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# THREE-DIMENSIONAL CFD ROTORDYNAMIC ANALYSIS OF GAS LABYRINTH SEALS (TP055)

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## ABSTRACT

Labyrinth seals are utilized inside turbomachinery to provide non-contacting control of internal leakage. These seals can also play an important role in determining the rotordynamic stability of the machine. Traditional labyrinth seal models are based on bulk-flow assumptions where the fluid is assumed to behave as a rigid body affected by shear stress at the interfaces. To model the labyrinth seal cavity, a single, driven vortex is assumed and relationships for the shear stress and divergence angle of the through flow jet are developed. These models, while efficient to compute, typically show poor prediction for seals with small clearances, high running speed, and high pressure (Childs, 1993).

In an effort to improve the prediction of these components, this work utilizes three-dimensional computational fluid dynamics (CFD) to model the labyrinth seal flow path by solving the Reynolds Averaged Navier Stokes equations. Unlike bulk-flow techniques, CFD makes no fundamental assumptions on geometry, shear stress at the walls, as well as internal flow structure. The method allows modeling of any arbitrarily shaped domain including stepped and interlocking labyrinths with straight or angled teeth. When only leakage prediction is required, an axisymmetric model is created. To calculate rotordynamic forces, a full 3D, eccentric model is solved. The results demonstrate improved leakage and rotordynamic prediction over bulk-flow approaches compared to experimental measurements.

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