MAE 253 – Experimental Aerodynamics I General Information and Lab 1 (Pressure Transducer Calibration)

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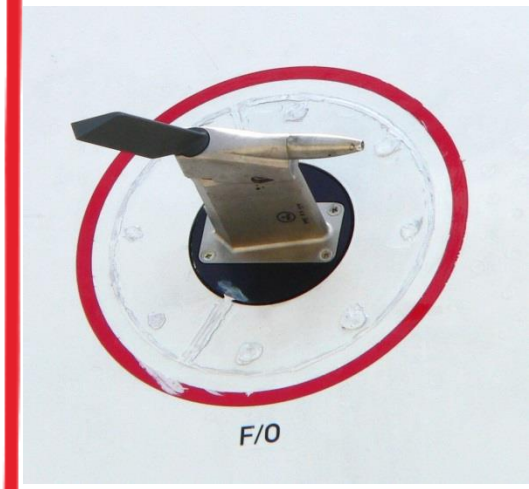


Outline

- General Information and Course Objectives
- Lab 1 - Objective
- Lab 1 – Theory
- Lab 1 - Expectations

General Information and Course Objectives

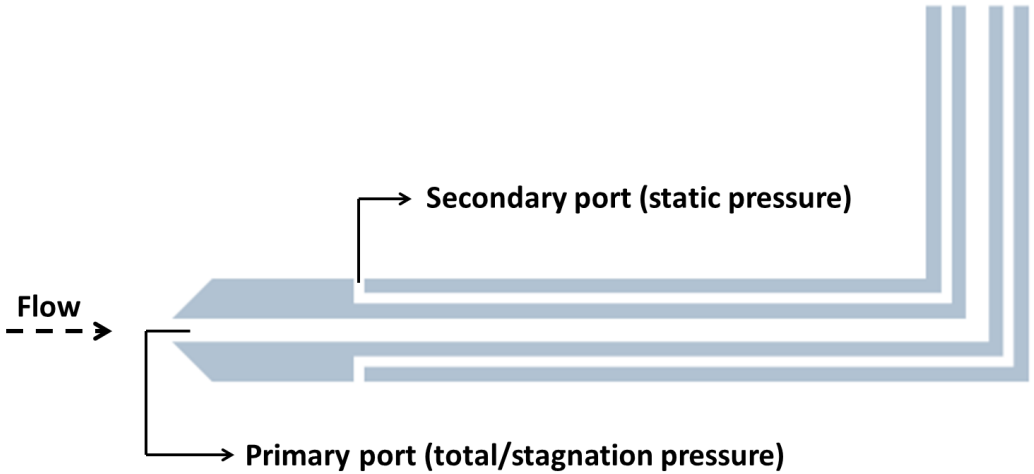
- Focus will be on optimized data acquisition and analysis techniques (LabView, Matlab, etc.).
- Lab reports in AIAA technical report format:
  - A short introduction will be required for each experiment.
  - Discuss the experimental setup, equations used to correct or reduce the data, and the steps taken to obtain your results in the methodology section.
  - A detailed discussion of the plots should be provided in the results section.
  - Codes (if any) can be provided in the appendix.
- 75% individual assignments and 25% group project work.
- Attendance is mandatory.
- BE SAFE!

Lab 1 - Objective

- A basic understanding of the subsonic wind tunnel instrumentation.
- Create a calibration curve for the Ashcroft® pressure transducer using the water manometer and pitot-static probe.
- Determine the pressure transducer calibration factors.

