

# Fluids Lab 1 (SPL1) – Assignment

## Wind Tunnel Pitot Measurements

### Learning Objectives

- Practice using pitot probe relations (Bernoulli, etc)
- Familiarization with tunnel test procedures
- Practice nondimensionalization of data

### Experimental Rig

Test Article: 47:1 Boeing Blended Wing Body (BWB) in Wright Brothers Wind Tunnel  
Instrumentation:

- Tunnel’s pitot-static probe. Reports  $p_{o_\infty} - p_\infty$  in Torr (mm Hg).
- Hand-held pitot-static probe. Reports  $p - p_\infty$  in Torr.

### Test Conditions

Nominal tunnel speed: 40 mph  
Angles of attack  $\alpha = -7^\circ, 7^\circ$

### Raw Data Acquired

For each angle of attack  $\alpha \dots$

- 0)  $p_{o_\infty} - p_\infty \equiv q_\infty$  (from tunnel’s pitot-static probe)
- 1)  $p(x) - p_\infty \equiv \Delta p(x)$ , top and bottom centerline, (from hand-held pitot-static probe)
- 2)  $p(x) - p_\infty \equiv \Delta p(x)$ , top and bottom off-centerline, (from hand-held pitot-static probe)

### Normalized Data Presentation and Analysis

- 1) Plot centerline  $C_p$  vs  $x/c_0$ , for  $\alpha = -7^\circ$  and  $7^\circ$ , for top and bottom. Put the four curves on one plot, label clearly. Centerline chord is  $c_0 = 37.7$  in.
- 2) Plot off-center  $C_p$  vs  $x/c_{10}$ , for  $\alpha = -7^\circ$  and  $7^\circ$ , for top and bottom. Put the four curves on one plot, label clearly. Off-center chord is  $c_{10} = 20.5$  in.
- 3) The best possible place to locate a static pressure sensor is that where  $C_p$  changes are the smallest as the angle of attack varies. In other words, where  $|dC_p/d\alpha|$  is minimum. From your data, estimate the value of  $|dC_p/d\alpha|$  and plot it versus  $x/c$ , for both the centerline and off-centerline.

*Submit the 2-sided turn-in sheet provided for parts 1) and 2). If the plots are clearly incorrect, partial credit can be given only if you show your work (equations used, sample calculations, etc). Attach a separate sheet for part 3) and any additional work. Feel free to use any graphic software to create the plot in part 3), i.e., Excel.*

Centerline and off-centerline pressure measurement locations:

