

Film Thickness and Flow Visualization Measurements in a Thrust Collar

Integrally geared compressors (IGCs) achieve high efficiencies and a low footprint by subjecting the thrust collars (TCs) and the bull gear (BG) to increased axial loads and increased speeds. A thrust collar test facility (TCTF) was developed to imitate an IGC. In our previous work, investigation of the oil film at the TC-BG contact was limited to qualitative images and CFD simulation.

Laser induced fluorescence (LIF) is proposed to obtain 2D, temporally resolved oil film thickness (OFT) data at the TC-BG contact surface. A calibration device was manufactured to quantify the LIF signal of a thin oil film at controlled temperatures, pressures, and film thicknesses. Initial LIF validation experiments were conducted with glass microscope slides. Results from the initial experiments show that the LIF intensity increases with increasing dye concentration and film thickness. The next steps of the experiment involve completing the calibration tests with the calibration device at various film conditions, then installing additional optics to measure the OFT at the IGC TC-BG contact surface. The proposed testing will provide the location of the minimum film thickness, and if edge thinning is occurring. The test results will be compared an in-house code to determine the accuracy of the load capacity predictions. The results will also be compared to a computational fluid dynamics model. After load testing is complete, starvation testing will begin. The testing will determine what is the minimum oil supply flow rate is before scoring occurs. The testing will aide in the design and modeling of TCs and ultimately could lead to an increase of the total load capacity.