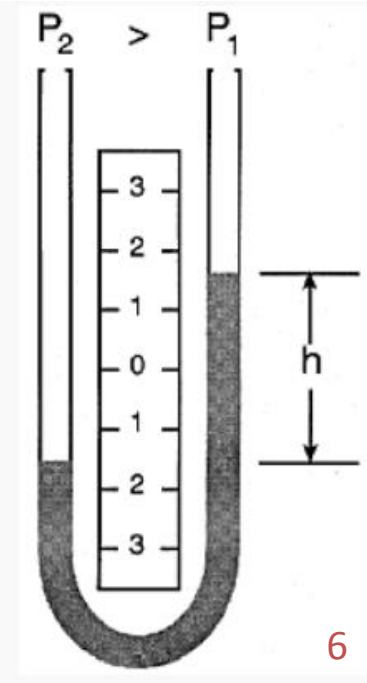
Lab 1 - Theory

- One of the important flow characteristic needed to determine the aerodynamics of a system is the airspeed.
- The pitot-static probe is the most commonly used instrument to measure fluid flow velocity.
- $P_{dynamic} = P_{total} - P_{static}$
- $U_\infty = \sqrt{\frac{2P_{dynamic}}{\rho}}$



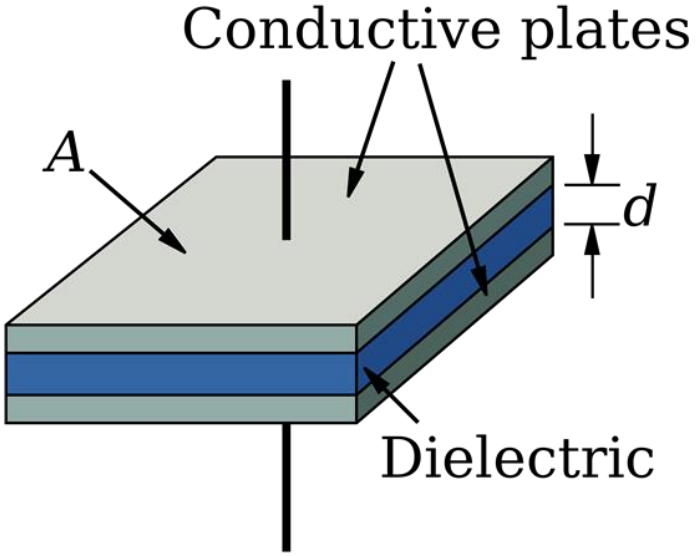
Lab 1 - Theory

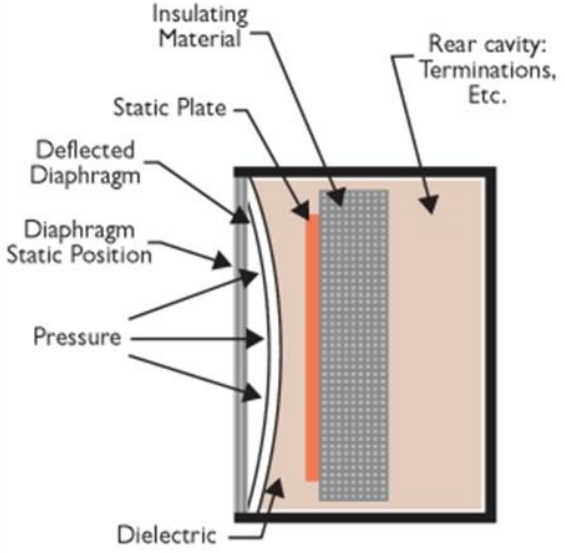
- One of the oldest and still existing pressure measurement systems is the manometer.
- The manometer has no moving parts and requires no calibration.
- The ports of the pitot-static probe are connected to the legs of the manometer.
- $\Delta P = P_{total\,(2)} - P_{static\,(1)} = \rho_{water} g h$



Lab 1 - Theory

- Due to the bulkiness of the manometer, a more realistic solution is needed to measure pressures on moving vehicles.
- One of the more common sensors are the capacitive pressure sensors.
- $C = \frac{\mu A}{d}$





Lab 1 – Expectations

- Create two calibration curves (increasing and decreasing velocities) for the Ashcroft® pressure sensor ($P_{manometer}$ vs. I_{sensor}).
- Data acquired:

$P_{transducer}$ (psf)	$h_{manometer}$ (inches)	I_{sensor} (mA)	$T_{transducer}$ (ºF)

- Create a linear fit through the data points and calculate the polynomial coefficients.
- Determine the hysteresis of the Ashcroft® pressure sensor.
- EXTRA CREDIT - Is the wind-tunnel pressure transducer calibrated correctly?