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RESEARCH MEMORANDUM

PERFORMANCE OF BASIC XJ79-GE-1 TURBOJET ENGINE AND ITS COMPONENTS

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NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

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PERFORMANCE OF BASIC XJ79-GE-1 TURBOJET ENGINE AND ITS COMPONENTS

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SUMMARY

An investigation to determine the performance of the XJ79-GE-1 turbojet engine and its components, while operating as integral parts of the engine, was conducted in an altitude test chamber at the NACA Lewis laboratory. Data were obtained over a range of Reynolds number indices from 0.60 to 0.08 and for various settings of the variable compressor stators and variable-area exhaust nozzle from fully open to fully closed positions.

Compressor performance and turbine performance are presented in the form of performance maps at selected values of Reynolds number index; the effects of Reynolds number on performance are summarized. The effects of variable stator angle and high inlet-air temperatures on compressor performance are also shown. Combustor performance is given in generalized form as a function of the usual combustor parameters. Exhaust system data are presented to permit the calculation of over-all engine performance from pumping characteristics. Maps of engine pumping characteristics are presented at selected values of Reynolds number index, and the general effect of Reynolds number on the pumping characteristics is summarized. Over-all engine performance (net thrust and specific fuel consumption) is presented for a flight Mach number of 0.9 at rated engine conditions over a range of altitudes to illustrate performance losses resulting from decreased Reynolds number index. All component and engine performance data are presented in tabular as well as graphical form.

INTRODUCTION

An investigation to determine the performance of the XJ79-GE-1 turbojet engine and its components while operating as integral parts of the engine was conducted over a range of Reynolds number indices in an altitude test chamber at the NACA Lewis laboratory. This engine incorporates variable inlet-guide vanes and variable stator vanes in the first six compressor stages as a means of avoiding part-speed surge. The engine also has an afterburner and iris-type variable primary and secondary

exhaust nozzles; however, during the investigation reported herein, the afterburner was inoperative and the secondary nozzle was removed. The variable-stator system and the variable exhaust nozzle are normally scheduled automatically by a combination electronic and hydraulic control, but they were manually positioned during this investigation.

The performance data were obtained over a range of Reynolds number indices from 0.60 to 0.08 with the variable stators in the open position and over a range of stator positions from 0° to 35° at a Reynolds number index of 0.20. At each Reynolds number index and stator position, data were obtained over a range of engine speeds at five exhaust-nozzle areas. Data were obtained at engine inlet temperatures up to 700° R, but the bulk of the data was obtained at an inlet temperature of approximately 416° R.

Component performance data are presented over a range of Reynolds number indices and variable stator positions. Generalized engine data are presented in a form that permits computation of engine performance at operating conditions other than those specifically investigated, and the method of such computation is illustrated. All component and engine performance data obtained during this investigation are presented in tabular as well as graphical form.

APPARATUS

Engine

The XJ79-GE-1 turbojet engine has a length of 207 inches and a maximum diameter of 32.6 inches at the turbine section. The frontal area based on the compressor tip diameter is 4.89 square feet. The dry weight of the engine and its accessories is about 3150 pounds. The manufacturer's static sea-level military performance rating (nonafterburning) is 9600 pounds of thrust with a specific fuel consumption of 0.87 pound per hour per pound of thrust at an engine speed of 7460 rpm and a turbine-outlet temperature of 1070° F.

The XJ79-GE-1 turbojet engine has several minor airflow bleeds that are used for cabin pressurization, anti-icing, turbine cooling, and bearing-seal pressurization. These bleed flows are extracted from the main engine airflow at the seventh and ninth compressor stages and at the seventeenth compressor-stage seal. The amount of bleed flows dumped overboard during this investigation did not exceed approximately 1.5 percent of the inlet airflow; the remainder of the bleed flows reentered the main stream before reaching the afterburner diffuser section.

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Engine Components

Compressor. - The seventeen-stage axial-flow compressor has variable inlet guide vanes and variable stator blades in the first six stages that are moved simultaneously from the open position to their respective closed positions. The angle of travel from open to closed for the variour stages is as follows: inlet guide vanes, 47°; first stator stage, 44°; second through fifth stages, 35°; and sixth stage, 41°. All references to stator position throughout the report will be in terms of the second through fifth stages as a matter of convenience; that is, the closed position will be referred to as 35°. The compressor has a constant tip diameter of 29.95 inches through the first fourteen stages and tapers down to a tip diameter of 29.3 inches at the seventeenth stage. The hub-tip radius ratios of the first, fourteenth, and seventeenth stages are 0.36, 0.86, and 0.88, respectively. The compressor was designed to deliver an airflow of 162 pounds per second and a total-pressure ratio of 12.2 at static sea-level military conditions.

Combustor. - The combustor is a cannular type with ten circular through-flow inner liners. Fuel is supplied to each liner through a single-inlet duplex fuel nozzle. Ignition is provided by a spark plug in one of the inner liners and spreads to the other liners through interconnecting crossfire tubes. The combustor-inlet reference velocity, based on the full burner section area of 4.33 square feet, is approximately 89 feet per second at design sea-level conditions.

Turbine. - The three-stage impulse-type turbine has a constant pitch-line diameter on all three stages and tip diameters of 28.4, 29.65, and 31.05 inches for the first, second, and third stages, respectively. The hub-tip radius ratios of the first, second, and third stages are 0.81, 0.70, and 0.59, respectively. The increase in annular area through the turbine occurs entirely in the turbine nozzles. The turbine was designed to operate at a turbine-inlet temperature of 1700° F at 7460 rpm. Damping rods are installed between adjacent third-stage rotor blades to reduce blade vibration. These rods are 3/16 inch in diameter and are situated at approximately 75 percent of the blade height.

Control and exhaust system. - The engine control schedules the variable-stator assembly to vary continuously as a function of corrected engine speed from the closed position (35°) at 64 percent of rated corrected speed to the open position (0°) at 90 percent of rated corrected speed (fig. 1). During the investigation, the original schedule was altered as shown by the dashed line of figure 1 to achieve a higher thrust during operation at a high engine-inlet temperature corresponding to a flight Mach number of 2.0. The primary exhaust nozzle, which is a convergent, variable-area iris-type nozzle, is scheduled to vary in gradual steps from an open position at idle conditions to a closed

position at military position of the power lever. During this investigation, however, the variable-stator assembly and the exhaust nozzle were manually controlled. The afterburner, which was inoperative during this investigation, has a maximum internal diameter of about 34 inches and includes a diffuser, fuel-injection bars, a pilot burner, a three-ring gutter-type flameholder, and a corrugated and louvered cooling liner. The variable secondary exhaust nozzle was removed during this investigation.

Installation

A view of the XJ79-GE-1 turbojet engine installed in the altitude test chamber is shown in figure 2. The engine was rigidly mounted on a flexure-plate supported test platform that was connected by a linkage to a calibrated null-type thrust cell. Dry refrigerated or heated air entered the engine inlet through a bellmouth Venturi duct, which was mounted to the engine inlet and test platform. The inlet section is separated from the exhaust section by the front bulkhead, which incorporates a labyrinth seal around the inlet Venturi duct to prevent the flow of combustion air directly into the exhaust section and to permit the measurement of thrust forces. The inlet- and exhaust-pressure controls are designed to maintain automatically a constant ram-pressure ratio and exhaust pressure.

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Instrumentation

Instrumentation for measuring pressures and temperatures was installed at various stations through the engine as shown in figure 3. The table presented on the figure indicates the number and type of measurements at each station. Total-pressure and temperature probes at each station were located at the approximate centers of equal annular-area increments so that measurements could be averaged arithmetically. Instrumentation was also provided to measure the portion of bleed flows dumped overboard through the compressor-discharge standpipes.

Pressures were measured by null-type diaphragm capsules and recorded by a digital, automatic multiple-pressure recorder. Temperatures were measured and recorded by iron-constantan and Chromel-Alumel thermocouples in conjunction with self-balancing potentiometers. Fuel flow was measured by a calibrated turbine-type flowmeter. The variable stator position and primary exhaust-nozzle area were determined from cold calibrations of output voltages from linear potentiometers in their actuating mechanisms.

PROCEDURE

Most of the data were obtained at the minimum inlet-air temperature consistently available (approximately 416° R) to extend the range of corrected engine speeds. Engine-inlet pressures were selected in conjunction with this inlet temperature to give a Reynolds number index range from 0.60 to 0.08. Some data were obtained at higher inlet-air temperatures up to 700° R at a constant Reynolds number index of 0.4 in order to investigate the effect of temperature itself on the reproducibility of the data.

With the variable stators in the open position, data were obtained at each Reynolds number index at five fixed settings of the variable-area exhaust nozzle over an engine speed range from military (7460 rpm) down to the surge region. At a Reynolds number index of 0.2, similar data were obtained for other settings of the variable stators down to the fully closed position. Fuel conforming to the specification MIL-F-5624A grade JP-4 with a lower heating value of 18,700 Btu per pound and a hydrogen-carbon ratio of 0.171 was used throughout the investigation. Definitions of symbols, methods of calculation, and a sample calculation of engine performance from generalized performance data are presented in appendixes A, B, and C, respectively.

RESULTS AND DISCUSSION

Component Performance

Compressor performance and turbine performance are presented in the form of performance maps at selected values of Reynolds number index, and the effects of Reynolds number on performance are summarized. The effects of variable stator angle and hot inlet-air temperatures on compressor performance are also shown. Combustor performance is presented in a generalized form as a function of the usual combustor parameters. Exhaust-system data are also shown to permit the calculation of over-all engine performance.

Compressor performance. - The compressor performance map at a Reynolds number index of 0.60 with the variable stators in the open position is shown in figure 4(a). At design compressor pressure ratio (12.2) and rated corrected engine speed (7460 rpm), the corrected airflow was approximately 159 pounds per second, and the compressor efficiency was 0.784. Compressor efficiency reached a maximum of 0.80 to 0.81 at a corrected engine speed of approximately 6900 rpm. At a given corrected engine speed, variation in compressor pressure ratio (as limited by operation of the compressor and turbine as engine components) caused variations in compressor efficiency only of the order of 0.01. The corrected airflow was unaffected by compressor-pressure-ratio variations at

high corrected engine speeds; but at a corrected speed of 6600 rpm, the corrected airflow was lowered about 3 percent by increasing pressure ratio over the range permitted by the variable-area exhaust nozzle.

The open-stator compressor performance map at a Reynolds number index of 0.20 is shown in figure 4(b). At the design pressure ratio and rated corrected engine speed, corrected airflow was about 2 percent lower and compressor efficiency was approximately 0.02 lower than at a Reynolds number index of 0.60. Peak compressor efficiency was approximately 0.03 lower and occurred at a slightly higher corrected speed. Variations in pressure ratio at a given corrected speed had a greater effect on corrected airflow at this lower Reynolds number index (0.20). At a corrected speed of 6600 rpm, increasing the compressor pressure ratio over the permissible range lowered the corrected airflow about 6.5 percent at a Reynolds number index of 0.2 compared with a 3 percent reduction at a Reynolds number index of 0.6.

The compressor performance at a Reynolds number index of 0.20 with the variable stators fully closed is shown in figure 4(c). The variable stators are scheduled to be closed only for the low-speed portion of the map. The compressor performance was mapped over the full range of corrected engine speed and exhaust-nozzle area at this stator position (fully closed) to permit the determination of compressor performance for other possible schedules of engine speed with stator position and other exhaust-nozzle area schedules. With the stators closed, the compressor operates in a region of considerably reduced airflow and pressure ratio and the peak compressor efficiency is less than 0.60. Corrected airflow was sensitive to compressor pressure ratio over the entire corrected engine speed range. The slope of the corrected speed line at 5200 rpm illustrates the advisability of scheduling a large exhaust-nozzle area at this operating condition.

Compressor efficiency and corrected airflow for open stator operation are shown in figure 5 as functions of Reynolds number index for constant values of corrected engine speed and compressor pressure ratio. Reynolds number variations had no appreciable effect on compressor efficiency or corrected airflow for values of Reynolds number index greater than approximately 0.4. At a corrected engine speed of 8000 rpm and a pressure ratio of 12.50, reducing the Reynolds number index from 0.4 to 0.08 lowered the compressor efficiency by 0.05 and lowered the corrected airflow approximately 7 percent. The decrease in efficiency and corrected airflow with decreasing Reynolds number index was greater at the lower corrected engine speeds. Compressor performance losses due to Reynolds number effects were also greater at higher compressor pressure ratios, especially in the low corrected-engine-speed region.

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Corrected airflow data obtained over a range of inlet-air temperatures corresponding to flight Mach numbers up to 2.0 did not appear to generalize within the expected accuracy of the airflow measurements (fig. 6(a)). The apparent trend of increasing corrected airflow with increased inlet temperature was still doubtful because the compressor pressure ratio was not quite constant in spite of the constant exhaust-nozzle area, and the hot-temperature data were in the low corrected-engine-speed region where pressure ratio was shown to have an effect (see fig. 5). However, after the effects of compressor pressure ratio were eliminated (fig. 6(b)), the trend of increasing corrected airflow still existed and amounted to approximately a 3 percent increase in corrected airflow for an increase in inlet temperature from 416° to 700° R. Although the reasons for this effect are not understood, it is believed that the accuracy of the data involved establishes the existence of this trend.

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The effect of stator position on compressor performance is shown in figure 7 for a range of exhaust-nozzle areas at a Reynolds number index of 0.20. Corrected airflow with the variable stators closed was approximately 38 percent of the open stator value at a corrected engine speed of 8000 rpm and about 44 percent of the open stator value at a corrected engine speed of 6700 rpm (fig. 7(a)). The corrected engine speeds at each stator position that correspond to the control schedule values (fig. 1) are shown on the figure by vertical dashes. The corrected airflow for off-schedule operation or for altered schedules may be approximated by linear interpolation.

Compressor pressure ratio (fig. 7(b)) with the variable stators closed was about 36 percent of the open stator value at a corrected engine speed of 8000 rpm and about 42 percent of the open stator value at 6700 rpm. At the corrected speed of 6700 rpm, the closed nozzle pressure ratio of 9.1 could be reduced to 8.3 by opening the exhaust nozzle or to 3.85 by closing the stator vanes. The low-speed stall-line intercept with open stators and an exhaust-nozzle area of 2.81 square feet and the approximate scheduled operating line of the variable stators are indicated on figure 7(b) to illustrate the necessity of an antistall device on this high-compression-ratio compressor.

The effect of stator position on compressor efficiency is shown in figure 7(c). Peak compressor efficiency was lowered from 0.77 to 0.75 by closing the variable stators from 0° to 18°, but dropped off rapidly to less than 0.60 when the stators were fully closed to 35°. The corrected engine speed at which the engine is scheduled to operate for a given stator position was in the region of peak compressor efficiency for the two closed-stator positions investigated.

Combustor performance. - The variation of combustion efficiency with the combustion parameter $w_{a,2}T_9$ is shown in figure 8. This parameter is approximately proportional to the combustor-inlet parameter PT/V and is more convenient in conjunction with over-all engine performance calculations. Combustion efficiency varied from 0.97 at the highest values of $w_{a,2}T_9$ to 0.90 at a combustion parameter of approximately 15,000, which essentially covered the range of engine and flight conditions investigated with the variable stators in the open position. With the stators closed at a Reynolds number index of 0.20, the combustion parameter could be reduced further, and the combustion efficiency dropped off rapidly with decreasing engine speed and increasing exhaust-nozzle area to about 0.33 at a combustion parameter $w_{a,2}T_9$ of 4500. However, this condition would not normally be encountered in actual flight and is presented as isolated combustor performance beyond the usual range of a combustor operating as an integral part of the engine. The combustor-inlet conditions of pressure, temperature, and reference velocity at this point were approximately 750 pounds per square foot absolute, 610° R, and 60 to 70 feet per second, respectively. The corresponding inlet conditions for the maximum combustion parameter and combustion efficiency were 13,626 pounds per square foot absolute, 1078° R, and 82 feet per second, respectively.

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The combustor total-pressure loss ratio as a function of combustor temperature ratio is shown in figure 9. As the temperature ratio increased from 1.45 to 2.05, the combustor total-pressure loss ratio decreased from 0.07 to 0.05. This reduction in total-pressure loss ratio results from the more rapid decrease in friction pressure loss that accompanies the decrease in combustor-inlet Mach number in comparison with the increasing momentum pressure loss as combustor temperature ratio is increased.

Turbine performance. - The over-all performance of the turbine is presented in terms of corrected turbine enthalpy drop and turbine gas-flow parameter for lines of constant corrected turbine speed, pressure ratio, and efficiency. The turbine performance map determined from open stator data at a compressor-inlet Reynolds number index of 0.60 is shown in figure 10(a). The range of engine speeds and exhaust-nozzle areas investigated caused the turbine-inlet Reynolds number index to vary from 1.04 to 1.41, but, as will be shown later, Reynolds number has little or no effect on turbine performance in this range. Over the narrow range of corrected turbine speed and pressure ratio as limited by operating in an engine at a constant stator position, the turbine efficiency varied from 0.86 to 0.88. The corrected turbine gas flow, which can be obtained by factoring out the corrected turbine speed and the factor 60 from the turbine gas-flow parameter, was about 28.3 pounds per second.

At a compressor-inlet Reynolds number index of 0.20 and open stator position, the Reynolds number index at the turbine inlet varied from 0.29 to 0.43 (fig. 10(b)). The turbine performance map was quite similar to that at the higher Reynolds number index; the corrected turbine gas flow was still about 28.3 pounds per second; the turbine efficiency varied from 0.86 to 0.88. However, the peak turbine efficiency of 0.88 occurred over a smaller range of the performance map than at the higher Reynolds number index.

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Turbine performance at the lowest turbine-inlet Reynolds number indices investigated (0.13 to 0.19) is shown in figure 10(c). The much larger range of this turbine performance map resulted from the combination of closed-stator data at a compressor-inlet Reynolds number index of 0.2 (lower right portion of map) and open-stator data at a compressor-inlet Reynolds number index of 0.08 (top left portion of map). The turbine efficiency lines must be considered only approximate because of the relatively large Reynolds number index variation for this low Reynolds number index range; but it is evident that the peak efficiency shifted to a region of lower corrected work and pressure ratio than at the higher Reynolds number indices. The minimum turbine efficiency encountered during the investigation was about 0.82 and occurred during closed-stator operation at a Reynolds number index of 0.20. The trend of the constant corrected speed lines to lower corrected gas flows at the low turbine pressure ratios indicates that the turbine nozzles were unchoked when operating with the variable stators in the closed position. When the turbine nozzles were choked, the corrected turbine gas flow was still about 28.3 pounds per second, the same as at the higher turbine Reynolds number indices.

The effect of Reynolds number on turbine performance is summarized in figure 11. At the conditions where Reynolds number effect could be isolated, that is, at constant values of corrected turbine speed and pressure ratio, the turbine efficiency was not affected by Reynolds number down to a Reynolds number index of about 0.4, but dropped off about 0.02 as the Reynolds number index was reduced to 0.15. There was no apparent Reynolds number effect on corrected turbine gas flow over the range of Reynolds number indices investigated.

Exhaust system. - The exhaust-system data are presented to allow calculation of over-all engine performance from pumping characteristics which are based on turbine-outlet pressure. Tailpipe total-pressure loss data are shown in figure 12 as a function of the turbine gas-flow parameter $w_{g,5}\sqrt{T_9}/P_5$, which is a function of the turbine-outlet Mach number. With the variable stators in the open position, the tailpipe total-pressure loss increased from 4.5 percent of the turbine-outlet total pressure at a gas-flow parameter of 1.02 up to about 13 percent at 1.47. At the static sea-level military condition, the gas-flow parameter is 1.26 and the total-pressure loss ratio is about 0.07. The turbine

gas-flow parameter could be lowered to 0.65 with the stators fully closed, at which point the total-pressure loss ratio was about 0.04. Data obtained with the largest exhaust-nozzle area resulted in total-pressure loss ratios as high as 0.35 (not shown on figure), indicating that choked flow existed somewhere near the turbine instead of at the exhaust-nozzle throat. The exhaust nozzle became unchoked at turbine gas-flow parameters somewhere between 1.47 and 1.53.

The velocity coefficient of the primary exhaust nozzle with the secondary nozzle removed is shown in figure 13 as a function of nozzle pressure ratio. When the exhaust nozzle was unchoked (nozzle pressure ratio $p_0/P_9 > 0.5$), data scatter made the values unreliable. When the exhaust nozzle was choked, however, the data fell about a mean value of about 0.985.

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Engine Performance

Several aspects of the over-all engine performance are discussed in this section. Typical effects of variable stator position on net thrust and specific fuel consumption are presented at a specific flight condition and exhaust-nozzle area. Engine pumping characteristics with open stators are presented at selected values of Reynolds number index and the general effect of Reynolds number on the pumping characteristics is summarized. Net thrust and specific fuel consumption are presented for a flight Mach number of 0.9 at rated engine conditions over a range of altitudes above the tropopause to illustrate over-all performance losses resulting from decreased Reynolds number index.

Some typical effects of variable stator position on over-all engine performance are shown in figure 14 for one specific flight condition and exhaust-nozzle area. Net thrust fell off rapidly in approximately linear fashion when the stators were closed. This is, of course, the expected trend on the basis of the corresponding airflow and compressor pressure ratio reductions (figs. 7(a) and (b)). Although the thrust dropped rapidly, the specific fuel consumption increased only slightly with closure of the stators to about the mid position (18°). However, the specific fuel consumption increased rapidly as the stators were closed further. This nonlinear variation of specific fuel consumption with stator position is a result of the similar variation in compressor efficiency with stator position shown in figure 7(c). Inasmuch as the variable stators are generally scheduled to be open except for certain engine transient operations at reduced speeds, the following presentation of generalized steady-state engine performance is confined to the open stator position.

