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PIV Measurements in the Princeton Superpipe[1] IAN E. GUNADY, LIUYANG DING, ALEXANDER PIQUE, ERIC LIMACHER, SIMERET GENET, ALEXANDER J. SMITS, MARCUS HULTMARK, Princeton University — A stereo-PIV system for the Princeton Superpipe facility is designed and tested. The Superpipe uses air at pressures up to 230 bar to study turbulent flows at Reynolds numbers, based on diameter, ranging from 30 x 10ˆ3 to 35 x 10ˆ6. The pipe has a diameter of D = 129 mm, a length of 202D, and is contained within the pressurized system. The main challenge for PIV is gaining optical access in this experimental arrangement and to reduce effects of changes in index of refraction. A ray-tracing algorithm was first employed to design the stereo imaging system. It was decided to use mirrors to image the flow with telephoto lenses placed outside the pressure vessel. This configuration avoids the complexity arising from changing refractive index and puts the cameras outside the high-pressure environment. In addition, a high-pressure particle seeding system with Laskin nozzles is developed, and the size distribution of DEHS droplets at up to 200 atm are characterized with a Phase Doppler Anemometry system. The PIV system is used to collect measurements of fully developed pipe flow at various Reynolds numbers. These data are then validated against previous measurements in the Superpipe using NSTAP, a MEMS velocity sensor.

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