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RM No. E7G03a

RESEARCH MEMORANDUM

for the

Air Materiel Command, Army Air Forces

PERFORMANCE OF COMPRESSOR OF XJ-41-V TURBOJET ENGINE

III - Compressor Static-Pressure Rise at Equivalent Compressor Speeds of 5000, 7000, 8000, and 9000 rpm

By John W. R. Creagh and Ambrose Ginsburg

Flight Propulsion Research Laboratory
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PERFORMANCE OF COMPRESSOR OF XJ-41-V TURBOJET ENGINE

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INTRODUCTION

At the request of the Air Materiel Command, Army Air Forces, an investigation is being conducted at the NACA Cleveland laboratory to determine the performance characteristics of the XJ-41-V turbojet-engine compressor.

The static-pressure variation in the direction of flow through the compressor was presented in reference 1 for an equivalent speed of 8000 rpm. An analysis of these pressures indicated that the maximum-flow limitation of the compressor was caused by separation, which reduced the effective flow area at the vaned-collector entrance.

As a result of this analysis, the flow area at the vaned-collector entrance was increased to obtain larger mass flows. The area increase was obtained by cutting back the entrance edges of the collector vanes, which resulted in an increased vaneless-diffuser radius. Comparative performance of the original and revised compressors at an equivalent speed of 8000 rpm is presented. The static-pressure rise through the compressor, determined from static pressures at the impeller entrance and the vaned-collector exit, is also presented together with the compressor adiabatic efficiency and the mass flow over an equivalent speed range from 5000 to 9000 rpm. These static-pressure data are presented for the purpose of correlating the compressor performance with the turbojet-engine performance.

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INSTRUMENTATION AND METHODS

The compressor installation, instrumentation, and test procedure are the same as described in reference 2, except at an engine speed of 5000 rpm. At the equivalent speed of 5000 rpm, a constant exit total pressure of 33 inches of mercury absolute was maintained. An entrance total pressure of 14 inches of mercury absolute was not used for this speed because of possible adverse pressure differentials being imposed upon the impeller casing.

The adiabatic efficiencies presented are based upon total pressures and temperatures in the simulated burner annulus.

RESULTS AND DISCUSSION

The compressor adiabatic efficiency η_{ad} and the corrected mass flow at an equivalent compressor speed of 8000 rpm for the original and revised compressors are presented in figure 1. Increasing the geometric flow area at the entrance to the collector vanes resulted in a 25-percent increase of maximum mass flow, increased peak adiabatic efficiency from 0.787 to 0.805, and shifted the peak efficiency point from a mass flow of 36.75 pounds per second to 43.02 pounds per second.

The static-pressure rise through the compressor is presented as a ratio of the static pressure at the vaned-collector exit to the static pressure at the entrance to the impeller. The exit static pressures used are an arithmetic average of the pressures measured on the inner and outer walls at stations G through L, as described and located in reference 1. The entrance static pressure used was measured at station 1 (described and located in reference 1). Figure 2 shows the compressor static-pressure ratios for equivalent impeller speeds of 5000, 7000, 8000, and 9000 rpm plotted against corrected mass flow with curves of compressor adiabatic efficiency superimposed.

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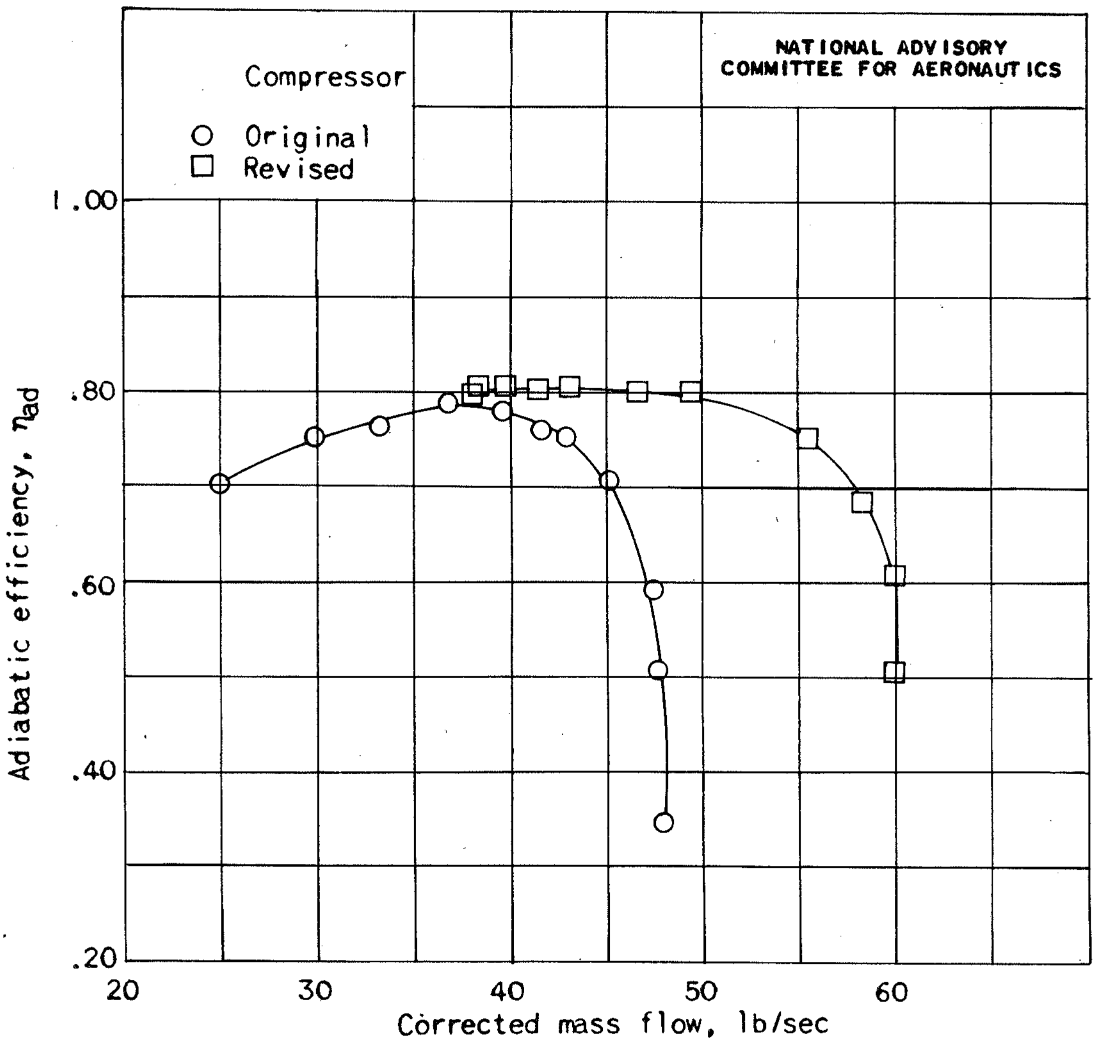