Pumping characteristic maps, which consist of the variation of engine pressure ratio with corrected engine speed with lines of constant engine temperature ratio and corrected airflow, are shown in figure 15 for Reynolds number indices of 0.6, 0.2, 0.12, and 0.08. The peaks of the lines of constant engine temperature ratio show the regions of maximum combined compressor and turbine efficiencies. The slope of the lines of constant corrected airflow at low corrected engine speeds reflects the reduction in corrected airflow with increasing pressure ratio as discussed in the compressor performance section. Over-all engine performance may be determined for choked exhaust-nozzle operation at any flight condition corresponding to a Reynolds number index greater than 0.08 by use of the pumping characteristic maps and several auxiliary curves (figs. 6, 8, 12, 13, 18, and 19). A sample calculation of engine performance using this method is presented in appendix C.

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The general trend of engine pressure ratio and corrected airflow with Reynolds number index is shown in figure 16 for several corrected engine-speed and temperature-ratio conditions. Curves similar to these can be constructed from the pumping maps for calculating engine performance at other engine conditions and can be interpolated for intermediate values of Reynolds number index.

The reduction in net thrust and increase in specific fuel consumption resulting from Reynolds number effects on the engine components are shown in figure 17 for the rated engine speed and limiting temperature condition over a range of altitudes from about 35,400 feet (tropopause) to 72,000 feet at a flight Mach number of 0.90. This corresponds to a range of compressor-inlet Reynolds number indices from 0.46 to 0.08. Increasing the altitude over this range reduced the corrected net thrust by 14 percent, 6 percent of which was due to reduced airflow. The lower engine pressure ratio resulting from reductions in the compressor and turbine efficiencies accounted for about 6 percent of the thrust loss, and about 2 percent was due to the increased tailpipe pressure loss brought about by the above effects on the turbine-outlet Mach number. The specific fuel consumption was increased about 16 percent as altitude was increased over this range, 6 percent of which can be charged to combustion efficiency, 8 percent to the compressor and turbine efficiencies, and 2 percent to the higher tailpipe pressure loss.

SUMMARY OF RESULTS

The results of performance tests on the XJ79-GE-1 turbojet engine and its components are summarized as follows:

1. At rated corrected engine speed (7460 rpm) and design compressor pressure ratio, the corrected airflow was 159 pounds per second and the compressor efficiency was 0.784 at a Reynolds number index of 0.6. At

this Reynolds number index, peak compressor efficiency was between 0.80 and 0.81 and occurred at a corrected engine speed of approximately 6900 rpm. Compressor performance was not appreciably affected by Reynolds number at Reynolds number index values greater than approximately 0.4. Lowering the Reynolds number index from 0.4 to 0.08 reduced the compressor efficiency 0.05 and lowered the corrected airflow approximately 7 percent at the highest corrected speed (8000 rpm) at which comparisons could be made. Increasing the engine inlet temperature from 416° to 700° R at a constant Reynolds number index resulted in approximately a 3 percent higher corrected airflow for a given corrected engine speed and compressor pressure ratio.

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2. Varying the variable stators from the open to closed position (0° to 35°), resulted in reductions in corrected airflow and compressor pressure ratio on the order of 60 percent. Peak compressor efficiency was lowered only 0.02 by closing the stators halfway, but decreased rapidly when the stators were closed further. Net thrust fell off rapidly when the stators were closed, but the specific fuel consumption remained relatively low until the stators were closed more than halfway. The planned schedule of variable stator position as a function of corrected engine speed apparently safely bypassed the low-speed stall region and passed through the regions of peak compressor efficiency.

3. Combustion efficiency varied from 0.97 to 0.90 over the range of engine and flight conditions investigated with the variable stators in the open position. The combustor total-pressure loss ratio varied from 0.05 to 0.07 over the range of combustor temperature ratios investigated.

4. Turbine efficiency varied only from 0.88 to 0.86 for open-stator operation throughout the investigation. The minimum turbine efficiency encountered was about 0.82 and occurred during closed-stator operation at a Reynolds number index of 0.20. Turbine efficiency was not affected by Reynolds number down to a turbine-inlet Reynolds number index of about 0.4, but dropped off about 0.02 as the turbine-inlet Reynolds number index was reduced to about 0.15. There was no apparent Reynolds number effect on corrected turbine gas flow over the range of Reynolds number indices investigated.

5. An increase in altitude from the tropopause to 72,000 feet at a flight Mach number of 0.9 (Reynolds number index reduction from 0.46 to 0.08) resulted in a 14 percent reduction in net thrust and an increase in specific fuel consumption of 16 percent in comparison with the values that would be obtained assuming no losses in component performance with increasing altitude.

Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio, March 20, 1958

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APPENDIX A

SYMBOLS

The following symbols are used in this report:

A	area, sq ft
B	balance force from thrust capsule, lb
C	coefficient
F	thrust, lb
g	acceleration due to gravity, 32.17 ft/sec^2
H	enthalpy, Btu/lb
M	Mach number
N	engine speed, rpm
P	total pressure, lb/sq ft abs
p	static pressure, lb/sq ft abs
R	gas constant, ft-lb/(lb)($^{\circ}$R)
T	total temperature, $^{\circ}$R
t	static temperature, $^{\circ}$R
V	velocity, ft/sec
w	flow rate, lb/sec or lb/hr
β	γ correction factor, $\frac{1.4}{\gamma} \frac{\left(\frac{\gamma + 1}{2}\right)^{\frac{\gamma}{\gamma-1}}}{\left(\frac{1.4 + 1}{2}\right)^{\frac{1.4}{1.4 - 1}}}$
γ	ratio of specific heats
δ	ratio of total pressure to NACA standard sea-level static pressure

$\delta/\varphi\sqrt{\theta}$ Reynolds number index

η efficiency

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

φ ratio of absolute viscosity to viscosity of NACA standard atmosphere at sea level

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Subscripts:

a air

B combustor

b bleed

C compressor

cr critical

eff effective

f fuel

g gas

id ideal

j jet

n net

s slip joint in inlet duct

T turbine

V velocity

0 free-stream conditions

1 inlet Venturi throat

2 compressor inlet

3 compressor outlet, combustor inlet

4	combustor outlet, turbine inlet
5	turbine outlet
5a	turbine outlet (GE control thermocouples)
9	exhaust-nozzle inlet

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APPENDIX B

METHODS OF CALCULATION

Airflow. - Airflow was determined from measurements of total-pressure upstream of the bellmouth, static pressure in the inlet Venturi throat, and temperature at the compressor inlet. These measurements were used to calculate engine-inlet airflow from the equation,

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$$w_a = pA\sqrt{\frac{2\gamma g}{(\gamma - 1)RT}\left(\frac{P}{p}\right)^{\frac{\gamma-1}{\gamma}}\left[\left(\frac{P}{p}\right)^{\frac{\gamma-1}{\gamma}} - 1\right]}$$

Overboard leakage airflow was calculated similarly from pressure and temperature measurements in the compressor discharge standpipes and was subtracted from the inlet airflow for all stations downstream of the point of extraction. Tailpipe gas flow was obtained from the expression

$$w_{g,5} = w_{a,1} - w_{a,b} + w_f/3600$$

Compressor efficiency. - The compressor efficiency is defined as the ratio of isentropic enthalpy rise to the actual enthalpy rise across the compressor

$$\eta_C = \frac{\left(H_{a,3}\right)_{isentropic} - H_{a,2}}{H_{a,3} - H_{a,2}}$$

The enthalpy values were determined from charts based on the material of reference 1 using variable specific heats.

Combustion efficiency. - The combustion efficiency is defined as the ratio of the ideal fuel-air ratio necessary to obtain the engine temperature rise to the actual fuel-air ratio:

$$\eta_B = \frac{\left(w_f/w_{a,5}\right)_{id}}{\left(w_f/w_{a,5}\right)_{actual}}$$

The ideal fuel-air ratio was determined from the fuel properties and the engine temperature rise (see fig. 18 or ref. 2).

Turbine efficiency. - The turbine efficiency is defined as the ratio of actual enthalpy drop to isentropic enthalpy drop across the turbine:

$$\eta_T = \frac{H_{g,4} - H_{g,5}}{(H_{g,4} - H_{g,5})_{isentropic}}$$

The turbine-inlet temperature T_4 was calculated by assuming that the turbine enthalpy drop equaled the compressor enthalpy rise. The enthalpy values were then determined from charts based on the material of reference 1 using variable specific heats.

Jet thrust (measured). - Jet thrust was determined from the thrust-measuring system by an algebraic summation of the forces acting on the engine:

$$F_j = B + A_s(P_1 - p_0)$$

where B is the balance force from the hydraulic capsule. The last term represents the momentum and pressure forces on the installation at the labyrinth seal.

Jet thrust (calculated). - Jet thrust was also calculated from the gas flow and effective jet velocity:

$$F_j = \frac{w_{g,5}}{g} V_{eff}$$

The effective velocity, which includes the effect of excess pressure not converted to velocity for supercritical pressure ratios, was obtained from the effective velocity parameter of reference 3 (also see fig. 19). The ratio of measured thrust to calculated thrust is the velocity coefficient C_V, which can be used for all choked nozzle conditions to obtain true jet thrust when multiplied by the calculated jet thrust.

Net thrust. - Net thrust was determined by subtracting the inlet momentum from the jet thrust:

$$F_n = F_j - \frac{w_{a,2}}{g} V_0$$

APPENDIX C

SAMPLE CALCULATION OF ENGINE PERFORMANCE

FROM GENERALIZED PERFORMANCE DATA

In order to illustrate the method for obtaining over-all engine performance from generalized performance data, a numerical example is presented for the following flight and engine conditions:

Altitude, ft	35,400
Flight Mach number, M_0	0.9
Engine speed, N, rpm	7460
Exhaust-gas total temperature, T_9, °R	1530

From these conditions the following quantities are known:

p_0 = 490 lb/sq ft abs

t_0 = 392.4° R

From these quantities, and assuming 100 percent ram-pressure recovery and an NACA standard day, the following parameters may be calculated:

V_0 = 874 ft/sec

P_2 = 829 lb/sq ft abs

T_2 = 456° R

$\sqrt{\theta_2}$ = 0.9373

δ_2 = 0.3918

$\delta_2/\varphi_2\sqrt{\theta_2}$ = 0.46

$N/\sqrt{\theta_2}$ = 7959 rpm

T_9/T_2 = 3.355

From figure 15, values of engine pressure ratio and corrected airflow can be obtained at a corrected engine speed of 7959 rpm and an engine temperature ratio of 3.355 for various values of Reynolds number index. Curves similar to those in figure 16 can be constructed and the engine pressure ratio and corrected airflow at a Reynolds number index

of 0.46 can be obtained:

$$P_5/P_2 = 2.633$$

$$w_{a,2}\sqrt{\theta_2/\delta_2} = 165.75 \text{ lb/sec}$$

and

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$$P_5 = 2183 \text{ lb/sq ft abs}$$

$$w_{a,2} = 69.29 \text{ lb/sec}$$

The overboard bleed flow is about 1.5 percent of the inlet airflow, and the airflow downstream of the turbine is

$$w_{a,5} = 68.25 \text{ lb/sec}$$

To determine combustion efficiency, the combustion parameter $w_{a,2}T_9$ is calculated,

$$w_{a,2}T_9 = 106.0\times10^3$$

and from figure 8,

$$\eta_B = 0.968$$

From the engine temperature rise, the ideal fuel-air ratio may be determined from figure 18

$$T_9 - T_2 = 1074^\circ \text{ R}$$

$$(w_f/3600\ w_{a,5})_{id} = 0.0148$$

Dividing by combustion efficiency to obtain actual fuel-air ratio yields

$$w_f/3600\ w_{a,5} = 0.01529$$

and

$$w_f = 1.044 \text{ lb/sec or } 3757 \text{ lb/hr}$$

To obtain the exhaust-nozzle total pressure, it is necessary to determine the tailpipe pressure loss, which is shown in figure 12 as a

function of $w_{g,5}\sqrt{T_9}/P_5$,

$$w_{g,5} = w_{a,5} + w_f/3600$$

$$= 68.25 + 1.04$$

$$= 69.29 \text{ lb/sec}$$

$$w_{g,5}\sqrt{T_9}/P_5 = 1.242$$

$$(P_5 - P_9)/P_5 = 0.0665$$

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and

$$P_9 = (1 - 0.0665)P_5 = 2038 \text{ lb/sq ft abs}$$

The exhaust-nozzle pressure ratio is

$$p_0/P_9 = 0.2404$$

From figure 13, the exhaust-nozzle velocity coefficient is

$$C_V = 0.985$$

To calculate thrust, the effective velocity must be determined. From the fuel-air ratio and exhaust-gas temperature, the ratio of specific heats is

$$\gamma_9 = 1.337$$

From figure 19, the effective velocity parameter is

$$V_{eff}/\sqrt{gRT_9} = 1.513$$

The effective velocity then becomes

$$V_{eff} = 2452 \text{ ft/sec}$$

and the jet thrust is

$$F_j = \frac{w_{g,5}}{g} C_V V_{eff} = 5201 \text{ lb}$$

By subtracting the inlet momentum, the net thrust becomes

$$F_n = F_j - \frac{w_{a,2}}{g} V_0 = 3319 \text{ lb}$$

and the specific fuel consumption is

$$w_f/F_n = 1.132 \text{ lb/(hr)(lb thrust)}$$

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3. Turner, L. Richard, Addie, Albert N., and Zimmerman, Richard H.: Charts for the Analysis of One-Dimensional Steady Compressible Flow. NACA TN 1419, 1948.

TABLE I. - PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Reading	Reynolds number index, $\frac{\delta_2}{\theta_2\sqrt{\delta_2}}$	Variable stator position, deg	Engine speed, N, rpm	Exhaust-nozzle area, A, sq ft	Compressor-inlet total temperature, T_2, °R	Compressor-outlet total temperature, T_3, °R	Turbine-inlet total temperature, T_4, °R	Turbine-outlet total temperature (GE control), T_{5a}, °R	Exhaust gas total temperature, T_9, °R	Compressor-inlet total pressure, P_2, $\frac{lb}{sq\ ft\ abs}$	Compressor-outlet total pressure, P_3, $\frac{lb}{sq\ ft\ abs}$	Turbine-inlet total pressure, P_4, $\frac{lb}{sq\ ft\ abs}$	Turbine-outlet total pressure, P_5, $\frac{lb}{sq\ ft\ abs}$	Exhaust-nozzle-inlet total pressure, P_9, $\frac{lb}{sq\ ft\ abs}$	Tank static pressure, P_0, $\frac{lb}{sq\ ft\ abs}$	Engine inlet air-flow, $w_{a,2}$, lb/sec	Overboard bleed air-flow, $w_{a,b}$, lb/sec	Tail-pipe gas flow, $w_{g,5}$, lb/sec	Fuel flow, w_f, lb/hr	Jet thrust, F_j, lb	Net thrust, F_n, lb
1	0.602	0	7456	2.556	418	1078	2114	1556	1527	957	13,626	12,927	2719	2550	743	84.90	0.91	84.98	4808	8105	4545
2	.606		7462	2.618	417	1078	2088	1405	1496	961	13,508	12,817	2654	2453	746	85.10	.89	85.25	4680	8940	4376
3	.606		7457	2.956	417	1071	1961	1360	1368	959	13,117	12,419	2287	2075	744	84.92	.91	84.86	4080	5310	3747
4	.602		7458	4.696	418	1081	1816	1195	1225	958	12,664	11,925	1854	1257	739	84.50	.86	84.33	3380	3819	2048
5	.603		7272	2.621	418	1048	1986	1428	1482	.960	13,074	12,396	2529	2356	739	84.35	.92	84.59	4250	5659	4079
6	.601		7266	2.956	419	1041	1866	1290	1297	959	12,754	12,056	2252	2010	748	84.19	.91	84.06	3690	5069	3525
7	.603		7265	4.701	416	1032	1753	1135	1163	963	12,262	11,560	1794	1200	737	84.21	.88	83.94	3105	3409	1662
8	.597		7274	4.714	419	1032	1753	1130	1162	953	12,242	11,511	1788	1192	735	83.41	.89	83.23	3090	3387	1824
9	.604		7082	2.339	416	1026	2061	1535	1512	955	15,129	12,465	2882	2719	741	83.18	.88	83.36	4650	6072	4544
10	.600		7090	2.359	419	1030	2048	1520	1499	958	13,082	12,430	2812	2663	740	83.27	.92	83.36	4580	6002	4483
11	.608		7083	2.805	417	1020	1905	1365	1357	964	12,704	12,038	2455	2286	742	84.22	.90	84.16	3920	5617	4044
12	.612		7066	2.958	412	1006	1774	1220	1226	966	12,330	11,629	2124	1914	749	84.06	.95	83.84	3580	4803	3284
13	.612		7066	4.685	414	1001	1667	1060	1104	961	11,951	11.255	1748	1201	744	83.86	.94	83.55	2850	3296	1750
14	.615		6710	2.127	410	977	2011	1825	1500	955	12,720	12,071	2971	2845	739	81.63	.88	81.76	4495	5985	4474
15	.609		6713	2.348	414	975	1879	1380	1368	956	12,177	11,527	2609	2478	744	80.96	.92	80.89	3845	5410	3954
16	.607		6712	2.613	415	968	1748	1245	1236	957	11,787	11,119	2266	2113	749	81.15	.89	80.91	3290	4841	3377
17	.605		6707	2.956	416	960	1634	1118	1125	957	11,418	10,757	1959	1779	722	80.82	.87	80.49	2900	4350	2788
18	.600		6329	2.127	417	935	1863	1410	1369	951	10,659	10,503	2570	2482	742	73.09	.92	72.94	3555	4887	3557
19	.604		6326	2.348	417	927	1739	1280	1265	957	10,679	10,104	2305	2187	750	73.68	.93	73.39	3105	4506	3177
20	.603		6329	2.611	417	918	1611	1140	1137	958	10,425	9,824	2019	1892	721	74.54	.87	74.19	2650	4141	2888
21	.613		6331	2.951	406	915	1806	1360	1332	975	10,106	9,513	1778	1682	741	76.84	.84	76.38	2875	3788	2512
22	.584		6333	4.696	418	906	1390	989	918	929	9,548	8,925	1375	1018	753	72.47	.90	71.48	1800	2062	844
23	.608		5964	2.138	414	878	1680	1265	1236	952	9,023	8,524	2137	2048	744	63.59	.83	63.29	2805	3719	2543
24	.604		5967	2.348	416	871	1575	1143	1135	955	8,765	8,259	1865	1789	.747	63.71	.83	63.32	2275	3362	2208
25	.607		5969	2.618	416	864	1462	1020	1026	960	8,575	8,067	1676	1575	753	64.72	.81	64.28	1980	2998	1834
26	.608		5960	2.956	416	859	1371	920	956	962	8,384	7,869	1470	1381	740	65.33	.79	64.81	1675	2643	1425
27	.602		5960	4.696	417	850	1269	795	836	950	7,864	7,345	1156	929	750	64.02	.86	63.33	1290	1446	298
28	.407		7457	2.592	416	1077	2102	1530	1511	.643	9,082	8,802	1778	1681	448	56.77	.62	56.88	3250	4153	2918
29	.404		7460	2.618	416	1074	2093	1525	1503	659	9,970	8,498	1745	1527	447	56.54	.60	56.45	3150	4094	2870
30	.406		7456	2.786	416	1072	2013	1440	1420	642	8,954	8,368	1612	1483	449	56.55	.59	56.52	2895	3861	2630
31	.402		7456	2.956	416	1068	1859	1370	1384	636	8,659	8,180	1510	1369	448	56.89	.63	56.25	2720	3757	2550
32	.409		7457	4.733	415	1060	1818	1220	1226	644	8,465	7,983	1245	828	454	57.10	.57	57.00	2320	2598	1378
33	.411		6711	2.173	417	984	2013	1530	1500	682	8,495	8,063	1989	1886	448	54.98	.69	54.87	3040	4083	2676
34	.385		6712	2.344	418	977	1906	1420	1383	609	8,104	7,658	1747	1257	412	53.17	.63	53.11	2640	3784	2563
35	.403		6712	2.618	418	969	1788	1270	1257	637	7,824	7,579	1513	1412	449	53.83	.62	53.68	2270	3358	2204
36	.407		6708	2.928	418	959	1642	1135	1134	643	7,682	7,199	1313	1194	448	53.67	.60	53.65	1940	3005	1854
37	.403		6715	4.730	416	954	1595	998	1015	638	7,357	6,894	1070	723	454	54.01	.62	53.67	1600	1947	828
38	.403		7319	2.885	498	1141	1979	1390	1389	801	9,831	9,082	1700	1584	428	62.46	.69	62.36	2800	4290	2574
39	———		7565	2.898	---	-----	----	-----	-----	795	9,525	8,970	1570	1528	420	------	----	------	2740	4210	----
40	.404		7000	2.885	497	1101	1855	1295	1299	807	8,930	8,388	1547	1432	430	59.46	.69	59.25	2375	3857	2024

