# AE-345- Single-stage Compressor Experiment

## 1 Introduction

A single-stage compressor (SSC) operates by drawing in atmospheric air and compressing it to a higher pressure in one continuous process. This type of compressor is commonly used in various applications, from industrial machinery to jet engines. This experiment will give you insights into key performance metrics such as pressure ratio, efficiency, and power consumption in SSC.

## 2 Theory

An axial single-stage compressor operates on the principle of converting the kinetic energy of incoming air into increased pressure. In an axial compressor, the airflow is parallel to the axis of rotation, unlike in a centrifugal compressor where the airflow is radial.

### 2.1 Components

i. Rotors: These are rotating blades attached to a central shaft.
ii. Stators: These are stationary blades fixed to the compressor casing.

### 2.2 Working Principle

i. Air Intake: Air enters the compressor through an inlet.
ii. Rotors: The air first encounters the rotor blades, which are rotating. As the rotor blades move, they impart kinetic energy to the air, increasing its velocity.
iii. Stators: After passing through the rotors, the air enters the stator blades. The stator blades are designed to convert the increased kinetic energy (high velocity) of the air into pressure energy by decelerating the airflow. This process increases the air pressure.
iv. Outlet: The high-pressure air exits the compressor and can be directed to the next stage (if it's part of a multi-stage compressor) or to the combustion chamber (in the case of a gas turbine engine).

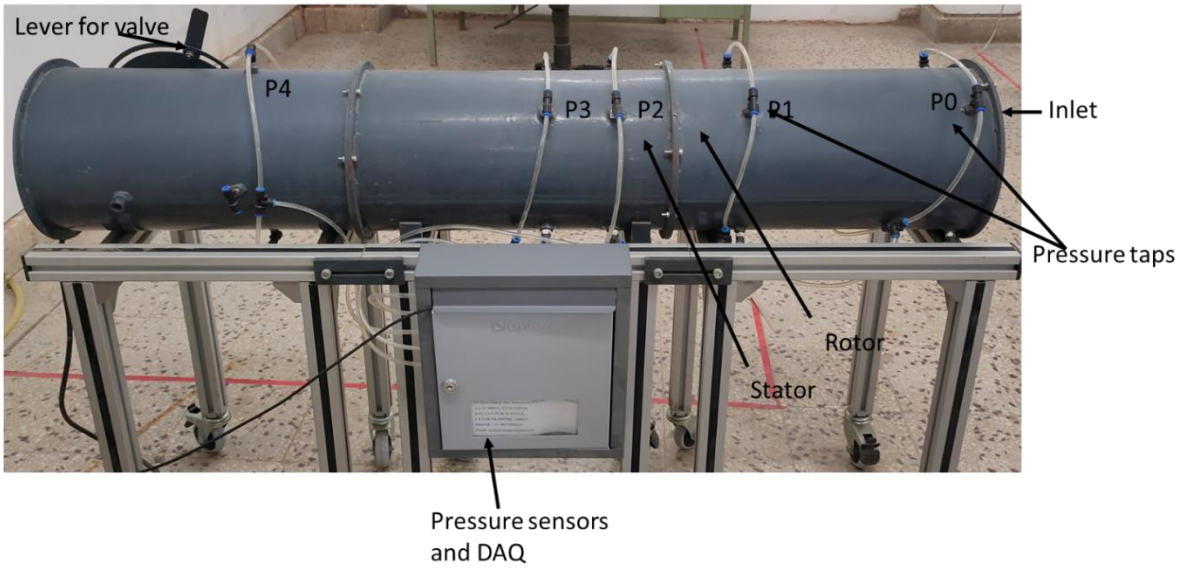
## 3 Apparatus:

i. Single stage compressor setup (stagger industries)
ii. Variable frequency drive (VFD – FRECON)
iii. Data acquisition system (DAQ)
iv. Data recording device and software (LabView)
v. Pressure sensors.

## 4 Experimental Setup

The following is the experimental setup of SSC.

Kindly note: A schematic of the setup must be included in the report




## 5 Procedure

i. Turn on the variable frequency drive (VFD)
ii. Set the desired frequency for the rotor on the VFD
iii. Ensure the valve at outlet is fully open for maximum mass flowrate
iv. Start the rotor and record pressure data at various locations
v. Change the exit area by slowly turning the lever and record the mass flowrate and corresponding pressure data
vi. Repeat the above steps at different RPMs
vii. Record all pressure data and mass flowrates for various frequencies

## 6 Observation Table

| SNo. | RPM | P0 | P1 | P2 | P3 | P4 | Mass flowrate |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## 7 Results & Discussions

i. Plot all pressure versus mass flowrate at different RPMs
ii. Calculate the pressure ratio and plot with mass flow rate at each RPM.
iii. Discuss your observations and results.

## 8 References


- *Roy Bhaskar, Aircraft Propulsion, 2008, Elsevier (India)*
- *El-Sayed Ahmed, Aircraft Propulsion and gas Turbine Engines, 2008, Taylor and Francis (CRC press).*