examined.

## INTRODUCTION

This study has been a part of the EU 7. FP project Hercules Beta. The aim of the project has been to reach the peak cylinder pressure of 300 bars and design and manufacture the needed components for that. Also the engine speed is going to be raised from 900 r/min to 1290 r/min (mean piston speed 12m/s). The reason for both is increasing the power density of the engine.

A totally new cylinder head has been designed. The main criterion of the new design has been the strength. A cross-flow cylinder head was chosen as the design basis with straightest possible cylinder head channels.

This study concentrates on the flow field simulation of the intake channels and cylinder. The main geometrical difference between the standard and the new cylinder head is that standard head has been designed to generate swirl. The standard head has intake and exhaust channel in the same side of the head. In the new head the channels are symmetrically positioned and designed to avoid flow restrictions. The in-cylinder flow field and cylinder charge in both heads are presented in this paper. Also the effect of closing one of the intake valves of the new design was studied in order to see possible effects in the swirl level.

The Extreme Value Engine (EVE) has been designed to be able to take very high firing pressures up to 400 bar. The components like connecting rod, crank shaft bearing and cylinder liner have been designed to sustain 400 bars as maximum firing pressure. The EVE engine is also very flexible with respect to valve lift, fuel injection and charge air pressure.

There are only a few publications about the intake valve flow and in-cylinder flow field of medium-speed diesel engines. Saarinen et al. [1] studied flow field over the similar cylinder head than the "old head" in this work. They used static boundary conditions and approximately the half of the amount of cells than in this work. The