Department of Aeronautical Engg.

Indian Institute of Technology, Kanpur

AE342 PROPULSTION – II Experiment No.

PERFORMANCE OF AXIAL FLOW COMPRESSOR

DESCRIPTION :-

The axial compressor test is basically made of two stage axial compressor directly coupled to a truncheon mounted multispeed electric motor. The stators are movable to allow transverse movement along the circumference of the blading.

The motor is mounted on ball bearing, with minimum friction, and is precision aligned with compressor shaft. A flexiable coupling connects motor and the compressor and takes care of minute misalignment. The two axial rotor stages are overhung on the shaft which is mounted on the case through ball bearings. The second stage stator can be rotated by turning the large knurled knob at front of compressor casing. A similar knob at the back of casing rotates first stage rotor. The rotation of stators allow a full length traversing along the periphery of the blading when the knob is rotated several turns from stop to stop. Numerous tap holes are put all along the flow path from inlet to measuring section, and they allow flow and pressure measurements.

The flow through the compressor and discharge pressure can be varied by closing or opening a butterfly valve, at the end of piping. The value is remotely controlled from main panel with a crank mechanism.

The venture measuring section has 8.5 in. throat and 15 in. trunk diameters. The transition section bring the flow from 16.5 in diameter to 14 in.

The speed is measured with a tachometer. The torque is measured with a torque sensor. The temperature is measured with a sealed thermometer. A number of precision pressure sensors can be connected to the desired taps.

**PROCEDURE :**

Set the flow control valve at the discharge pipe to a mid open position. Make sure that the speed selector switch is never left in an intermediated position, between markings 1,2,3 or 4 when changing the speed go directly from 1 to 2, 2 to 3, 3 to 4, 3 to 2, etc. Torque is measured by type 4520A Kistler torque sensors. Pressure sensors by taking taps from the holes of their sections.

Keep the butterfly valve fully open for the first set of readings. Take another two sets of readings for three different positions of the butterfly valve. Take the readings for all the four compressor speeds when the butterfly valve is at particular setting.

Following reading should be noted

1. Pressure difference across the venture.

2. Static pressure rise across the compressor.

3. Compressor r.p.m. and room temperature.

4. Torque using torque sensor.

**SAMPLE CALCULATION**

1. Discharge is obtained by using relation

Q = 0.283.Cd.A2 m3 /s

D2 = 8.5 in D1 = 14 in

A2 = x ft2 , Cd = 0.99

= density of air at room temperature in lbs /ft3

= ((bs /ft3 )

Tk = Ambient temp = (F-32) 5/9 + 273

Where F = Temp in F.

P1 – P2 = 5.2 x h1

h1 = manometer reading across venture in inches of water.

(2) Power = 4.26 x 10-4 x T1  x N KW.

N = RPM

Where T1  is the reading of dynomometer (small no. of parts)

(3) Velocity

V1 = Q/A1  in m/s

(4) Static pressure

Pst = (2 x 0.2627 + Patm ) KN/m2

Where 2 is the pressure difference in inches of water across Dwyer flex tube manometer

Patm = 101.3 KN/m2

Pst = Pst - Patm

(5) Stagnation pressure

Pstage = Pst + x 10-3 ) KN/m2 ,

Pstage = Pstage  - Patm

**RESULTS & DISCUSSION :**

1. Plot discharge Vs r.p.m. for different throttle setting.

2. Plot pressure rise vs r.p.m. for different throttle setting.

3. Power vs r.p.m. at full throttle.

1. Briefly discuss the nature of curves obtained. How do you think the volume flow rate, pressure ratio and power required should vary with r.p.m. of a fan ?

2. What are the various non-dimensional groups of parameters used to describe the performance of a compressor blade row ? Observe blade shape and compare this with regular compressor blades.

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| INPUT  Pressure Range | 0.35 0.7 1.0 BAR  5 10 15 PSI |
| Operational Mode | Absolute Gage, Sealed Gage, Differential |
| Maximum Electrical Excitation | 12 VDC/AC |
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* Measuring ranges from 1…..1 000 N-m
* Speed up to 10 000 1/min
* High frequency response
* Maintenance-free thanks to contactfree signal transmission
* Shaft end
* Integral speed measurement

**Description**

The robust Type 4520A…. for measuring torque on rotating shafts offers particularly good value for money and is recommended primarily as an entry-level solution for torque measurement. Frequency modulation is used to transmit the torque signal from the rotating shaft without contact and convert it into an analog signal. The speed signal at 60 pulses/rev. is available as TTL signal level. An external electrical control input is provided as standard.

**Applications**

Type 4520A…. is suitable for static and dynamic measurement of torques in assembly and for quality control in production and the laboratory.

**Technical Data**

Measuring range N-m 1 …… 1 00000