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TIP SHAPE, HEIGHT, AND THICKNESS INFLUENCES ON NONLINEAR ACOUSTIC DAMPING FROM BAFFLE BLADES

Abstract

Combustion instabilities have occurred in nearly every liquid rocket engine development program. Baffle blades are commonly used to damp these instabilities. Though a great deal of empirical research on baffles was done during the Apollo program, it resulted in little knowledge of the fundamental baffle damping mechanism. In the current work, a test facility was constructed that simulates the local acoustic field near the tip of a single baffle blade. This facility was used to test a thin, sharp tipped blade; a thick, square tipped blade; and a thick, round tipped blade. By measuring the high-acoustic-pressure oscillations at two locations in the chamber, the complex reflection coefficient magnitude was calculated quantifying the acoustic resistance caused by the blade. Compared to the two thick blades, the thin blade showed significantly higher damping. Acoustic simulations showed that the two thick blades have similar peak acoustic velocities, while the thin blade's peak acoustic velocity was over three times larger. In other high-amplitude acoustic systems with nonlinear damping due to flow separation (e.g., orifice in a duct), the damping is proportional to the peak acoustic velocity. The current observations suggest the main source of damping from a baffle blade comes from flow separation.