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, lb/(hr)(lb thrust)	Engine total-temperature ratio, T_9/T_2	Engine total-pressure ratio, P_9/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $w_{a,2}\sqrt{\theta_2}/\delta_2$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_C	Combustor: Combustor total-pressure loss ratio, $(P_3 - P_4)/P_3$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $w_f/w_{a,3}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $N/\sqrt{\theta_{4,cr}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\Delta H_T/\theta_{4,cr}$, Btu/lb	Turbine: Corrected turbine gas flow, $w_{g,4}\sqrt{\theta_{4,cr}}\,\beta/\delta_4$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $w_{g,5}\sqrt{T_9}/P_5$	Tailpipe: Tailpipe total-pressure loss ratio, $(P_5 - P_9)/P_5$	Ex. Nozzle: Exhaust-nozzle pressure ratio, P_0/P_9	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
1.062	3.685	2.841	8308	166.28	14.24	0.710	0.051	0.988	0.0160	4.754	0.873	3792	41.29	27.77	1.221	0.062	0.2914	0.994	1
1.065	3.588	2.741	8324	167.96	14.06	.702	.051	.985	.0154	4.886	.876	3821	41.83	27.88	1.252	.069	.3041	.987	2
1.073	3.281	2.385	8319	167.97	13.68	.699	.055	.975	.0133	5.450	.879	3884	44.17	28.14	1.375	.094	.3588	.984	3
1.052	2.928	1.935	8311	167.47	13.22	.699	.059	.984	.0113	6.451	.887	4034	46.91	27.96	1.391	.333	.5974	.971	4
1.042	3.402	2.634	8103	167.24	13.62	.729	.054	.971	.0142	4.880	.878	3762	41.89	28.34	1.281	.068	.3137	.983	5
1.047	3.095	2.327	8087	166.91	13.28	.727	.055	.967	.0123	5.382	.875	3877	44.19	28.21	1.356	.100	.3721	.986	6
1.077	2.796	1.882	8115	167.39	12.87	.716	.058	.961	.0104	6.438	.867	4020	48.74	28.01	1.598	.331	.6142	.957	7
1.094	2.773	1.873	8096	166.39	12.85	.724	.060	.961	.0104	6.449	.868	4025	48.80	27.84	1.590	.332	.6149	.971	8
1.023	3.635	2.997	7910	165.01	13.75	.751	.051	.961	.0137	4.355	.864	3810	38.90	28.16	1.132	.050	.2725	.984	9
1.022	3.578	2.935	7880	165.23	13.66	.752	.050	.969	.0134	4.420	.876	3810	39.69	28.22	1.148	.055	.2779	.992	10
.869	3.254	2.547	7902	165.70	13.18	.744	.053	.979	.0131	4.905	.880	3742	41.89	28.38	1.283	.069	.3246	1.015	11
1.026	2.978	2.222	7952	165.82	12.90	.737	.057	.976	.0113	5.478	.882	3878	44.21	28.15	1.382	.099	.3913	.988	12
1.029	2.687	1.817	7936	165.07	12.44	.735	.058	.965	.0098	6.446	.869	4007	48.63	27.93	1.590	.312	.6195	.975	13
1.005	3.659	3.118	7850	161.09	15.35	.788	.051	.970	.0155	4.043	.868	3453	37.59	28.22	1.066	.042	.2598	.987	14
.977	3.304	2.729	7817	160.06	12.74	.780	.053	.970	.0134	4.416	.881	3571	39.73	28.23	1.147	.052	.3008	.980	15
.974	2.978	2.368	7808	160.39	12.32	.779	.057	.970	.0114	4.907	.881	3700	41.91	28.16	1.288	.068	.3545	.986	16
1.004	2.700	2.047	7491	159.98	11.93	.780	.050	.986	.0098	5.491	.875	3817	43.85	27.94	1.377	.092	.4056	.991	17
.989	3.331	2.702	7060	145.79	11.42	.802	.051	.970	.0137	4.009	.866	3381	37.01	28.36	1.068	.042	.3014	.985	18
.977	3.054	2.410	7057	146.02	11.16	.805	.054	.968	.0119	4.382	.878	3495	39.21	28.08	1.132	.052	.3429	.988	19
.982	2.727	2.112	7060	147.89	10.90	.807	.058	.966	.0100	4.868	.880	3629	41.58	28.06	1.239	.065	.3811	.989	20
.984	2.469	1.894	7065	149.64	10.37	.794	.059	.904	.0083	5.380	.884	3746	43.37	28.77	1.379	.080	.4571	1.009	21
2.133	2.198	1.478	7067	148.14	10.20	.801	.065	.942	.0070	6.499	.880	3900	45.81	27.65	1.587	.281	.7419	.971	22
1.024	2.971	2.221	6861	125.24	9.38	.801	.056	.954	.0118	3.989	.891	3357	37.78	28.29	1.041	.042	.3633	.978	23
1.030	2.724	1.982	6854	126.39	9.10	.803	.058	.947	.0101	4.385	.888	3453	39.52	28.14	1.128	.050	.4152	.981	24
1.069	2.486	1.748	6856	127.71	8.93	.802	.059	.952	.0085	4.813	.877	3579	40.82	28.11	1.228	.060	.4761	.978	25
1.177	2.248	1.528	6857	128.65	8.72	.801	.064	.953	.0072	5.341	.880	3695	42.91	28.13	1.348	.081	.5477	.983	26
4.329	1.981	1.213	6849	127.18	8.28	------	.069	.952	.0067	6.341	.881	3836	46.23	28.26	1.572	.198	.8075	.958	27
1.107	3.632	2.765	8329	167.28	14.19	.702	.053	.945	.0160	4.858	.878	3758	41.75	28.19	1.245	.066	.2897	.994	28
1.098	3.815	2.731	8329	167.62	14.04	.701	.053	.963	.0157	4.870	.878	3764	41.91	28.33	1.259	.068	.2747	.991	29
1.101	3.413	2.811	8328	167.76	13.78	.698	.055	.962	.0143	5.191	.880	3833	43.44	28.35	1.330	.080	.3028	.986	30
1.087	3.279	2.374	8330	167.85	13.61	.697	.055	.961	.0138	5.417	.884	3884	44.38	28.30	1.378	.093	.3279	1.017	31
1.088	2.952	1.933	8339	167.74	13.17	.690	.059	.958	.0114	6.412	.888	4029	48.86	28.28	1.602	.337	.5496	.961	32
1.067	3.587	3.020	7467	159.87	13.03	.783	.061	.987	.0158	4.095	.887	3450	37.73	28.37	1.078	.042	.2375	.987	33
1.022	3.349	2.689	7497	165.40	13.31	.804	.055	.957	.0140	4.380	.875	3546	39.34	28.18	1.135	.052	.2496	.990	34
1.030	3.022	2.375	7497	160.11	12.28	.781	.058	.955	.0119	4.872	.879	3676	41.84	28.39	1.258	.067	.3180	.983	35
1.057	2.726	2.042	7492	158.70	11.92	.781	.060	.947	.0101	5.483	.878	3811	43.80	27.93	1.376	.081	.3752	.989	36
1.056	2.440	1.677	7500	160.38	11.53	.774	.063	.952	.0084	6.443	.881	3952	45.93	28.06	1.588	.324	.6279	.955	37
1.179	2.806	2.192	7494	161.12	12.02	.778	.057	.973	.0126	5.342	.872	3796	43.58	28.39	1.367	.065	.2754	.983	38
------	------	2.069	------	------	11.87	------	.056	------	------	5.371	------	------	------	------	------	.065	.2752	------	39
1.173	2.614	1.942	7153	152.58	11.07	.798	.061	.970	.0115	5.363	.872	3747	43.45	28.23	1.365	.068	.3003	.998	40

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Heading	Reynolds number index, $\frac{\delta_2}{\theta_2\sqrt{\theta_2}}$	Variable stator position, deg	Engine speed, N, rpm	Exhaust-nozzle area, A, sq ft	Compressor-inlet total temperature, T_2, °R	Compressor-outlet total temperature, T_3, °R	Turbine-inlet total temperature, T_4, °R	Turbine-outlet total temperature (OK control), T_{5a}, °R	Exhaust gas total temperature, T_9, °R	Compressor-inlet total pressure, P_2, lb/sq ft abs	Compressor-outlet total pressure, P_3, lb/sq ft abs	Turbine-inlet total pressure, P_4, lb/sq ft abs	Turbine-outlet total pressure, P_5, lb/sq ft abs	Exhaust-nozzle-inlet total pressure, P_9, lb/sq ft abs	Tank static pressure, P_0, lb/sq ft abs	Engine inlet air-flow, $w_{a,2}$, lb/sec	Overboard bleed air-flow, $w_{a,b}$, lb/sec	Tail-pipe gas flow, $w_{g,5}$, lb/sec	Fuel flow, w_f, lb/hr	Jet thrust, F_j, lb	Net thrust, F_n, lb
41	0.397	0	6817	2.896	497	1073	1770	1220	1255	765	6,120	7821	1420	1298	430	55.28	0.64	55.04	2033	3372	1680
42	.368		6924	3.178	532	1097	1718	1165	1183	803	7,286	8811	1184	1049	439	49.60	.56	49.38	1675	2878	1108
43	.472		6394	3.178	529	1064	1604	1060	1098	1016	8,228	7886	1351	1179	431	58.59	.63	57.85	1880	3191	1059
44	.403		6427	2.893	497	1018	1804	1090	1112	806	6,895	8284	1159	1072	434	47.79	.59	47.47	1465	2564	1103
45	.371		6428	3.178	528	1058	1528	1016	1040	1229	9,189	8548	1473	1303	426	67.24	.68	66.84	1715	3687	1002
46	.371		6298	3.178	524	1017	1478	970	1004	1223	8,526	7924	1367	1208	429	63.16	.68	62.70	1480	3321	817
47	.372		6182	3.176	522	1000	1451	945	972	1219	7,992	7441	1278	1151	423	60.19	.65	59.72	1330	3044	650
48	.398		6096	2.883	499	970	1458	996	1018	800	5,365	5008	948	868	431	39.90	.055	39.51	1037	1820	397
49	.400		7481	2.920	597	1271	2096	1455	1471	1015	10,385	9742	1822	1685	431	64.71	.052	64.81	2930	4698	2189
50	.404		7456	3.155	595	1282	2024	1395	1410	1019	10,313	9548	1705	1608	429	65.39	.64	65.30	2700	4444	1900
51	.397		7454	3.178	605	1278	2025	1400	1410	1022	10,055	9384	1844	1450	431	62.80	.62	62.71	2600	4264	1603
52	.399		7202	2.910	603	1236	1963	1360	1382	1020	9,136	8649	1592	1453	422	58.40	.51	58.38	2336	3978	1869
53	.402		7199	3.178	595	1210	1888	1300	1314	1015	8,120	8500	1491	1313	432	59.45	.61	59.26	2170	3736	1456
54	.400		7050	2.910	599	1205	1882	1300	1320	1017	8,417	7877	1463	1334	428	54.89	.53	54.76	2020	3922	1381
55	.398		7050	3.178	603	1200	1820	1240	1262	1020	8,293	7715	1354	1194	427	55.20	.56	54.98	1840	3290	1122
56	.408		6880	3.181	597	1177	1786	1190	1209	1024	7,778	7241	1265	1118	428	52.58	.56	52.28	1620	2988	814
57	.403		6704	2.880	597	1156	1748	1180	1222	1021	7,170	6698	1252	1144	424	48.84	.51	48.41	1350	2836	929
58	.399		6760	3.184	602	1163	1699	1150	1172	1021	7,143	6848	1166	1026	424	49.21	.50	48.95	1410	2639	700
59	.392		7600	3.170	703	1395	2116	1460	1485	1218	10,058	9361	1652	1459	428	61.48	.55	61.47	2810	4279	1482
60	.398		7483	2.906	692	1363	2186	1535	1558	1212	10,236	9580	1804	1648	436	62.04	.46	62.18	2880	4546	1752
61	.396		7456	3.157	702	1398	2042	1406	1435	1224	8,583	8224	1374	1349	429	59.03	.57	58.89	2280	3976	1466
62	.400		7399	3.157	696	1356	2028	1390	1415	1224	8,288	8428	1327	1347	428	58.41	.55	58.28	2145	3619	1148
63	.398		7301	3.157	696	1340	1979	1356	1380	1220	8,801	8164	1443	1272	428	56.07	.55	55.89	1850	3557	978
64	.397		7283	3.157	697	1333	1960	1335	1364	1221	8,614	8018	1411	1243	430	54.72	.52	54.57	1878	3401	902
65	.397		7196	3.162	697	1323	1928	1315	1342	1219	8,323	7749	1365	1203	435	53.48	.53	53.28	1770	3289	864
66	.205		7463	2.657	422	1091	2122	1545	1523	327	4,485	4247	672	611	218	28.27	.31	28.53	1609	2070	1385
67	.202		7480	2.936	422	1066	1998	1425	1398	325	4,367	4124	785	695	215	28.02	.30	28.05	1420	1881	1220
68	.202		7464	4.869	422	1078	1847	1245	1248	326	4,235	3985	826	414	217	28.27	.26	28.24	1183	1348	890
69	.203		7289	2.575	419	1063	2061	1555	1504	324	4,387	4168	898	828	215	28.11	.50	28.17	1572	2051	1392
70	.197		7273	2.618	421	1065	2062	1510	1463	316	4,279	4051	842	785	215	27.28	.53	27.27	1502	1952	1350
71	.198		7270	2.936	425	1058	1918	1360	1356	320	4,177	3839	730	662	214	27.38	.53	27.31	1290	1759	1127
72	.198		7272	4.873	425	1048	1774	1195	1194	320	4,065	3806	598	384	219	27.82	.26	27.58	1073	1255	816
73	.205		7079	2.477	417	1038	2054	1535	1501	325	4,389	4138	914	861	214	27.84	.32	27.87	1553	2063	1405
74	.204		7081	2.618	417	1051	1971	1445	1415	324	4,254	4021	857	779	216	27.92	.36	27.87	1420	1911	1269
75	.204		7088	2.963	417	1025	1836	1300	1279	323	4,119	3884	722	655	214	27.86	.32	27.80	1221	1731	1045
76	.202		7060	4.873	419	1017	1702	1140	1145	325	3,980	3733	586	387	217	27.71	.29	27.62	988	1189	556
77	.199		6711	2.278	421	1000	2022	1530	1502	319	4,010	3801	908	864	214	25.95	.35	25.82	1442	1914	1318
78	.205		6710	2.548	414	990	1978	1490	1456	322	4,093	3878	890	833	215	26.80	.34	26.78	1430	1937	1317
79	.201		6716	2.818	417	985	1868	1325	1304	318	3,904	3686	781	708	214	26.55	.36	26.44	1180	1712	1106
80	.199		6712	2.954	418	978	1703	1195	1186	317	3,779	3550	658	586	211	26.46	.31	26.35	1010	1525	914

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, lb/(hr)(lb thrust)	Engine total-temperature ratio, T_9/T_2	Engine total-pressure ratio, P_9/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $w_{a,2}\sqrt{\theta_2}/\delta_2$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_c	Combustor: Combustor total-pressure loss ratio, $(P_3 - P_4)/P_3$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $w_f/w_{a,5}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $N/\sqrt{\theta_{4,cr}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\Delta H_T/\theta_{4,cr}$, Btu/lb	Turbine: Corrected turbine gas flow, $w_{g,4}\sqrt{\theta_{4,cr}}\,\beta/\delta_4$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $w_{g,5}\sqrt{T_9}/P_5$	Tailpipe: Tailpipe total-pressure loss ratio, $(P_5 - P_9)/P_5$	Ex. Nozzle: Exhaust-nozzle pressure ratio, p_0/P_9	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
1.903	2.485	1.791	6966	144.36	10.24	0.800	0.082	0.961	0.0104	5.367	0.870	3733	43.26	28.16	1.362	0.087	0.3318	0.985	41
1.811	2.227	1.474	8743	132.27	9.07	.809	.065	.929	.0095	5.759	.854	3789	43.74	27.79	1.436	.114	.4118	.976	42
1.588	2.087	1.310	8585	122.74	8.10	.784	.068	.842	.0081	5.760	.858	3785	43.89	28.15	1.455	.114	.3856	.983	43
1.528	2.237	1.450	8568	122.78	8.31	.790	.064	.861	.0088	5.358	.867	3689	42.67	28.05	1.354	.083	.4049	.996	44
1.711	1.977	1.188	6390	116.47	7.49	.785	.071	.944	.0072	5.603	.860	3781	43.61	28.19	1.483	.116	.3262	.983	45
1.811	1.916	1.118	6265	109.02	6.87	.774	.071	.969	.0068	5.797	.865	3761	43.84	28.07	1.454	.116	.3548	.972	46
2.048	1.862	1.048	6173	104.79	6.56	.784	.069	.957	.0062	5.822	.858	3757	43.50	28.00	1.457	.115	.3740	.971	47
1.757	2.040	1.183	6216	103.48	6.71	.755	.066	.944	.0073	5.295	.861	3652	41.95	27.59	1.333	.081	.4960	.993	48
1.339	2.464	1.795	6960	144.61	10.21	.806	.080	.952	.0127	5.347	.870	3772	43.64	28.24	1.364	.087	.2592	.990	49
1.421	2.370	1.671	6962	145.42	10.19	.806	.065	.971	.0118	5.664	.867	3824	44.53	28.31	1.440	.116	.2849	.975	50
1.442	2.351	1.608	6902	140.42	9.84	.805	.067	.954	.0117	5.708	.863	3825	44.55	27.93	1.432	.118	.2972	.987	51
1.399	2.292	1.561	6681	130.59	8.96	.802	.064	.968	.0112	5.369	.865	3749	43.28	28.13	1.363	.087	.2904	.991	52
1.511	2.206	1.469	6722	132.73	8.99	.819	.068	.954	.0105	5.701	.857	3825	43.98	28.09	1.441	.119	.3290	.979	53
1.483	2.204	1.439	6546	122.86	8.28	.794	.064	.848	.0104	5.364	.866	3735	43.30	27.89	1.360	.088	.3206	.989	54
1.640	2.093	1.327	6521	123.43	8.13	.803	.070	.957	.0094	5.698	.855	3850	43.60	27.76	1.442	.118	.3576	.980	55
1.772	2.025	1.255	6418	116.42	7.59	.785	.069	.954	.0087	5.724	.863	3780	44.10	28.01	1.437	.119	.3839	.976	56
1.668	2.047	1.226	6254	108.07	7.02	.774	.066	.947	.0090	5.348	.861	3690	42.81	28.00	1.352	.088	.3708	.990	57
2.014	1.947	1.142	6277	109.84	7.00	.774	.069	.950	.0081	5.702	.857	3772	43.57	28.07	1.437	.120	.4133	.977	58
1.729	2.112	1.356	6529	124.33	8.28	.805	.069	.953	.0115	5.866	.858	3813	44.23	28.10	1.434	.117	.2920	.978	59
1.632	2.251	1.486	6479	125.10	8.45	.804	.064	.937	.0129	5.310	.859	3696	43.00	28.25	1.360	.088	.2661	.978	60
1.785	2.041	1.288	6410	118.63	7.81	.814	.067	.944	.0106	5.670	.854	3807	43.91	27.74	1.418	.118	.3069	.983	61
1.868	2.036	1.248	6385	116.82	7.57	.788	.069	.967	.0103	5.680	.862	3794	44.27	28.24	1.436	.118	.3177	.969	62
2.004	1.983	1.183	6305	112.61	7.21	.788	.070	.966	.0098	5.672	.852	3705	43.82	28.19	1.438	.119	.3385	.967	63
2.079	1.957	1.156	6258	109.91	7.06	.784	.069	.955	.0096	5.662	.858	3776	43.89	27.95	1.428	.119	.3458	.968	64
2.075	1.925	1.120	6208	107.59	6.83	.781	.069	.957	.0093	5.677	.857	3777	43.80	28.00	1.430	.119	.3599	.982	65
1.153	3.609	2.687	8277	184.99	13.72	.692	.053	.954	.0160	4.070	.878	3741	41.96	28.59	1.258	.070	.2814	.982	66
1.164	3.315	2.354	8275	184.48	13.44	.690	.056	.934	.0145	5.391	.878	3851	44.06	28.24	1.370	.092	.3085	.987	67
1.714	2.957	1.920	8278	185.42	12.99	.698	.060	.943	.0118	5.387	.869	4004	46.88	28.50	1.395	.339	.5242	.980	68
1.129	3.589	2.735	8090	184.97	13.57	.710	.052	.953	.0157	4.704	.877	3679	41.24	28.55	1.233	.064	.2569	.980	69
1.129	3.523	2.668	8075	184.45	13.54	.712	.053	.944	.0155	4.811	.874	3698	41.54	28.40	1.247	.065	.2715	.988	70
1.145	3.163	2.281	8063	183.36	13.05	.711	.057	.939	.0133	5.396	.877	3828	43.94	28.21	1.368	.093	.3233	.985	71
1.748	2.825	1.865	8055	184.92	12.67	.710	.061	.961	.0109	6.306	.868	3978	46.72	28.29	1.599	.339	.5558	.985	72
1.107	3.800	2.812	7897	182.47	13.44	.730	.063	.949	.0157	4.327	.856	3604	39.84	28.38	1.169	.060	.2485	.985	73
1.119	3.595	2.583	7899	183.47	13.14	.729	.066	.953	.0144	4.804	.875	3660	41.45	28.59	1.255	.089	.2773	.972	74
1.125	3.087	2.235	7904	183.65	12.75	.727	.067	.945	.0124	5.380	.882	3811	44.02	28.44	1.377	.093	.3287	.979	75
1.791	2.733	1.814	7880	183.15	12.32	.728	.062	.950	.0101	6.370	.866	3951	46.47	28.28	1.584	.340	.5607	.954	76
1.094	3.568	2.846	7461	154.99	12.57	.762	.062	.949	.0157	4.165	.864	3443	37.99	28.50	1.108	.049	.2477	.988	77
1.086	3.522	2.792	7513	157.86	12.71	.758	.063	.951	.0161	4.311	.866	3480	38.81	28.35	1.137	.051	.2497	.982	78
1.074	3.127	2.393	7492	158.36	12.29	.760	.065	.947	.0127	4.846	.880	3682	41.65	28.42	1.255	.068	.3018	.982	79
1.105	2.835	2.076	7479	156.51	11.92	.763	.061	.956	.0108	5.395	.874	3743	43.53	28.40	1.378	.094	.3540	.974	80

