

EFFECT OF PARTIAL ADMISSION ON THE PERFORMANCE OF A CENTRIFUGAL BLOWER

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CERTIFICATE

This is to certify that the thesis entitled
'EFFECT OF PARTIAL ADMISSION ON THE PERFORMANCE OF A
CENTRIFUGAL BLOWER' by Syed Zahier Haider has been prepared
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regulations of the Indian Institute of Technology, Delhi.
I further certify that the thesis has attained a standard
required for a Ph.D. degree of the institute. The results
contained in this thesis have not been submitted, in part
or full, to any other university for any degree or diploma.

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The aim of the present investigation is to study the effect of partial admission on the performance of a centrifugal blower.

The review of literature revealed that axial width (or b/D) of the centrifugal impeller had significant effect on the performance of the machine. The impeller characteristics considerably drop down with the reduction in axial width of the impeller, leading to excessive losses. Conditions can be improved by increasing its width and correspondingly blocking a fraction of the flow passage in the peripheral direction.

A test rig consisting mainly of centrifugal blower, inlet duct, with a mechanism to hold the blanking arc in any peripheral position and the discharge duct with flow measuring device were designed and fabricated. The blanking arc rotation mechanism has a provision to mount a 3-hole probe to measure the entry flow field at the mid height of the blower.

Experimental programme was concerned with the data collection in terms of total and static pressures in inlet and discharge ducts, static pressure distribution at the suction-side side wall and around the centre line of the volute casing. Pull at the dynamometer balance, temperatures at entry and

exit, pressure difference across flow measuring device and speed was also recorded. For some configurations, at entry to the blower, velocity and total pressure was also recorded. Calculations of pressure ratio, non dimensional mass flow rate, average flow coefficient, power absorbed, isentropic and over-all efficiencies speed parameter and pressure rise across the stage were made. Matching loss and suction chamber loss at design point were also calculated.

Blower F ($b/D = 0.1052$) designed for 100 percent entry was tested at five speeds (1850 to 3100). Five other blowers (b/D varying from 0.1259 to 0.2105) each designed for a particular degree of admission (50 percent to 83.33 percent) were tested with five degrees of admission (varying from 50 percent to 100 percent), one combination of ($b/D, \epsilon$) corresponded to the design point. Each combination of b/D and ϵ was tested for five speeds.

In blower A ($b/D = 0.2105$) blanking arc position was also changed in steps of 60° for $\epsilon = 50$ percent, 66.67 percent and 83.33 percent. In other blowers blanking arc position was changed in steps of 60° for the design combination of $b/D, \epsilon$ only. The other arcs were placed in the optimum position determined on the basis of earlier investigations.

The data obtained from the tests were analysed and presented in graphical form. The overall efficiency of all the blowers with design degree of admission was higher than the full admission blower ($b/D = 0.1052$, $\epsilon = 100$ percent).

The efficiency gradually increases with increase in b/D value and decrease in degree of admission (ϵ).

Relative position of the blanking arc with respect to the discharge point had a strong influence on the performance of the test blowers.

All blowers with partial admissions were under unstable operation at low mass flow rate and a periodic repetition of sound could be heard, interspersed with in essentially steady state operations conditions.

With design values of (b/D , ϵ) the matching losses increased with increase ϵ and decrease in b/D . However the suction chamber loss showed the reverse trend.

For a given pressure rise flow coefficient characteristics of a blower with $\epsilon = 100$ percent and inlet velocity and total pressure profiles the pressure rise at the average flow coefficient, was found using parallel compressor theory. This was compared with experiments.

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