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3D Velocity and Temperature Measurements of Freestream Turbulence Effects on a Pitched Jet in Crossflow[1] DAVID S. CHING, HAOSEN H.A. XU, CHRISTOPHER J. ELKINS, JOHN K. EATON, Stanford University — The effect of freestream turbulence on a heated round jet pitched 30° to a crossflow is studied with 3D velocity and temperature measurements. The jet and mainstream have the same velocity, corresponding to a jet Reynolds number of 3000. Two different turbulence grids give freestream turbulence levels of 5% and 8% at the hole location. The 8% grid creates weak secondary flows in the mainstream, while the 5% turbulence grid does not generate any measurable secondary flows. Magnetic Resonance Velocimetry and Magnetic Resonance Thermometry are used to acquire full-full 3D mean velocity and temperature fields. The results are compared to previous studies with no turbulence generators. The 5% turbulence case has the most rapid thermal spreading and the lowest adiabatic wall temperatures averaged over the entire domain. However, the 8% turbulence case has higher adiabatic wall temperatures. The mainstream secondary flows in the 8% turbulence case push the injected fluid closer to the wall, raising the wall temperature and overwhelming the effect of turbulence. The results show that freestream turbulence increases thermal spreading, but that even small secondary flows overwhelm freestream turbulence effects.

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