Effect of Phase Angle of Transverse Acoustics on Shear Coaxial Jets for Two Geometries

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This present study extends previous work done at AFRL on shear coaxial jet spreading angles and dark core length measurements from subcritical to supercritical pressures using nitrogen as the working fluid. With a second acoustic source to generate a variable phase acoustic field, the present study on coaxial jet behavior spanned a range of outer to inner jet momentum flux ratios (J) from .019 to 23, obtaining results for at least 6 different J values at each pressure condition. Acoustic forcing at 3 kHz was utilized to maximize the pressure fluctuations within the chamber, reaching maximum values between 1% to 4% of the mean chamber pressure. The coaxial jet was exposed to pressure node (velocity antinode) conditions, where pressure perturbations are minimum and velocity perturbations maximum; to pressure antinode (velocity node) conditions, where pressure fluctuations are maximum and velocity fluctuations are minimum; and other acoustic conditions in between by carefully varying the phase angle between the two acoustic sources.

Two different geometries were studied; one with a thick inner jet lip (Inj A) and another one with a very thin lip (lnj B). A noticeable difference between the two geometries is the effect of the phase angle on the dark core. In general, phase angle had a weak effect on most results obtained with Inj A. On those cases that the effect was clear, being at a pressure node shortened the dark core length the most. In contrast, the results for Inj B showed a clear phase angle effect with the longest dark cores occurring at the pressure node. Both geometries showed the largest reduction of the dark core length at moderate J values and as the J increased the maximum reduction decreased. All these results were found to be independent of the relative acoustic pressure the coaxial jets were exposed to.

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