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Operation Cycle Model of ASz62IR Radial Aircraft Engine

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Abstract : Today's very important element relating to air transport is the environment impact issues. Nowadays there are no emissions standards for turbine and piston engines used in air transport. However, it should be noticed that the environmental effect in the form of exhaust gases from aircraft engines should be as small as possible. For this purpose, R&D centers often use special software to simulate and to estimate the negative effect of engine working process. For cooperation between the Lublin University of Technology and the Polish aviation company WSK "PZL-KALISZ" S.A., to achieve more effective operation of the ASz62IR engine, one of such tools have been used. The AVL Boost software allows to perform 1D simulations of combustion process of piston engines. ASz62IR is a nine-cylinder aircraft engine in a radial configuration. In order to analyze the impact of its working process on the environment, the mathematical model in the AVL Boost software have been made. This model contains, among others, model of the operation cycle of the cylinders. This model was based on a volume change in combustion chamber according to the reciprocating movement of a piston. The simplifications that all of the pistons move identically was assumed. The changes in cylinder volume during an operating cycle were specified. Those changes were important to determine the energy balance of a cylinder in an internal combustion engine which is fundamental for a model of the operating cycle. The calculations for cylinder thermodynamic state were based on the first law of thermodynamics. The change in the mass in the cylinder was calculated from the sum of inflowing and outflowing masses including: cylinder internal energy, heat from the fuel, heat losses, mass in cylinder, cylinder pressure and volume, blowdown enthalpy, evaporation heat etc. The model assumed that the amount of heat released in combustion process was calculated from the pace of combustion, using Vibe model. For gas exchange, it was also important to consider heat transfer in inlet and outlet channels because of much higher values there than for flow in a straight pipe. This results from high values of heat exchange coefficients and temperature coefficients near valves and valve seats. A Zapf modified model of heat exchange was used. To use the model with the flight scenarios, the impact of flight altitude on engine performance has been analyze. It was assumed that the pressure and temperature at the inlet and outlet correspond to the values resulting from the model for International Standard Atmosphere (ISA). Comparing this model of operation cycle with the others submodels of the ASz62IR engine, it could be noticed, that a full analysis of the performance of the engine, according to the ISA conditions, can be made. This work has been financed by the Polish National Centre for Research and Development, INNOLOT, under

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