Figure 1. - Compressor performance for original and revised compressors at equivalent speed of 8000 rpm.

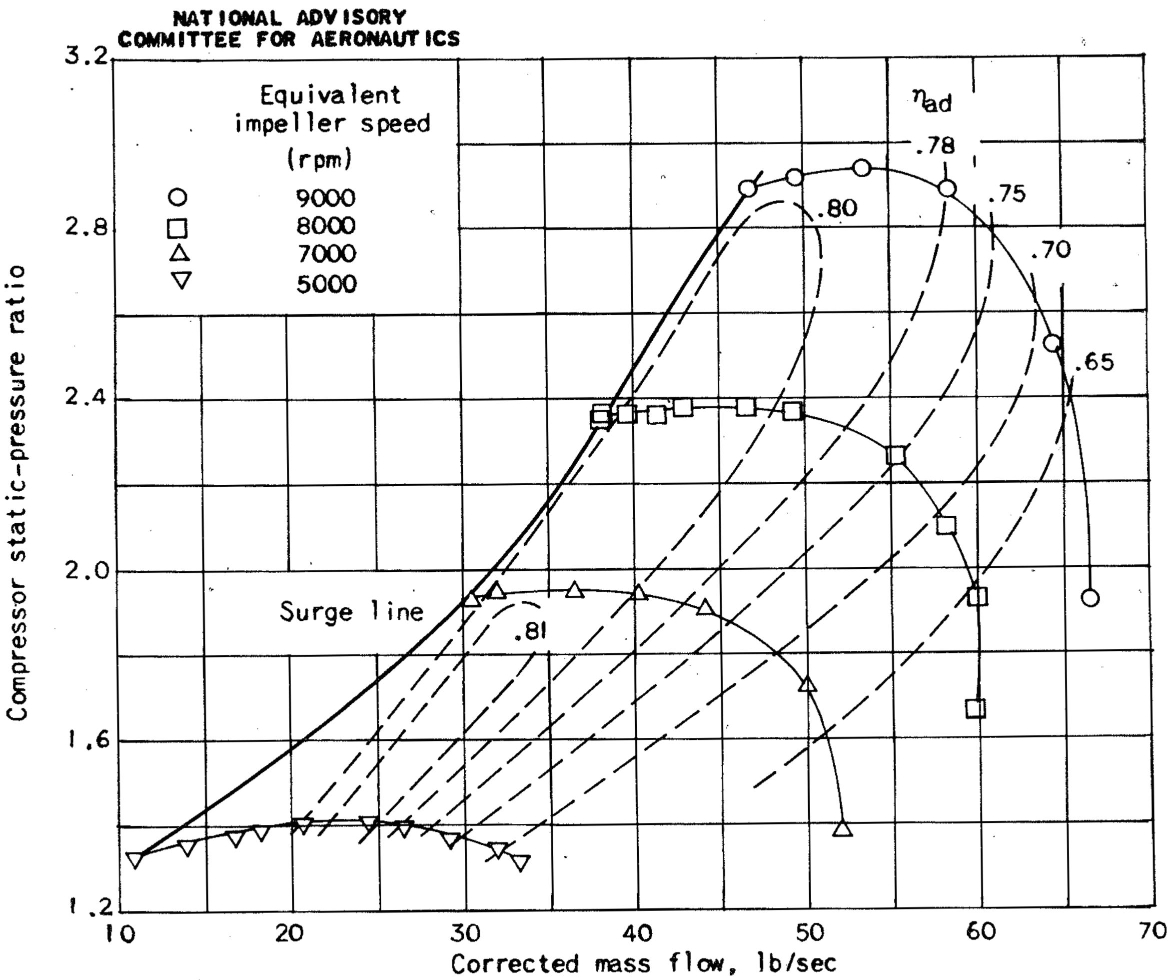

Figure 2. - Compressor performance characteristics.

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