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, lb/(hr)(lb thrust)	Engine total-temperature ratio, T_9/T_2	Engine total-pressure ratio, P_9/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $w_{a,2}\sqrt{\theta_2}/\delta_2$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_c	Combustor: Combustor total-pressure loss ratio, $(P_3 - P_4)/P_3$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $w_f/w_{a,5}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $N/\sqrt{\theta_{4,cr}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\Delta H_T/\theta_{4,cr}$, Btu/lb	Turbine: Corrected turbine gas flow, $w_{g,4}\sqrt{\theta_{4,cr}}\,\beta/\delta_4$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $w_{g,5}\sqrt{T_9}/P_5$	Tailpipe: Tailpipe total-pressure loss ratio, $(P_5 - P_9)/P_5$	Ex. Nozzle: Exhaust-nozzle pressure ratio, p_0/P_9	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
1.903	2.485	1.791	6966	144.36	10.24	0.800	0.082	0.961	0.0104	5.367	0.870	3733	43.26	28.16	1.362	0.087	0.3318	0.985	41
1.811	2.227	1.474	8743	132.27	9.07	.809	.065	.929	.0095	5.759	.854	3789	43.74	27.79	1.436	.114	.4118	.976	42
1.588	2.087	1.310	8585	122.74	8.10	.784	.068	.842	.0081	5.760	.858	3785	43.89	28.15	1.455	.114	.3856	.983	43
1.528	2.237	1.450	8568	122.78	8.31	.790	.064	.861	.0088	5.358	.867	3689	42.67	28.05	1.354	.083	.4049	.996	44
1.711	1.977	1.188	6390	116.47	7.49	.785	.071	.944	.0072	5.603	.860	3781	43.61	28.19	1.483	.116	.3262	.983	45
1.811	1.916	1.118	6265	109.02	6.87	.774	.071	.969	.0068	5.797	.865	3761	43.84	28.07	1.454	.116	.3548	.972	46
2.048	1.862	1.048	6173	104.79	6.56	.784	.069	.957	.0062	5.822	.858	3757	43.50	28.00	1.457	.115	.3740	.971	47
1.757	2.040	1.183	6216	103.48	6.71	.755	.066	.944	.0073	5.295	.861	3652	41.95	27.59	1.333	.081	.4960	.993	48
1.339	2.464	1.795	6960	144.61	10.21	.806	.080	.952	.0127	5.347	.870	3772	43.64	28.24	1.364	.087	.2592	.990	49
1.421	2.370	1.671	6962	145.42	10.19	.806	.065	.971	.0118	5.664	.867	3824	44.53	28.31	1.440	.116	.2849	.975	50
1.442	2.351	1.608	6902	140.42	9.84	.805	.067	.954	.0117	5.708	.863	3825	44.55	27.93	1.432	.118	.2972	.987	51
1.399	2.292	1.561	6681	130.59	8.96	.802	.064	.968	.0112	5.369	.865	3749	43.28	28.13	1.363	.087	.2904	.991	52
1.511	2.206	1.469	6722	132.73	8.99	.819	.068	.954	.0105	5.701	.857	3825	43.98	28.09	1.441	.119	.3290	.979	53
1.483	2.204	1.439	6546	122.86	8.28	.794	.064	.848	.0104	5.364	.866	3735	43.30	27.89	1.360	.088	.3206	.989	54
1.640	2.093	1.327	6521	123.43	8.13	.803	.070	.957	.0094	5.698	.855	3850	43.60	27.76	1.442	.118	.3576	.980	55
1.772	2.025	1.255	6418	116.42	7.59	.785	.069	.954	.0087	5.724	.863	3780	44.10	28.01	1.437	.119	.3839	.976	56
1.668	2.047	1.226	6254	108.07	7.02	.774	.066	.947	.0090	5.348	.861	3690	42.81	28.00	1.352	.088	.3708	.990	57
2.014	1.947	1.142	6277	109.84	7.00	.774	.069	.950	.0081	5.702	.857	3772	43.57	28.07	1.437	.120	.4133	.977	58
1.729	2.112	1.356	6529	124.33	8.28	.805	.069	.953	.0115	5.866	.858	3813	44.23	28.10	1.434	.117	.2920	.978	59
1.632	2.251	1.486	6479	125.10	8.45	.804	.064	.937	.0129	5.310	.859	3696	43.00	28.25	1.360	.088	.2661	.978	60
1.785	2.041	1.288	6410	118.63	7.81	.814	.067	.944	.0106	5.670	.854	3807	43.91	27.74	1.418	.118	.3069	.983	61
1.868	2.036	1.248	6385	116.82	7.57	.788	.069	.967	.0103	5.680	.862	3794	44.27	28.24	1.436	.118	.3177	.969	62
2.004	1.983	1.183	6305	112.61	7.21	.788	.070	.966	.0098	5.672	.852	3705	43.82	28.19	1.438	.119	.3385	.967	63
2.079	1.957	1.156	6258	109.91	7.06	.784	.069	.955	.0096	5.662	.858	3776	43.89	27.95	1.428	.119	.3458	.968	64
2.075	1.925	1.120	6208	107.59	6.83	.781	.069	.957	.0093	5.677	.857	3777	43.80	28.00	1.430	.119	.3599	.982	65
1.153	3.609	2.687	8277	184.99	13.72	.692	.053	.954	.0160	4.070	.878	3741	41.96	28.59	1.258	.070	.2814	.982	66
1.164	3.315	2.354	8275	184.48	13.44	.690	.056	.934	.0145	5.391	.878	3851	44.06	28.24	1.370	.092	.3085	.987	67
1.714	2.957	1.920	8278	185.42	12.99	.698	.060	.943	.0118	5.387	.869	4004	46.88	28.50	1.395	.339	.5242	.980	68
1.129	3.589	2.735	8090	184.97	13.57	.710	.052	.953	.0157	4.704	.877	3679	41.24	28.55	1.233	.064	.2569	.980	69
1.129	3.523	2.668	8075	184.45	13.54	.712	.053	.944	.0155	4.811	.874	3698	41.54	28.40	1.247	.065	.2715	.988	70
1.145	3.163	2.281	8063	183.36	13.05	.711	.057	.939	.0133	5.396	.877	3828	43.94	28.21	1.368	.093	.3233	.985	71
1.748	2.825	1.865	8055	184.92	12.67	.710	.061	.961	.0109	6.306	.868	3978	46.72	28.29	1.599	.339	.5558	.985	72
1.107	3.800	2.812	7897	182.47	13.44	.730	.063	.949	.0157	4.327	.856	3604	39.84	28.38	1.169	.060	.2485	.985	73
1.119	3.595	2.583	7899	183.47	13.14	.729	.066	.953	.0144	4.804	.875	3660	41.45	28.59	1.255	.089	.2773	.972	74
1.125	3.087	2.235	7904	183.65	12.75	.727	.067	.945	.0124	5.380	.882	3811	44.02	28.44	1.377	.093	.3287	.979	75
1.791	2.733	1.814	7880	183.15	12.32	.728	.062	.950	.0101	6.370	.866	3951	46.47	28.28	1.584	.340	.5607	.954	76
1.094	3.568	2.846	7461	154.99	12.57	.762	.062	.949	.0157	4.165	.864	3443	37.99	28.50	1.108	.049	.2477	.988	77
1.086	3.522	2.792	7513	157.86	12.71	.758	.063	.951	.0161	4.311	.866	3480	38.81	28.35	1.137	.051	.2497	.982	78
1.074	3.127	2.393	7492	158.36	12.29	.760	.065	.947	.0127	4.846	.880	3682	41.65	28.42	1.255	.068	.3018	.982	79
1.105	2.835	2.076	7479	156.51	11.92	.763	.061	.956	.0108	5.395	.874	3743	43.53	28.40	1.378	.094	.3540	.974	80

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, lb/(hr)(lb thrust)	Engine total-temperature ratio, T_5/T_2	Engine total-pressure ratio, P_5/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $w_{a,2}\sqrt{\theta_2}/\delta_2$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_C	Combustor: Combustor total pressure loss ratio, $(P_3 - P_4)/P_3$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $w_f/w_{a,3}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $N/\sqrt{\theta_{4,cr}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\Delta H_T/\theta_{4,cr}$, Btu/lb	Turbine: Corrected turbine gas flow, $w_{g,4}\sqrt{\theta_{4,cr}}/\delta_4$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $w_{g,5}\sqrt{T_5}/P_5$	Tailpipe: Tailpipe total-pressure loss ratio, $(P_5 - P_9)/P_5$	Ex. Nozzle: Exhaust-nozzle pressure ratio, P_0/P_9	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
2.024	2.515	1.887	7454	136.43	11.48	0.756	0.063	0.933	0.0091	6.575	0.866	3874	46.10	27.99	1.874	0.340	0.6056	0.960	81
1.183	3.450	2.579	7042	138.00	10.75	.762	.062	.935	.0151	3.864	.854	3329	36.30	28.50	1.065	.042	.2985	.985	82
1.104	3.137	2.320	7017	137.78	10.57	.773	.063	.938	.0131	4.314	.867	3431	38.60	28.29	1.127	.063	.3024	.986	83
1.122	2.820	2.019	7026	140.25	10.34	.770	.067	.939	.0110	4.927	.872	3569	41.00	28.40	1.250	.066	.3463	.979	84
1.193	2.581	1.789	7031	140.42	10.07	.762	.065	.935	.0094	5.361	.877	3680	43.13	28.40	1.368	.093	.4188	.978	85
3.194	2.252	1.413	5882	138.97	8.54	.767	.065	.929	.0078	6.319	.857	3822	45.24	28.19	1.577	.303	.7079	.945	86
1.187	3.100	2.054	6604	114.28	8.62	.749	.064	.922	.0130	3.980	.856	3877	36.53	28.29	1.042	.042	.3539	.974	87
1.200	2.846	1.857	6615	115.60	8.45	.750	.058	.928	.0113	4.289	.846	3387	38.16	28.30	1.122	.062	.3823	.978	88
1.291	2.504	1.630	6568	116.17	8.27	.767	.060	.882	.0097	4.775	.848	3885	40.29	27.69	1.206	.088	.4381	.985	89
1.439	2.310	1.450	6608	119.06	8.17	.760	.064	.895	.0082	5.278	.867	3835	42.12	27.98	1.330	.091	.5058	.974	90
10.250	2.083	1.178	6605	119.01	7.87	.754	.068	.862	.0089	6.229	.853	3763	44.47	28.08	1.553	.240	.7911	.936	91
1.142	3.602	2.652	8320	162.68	13.57	.687	.055	.937	.0160	4.834	.860	3763	41.97	28.52	1.257	.075	.2797	.989	92
1.124	3.436	2.559	8099	161.38	13.11	.705	.057	.928	.0147	4.835	.879	3748	41.77	28.65	1.262	.074	.2878	.979	93
1.108	3.279	2.478	7874	160.40	12.73	.730	.058	.932	.0138	4.840	.877	3931	41.55	27.13	1.282	.073	.2906	.980	94
1.081	3.017	2.260	7448	152.34	11.71	.756	.059	.935	.0121	4.878	.873	3660	41.38	28.38	1.260	.071	.3171	.984	95
1.105	2.765	1.956	7029	138.16	10.15	.759	.060	.908	.0106	4.853	.881	3593	41.55	28.47	1.256	.070	.3748	.982	96
1.256	2.520	1.634	6620	118.13	8.31	.758	.062	.947	.0095	4.771	.869	3339	40.21	28.30	1.204	.067	.4488	1.001	97
3.044	2.551	1.525	6303	122.20	------	------	------	.925	.0098	5.555	.867	4291	46.15	28.15	1.382	.264	.7418	1.003	98
1.228	3.544	2.202	6284	116.99	9.81	.651	.056	.932	.0158	4.208	.875	3832	38.48	28.24	1.099	------	------	------	99
1.249	3.428	2.106	6244	116.94	9.63	.654	.055	.921	.0154	4.321	.875	3867	39.01	28.26	1.127	.047	.3385	.990	100
1.285	3.106	1.867	6252	118.28	9.35	.651	.059	.942	.0129	4.814	.881	4002	41.67	28.30	1.240	.065	.3923	.981	101
1.398	2.837	1.811	6255	119.28	9.10	.650	.061	.928	.0113	5.305	.876	4134	43.29	28.04	1.340	.090	.4837	.977	102
3.946	2.489	1.275	6251	119.51	8.76	.647	.066	.928	.0091	6.424	.869	4304	45.39	27.91	1.584	.271	.7376	.965	103
1.206	3.284	2.081	8067	118.61	9.47	.673	.064	.920	.0143	4.303	.877	3850	39.03	27.97	1.110	.049	.3408	.994	104
1.248	3.248	2.073	8045	118.97	9.65	.681	.057	.901	.0144	4.375	.882	3858	39.57	27.84	1.112	.048	.3384	.984	105
1.274	2.957	1.808	8076	120.39	9.23	.676	.057	.927	.0120	4.817	.880	4003	41.48	28.12	1.232	.066	.4000	.976	106
1.405	2.679	1.678	8079	120.21	8.98	.675	.061	.909	.0104	5.347	.887	4144	43.96	27.84	1.357	.091	.4771	.976	107
4.068	2.365	1.285	8076	119.45	8.70	.670	.064	.913	.0065	6.484	.858	4300	46.02	27.49	1.575	.258	.7854	.973	108
1.195	3.481	2.292	7886	116.47	9.46	.691	.051	.909	.0156	3.913	.876	3712	36.95	27.90	1.016	.045	.3173	.997	109
1.213	3.143	1.991	7864	116.19	9.06	.686	.055	.924	.0133	4.301	.883	3833	39.18	28.03	1.110	.063	.3850	.987	110
1.294	2.825	1.709	7828	116.39	8.69	.688	.056	.933	.0111	4.790	.888	3966	41.57	28.19	1.226	.087	.4175	.971	111
------	2.276	1.194	7540	118.01	------	------	------	------	------	------	------	------	------	------	------	.281	.7821	------	112
1.210	3.116	1.975	7450	108.77	8.23	.704	.057	.909	.0133	3.927	.877	3679	38.93	27.07	1.018	.043	.3577	.991	113
1.215	2.882	1.744	7009	100.07	7.29	.727	.059	.946	.0111	3.937	.864	3616	36.25	28.59	1.042	.045	.4165	.977	114
1.298	2.611	1.549	6594	93.58	6.49	.748	.060	.981	.0096	3.934	.848	3552	33.25	28.53	1.050	.044	.4688	.965	115
1.838	2.177	1.189	5788	74.05	4.76	.749	.064	.888	.0073	3.712	.841	3417	33.43	27.90	.978	.039	.6173	1.002	116
2.075	2.042	1.106	5779	74.12	4.65	.753	.066	.845	.0069	3.927	.842	3494	34.57	27.89	1.065	.045	.6263	.998	117
3.165	1.917	1.022	5765	73.92	4.56	.741	.069	.833	.0061	4.154	.854	3571	36.16	27.79	1.071	.051	.7175	.995	118
8.828	1.808	.939	5792	75.32	4.47	.732	.070	.806	.0055	4.498	.849	3635	37.10	28.14	1.146	.056	.7713	.991	119
2.067	3.478	1.295	8065	88.99	5.10	.685	.062	.845	.0172	3.751	.860	3825	35.36	28.53	.928	.043	.5414	.988	120

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Reading	Reynolds number index, $\frac{\delta_2}{\varphi_2\sqrt{\theta_2}}$	Variable stator position, deg	Engine speed, N, rpm	Exhaust-nozzle area, A_9, sq ft	Compressor-inlet total temperature, T_2, °R	Compressor-outlet total temperature, T_3, °R	Turbine-inlet total temperature, T_4, °R	Turbine-outlet total temperature (GE control), T_{5a}, °R	Exhaust gas total temperature, T_9, °R	Compressor-inlet total pressure, P_2, lb/sq ft abs	Compressor-outlet total pressure, P_3, lb/sq ft abs	Turbine-inlet total pressure, P_4, lb/sq ft abs	Turbine-outlet total pressure, P_5, lb/sq ft abs	Exhaust-nozzle-inlet total pressure, P_9, lb/sq ft abs	Tank static pressure, P_0, lb/sq ft abs	Engine inlet air-flow, $w_{a,2}$, lb/sec	Overboard bleed air-flow, $w_{a,b}$, lb/sec	Tail-pipe gas flow, $w_{g,6}$, lb/sec	Fuel flow, w_f, lb/hr	Jet thrust, F_j, lb	Net thrust, F_n, lb
121	0.197	35	7088	2.158	423	909	1851	1475	1413	318	1580	1488	405	387	218	10.05	0.10	10.05	550	307	279
122	.204		6716	2.189	423	855	----	1315	1286	330	----	----	384	367	217	10.23	----	------	471	----	----
123	.200		6331	2.175	423	808	1511	1195	1182	383	1322	1243	353	337	218	9.88	0	9.78	407	371	180
124	.200		5981	2.175	423	761	1380	1100	1085	323	1208	1133	332	317	218	9.18	.11	9.14	350	311	101
125	.201		7455	2.339	417	947	1910	1495	1429	319	1695	1804	396	380	217	10.99	.10	11.03	602	827	280
126	.200		7270	2.339	422	918	1812	1415	1359	322	1624	1534	386	368	218	10.67	.15	10.54	550	448	206
127	.200		7075	2.339	423	891	1743	1360	1305	325	1541	1458	372	355	218	10.56	.11	10.56	504	448	207
128	.199		6718	2.339	423	843	1681	1240	1184	321	1404	1322	345	329	214	9.15	.19	9.05	435	376	164
129	.202		6333	2.339	419	797	1458	1135	1092	328	1297	1219	332	317	220	9.22	.11	9.19	380	354	127
130	.200		5955	2.346	422	758	1338	1050	1015	323	1175	1108	314	300	220	9.20	0	9.28	335	288	74
131	.199		5219	2.346	423	684	1170	920	918	322	984	908	292	279	224	7.51	0	7.58	281	189	24
132	.200		4530	2.346	422	626	1013	838	813	323	777	728	274	264	227	6.18	0	6.21	281	122	-11
133	.200		7436	2.621	422	946	1795	1360	1312	322	1627	1544	352	335	217	10.58	.10	10.58	520	448	207
134	.205		7273	2.621	422	920	1703	1280	1242	327	1586	1492	345	326	216	10.65	.15	10.60	478	421	172
135	.201		7082	2.628	422	883	1629	1225	1188	324	1507	1418	332	315	217	10.61	.11	10.59	441	382	136
136	.200		6706	2.621	423	841	1500	1150	1104	323	1377	1293	319	303	219	10.13	.11	10.10	385	331	101
137	.197		6330	2.628	423	800	1385	1070	1031	318	1262	1173	304	290	221	9.60	.11	9.56	352	279	68
138	.200		6348	2.628	423	798	1379	1060	1022	325	1270	1189	306	291	221	9.18	0	9.25	352	275	67
139	.198		5931	2.682	423	754	1281	990	958	317	1149	1078	291	277	218	9.08	.18	8.99	307	237	54
140	.199		5226	2.682	422	---	----	870	854	320	945	880	270	258	219	7.50	0	7.65	258	188	-13
141	.197		4510	2.682	424	619	965	780	768	320	744	698	252	242	215	6.12	.12	6.04	231	99	-42
142	.199		7469	2.966	421	958	1707	1270	1231	319	1580	1497	319	300	217	10.82	.10	10.63	493	358	118
143	.203		7272	2.958	419	907	1831	1200	1175	324	1559	1468	314	296	217	10.72	.10	10.71	437	343	97
144	.202		7064	2.918	417	881	1878	1165	1137	321	1463	1393	309	293	217	10.71	.11	10.68	406	324	82
145	.199		6708	2.910	421	834	1442	1076	1046	320	1354	1270	298	281	219	10.66	.15	10.58	357	277	38
146	.197		5851	2.915	423	732	1244	950	928	319	1125	1052	---	285	220	8.48	.11	8.60	282	197	4
147	.198		5210	2.908	424	680	1094	845	838	321	933	874	264	262	220	8.13	.12	8.06	258	142	-40
148	.207		4507	2.953	420	609	911	730	718	332	767	713	247	238	218	6.28	.12	6.21	285	96	-83
149	.201		7455	4.879	418	924	1552	1088	1071	320	1543	1443	265	239	215	11.13	.10	11.11	389	188	-66
150	.199		7267	4.882	419	898	1487	1045	1035	318	1467	1374	258	237	216	10.84	.11	10.80	360	169	-71
151	.204		7088	4.882	419	871	1458	1000	997	328	1439	1344	257	236	216	10.31	.15	10.22	340	171	-69
152	.202		6708	4.889	423	828	1324	945	935	326	1322	1235	250	234	217	10.28	.16	10.17	302	144	-85
153	.204		6340	4.869	417	778	1221	885	867	323	1213	1130	246	231	218	9.34	.11	9.28	272	126	-88
154	.204		5948	4.869	418	730	1126	840	815	328	1111	1054	243	230	217	9.34	.11	9.27	247	100	-115
155	.202		5110	4.898	420	682	995	765	749	324	905	844	238	228	218	8.21	.17	8.08	209	64	-126
156	.189		4498	4.898	420	610	887	720	699	319	789	879	233	225	217	6.89	.12	6.83	271	45	-110
157	.121	0	7480	2.820	418	1099	2112	1530	1506	192	2625	2479	488	447	140	16.46	.14	15.56	960	1148	812
158	.121		7447	2.938	418	1095	2032	1498	1457	192	2585	2435	485	421	140	16.45	.17	15.48	908	1100	765
159	.121		7458	4.879	417	1085	1911	1310	1298	192	2507	2359	376	248	143	16.56	.18	18.58	782	748	419
160	.122		7281	2.764	417	1075	2079	1480	1489	194	2595	2450	493	455	139	16.61	.17	18.65	855	1139	791

