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Thermal Imaging of Aircraft Piston Engine in Laboratory Conditions

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Abstract : The main task of the engine cooling system is to maintain its average operating temperatures within strictly defined limits. Too high or too low average temperatures result in accelerated wear or even damage to the engine or its individual components. In order to avoid local overheating or significant temperature gradients, leading to high stresses in the component, the aim is to ensure an even flow of air. In the case of analyses related to heat exchange, one of the main problems is the comparison of temperature fields because standard measuring instruments such as thermocouples or thermistors only provide information about the course of temperature at a given point. Thermal imaging tests can be helpful in this case. With appropriate camera settings and taking into account environmental conditions, we are able to obtain accurate temperature fields in the form of thermograms. Emission of heat from the engine to the engine compartment is an important issue when designing a cooling system. Also, in the case of liquid cooling, the main sources of heat in the form of emissions from the engine block, cylinders, etc. should be identified. It is important to redesign the engine compartment ventilation system. Ensuring proper cooling of aircraft reciprocating engine is difficult not only because of variable operating range but mainly because of different cooling conditions related to the change of speed or altitude of flight. Engine temperature also has a direct and significant impact on the properties of engine oil, which under the influence of this parameter changes, in particular, its viscosity. Too low or too high, its value can be a result of fast wear of engine parts. One of the ways to determine the temperatures occurring on individual parts of the engine is the use of thermal imaging measurements. The article presents the results of preliminary thermal imaging tests of aircraft piston diesel engine with a maximum power of about 100 HP. In order to perform the heat emission tests of the tested engine, the ThermaCAM S65 thermovision monitoring system from FLIR (Forward-Looking Infrared) together with the ThermaCAM Researcher Professional software was used. The measurements were carried out after the engine warm up. The engine speed was 5300 rpm The measurements were taken for the following environmental parameters: air temperature: 17 °C, ambient pressure: 1004 hPa, relative humidity: 38%. The temperatures distribution on the engine cylinder and on the exhaust manifold were analysed. Thermal imaging tests made it possible to relate the results of simulation tests to the real object by measuring the rib temperature of the cylinders. The results obtained are necessary to develop a CFD (Computational Fluid Dynamics) model of heat emission from the engine bay. The project/research was financed in the framework of the project Lublin University of Technology-Regional Excellence Initiative, funded by the Polish Ministry of Science and Higher Education (contract no. 030/RID/2018/19).

Keywords : aircraft, piston engine, heat, emission

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