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Power Jets Memorandum No. M. 1201

Calculated performance curves for three axial flow compressors
with low, medium and high stagger blades

- by -

Marjorie Mettam,

Ref: PVE/1301-40/MA/MS.

April, 1946.

Summary.

In the absence of complete test characteristics for axial compressors with low, medium and high stagger bladings, estimates of performance have been made for three typical compressors, and the results obtained are given in this memorandum. Though the results are only strictly applicable to the compressors that were designed, they probably show the changes that may be generally expected between compressor blades of various staggers. The slope of the pressure ratio curves become steeper and the value of the efficiency falls more rapidly away from the design speed with an increase in stagger. The maximum efficiency, however, is further away from the surge point at the higher staggers.

1.0 Introduction

In the past, in this country, compressors have been mostly designed with low stagger blades, while in America and on the Continent high stagger blades have generally been used. A fair amount of test data is available here on low stagger blading, but as yet no corresponding complete characteristics were available on blading with high stagger. So that, this theoretical investigation was carried out in order to provide typical but comparable performance curves for low, medium and high stagger compressors.

To make the results directly comparable, all the compressors have the same overall temperature rise at the design point and the same mass flow.

A diffusion loss of total head has been assumed in the calculations, so that pressure ratios and efficiencies may be taken to be those at entrance to the combustion chambers.

2.0 The design of the compressors.

Each compressor has been designed to have a mass flow of 50 lbs/sec. and a temperature rise of 166°C in eight stages. This gives a pressure ratio in each case of slightly over 4 : 1.

The design air outlet angles (α_2^M) for the blades of the low, medium and high stagger compressors were chosen to be 15° , 30° and 45° respectively at mean diameter. These gave staggers of -20.6° , -34.2° and -47.5° at mean diameter. The blades are constant reaction and have parabolic arc cambers.

The design r.p.m. (N) for the low, medium and high stagger compressors are 6,400, 9,400 and 10,300 respectively.

3.0 The performance calculations

In general, the performance calculations have been carried out by similar methods to those given in ref. 1.

A diffuser efficiency of 80% was assumed. This corresponds to a loss of 20% of the outlet dynamic head in the diffuser pipe, which is the minimum probable loss between the compressors and their combustion chambers.

The curves obtained are plotted in Fig. 1.

4.0 Conclusions

The curves of Fig. 1 show typical performance curves for low, medium and high stagger compressors. Though only strictly applicable to the compressors that were designed, they probably show the changes that may be generally expected between compressor blades of various staggers. The slope of the pressure ratio curves becomes steeper and the value of the efficiency falls more rapidly away from the design speed with an increase in stagger. The maximum efficiency, however, is further away from the surge point at the higher staggers.

List of Figures

Figure 1. SK. 1642 Performance curves for low, medium and high stagger compressors.

References.

<u>No.</u>	<u>Author.</u>	<u>Title etc.</u>
1	A. R. Howell	The present basis of axial flow compressor design. Part II. R.A.E. Report No.E.3961. (1942)

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