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, lb/(hr)(lb thrust)	Engine total-temperature ratio, T_0/T_2	Engine total-pressure ratio, P_5/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $w_{a,2}\sqrt{\theta_2}/\delta_2$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_0	Combustor: Combustor total pressure loss ratio, $(P_3 - P_4)/P_3$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $w_f/w_{a,3}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $N/\sqrt{\theta_{4,or}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\Delta H_T/\theta_{4,or}$, Btu/lb	Turbine: Corrected turbine gas flow, $w_{g,4}\sqrt{\theta_{4,or}}/\delta_4$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $w_{g,5}\sqrt{T_9}/P_5$	Tailpipe: Tailpipe total-pressure loss ratio, $(P_5 - P_9)/P_5$	Ex. Nozzle: Exhaust-nozzle pressure ratio, P_0/P_9	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
1.971	3.340	1.274	7848	60.37	4.97	0.302	0.083	0.901	0.0154	3.894	0.849	3795	34.40	28.90	0.835	0.045	0.5561	1.000	121
------	2.995	1.154	7459	59.20	------	------	------	------	------	------	------	------	------	------	------	.044	.5915	------	122
2.713	2.725	1.093	7015	57.27	4.09	.545	.058	.909	.0117	3.527	.855	3745	33.25	28.17	.938	.045	.8489	.958	123
3.465	2.510	1.026	6602	54.31	3.74	.572	.062	.775	.0108	3.413	.859	3671	31.79	27.77	.898	.045	.8877	.980	124
2.150	3.427	1.248	8317	65.33	5.31	.477	.054	.923	.0184	4.030	.860	3934	36.88	27.89	1.048	.045	.5711	.962	125
2.870	3.220	1.199	8063	62.66	5.04	.488	.055	.851	.0147	3.974	.852	3935	38.17	27.14	1.006	.047	.5924	.901	126
2.435	3.085	1.152	7857	62.47	4.77	.506	.053	.917	.0134	3.922	.860	3905	36.19	27.98	1.025	.046	.6141	.953	127
2.652	2.798	1.075	7441	54.45	4.37	.528	.058	.734	.0125	3.852	.857	3868	35.38	28.17	.903	.046	.8505	1.039	128
2.992	2.606	1.051	7048	54.47	4.03	.540	.060	.747	.0118	3.872	.875	3948	37.80	28.68	.915	.045	.6940	1.065	129
4.827	2.405	.972	6604	54.36	3.64	.560	.052	.784	.0102	3.513	.845	3734	32.56	28.26	.840	.045	.7335	.985	130
10.800	2.186	.907	5781	44.58	2.89	.596	.063	.642	.0097	3.092	.818	3498	28.57	26.28	.784	.046	.8029	.984	131
------	1.927	.848	5024	38.40	2.41	.509	.065	.421	.0118	2.657	.838	3257	25.72	24.91	.846	.037	.8598	.984	132
2.812	3.109	1.093	8289	62.54	------	------	.061	.885	.0139	4.386	.862	4067	39.01	28.80	1.087	.054	.8517	1.011	133
2.779	2.943	1.049	8065	62.16	4.85	.485	.059	.850	.0127	4.360	.872	4059	38.84	27.17	1.069	.053	.8546	.998	134
3.196	2.815	1.025	7854	62.49	4.65	.492	.060	.854	.0117	4.265	.876	4038	38.54	27.94	1.100	.051	.8869	.985	135
5.812	2.610	.988	7427	59.93	4.26	.517	.061	.822	.0107	4.063	.869	3982	36.91	27.94	1.052	.050	.7228	.971	136
8.178	2.437	.956	7034	57.66	3.84	.535	.063	.804	.0105	3.889	.849	3925	34.98	27.95	1.010	.046	.7821	.978	137
5.254	2.416	.947	7069	84.31	3.93	.557	.064	.716	.0107	3.868	.862	3926	35.55	26.67	.966	.048	.7598	.988	138
2.029	2.265	.918	6570	54.78	3.63	.566	.064	.710	.0096	3.698	.855	3802	34.06	27.54	.956	.048	.7670	.971	139
------	2.024	.844	5788	44.73	2.95	------	.069	.561	.0098	3.259	------	------	------	------	.817	.045	.8486	.985	140
------	1.811	.788	4989	36.59	2.33	.591	.065	.411	.0107	2.761	.855	3521	26.59	24.71	.684	.040	.8884	.992	141
4.280	2.924	1.000	6288	63.45	4.98	.478	.059	.835	.0131	4.895	.861	4161	40.02	27.19	1.169	.080	.7253	.939	142
4.505	2.804	.969	6093	62.91	4.79	.482	.061	.882	.0115	4.643	.860	4144	39.66	27.44	1.139	.057	.7351	.940	143
4.976	2.727	.963	7905	63.29	4.62	.491	.061	.899	.0107	4.508	.870	4102	38.40	28.18	1.165	.052	.7406	.921	144
9.385	2.488	.925	7449	63.50	4.23	.517	.062	.878	.0095	4.220	.868	4063	38.00	29.18	1.156	.051	.7794	.905	145
70.300	2.194	------	6592	51.85	3.53	.555	.065	.728	.0092	------	------	3867	33.90	26.51	------	------	.8302	.970	146
------	1.975	.822	5764	40.44	2.91	.591	.063	.620	.0083	3.511	.834	3606	30.84	27.95	.884	.046	.8730	.916	147
------	1.710	.744	5010	36.01	2.31	.600	.070	.386	.0120	2.867	.850	3414	27.37	24.07	.674	.036	.9076	1.021	148
------	2.562	.822	6318	56.06	4.82	.486	.065	.890	.0098	5.487	.861	4355	42.78	27.97	1.365	.081	.8996	.874	149
------	2.470	.811	6088	63.61	4.61	.479	.063	.858	.0095	5.326	.853	4296	41.73	27.45	1.392	.061	.9114	.909	150
------	2.379	.788	7869	60.11	4.41	.487	.066	.828	.0093	5.228	.847	4300	42.06	26.58	1.258	.092	.9153	.977	151
------	2.210	.767	7426	60.23	4.06	.513	.066	.813	.0083	4.838	.848	4229	39.80	27.60	1.244	.064	.9274	.929	152
------	2.072	.762	7073	54.06	3.76	.528	.066	.713	.0082	4.593	.853	4157	38.35	26.59	1.111	.061	.9351	.984	153
------	1.960	.746	6626	54.57	3.42	.548	.069	.694	.0078	4.235	.847	4062	36.41	27.62	1.069	.054	.9435	.892	154
------	1.783	.735	5890	43.24	2.79	.594	.067	.588	.0072	3.546	.826	3708	31.58	27.57	.929	.055	.9600	.790	155
------	1.664	.730	4898	41.10	2.29	.588	.069	.327	.0112	2.914	.821	3450	27.90	27.40	.776	.043	.9731	.853	156
1.182	3.805	2.542	8313	163.06	13.88	.872	.056	.914	.0184	5.080	.871	5747	42.61	28.68	1.317	.064	.3132	.990	157
1.190	3.484	2.422	8298	162.78	13.45	.880	.057	.917	.0165	5.257	.863	5786	42.82	28.49	1.353	.066	.3325	.988	158
1.319	3.113	1.956	8321	163.68	13.08	.868	.059	.927	.0129	5.274	.867	5934	45.49	28.59	1.387	.340	.3766	.959	159
1.182	3.571	2.541	8122	162.37	13.38	.886	.056	.938	.0158	4.970	.870	5681	41.85	28.85	1.303	.077	.3058	.974	160

TABLE I. - Continued. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Reading	Reynolds number index, $\frac{\delta_2}{\theta_2\sqrt{\delta_2}}$	Variable stator position, deg	Engine speed, N, rpm	Exhaust-nozzle area, A, sq ft	Compressor-inlet total temperature, T_2, °R	Compressor-outlet total temperature, T_3, °R	Turbine-inlet total temperature, T_4, °R	Turbine-outlet total temperature (GE control), T_{5a}, °R	Exhaust gas total temperature, T_9, °R	Compressor-inlet total pressure, P_2, lb/sq ft abs	Compressor-outlet total pressure, P_3, lb/sq ft abs	Turbine-inlet total pressure, P_4, lb/sq ft abs	Turbine-outlet total pressure, P_5, lb/sq ft abs	Exhaust-nozzle-inlet total pressure, P_9, lb/sq ft abs	Tank static pressure, p_0, lb/sq ft abs	Engine inlet air-flow, $w_{a,2}$, lb/sec	Overboard bleed air-flow, $w_{e,b}$, lb/sec	Tail-pipe gas flow, $w_{g,5}$, lb/sec	Fuel flow, w_f, lb/hr	Jet thrust, F_j, lb	Net thrust, F_n, lb
161	0.124	0	7290	2.946	417	1069	1992	1445	1407	197	2595	2442	451	418	140	16.72	0.18	16.78	885	1096	741
162	.125		7287	4.873	417	1068	1850	1245	1245	195	2451	2308	367	243	144	16.67	.14	16.68	702	713	579
163	.119		7068	2.953	423	1058	1906	1370	1348	192	2443	2301	456	398	139	16.22	.14	16.25	775	1017	660
164	.122		7070	4.876	417	1051	1754	1190	1189	193	2364	2216	381	254	145	16.54	.12	16.55	646	666	548
165	.121		6707	2.391	423	1015	2053	1550	1510	198	2581	2249	521	493	138	15.33	.16	15.37	865	1099	770
166	.119		6712	2.818	423	1006	1901	1410	1375	193	2307	2178	456	425	134	15.43	.18	15.45	762	996	656
167	.122		6706	2.951	417	984	1776	1280	1245	193	2251	2097	398	356	134	15.54	.17	15.50	645	816	553
168	.121		6707	4.875	418	980	1649	1105	1110	193	2160	2019	322	212	127	15.52	.17	15.45	545	514	261
169	.122		6332	2.182	420	982	1986	1550	1499	196	2003	1901	492	460	125	12.82	.16	12.85	755	950	654
170	.119		6331	2.360	422	954	1854	1406	1370	192	1958	1830	425	402	121	12.87	.11	12.90	645	870	565
171	.121		6324	2.818	420	948	1728	1270	1243	194	1914	1805	377	351	124	13.28	.14	13.25	565	791	470
172	.120		6333	2.923	419	940	1621	1150	1130	192	1845	1767	332	300	118	13.38	.15	13.53	510	730	389
173	.120		6340	4.876	419	933	1497	995	1007	191	1823	1703	272	188	126	13.54	.14	13.48	450	449	153
174	.119	6	7450	2.652	422	1073	2077	1545	1499	199	2400	2287	473	441	154	15.25	.14	15.31	865	1012	748
175	.123		7472	2.981	423	1088	1951	1385	1371	198	2417	2276	427	397	152	15.42	.14	15.45	780	948	833
176	.123		7473	4.873	417	1050	1808	1220	1222	195	2350	2187	345	236	159	15.84	.17	15.80	655	583	324
177	.121		7267	2.936	423	1033	1958	1350	1298	196	2289	2154	404	388	157	15.17	.15	15.17	702	882	598
178	.121		7270	4.879	423	1025	1718	1150	1160	196	2213	2074	327	250	162	15.17	.12	15.18	580	521	278
179	.081	0	7410	2.958	420	1098	2087	1640	1484	130	1707	1613	306	277	118	10.61	.10	10.65	814	648	527
180	.081		7481	4.912	419	1093	1854	1370	1340	130	1672	1374	253	177	128	10.82	.13	10.81	632	583	313
181	.082		7270	2.958	420	1077	2085	1490	1439	131	1688	1593	301	272	119	10.79	.07	10.86	862	654	510
182	.082		7278	4.912	419	1068	1862	1310	1294	131	1635	1537	247	174	125	10.88	.10	10.87	486	380	284
183	.084		7483	3.373	456	1138	2051	1470	1437	150	1864	1756	308	256	124	11.88	.15	11.89	807	651	452
184	.082		6764	2.621	461	1094	2043	1535	1478	149	1817	1432	308	286	122	9.74	.13	9.73	525	565	397
185	.082		6788	2.628	462	1065	1996	1519	1455	148	1610	1426	302	282	121	9.74	.10	9.76	518	565	394
186	.082		6769	2.953	462	1064	1886	1390	1345	149	1479	1392	289	245	126	9.93	.08	9.85	480	474	317
187	.081		6784	4.902	461	1049	1757	1220	1212	147	1431	1342	225	178	145	10.07	.14	10.01	349	247	201

TABLE I. - Concluded. PERFORMANCE DATA OF XJ79-GE-1 TURBOJET ENGINE

Specific fuel consumption, w_f/F_n, $\frac{lb}{(hr)(lb\ thrust)}$	Engine total-temperature ratio, T_9/T_2	Engine total-pressure ratio, P_9/P_2	Compressor: Corrected engine speed, $N/\sqrt{\theta_2}$, rpm	Compressor: Corrected airflow, $\frac{w_{a,2}\sqrt{\theta_2}}{\delta_2}$, lb/sec	Compressor: Compressor pressure ratio, P_3/P_2	Compressor: Compressor efficiency, η_C	Combustor: Combustor total pressure loss ratio, $\frac{P_3 - P_4}{P_3}$	Combustor: Combustion efficiency, η_B	Combustor: Fuel-air ratio, $\frac{w_f}{w_{a,5}}$	Turbine: Turbine pressure ratio, P_4/P_5	Turbine: Turbine efficiency, η_T	Turbine: Corrected turbine speed, $\frac{N}{\sqrt{\theta_{4,or}}}$, rpm	Turbine: Corrected turbine enthalpy drop, $\frac{\Delta H_T}{\theta_{4,or}}$, Btu/lb	Turbine: Corrected turbine gas flow $\frac{w_{g,4}\sqrt{\theta_{4,or}}\ \beta}{\delta_4}$, lb/sec	Tailpipe: Tailpipe gas flow parameter, $\frac{w_{g,5}\sqrt{T_9}}{P_5}$	Tailpipe: Tailpipe total-pressure loss ratio, $\frac{P_5 - P_9}{P_5}$	Ex. Nozzle: Exhaust-nozzle pressure ratio, $\frac{P_0}{P_9}$	Ex. Nozzle: Effective velocity coefficient, C_V	Reading
1.194	3.374	2.340	8121	160.98	13.16	0.688	0.068	0.905	0.0149	5.297	0.867	3764	43.16	28.47	1.364	0.093	0.3349	0.988	161
1.862	2.986	1.882	8107	162.07	12.57	.680	.060	.945	.0118	5.276	.860	3915	46.04	28.78	1.603	.338	.5928	.952	162
1.140	3.180	2.271	7929	161.48	12.72	.724	.068	.935	.0134	5.278	.864	3756	42.85	28.44	1.367	.092	.3510	.985	163
1.853	2.881	1.819	7887	160.61	12.26	.701	.063	.927	.0111	5.313	.852	3887	45.47	28.61	1.408	.333	.5187	.968	164
1.149	3.570	2.672	7429	150.11	12.21	.738	.055	.917	.0163	4.517	.849	3432	38.00	28.55	1.146	.064	.2799	.983	165
1.162	3.251	2.383	7436	152.74	11.95	.740	.057	.932	.0138	4.772	.858	3549	40.37	28.72	1.256	.068	.3153	.966	166
1.168	2.988	2.031	7481	152.74	11.58	.723	.060	.930	.0117	5.349	.867	3664	43.12	28.89	1.395	.092	.3567	.973	167
2.271	2.855	1.668	7474	152.72	11.19	.719	.068	.932	.0099	5.270	.869	3802	48.22	28.77	1.599	.342	.5981	.948	168
1.181	3.589	2.452	7039	124.55	10.22	.723	.051	.898	.0166	5.844	.858	3281	56.58	26.00	1.051	.046	.2874	1.010	169
1.186	3.246	2.205	7021	127.95	10.09	.734	.056	.914	.0141	4.528	.882	3369	37.92	26.33	1.129	.050	.3010	.997	170
1.181	2.960	1.943	7030	130.26	9.87	.727	.057	.937	.0118	4.788	.888	3502	40.31	28.28	1.239	.069	.3533	.980	171
1.511	2.897	1.729	7048	134.53	9.61	.733	.062	.888	.0106	5.322	.867	3619	42.72	28.84	1.370	.096	.3933	.972	172
3.233	2.403	1.424	7056	134.73	9.55	.731	.066	.879	.0089	6.281	.889	3767	48.39	28.28	1.573	.320	.6811	.955	173
1.156	3.552	2.464	8262	161.71	12.50	.675	.055	.932	.0159	4.793	.868	3766	41.01	28.70	1.253	.065	.3499	.962	174
1.194	3.241	2.157	8276	160.66	12.21	.676	.058	.923	.0140	5.338	.871	3900	43.38	28.19	1.357	.094	.3928	.990	175
2.022	2.950	1.769	8337	162.06	11.95	.670	.061	.920	.0118	5.339	.850	4053	46.47	28.12	1.561	.316	.6737	.959	176
1.174	3.071	2.061	8038	147.90	11.68	.696	.069	.912	.0130	5.332	.875	3881	43.46	28.19	1.355	.089	.4266	.992	177
2.101	2.742	1.688	8053	147.90	11.29	.692	.063	.918	.0107	5.343	.882	4039	46.17	28.09	1.579	.297	.7043	.956	178
1.145	3.533	2.354	8257	163.48	13.13	.661	.065	.887	.0163	5.271	.858	3744	49.74	28.05	1.341	.095	.4280	.994	179
1.700	3.198	1.946	8504	165.41	12.07	.687	.059	.880	.0141	5.218	.889	3893	46.06	27.70	1.535	.300	.7119	.950	180
1.141	3.426	2.298	8081	156.81	12.86	.676	.055	.924	.0151	5.292	.859	3726	48.75	28.48	1.387	.096	.4375	.981	181
1.687	3.089	1.885	8100	154.73	12.46	.671	.060	.907	.0131	5.293	.858	3857	45.69	28.02	1.554	.298	.7184	.967	182
1.343	3.158	2.063	7998	156.89	12.43	.688	.056	.939	.0144	5.701	.859	3785	44.44	28.56	1.483	.136	.4682	.983	183
1.322	3.198	2.054	7177	130.40	10.18	.673	.056	.920	.0152	4.880	.862	3458	41.30	26.56	1.220	.063	.4268	.952	184
1.316	3.145	2.027	7173	130.54	10.13	.707	.058	.910	.0150	4.719	.855	3498	40.17	26.41	1.231	.066	.4281	.959	185
1.451	2.911	1.805	7174	133.08	9.95	.711	.059	.922	.0150	5.175	.850	3595	41.70	28.90	1.356	.089	.5143	.913	186
1.935	2.628	1.517	7177	136.58	9.74	.707	.062	.928	.0109	6.018	.847	3719	44.44	28.98	1.583	.202	.6148	.870	187

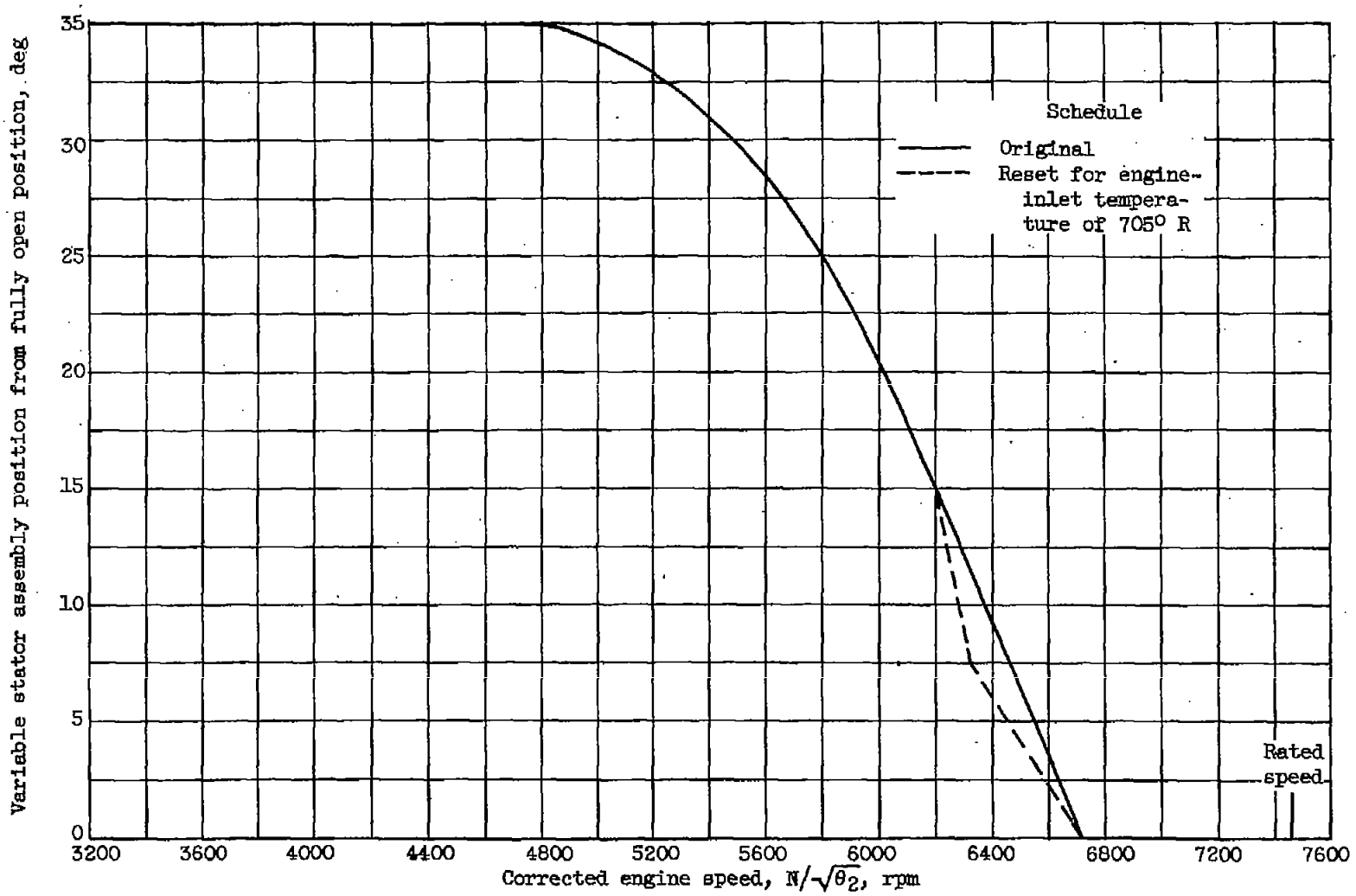

Figure 1. - The variation of variable-stator position with corrected engine speed for the original schedule and for the reset schedule in effect at an engine-inlet temperature of 705° R.

