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Accurate and Independent Measurements of Wall-Shear Stress in Turbulent Flows J.-D. RÜEDI, R. DUNCAN, S. IMAYAMA, K. CHAUHAN, AND ICET TEAM — Oil Film Interferometry (OFI) is used to directly measure the wall-shear stress in the high Reynolds number turbulent boundary layers from three facilities used for ICET. Various optical arrangements were utilized to collect the digital images generated on transparent plugs integrated into the boundary layer surface. Test-section free stream velocities ranging from 10 to 60 m/s and development lengths from 5.5m to 21 m, resulted in friction velocities varying from 0.35 to 1.65 m/s, corresponding to boundary layer thicknesses varying by factors of nearly four. Silicon oils with viscosities from 20 to 1000 cSt were employed in the measurements, with multiple oils used for several of the test conditions. A reference temperature measurement was used in all three facilities and for the calibration of the oils as a function of temperature in four different laboratories using two types of viscometers. The processing of the images was carried out using several approaches and compared for consistency of the results. Results of the skin friction coefficient from the three wind tunnels are examined and compared as a function of the displacement thickness Reynolds number, as determined from hot-wire and Pitot probe profiles at comparable conditions, and are found to be accurately represented by the logarithmic Rotta relation. The various uncertainties and the final accuracy of this type of measurement are discussed.

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