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RESEARCH MEMORANDUM

for the

Air Materiel Command, U. S. Air Force

PERFORMANCE OF J33-A-27 TURBOJET-ENGINE COMPRESSOR

II - OVER-ALL PERFORMANCE CHARACTERISTICS OF MODIFIED COMPRESSOR AT EQUIVALENT IMPELLER SPEEDS FROM 6100 TO 13,250 RPM

By William L. Beede and Ambrose Ginsburg

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SUMMARY

A modified J33-A-27 compressor was operated over a range of equivalent impeller speeds from 6100 to 13,250 rpm in order to obtain the over-all compressor performance.

At the equivalent design speed of 11,800 rpm, the maximum efficiency of 0.764 and peak pressure ratio of 4.56 occurred at an equivalent weight flow of 104.07 pounds per second. At the highest equivalent speed (13,250 rpm) a maximum efficiency of 0.711, a maximum equivalent weight flow of 123.00 pounds per second, and a peak pressure ratio of 5.76 were obtained.

INTRODUCTION

An investigation to determine the performance characteristics of a series of J33 turbojet-engine compressors is being conducted at the NACA Lewis laboratory at the request of the Air Materiel Command, U. S. Air Force. The J33-A-27 compressor was modified in order to obtain improved matching between the compressor and turbine of the engine. The over-all performance characteristics of this modified compressor are herein presented. Initial runs were made over a range of equivalent impeller speeds from 6100 to 11,800 rpm (design speed), ambient inlet air temperature, and inlet pressure of 14 inches of mercury absolute. In order to determine

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the compressor performance at overspeed operation, additional runs were made at equivalent impeller speeds of 12,600 and 13,250 rpm, inlet air temperature of -55° F, and an inlet pressure of 10 inches of mercury absolute.

APPARATUS AND INSTRUMENTATION

The J33-A-27 compressor described in reference 1 was modified to obtain better matching between the compressor and turbine components of the engine. The diffuser inlet vanes were altered in order to shift the compressor operating curves to lower weight flows, which would tend to improve the engine acceleration characteristics. The compressor inlet was also altered by the removal of the splitter vanes and the extension of the impeller casing in an axial direction for approximately one inch upstream of the impeller.

The instrumentation is the same as that in reference 2 with the exception that nonadjustable flat-plate submerged orifices were used to measure the compressor air weight flows.

SYMBOLS

The following symbols are used in this report:

N actual impeller rotative speed, rpm

P_1 inlet total pressure, inches mercury absolute

P_2 outlet total pressure, inches mercury absolute

Q actual air volume flow, cubic feet per second

W actual air weight flow, pounds per second

δ ratio of inlet total pressure to NACA standard sea-level pressure

η_{ad} adiabatic temperature-rise efficiency

θ ratio of inlet total temperature to NACA standard sea-level temperature

PROCEDURE

Initial runs were made over a range of equivalent impeller speeds from 6100 to 11,800 rpm, with ambient inlet air temperature and an inlet pressure of 14 inches of mercury absolute. To determine the effect of overspeed operation, additional runs were made at equivalent impeller speeds of 12,600 and 13,250 rpm. Because the maximum allowable actual impeller speed was 12,000 rpm, runs at equivalent impeller speeds of 12,600 and 13,250 rpm were made at an inlet air temperature of -55° F. Because of the limited quantity of refrigerated air available, the inlet pressure was reduced from 14 to 10 inches of mercury absolute. The reduced inlet temperature and reduced inlet pressure used in the two highest speed runs would be expected to show efficiencies slightly lower in comparison with the lower speed runs of this investigation (see reference 2). All runs were made from choked weight flow to that of incipient surge.

RESULTS AND DISCUSSION

The performance of the modified J33-A-27 compressor is shown in figure 1. The peak adiabatic temperature-rise efficiency of 0.784 occurred at an equivalent impeller speed of 7000 rpm. At the equivalent design speed of 11,800 rpm the maximum efficiency, the peak pressure ratio, and surge occurred simultaneously at an equivalent weight flow of 104.07 pounds per second. The maximum efficiency was 0.764 and the peak pressure ratio was 4.56. The maximum equivalent weight flow at this speed was 110.70 pounds per second.

At the highest equivalent speed (13,250 rpm), the maximum efficiency of 0.711 and the peak pressure ratio of 5.76 occurred at an equivalent weight flow of 118.32 pounds per second. The maximum equivalent weight flow at this speed was 123.00 pounds per second.