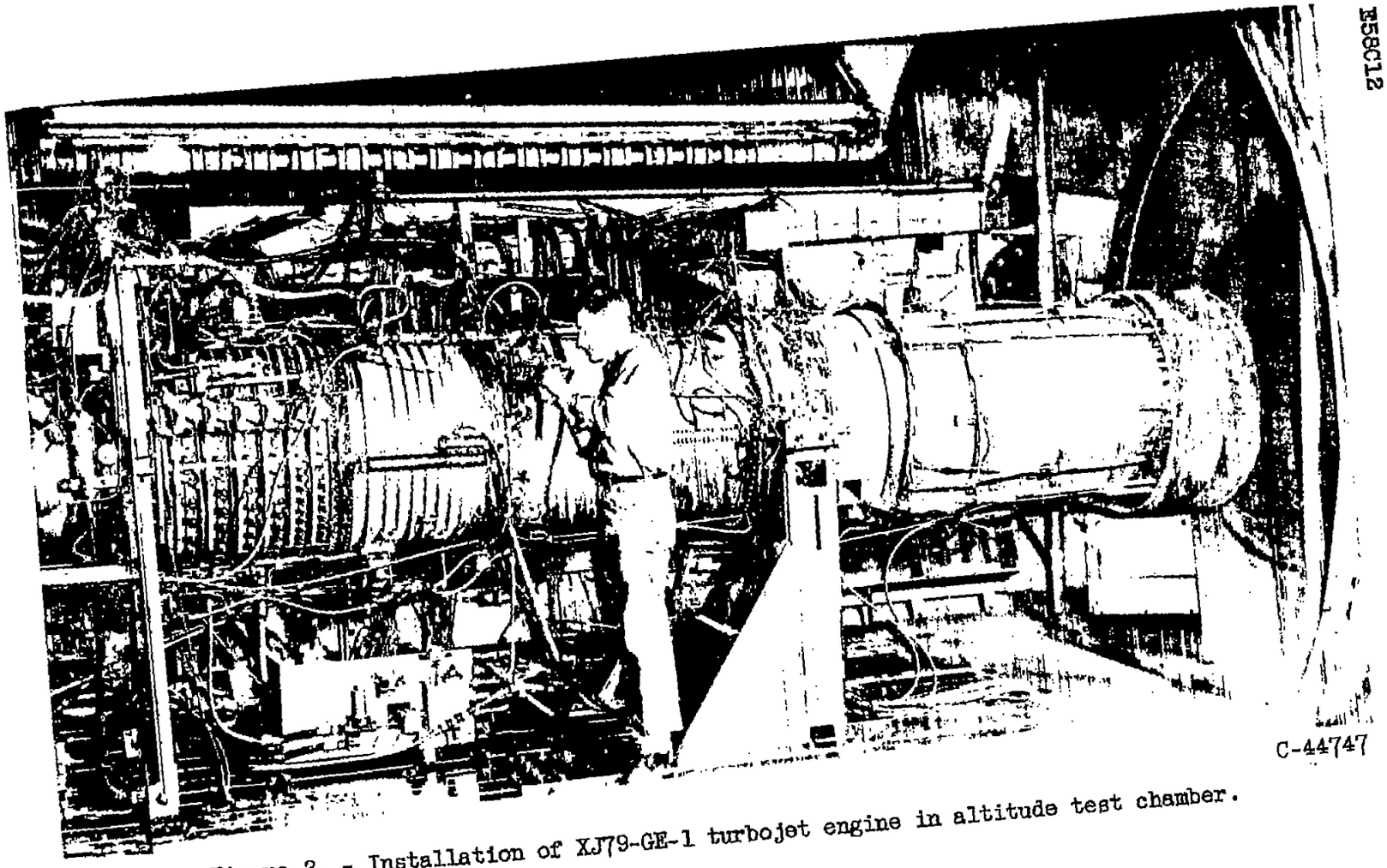

Figure 2. - Installation of XJ79-GE-1 turbojet engine in altitude test chamber.

Station	Number of probes			Number of rakes
	Total pressure	Wall static pressure	Thermocouples	
1	--	6	--	--
2	9	--	9	2
3	15	--	15	3
4	10	--	--	--
5	30	2	39	6
9	24	--	24	4
Ambient	4 trailing static probes on exhaust-nozzle outer surface			

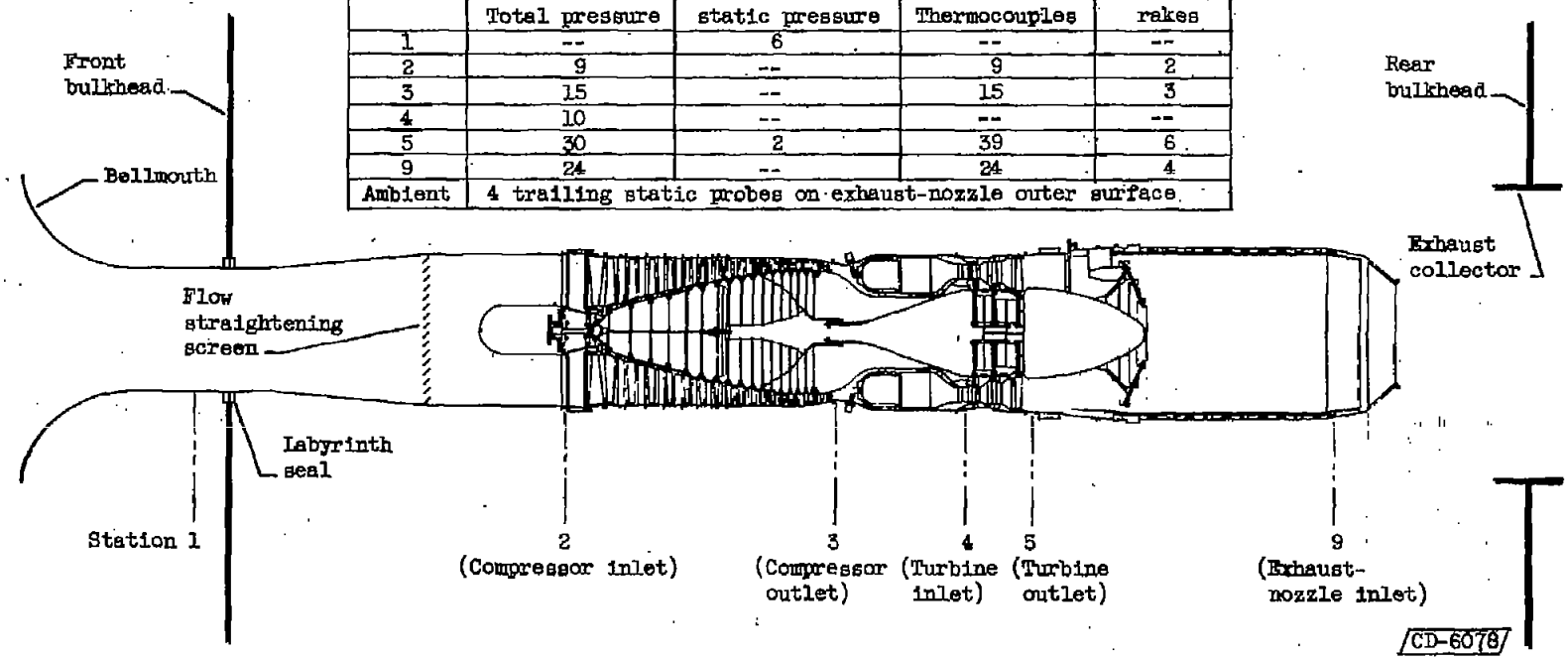

Figure 3. - Schematic diagram of engine and instrumentation stations.

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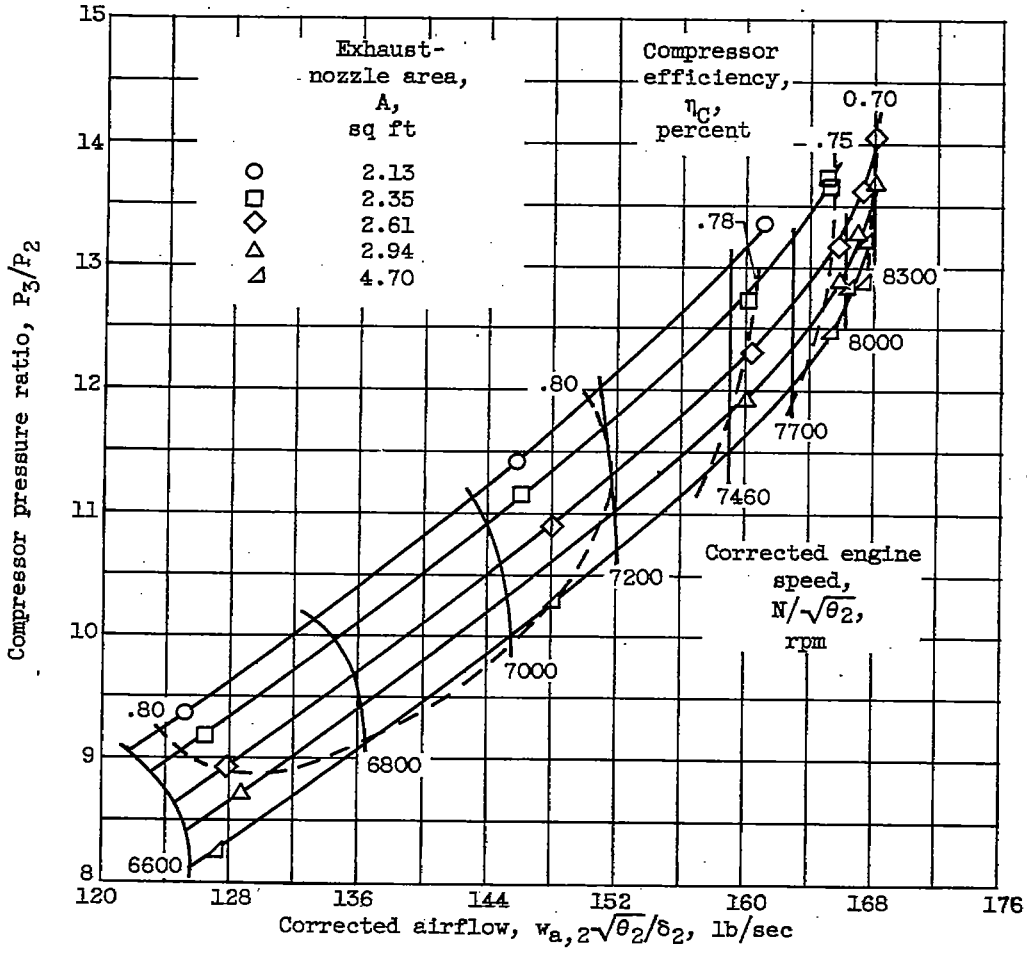

(a) Compressor-inlet Reynolds number index, 0.60; variable stators open.

Figure 4. - Compressor performance maps.

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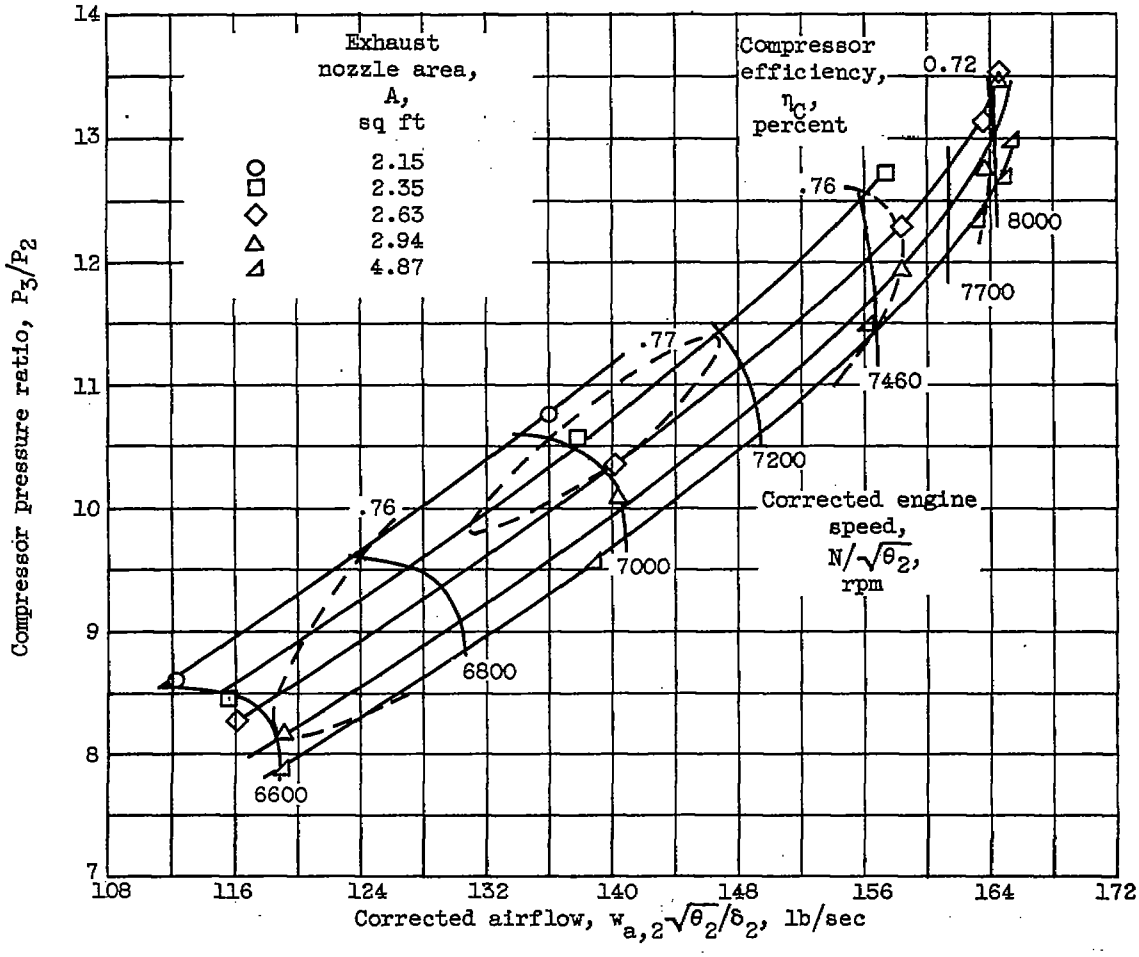

(b) Compressor-inlet Reynolds number index, 0.20; variable stators open.

Figure 4. - Continued. Compressor performance maps.

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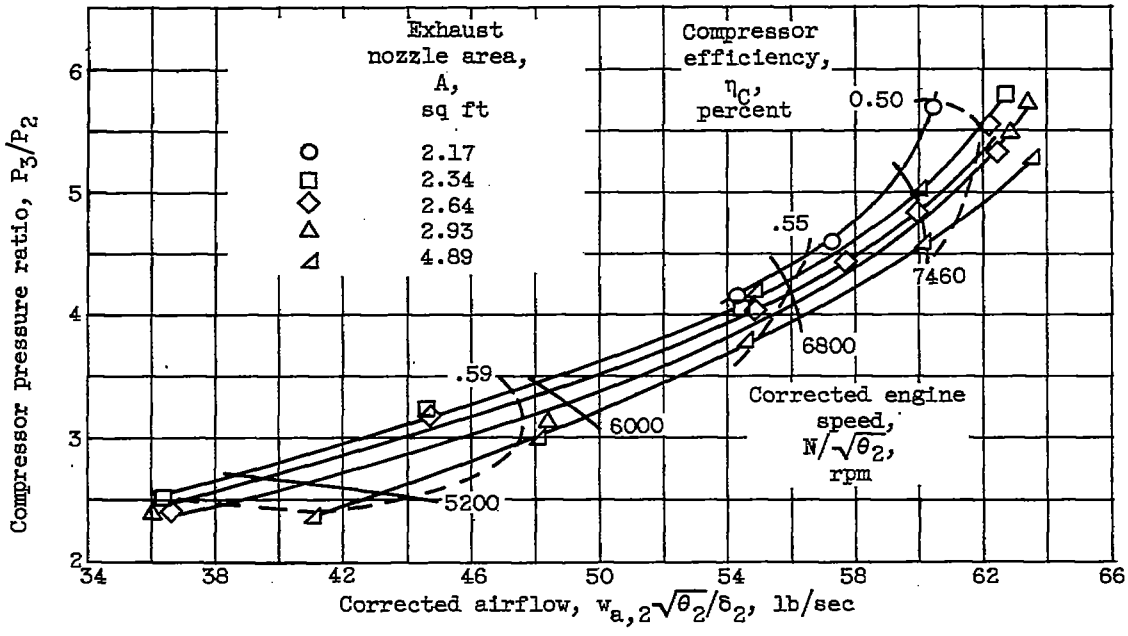

(c) Compressor-inlet Reynolds number index, 0.20; variable stators closed (35°).

Figure 4. - Concluded. Compressor performance maps.

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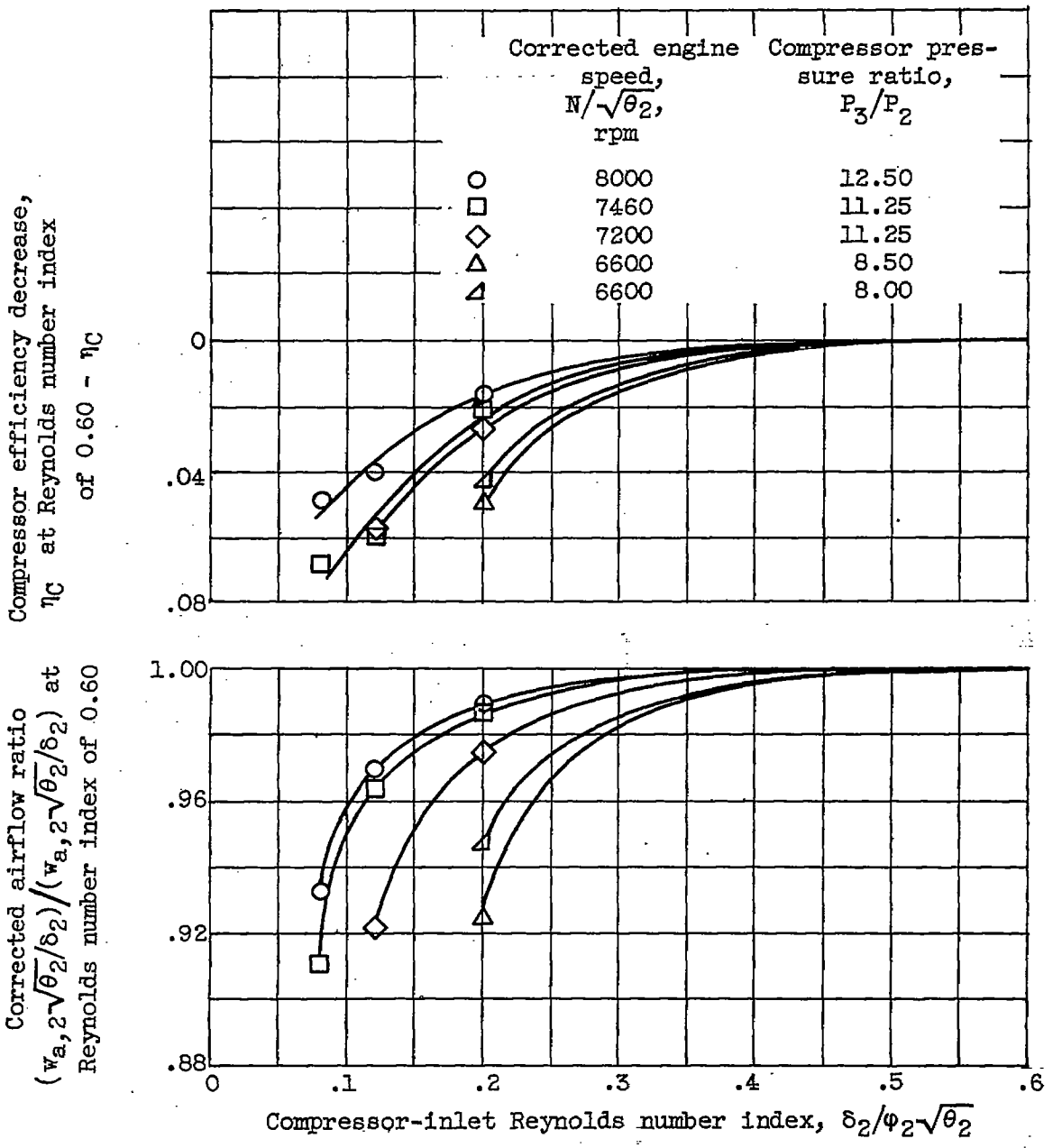

Figure 5. - Reynolds number effects on compressor performance. Variable stators open.

