Phase-locked stereoscopic PIV measurements of the turbulent swirling flow in a dynamic model of a uniflow-scavenged two-stroke engine cylinder

It is desirable to use computational fluid dynamics for the optimization of in-cylinder processes in large two-stroke low-speed uniflow-scavenged marine diesel engines. However, the complex nature of the turbulent swirling in-cylinder flow necessitates experimental data for validation of the used turbulence models. In the present work, the flow in a dynamic scale model of a uniflow-scavenged cylinder is investigated experimentally. The model has a transparent cylinder and a movable piston driven by a linear motor. The flow is investigated using phase-locked stereoscopic particle image velocimetry (PIV) and time resolved laser Doppler anemometry (LDA). Radial profiles of the phase-averaged mean velocities are computed from the velocity fields recorded with PIV and the validity of the obtained profiles is demonstrated by comparison with reference LDA measurements. Radial profiles are measured at five axial positions for 15 different times during the engine cycle and shows the temporal and spatial development of the swirling in-cylinder flow. The tangential velocity profiles in the bottom of the cylinder near the end of the scavenging process are characterized by a concentrated swirl resulting in wake-like axial velocity profiles and the occurrence of a vortex breakdown. After scavenge port closing the axial velocity profiles indicate that large transient swirl-induced structures exists in the cylinder. Comparison with profiles obtained under steady-flow conditions shows that the steady profiles in general will not be representative for the dynamic conditions. The temporal development of the swirl strength is investigated by computing the angular momentum. The swirl strength shows an exponential decay from scavenge port closing to scavenge port opening corresponding to a reduction of 34%.

General information
State: Published
Organisations: Department of Mechanical Engineering, Fluid Mechanics, Coastal and Maritime Engineering, MAN Diesel and Turbo
Contributors: Ingvorsen, K. M., Meyer, K. E., Walther, J. H., Mayer, S.
Number of pages: 12
Publication date: 2013

Host publication information
Title of host publication: Proceedings of the 10th International Symposium on Particle Image Velocimetry
Publisher: TU Delft
Electronic versions:
Phase_locked_stereoscopic_PIV_measurements.pdf
URLs:
http://www.piv2013.org/
Source: dtu
Source-ID: u::7911
Research output: Research - peer-review › Article in proceedings – Annual report year: 2013