SUMMARY OF RESULTS

The following results were obtained from the over-all performance investigation of the modified J33-A-27 compressor:

1. At the equivalent design speed of 11,800 rpm, the maximum efficiency of 0.764 and the peak pressure ratio of 4.56 occurred at an equivalent weight flow of 104.07 pounds per second. The maximum equivalent weight flow at this speed was 110.70 pounds per second.

2. At the highest equivalent speed (13,250 rpm), a maximum efficiency of 0.711, a maximum equivalent weight flow of 123.00 pounds per second, and a peak pressure ratio of 5.76 were obtained.

Lewis Flight Propulsion Laboratory,
National Advisory Committee for Aeronautics,
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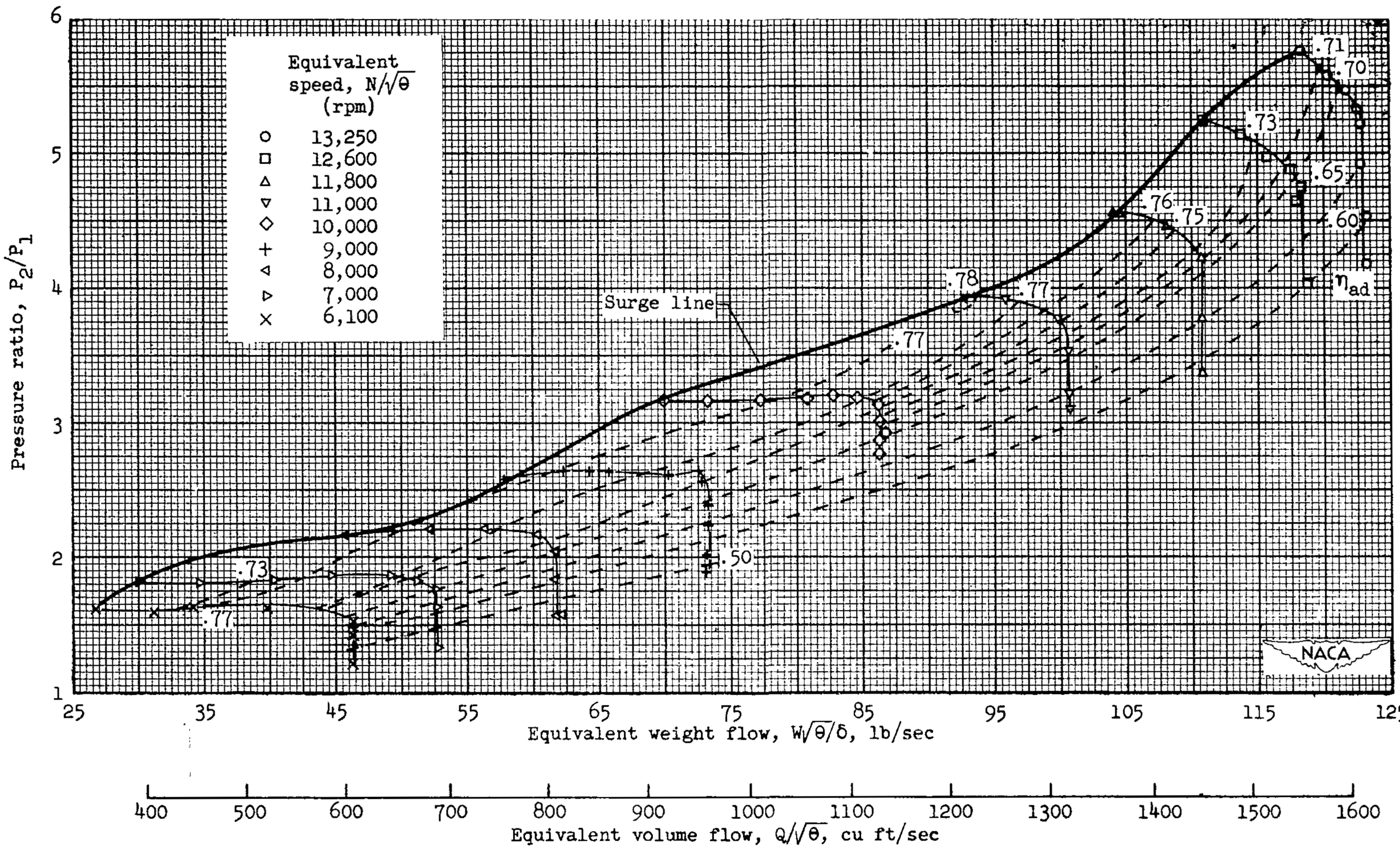
REFERENCES

