

ERCIYES UNIVERSITY FACULTY OF ENGINEERING
DEPARTMENT OF ENERGY SYSTEMS ENGINEERING



EXPERIMENT SHEET

EXPERIMENT TITLE

PRESSURE MEASUREMENT ON AN AIRFOIL

COURSE INSTRUCTOR

INSTRUCTOR CONDUCTING THE EXPERIMENT

EXPERIMENT

GROUP:

EXPERIMENT

DATE :

SUBMISSION

DATE :

1. PURPOSE OF THE EXPERIMENT: Investigation of the pressure distribution over an airfoil.

2. THEORY OF THE EXPERIMENT:

Pressure Measurement on an Airfoil

Pitot tubes and Pitot-static tubes are widely used for flow rate measurements. A Pitot tube consists of a tube with a pressure port at the stagnation point that measures stagnation pressure. A Pitot-static tube, on the other hand, features both a stagnation pressure port and multiple circumferential static pressure ports, measuring both static and stagnation pressures as shown Figure 1.

- a) The Pitot tube measures the stagnation pressure at the nose of the tube.
- b) The Pitot-static tube, on the other hand, measures both stagnation pressure and static pressure, and the flow velocity can be calculated from these values.

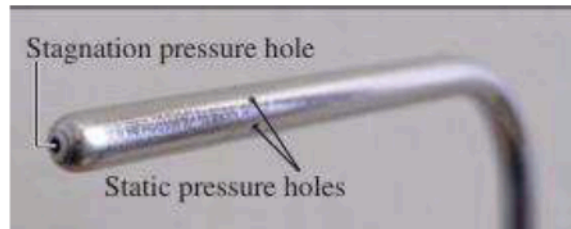


Figure 1. Close-up of a Pitot-static probe

In this experimental method, the pressure distribution over the airfoil is measured. The experimental setup consists of a manometer, a Pitot tube, and pressure taps. Density calculations were performed using actual pressure, humidity, and temperature data obtained from the Regional Directorate of Meteorology. A NACA2415 airfoil with a chord length of 18 cm, as shown in Figure 4, was used for the pressure coefficient measurement experiments.

Before conducting the pressure measurements, the Reynolds number for the experiment was determined, and the wind tunnel speed was set. The dynamic pressure equation (Equation 1) was utilized to adjust the tunnel speed.

$$\Delta P = \frac{1}{2} \rho v_{\infty}^2 \quad (1)$$

The pressure distribution around the airfoil is determined by measuring pressure differences at pressure taps and non-dimensionalizing them as shown in Equation 2; this dimensionless quantity is termed the pressure coefficient and is denoted by C_p . In this equation, P represents the static pressure at the measurement point on the airfoil, P_{∞} is the free-stream static pressure, V is the free-stream velocity, and ρ is the fluid density. The pressure coefficient is a significant parameter; it not only enables the determination of lift, drag, and moment coefficients but also allows for the identification

of the location of laminar separation bubbles, as well as separation and reattachment points on the airfoil surfaces.

$$C_p = \frac{p - p_\infty}{\frac{1}{2}\rho v_\infty^2} \quad (2)$$

The pressure distribution on the airfoil is given in Figure 2.

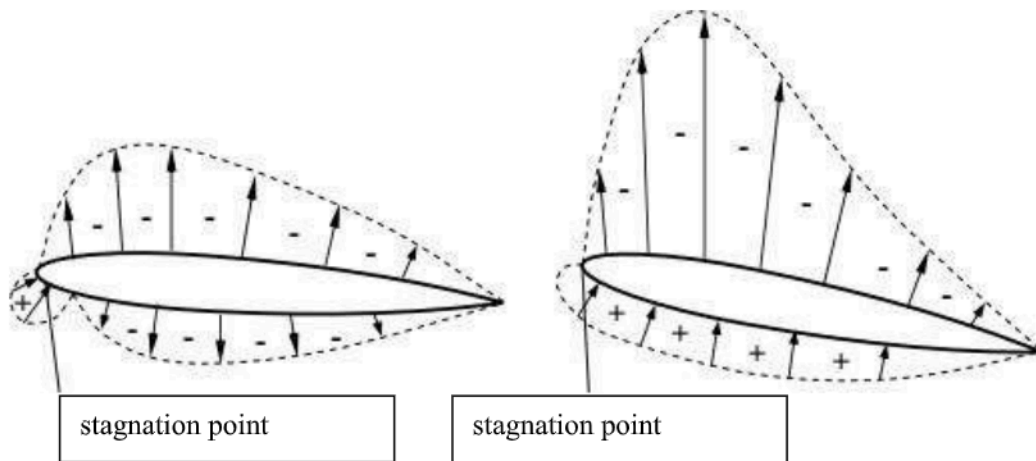


Figure 2. a) At low angles of attack b) At high angles of attack

The variation of the pressure distribution over the airfoil along the chord length is shown in Figure 3. Since the pressure in the upper region is lower than that in the free-stream region, it is represented as negative.

