Introduction

The efficiency of internal combustion engines in airplanes is dependent on the mass flow rate (leakage) of the gas passing through the engine. Engine seals are one solution to this problem.

Methods

After validating the numerical method of ANSYS CFX Workbench v19.1, it was used in an iterative design process to model and simulate the engine seal. A 0.1 degree slice of the seal was created at full length, with the proper dimensional constraints, simulation settings, and boundary conditions. The output of interest was the mass flow rate at the outlet of the seal.

Design

The final seal design attempts to combine three methods of flow reduction: cavities, a difficult path (labyrinth), and increased length. There are cavities at the edges to create large eddy currents, while the rest of the seal creates a long, difficult path as well as smaller eddy currents. The images below show this design, but actually represent the fluid domain, not the seal structure itself.

Results

Findings

Final Design Leakage = 0.00907 kg/s

The final leakage was 22.1% of the original design leakage. The combined effect of the three methods proved essential, especially the multitude of small eddy currents and the additional distance the fluid had to travel to get from the inlet to the outlet.