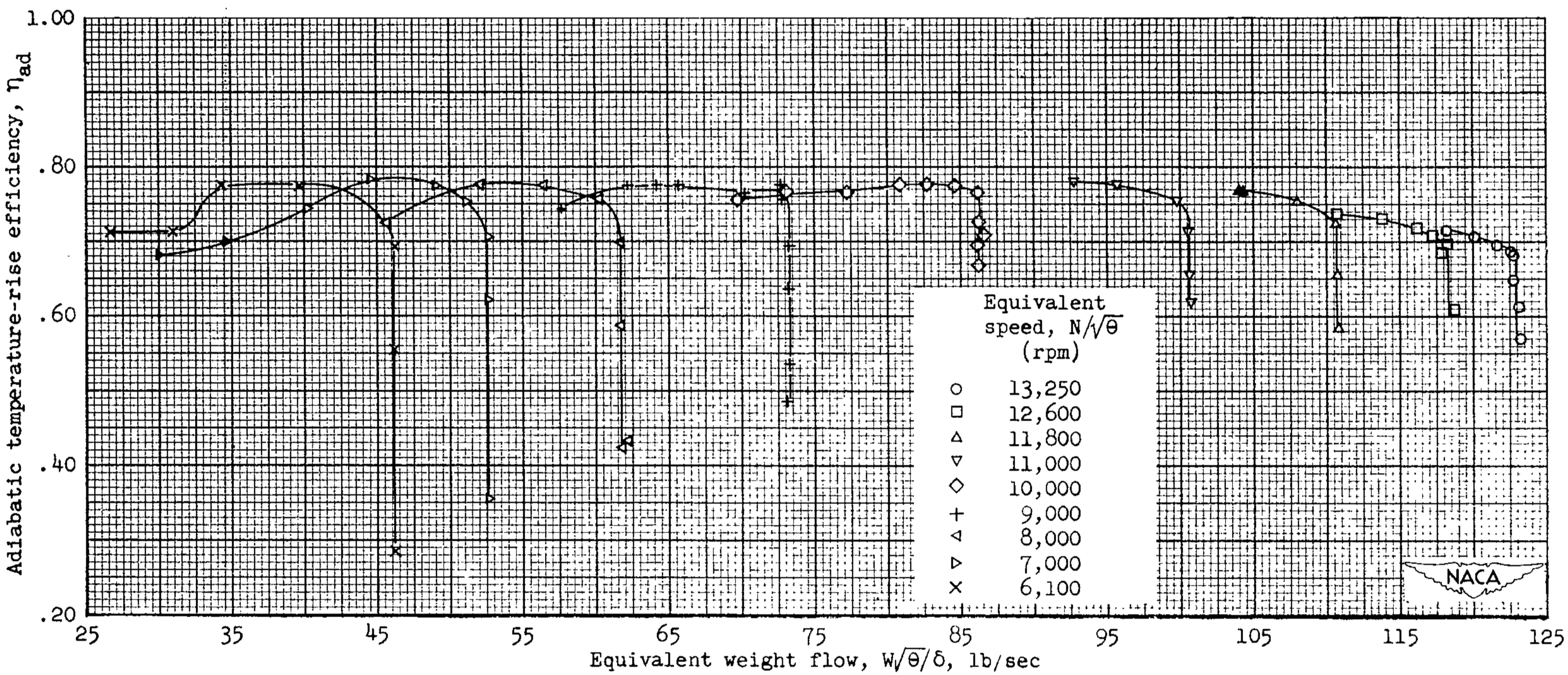
1. Kovach, Karl, and Osborn, Walter M.: Performance of J33-A-27 Turbojet-Engine Compressor. I - Over-All Performance Characteristics at Equivalent Impeller Speeds from 6100 to 11,800 rpm. NACA RM SE9F30, U. S. Air Force, 1949.

2. Beede, William L., Kovach, Karl, and Creagh, John W. R.: Performance of J-33-A-21 Turbojet-Engine Compressor. I - Over-All Performance Characteristics at Equivalent Impeller Speeds from 6000 to 13,400 rpm. NACA RM SE8C15, U. S. Air Force, 1948.



(a) Pressure ratio.

Figure 1. - Performance of modified J33-A-27 compressor.



(b) Adiabatic temperature-rise efficiency.

Figure 1. - Concluded. Performance of modified J33-A-27 compressor.