Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Measurements of wall shear stress in a planar turbulent Couette flow with porous walls PAUL BEUTHER, Kimberly-Clark Corp. — Measurements of drag on a moving web in a multi-span festoon show a stronger than expected dependency on the porosity of the web. The experiments suggest a wall shear stress 3-4 times larger than non-porous webs or historical Couette flow data for solid walls. Previous DNS studies by Jimenez et.al. (JFM Vol 442) of boundary layers with passive porous surfaces predict a much smaller increase in wall shear stress for a porous wall of only 40%. Other DNS studies by Quadrio et.al. (JFM Vol 576) of porous walls with periodic transpiration do show a large increase in drag under certain periodic conditions of modest amplitude. Although those results are aligned in magnitude with this study, the exact reason for the observed high drag for porous webs in this present study is not understood because there was no external disturbance applied to the web. It can be hypothesized that natural flutter of the web results in a similar mechanism shown in the periodic DNS study, but when the natural flutter was reduced by increasing web tension, there was only a small decrease of the drag. A key difference in this study is that because of the multiple parallel spans in a festoon, any transpiration in one layer must act in the opposite manner on the adjacent span.

Paul Beuther
Kimberly-Clark Corp.

Date submitted: 22 Jul 2013 Electronic form version 1.4