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Steady-State Stiffness of Foil Air Journal Bearings at Elevated Temperatures©

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A previously developed test method for measuring steady-state stiffness of foil air journal bearings is extended to measure trends in bearing stiffness at high temperature. Steady-state stiffness of the tested foil bearing is found to decrease in general as the temperature increases from 25 °C to 538 °C. The magnitude of stiffness change observed is roughly a factor of two, which is important information for the design of future high speed turbomachinery. It is expected that damping in foil bearings may also be affected by changes in temperature necessitating future testing to evaluate the trends in dynamic bearing characteristics.

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NOMENCLATURE

C	= radial clearance
$E(T)$	= modulus of elasticity, a function of temperature
L	= bearing length
K	= stiffness
K	= dimensionless stiffness: $K = KC/(P_aR^2)$
κ	= dimensionless stiffness: $\kappa = K/(E(T)t)$
N	= speed in radians per second
P	= load per unit area: $P=W/(2RL)$
P_a	= ambient pressure
R	= journal radius
S	= Sommerfeld Number; $S=(\mu N/P)(R/C)^2$
S	= $W/(\mu(T)RNL)$
t	= foil thickness
T	= temperature
W	= load
W	= dimensionless load: $W = W/(PaR^2)$
Λ	= dimensionless speed: $\Lambda = 6\mu\ (N/P_a)\ (R/C)^2$
$\mu(T)$	= absolute viscosity, a function of temperature