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Simulation Research of Diesel Aircraft Engine

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Abstract : This paper presents the simulation results of a new opposed piston diesel engine to power a light aircraft. Created in the AVL Boost, the model covers the entire charge passage, from the inlet up to the outlet. The model shows fuel injection into cylinders and combustion in cylinders. The calculation uses the module for two-stroke engines. The model was created using sub-models available in this software that structure the model. Each of the sub-models is complemented with parameters in line with the design premise. Since engine weight resulting from geometric dimensions is fundamental in aircraft engines, two configurations of stroke were studied. For each of the values, there were calculated selected operating conditions defined by crankshaft speed. The required power was achieved by changing air fuel ratio (AFR). There was also studied brake specific fuel consumption (BSFC). For stroke S1, the BSFC was lowest at all of the three operating points. This difference is approximately 1-2%, which means higher overall engine efficiency but the amount of fuel injected into cylinders is larger by several mg for S1. The cylinder maximum pressure is lower for S2 due to the fact that compressor gear driving remained the same and boost pressure was identical in the both cases. Calculations for various values of boost pressure were the next stage of the study. In each of the calculation case, the amount of fuel was changed to achieve the required engine power. In the former case, the intake system dimensions were modified, i.e. the duct connecting the compressor and the air cooler, so its diameter D = 40 mm was equal to the diameter of the compressor outlet duct. The impact of duct length was also examined to be able to reduce the flow pulsation during the operating cycle. For the so selected geometry of the intake system, there were calculations for various values of boost pressure. The boost pressure was changed by modifying the gear driving the compressor. To reach the required level of cruising power N = 68 kW. Due to the mechanical power consumed by the compressor, high pressure ratio results in a worsened overall engine efficiency. The figure on the change in BSFC from 210 g/kWh to nearly 270 g/kWh shows this correlation and the overall engine efficiency is reduced by about 8%. Acknowledgement: This work has been realized in the cooperation with The Construction Office of WSK "PZL-KALISZ" S.A." and is part of Grant Agreement No. POIR.01.02.00-00-0002/15 financed by the Polish National Centre for Research and Development.

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