Test bench and measurement system development for classical and more-electric aero-engine oil system components characterization

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Recent aero-engine technological evolutions have significantly increased the constraints on oil system components through increasing oil flow rates and temperature. This trend will continue with future engines, that require more lubrication due to higher rotational speeds and also a more efficient cooling due to the reduced fuel consumption and rise in temperature. This is even more true in the case of the electrification of several engine functions. Therefore, even if often hidden behind other evolutions, new oil systems components are regularly designed and tested. For these purposes, the Aero-Thermo-Mechanics department of Université Libre de Bruxelles has, over the last years, built a test bench and participated to the development of measurement systems to characterize the performance of these components.

This paper presents this test bench, designed to reach a Technology Readiness Level of 5, and to provide oil and air flow rates at different temperatures and pressures to the tested component. Through the participation to several research projects (in Clean Sky and FP7: LubSEP, LuBEST, Elubsys, etc.), several components were tested: feed and scavenge pumps, air-oil breathers, oil heat exchangers, health-monitoring sensors and filters. This paper presents the capacities and the instrumentation of this test bench. It also presents the measurement techniques developed and used to characterize these components: imaging systems, droplet sizing, mass flow rates, etc. Results of this testing are also presented and summarized to illustrate the capacities of the test bench and how it helps reaching higher TRL levels from research developments. In particular, the paper shows how oil consumption is measured by an innovative radio-traced method, the size of droplets emitted by engine breathers, the impact of solid particles on pump performance and of the oil system pressure on the components. As a conclusion, this paper illustrates how the effect of new components design, engine design (including more-electric aircraft) can be assessed on a carefully designed test bench, helping to shape future engine developments.