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Investigating Constructions and Operation of Internal Combustion Engine Water Pumps

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Abstract : The water pump in the compression-ignition internal combustion engine transports a hot coolant along a system of ducts from the engine block to the radiator where coolant temperature is lowered. This part needs to maintain a constant volumetric flow rate. Its power should be regulated to avoid a significant drop in pressure if a coolant flow decreases. The internal combustion engine cooling system uses centrifugal pumps for suction. The paper investigates 4 constructions of engine pumps. The pumps are from diesel engine of a maximum power of 75 kW. Each of them has a different rotor shape, diameter and width. The test stand was created and the geometry inside the all 4 engine blocks was mapped. For a given pump speed on the inverter of the electric engine motor, the valve position was changed and volumetric flow rate, pressure, and power were recorded. Pump speed was regulated from 1200 RPM to 7000 RPM every 300 RPM. The volumetric flow rates and pressure drops for the pump speeds and efficiencies were specified. Accordingly, the operations of each pump were mapped. Our research was to select a pump for the aircraft compression-ignition engine. There was calculated a pressure drop at a given flow on the block and radiator of the designed aircraft engine. The water pump should be lightweight and have a low power demand. This fact shall affect the shape of a rotor and bearings. The pump volumetric flow rate was assumed as 3 kg/s (previous AVL BOOST research model) where the temperature difference was 5°C between the inlet (90°C) and outlet (95°C). Increasing pump speed above the boundary flow power defined by pressure and volumetric flow rate does not increase it but pump efficiency decreases. The maximum total pump efficiency (PCC) is 45-50%. When the pump is driven by low speeds with a 90% closed valve, its overall efficiency drops to 15-20%. 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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