# NASA TECH BRIEF



## Squeeze-Film Gas Bearing Technology

Squeeze-film lubrication is fundamentally derived from the same physical process which provides load-carrying capacity to self-acting and externally pressurized gas (air) film bearings. In each case, pressure buildup within the boundaries of the bearing is created by viscous retardation of the gas flow. The three types of bearing, however, differ in the origin of flow. In a self-acting bearing, adherence to the sliding surface causes ambient gas to enter the bearing gap. In an externally pressurized bearing, a high-pressure supply forces gas flow through the gap. In a squeeze-film gas bearing, high frequency transverse oscillations of one of the bearing surfaces provide the pumping action of ambient air. The oscillatory squeeze motion results in a time-averaged pressurization effect, primarily as a consequence of the compressibility of the gas film; the magnitude of this pressurization increases with the amplitude of oscillation relative to the average gap. The advantages of the squeeze-film bearing relative to the externally pressurized bearing include compactness, simplicity of construction, and ease of regulation. Its load-carrying capacity, however, is limited by the ambient pressure.

The squeeze-film bearing has been studied as part of a program to develop a low-friction suspension for the output-axis gimbal of a single-degree-of-freedom gyroscope. This study includes a review of the pertinent technical literature, the theory of squeeze-film lubrication, and design elements pertaining to oscillation drivers (primarily piezoelectric transducers), concentrators, wave extenders, and self-tuning electrical drive circuits. The asymptotic theory for the steady-state squeeze film, including edge correction, is applied to a circular thrust disc, a conical bearing with uniform axial excursion, a cylindrical journal bearing, and a spherical bearing with uniform axial excursion.

A squeeze-film journal bearing employing a floating tubular transducer, described in Tech Brief 66-10226 as a conceptual design, has been fabricated. In an experimental study of this bearing, the transducer was excited by a self-tuning oscillator. The measured load-deflection values were found to be in close agreement with the values derived from the asymptotic theory of the squeeze film. The floating tubular transducer was also used to construct a squeeze-film bearing for simultaneous journal and thrust loads. The thrust bearing area of this design is limited by the maximum thickness of the tube wall that can be manufactured; consequently, its thrust load capacity is marginal.

**Note:**

Complete details may be obtained from:
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No patent action is contemplated by NASA.

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