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Mean Flow and Wall Shear Measurements in Turbulent Boundary Layers with Various Imposed Complex Pressure Gradients PAUL ROZIER, RICHARD DUNCAN, HASSAN NAGIB, IIT, Chicago — Mean flow velocity profiles with miniature Pitot probes, and wall-shear stress measurements with oil film interferometry, are used to document the development of high Reynolds number turbulent boundary layers on a flat plate under the influence of four different complex pressure gradients. The National Diagnostic Facility (NDF) is uniquely suited for establishing and documenting such flow conditions to serve as grounds for testing various turbulence models in well-known, two-dimensional boundary layers. Each of the four conditions starts with a zero pressure gradient and returns to it again along the test section. Two of the conditions include an adverse gradient region followed by a favorable one, and the other two cases experience the same two effects in the opposite sequence but to comparable magnitudes of free-stream velocity variations. The mean velocity profiles are measured and used to determine parameters such as the shape factor, the logarithmic overlap-region parameters, and the wake or outer flow parameters. The effect of the initial boundary layer conditions on the development of such complex flows is also examined by changing the position of the pressure gradient "hump" between two sets of two opposite gradients conditions. The results will be briefly compared to computations at IIT of nearly the same flow conditions.

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