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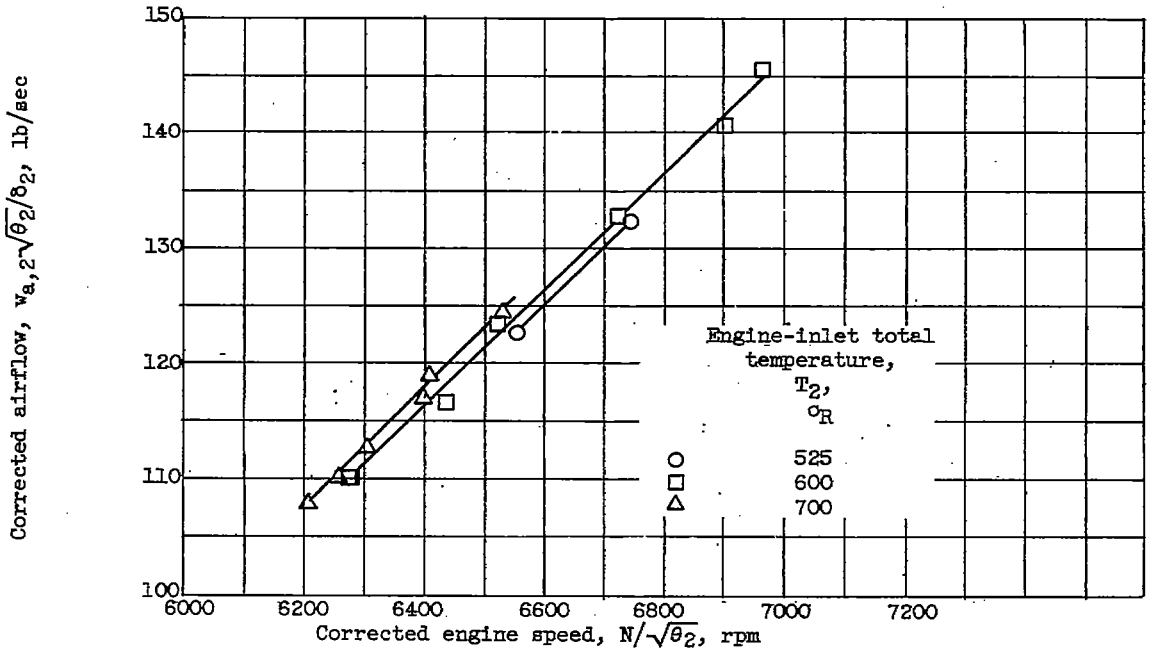
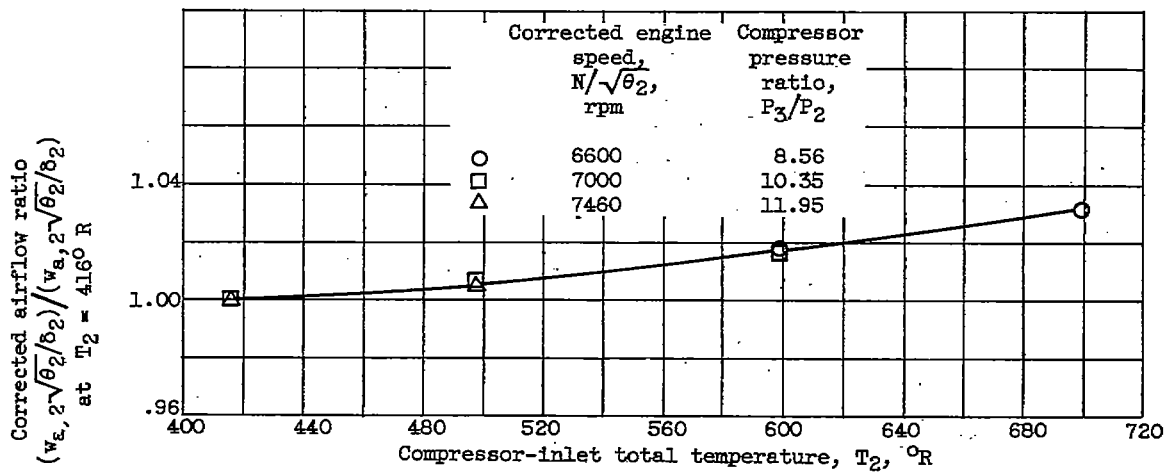


(a) Constant exhaust-nozzle area, 3.16 sq ft



(b) Constant corrected engine speed and compressor pressure ratio.

Figure 6. - Effect of inlet temperature on corrected airflow. Reynolds number index, 0.4; variable stators open.

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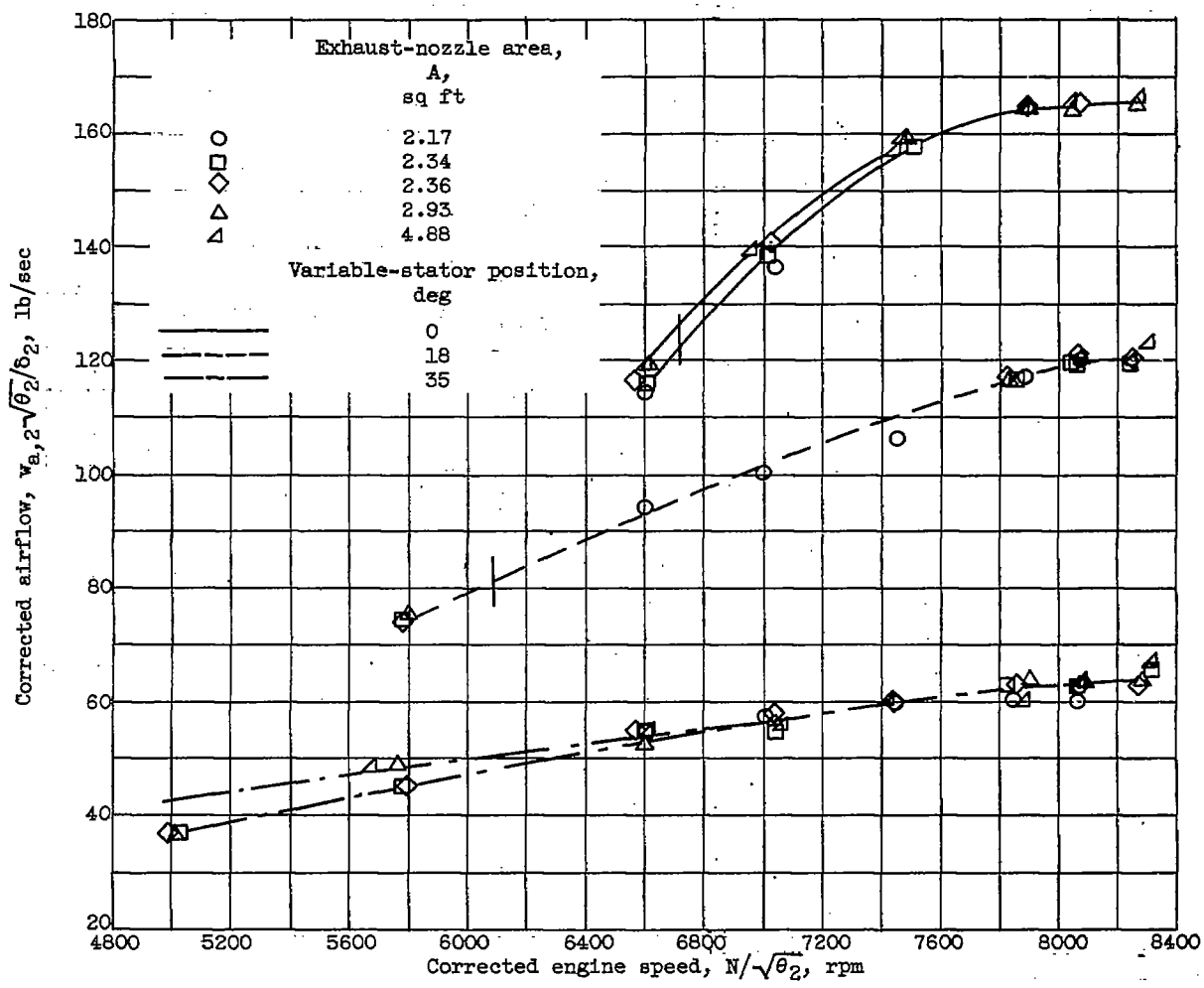

(a) Corrected airflow.

Figure 7. - Effect of variable-stator position on compressor performance at Reynolds number index of 0.20.

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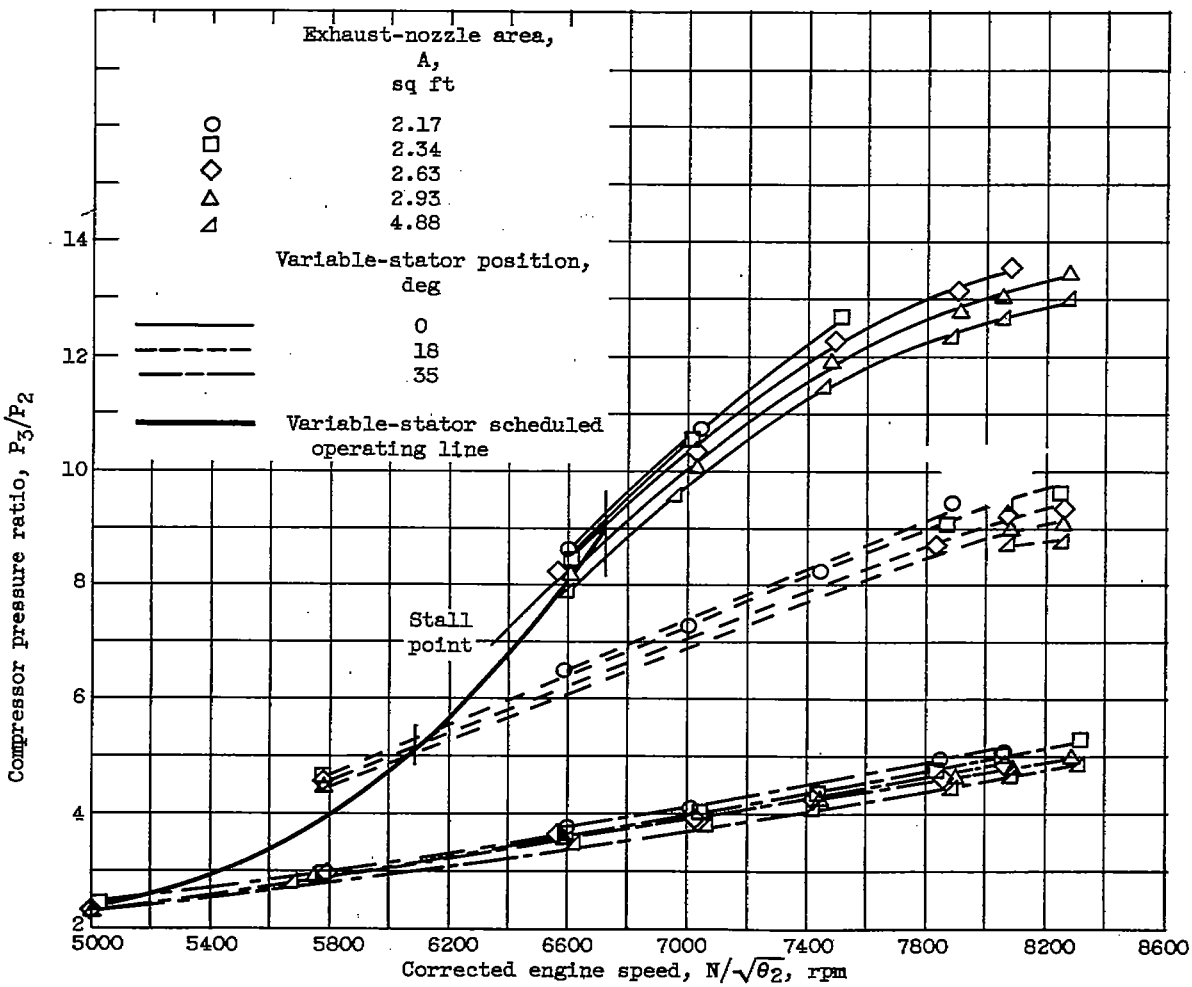

(b) Compressor pressure ratio.

Figure 7. - Continued. Effect of variable stator position on compressor performance at Reynolds number index of 0.20.

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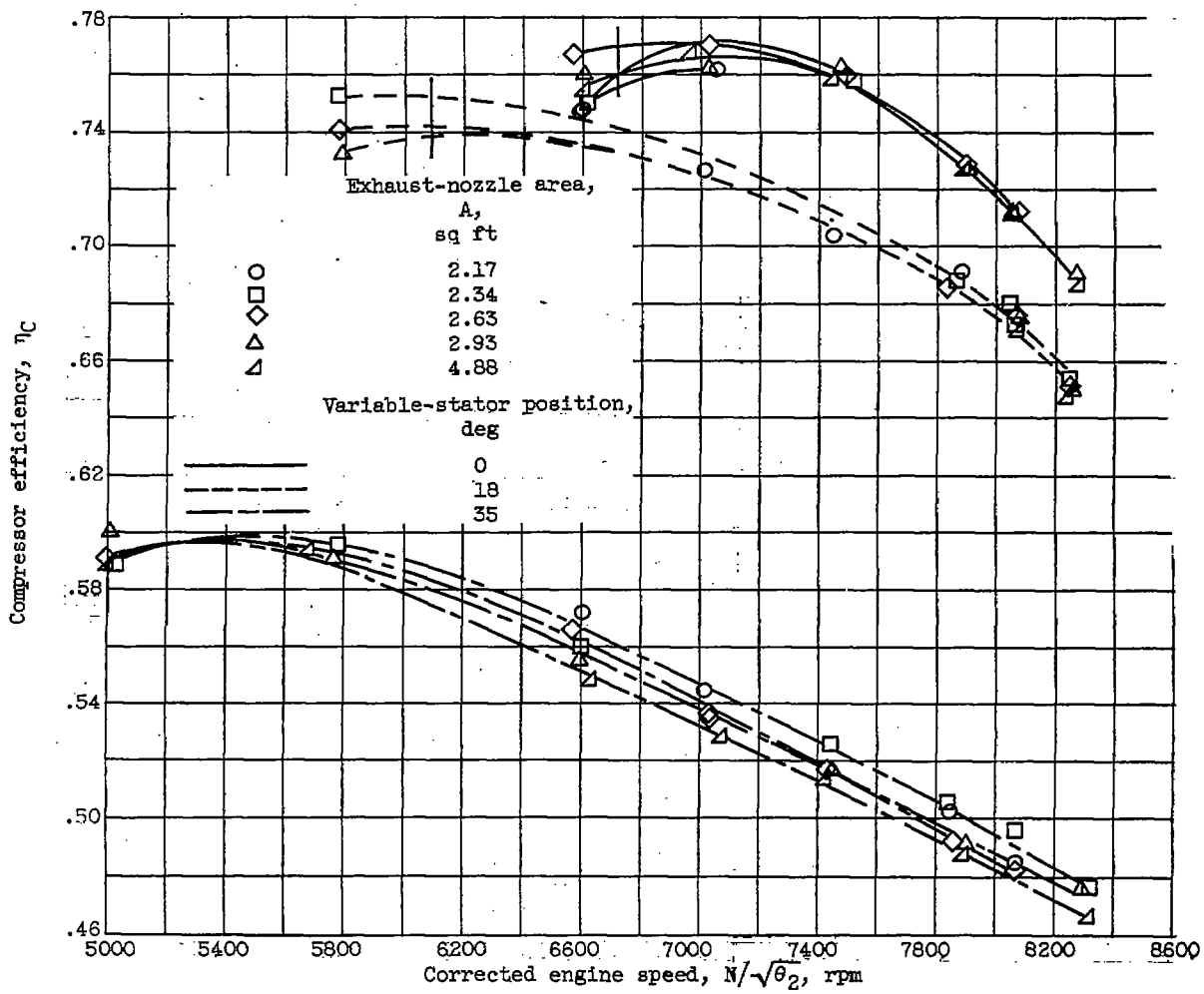


(c) Compressor efficiency.

Figure 7. - Concluded. Effect of variable stator position on compressor performance at Reynolds number index of 0.20.

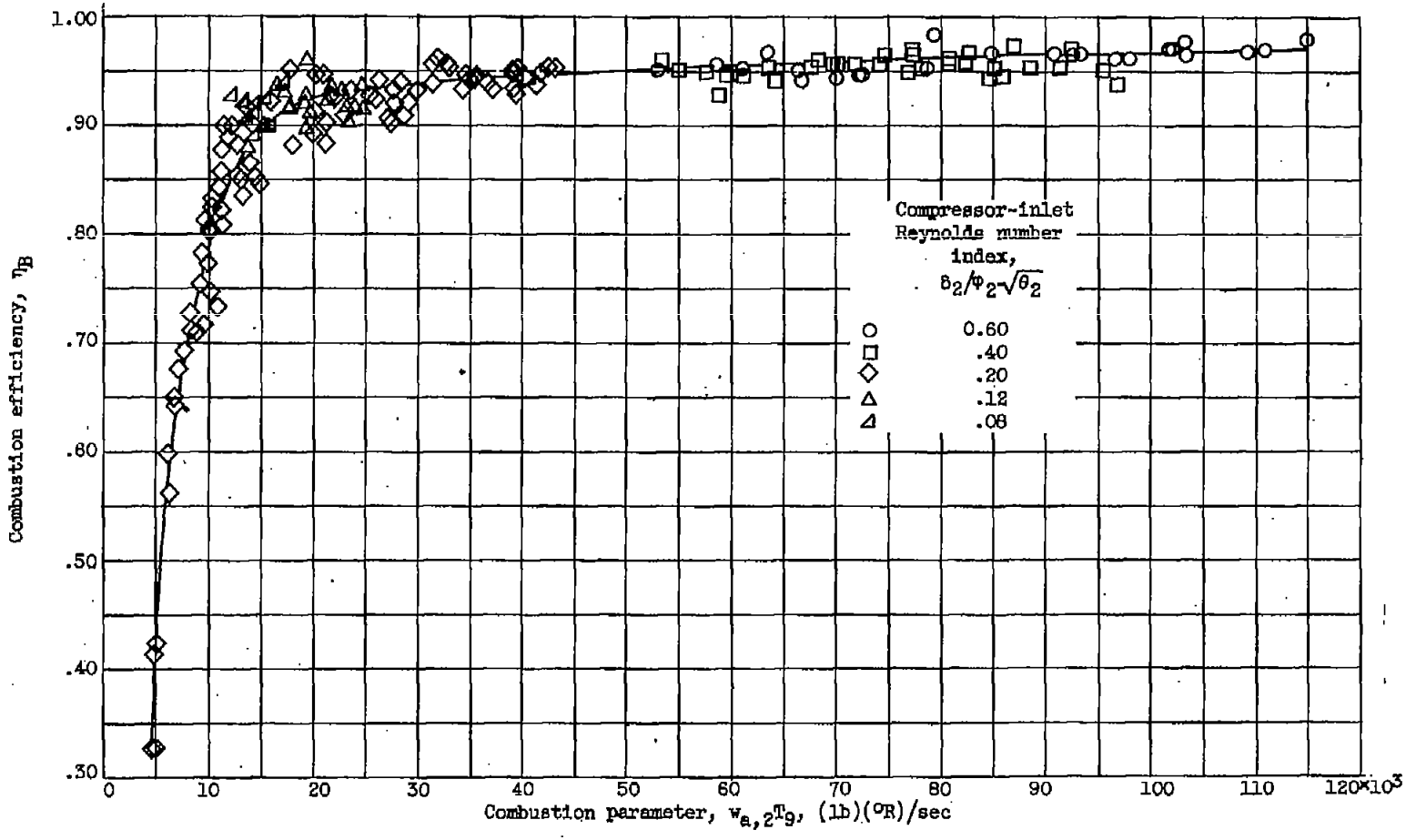


Figure 8. - Combustion efficiency.

