
Evaluating the Influence of Bore-to-Stroke Ratio on Emission Characteristics and Residual Gas Fraction in Propane-Fueled Internal Combustion Engines

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This study investigates the influence of bore-to-stroke ratio and combustion duration on engine performance, emissions, and residual gas fraction in a spark-ignition engine fueled by pure propane. A combination of experimental testing on a two-cylinder engine with a control dynamometer and simulations using AVL-Boost software was employed to analyze key combustion characteristics. The findings indicate that peak pressure rise, combustion duration, and effective release energy are highly dependent on the bore-to-stroke ratio, whereas RGF exhibits less sensitivity to this parameter. Increasing the bore-to-stroke ratio led to a decrease in residual gas fraction, an increase in effective release energy, and improvements in ignition timing, combustion duration, and volumetric efficiency. The peak pressure rise reached its maximum value of 3.05 bar/deg at a bore-to-stroke ratio of 0.966. Regarding emissions, HC and CO levels decreased with an increasing bore-to-stroke ratio, while NO_x emissions increased. In terms of engine performance, a bore-to-stroke ratio of 0.8 resulted in a 7.68% improvement in maximum engine torque compared to the reference ratio of 1.06. Additionally, the lowest NO_x emissions were observed at a bore-to-stroke ratio of 0.88.

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