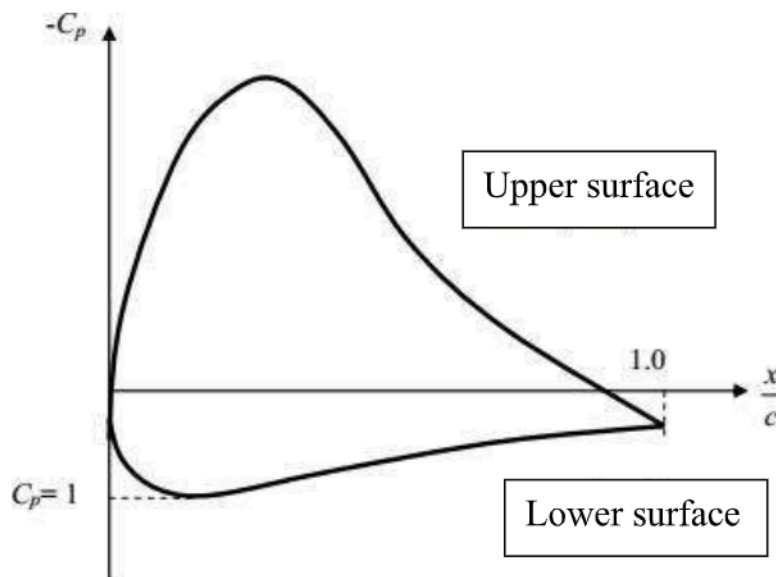


Figure 3. Variation of the pressure coefficient along the airfoil chord.

3. EXPERIMENTAL SETUP

The experimental setup is shown in Figure 4. Pressure measurements will be taken using pressure taps located on the upper and lower surfaces of the airfoil to determine the pressure

distribution across the wing. A Pitot tube and a manometer will be used for these measurements.

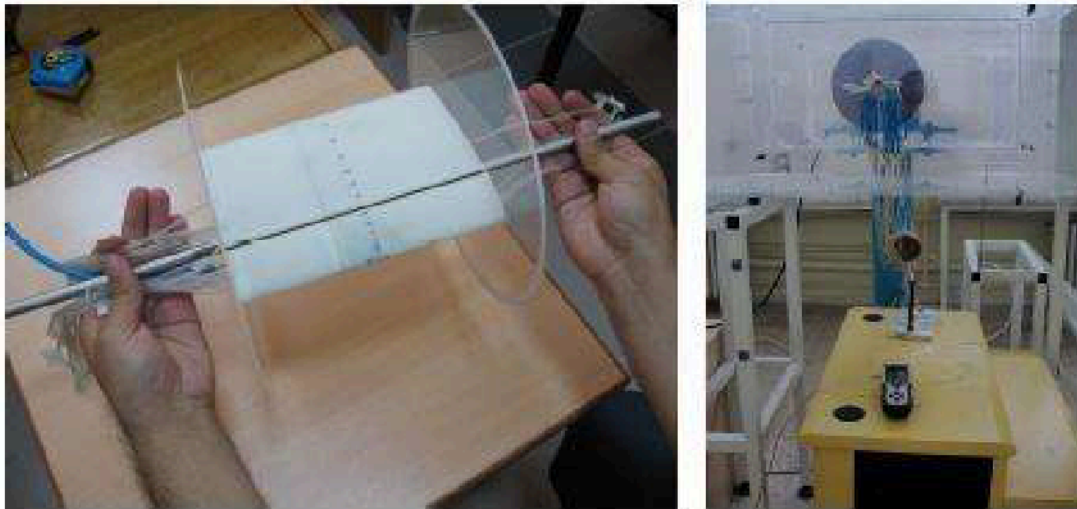


Figure 4. Experimental setup for pressure measurement.

4.RESULTS AND EVALUATION

After the measurements are obtained for each point, the pressure coefficient (C_P) will be calculated, and a graph of the variation will be plotted.

Measurement Point	ΔP
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	