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Laboratory investigation of a thermally stable boundary layer subject to a step change in wall temperature[1] TYLER VAN BUREN, OWEN J. WILLIAMS, Princeton University, ALEXANDER J. SMITS, Princeton University, Monash University — Thermally stable boundary layers with a step change in boundary condition are seen in industrial applications (e.g. plate heat exchangers) as well as in nature (e.g. onshore breezes). Previous studies indicate that bulk indicators of stability are often insufficient to describe the local state of turbulence because the local flow strongly depends on its upstream history. Experiments were conducted to gain further insight into these flows. A low-speed wind tunnel was used to generate a rough-wall boundary layer at up to $Re_\theta = 1500$. After a development length of approximately 22δ, the downstream half of the tunnel wall was heated, creating a step change in wall temperature of up to $135^\circ C$. Particle image velocimetry and a thermocouple rake were used to measure the fluctuating velocity field and mean temperature profile at three locations downstream of the step change. We examine the rate of growth of the internal boundary layer and the corresponding evolution of the turbulent stresses in relation to changes in mean local stratification.

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