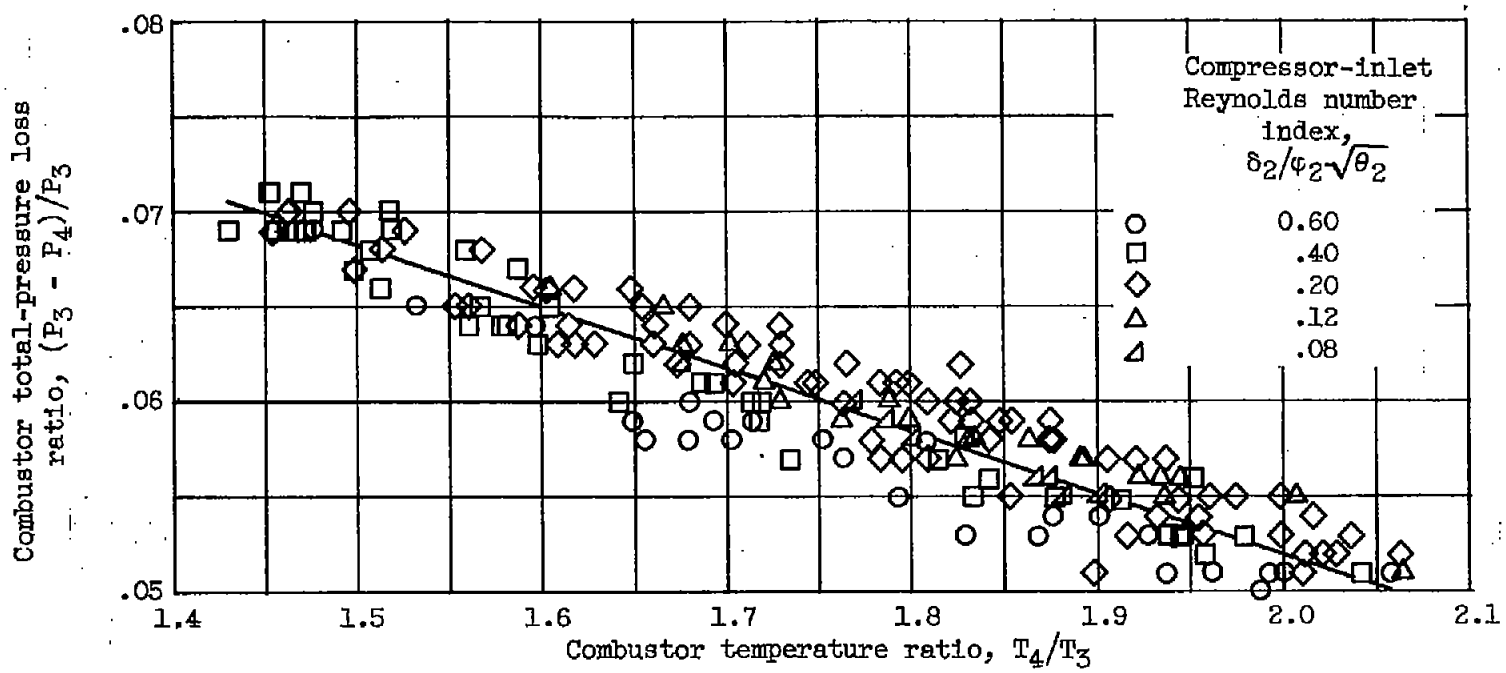
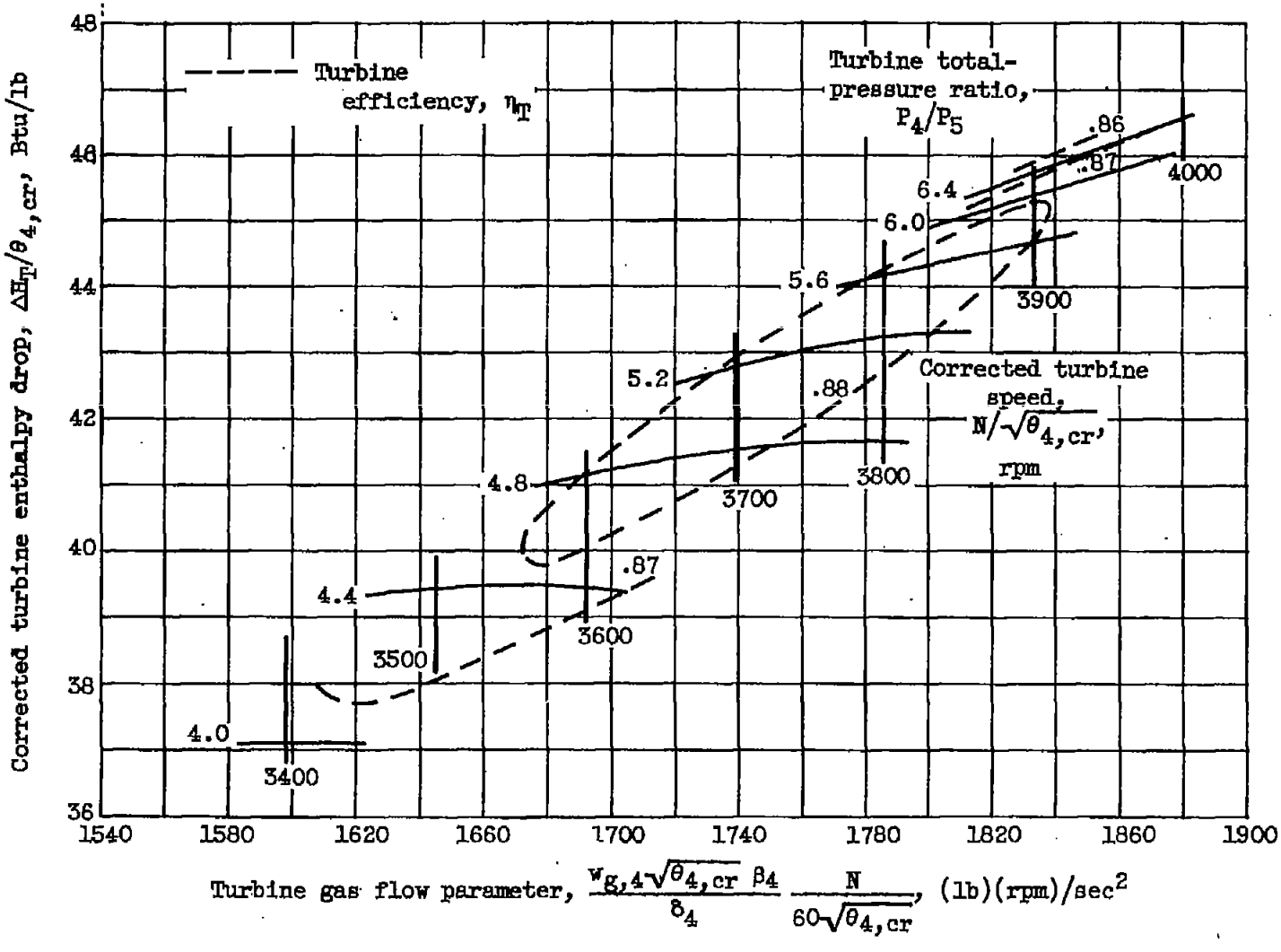
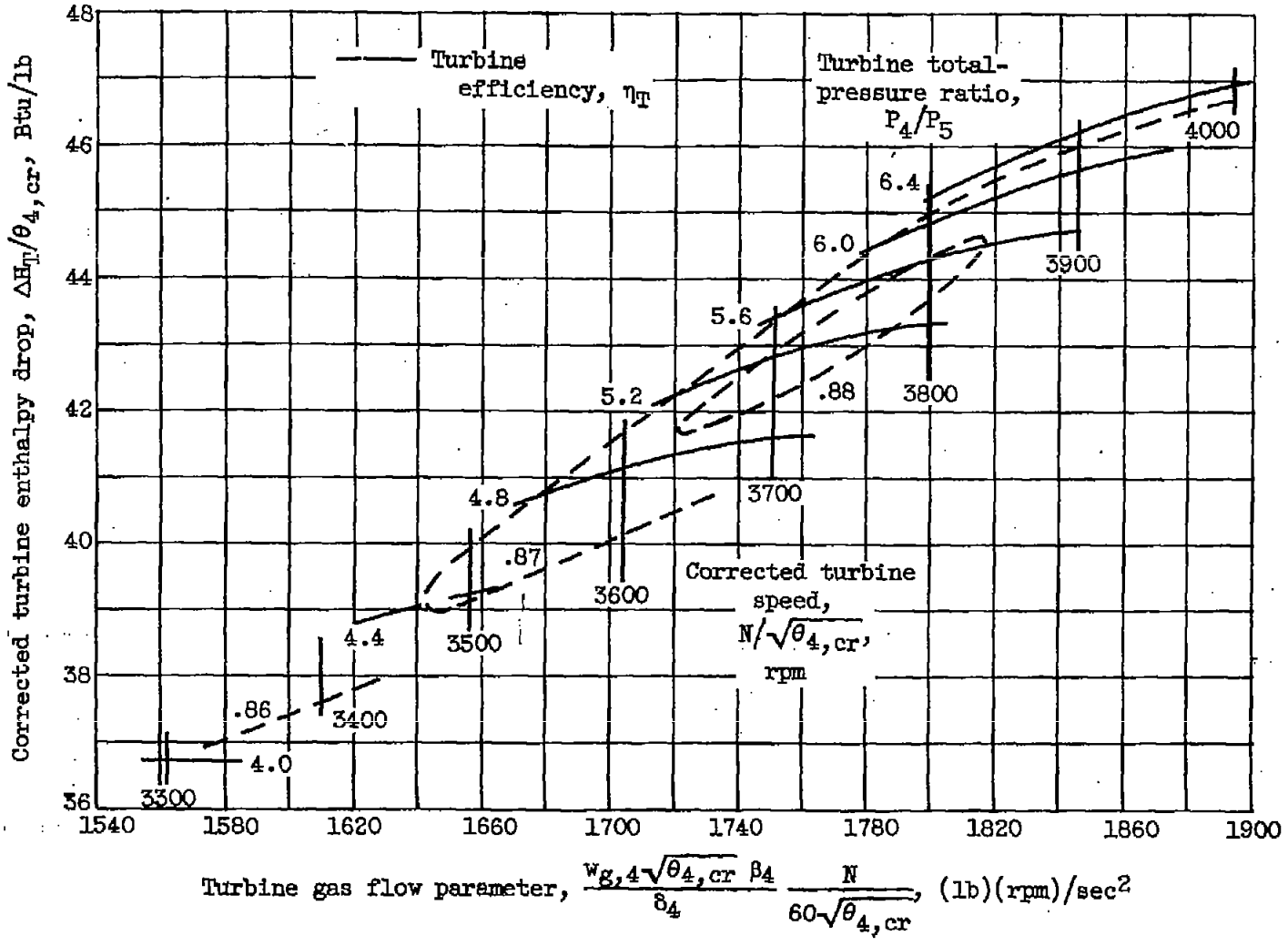


Figure 9. - Combustor total-pressure loss.



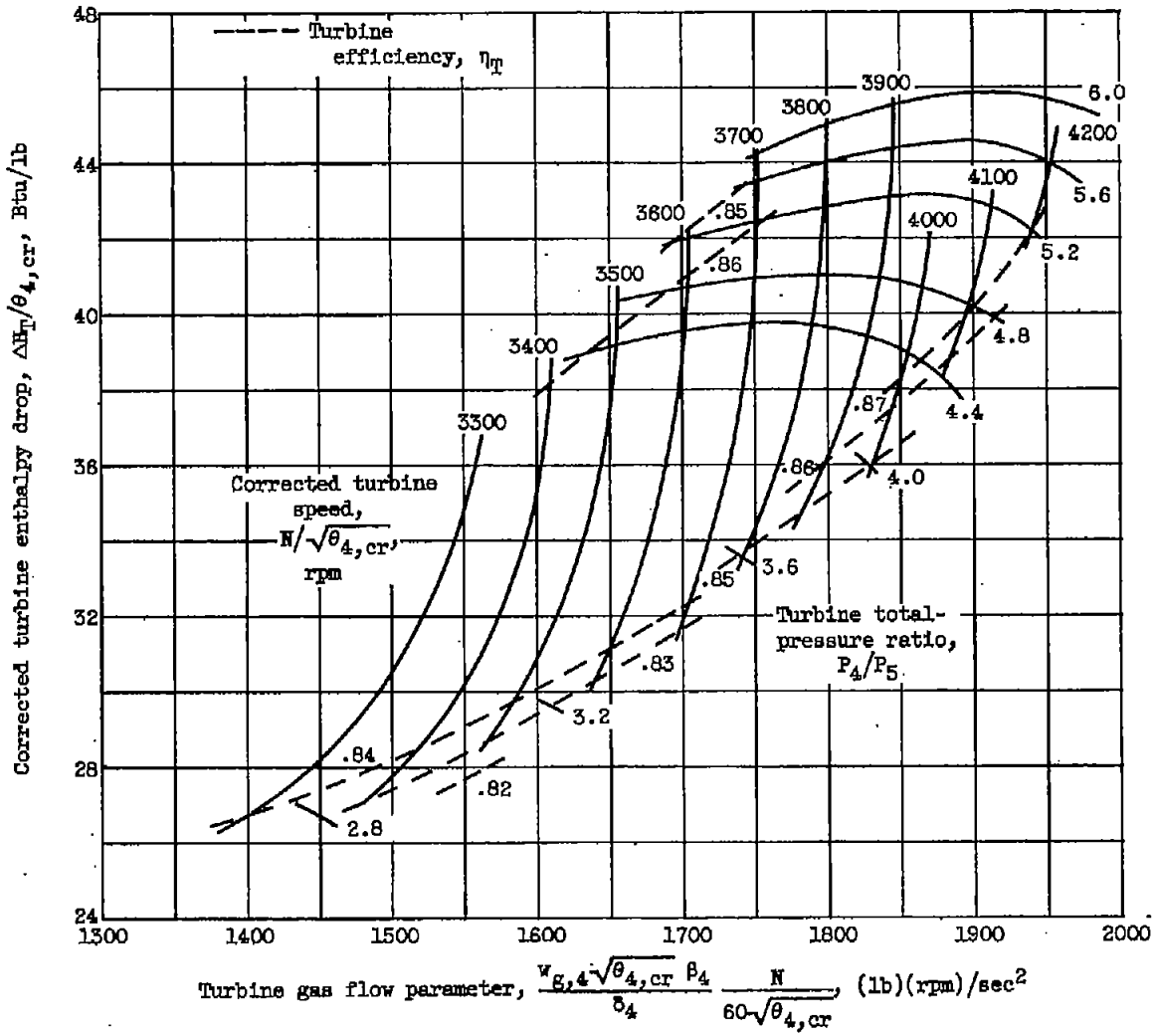
(a) Turbine-inlet Reynolds number index, 1.04 to 1.41.

Figure 10. - Turbine performance maps.



(b) Turbine-inlet Reynolds number index, 0.29 to 0.43.

Figure 10. - Continued. Turbine performance maps.



(c) Turbine-inlet Reynolds number index, 0.13 to 0.19.

Figure 10. - Concluded. Turbine performance maps.

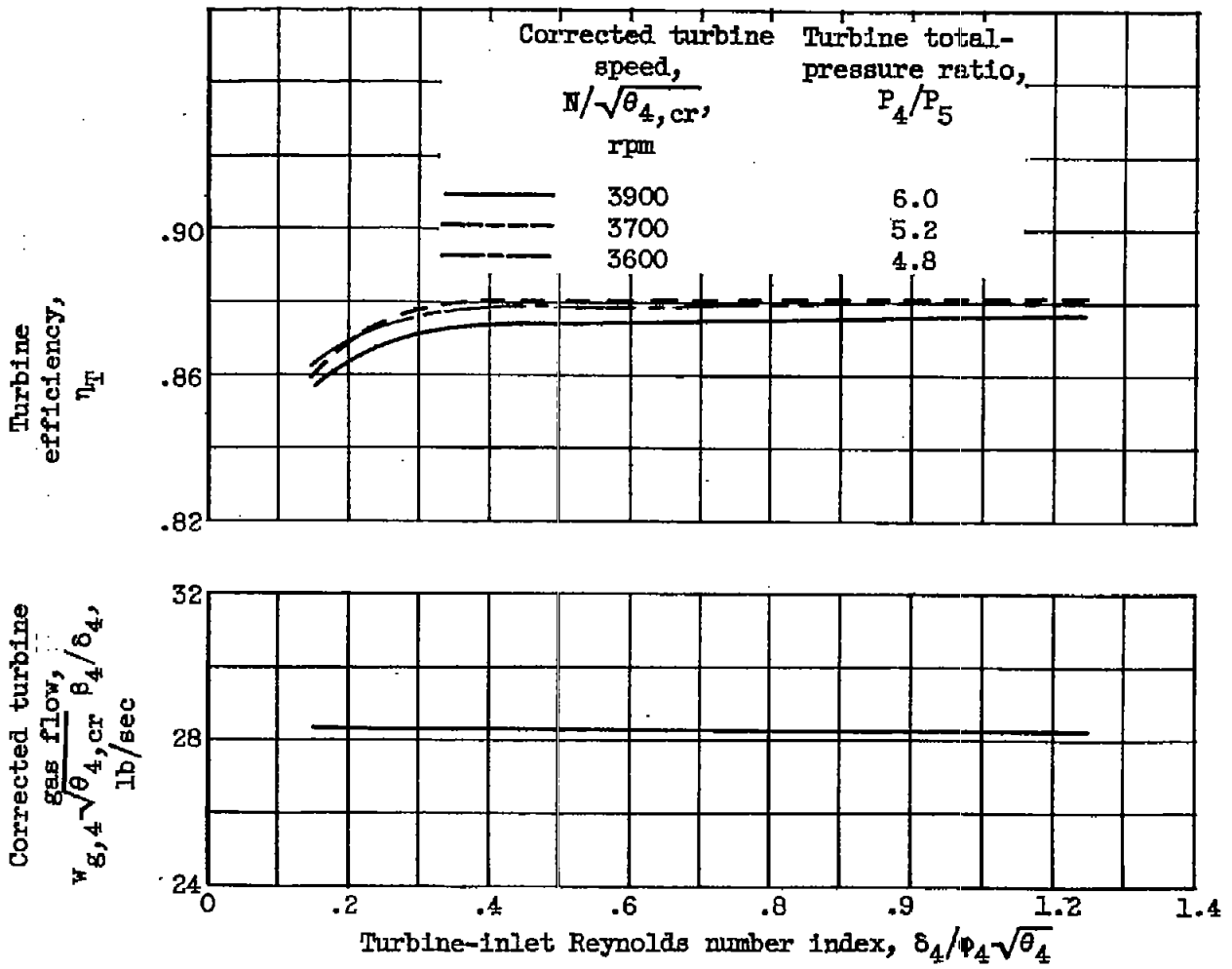


Figure 11. - Reynolds number effects on turbine performance.

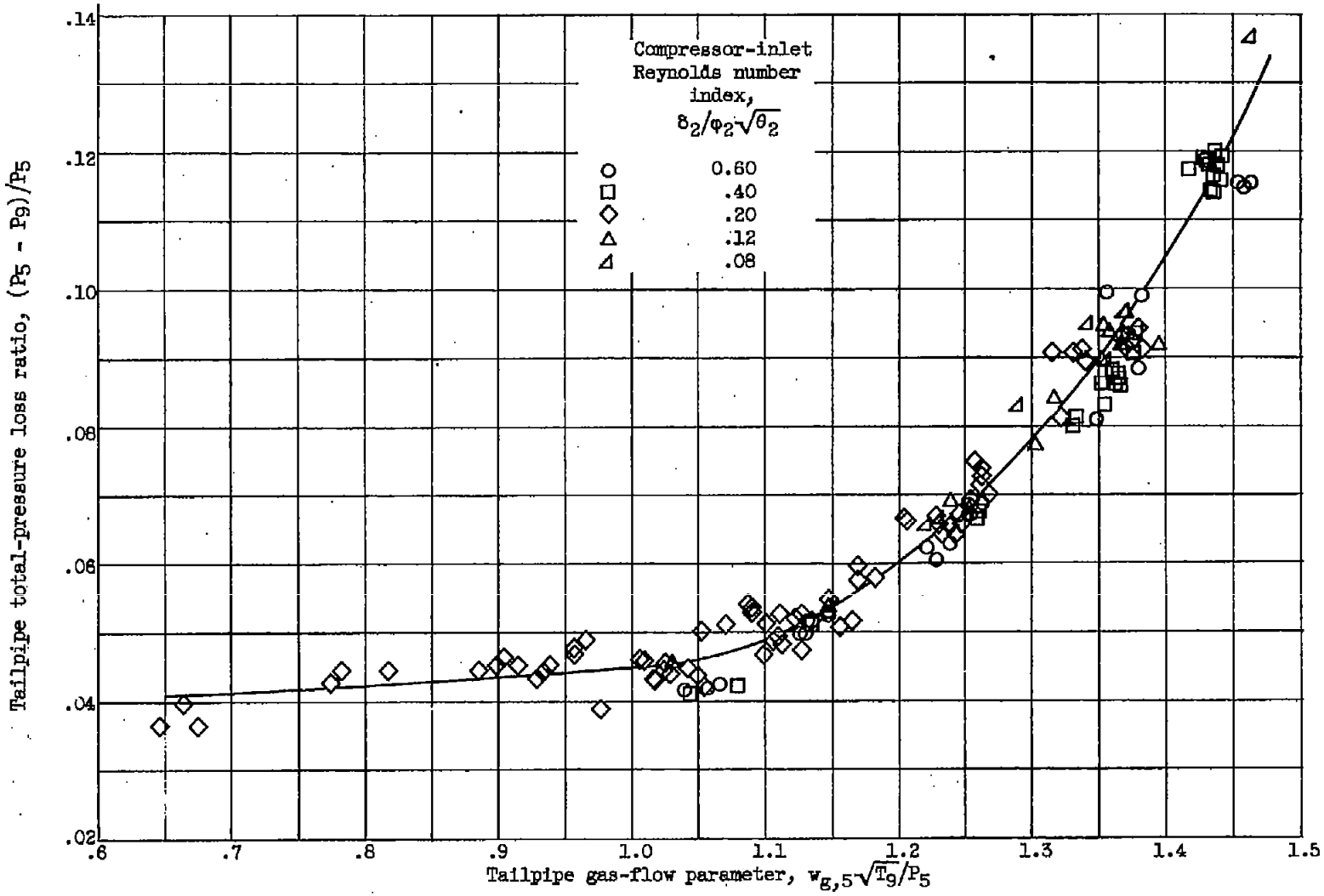


Figure 12. - Tailpipe total-pressure loss.

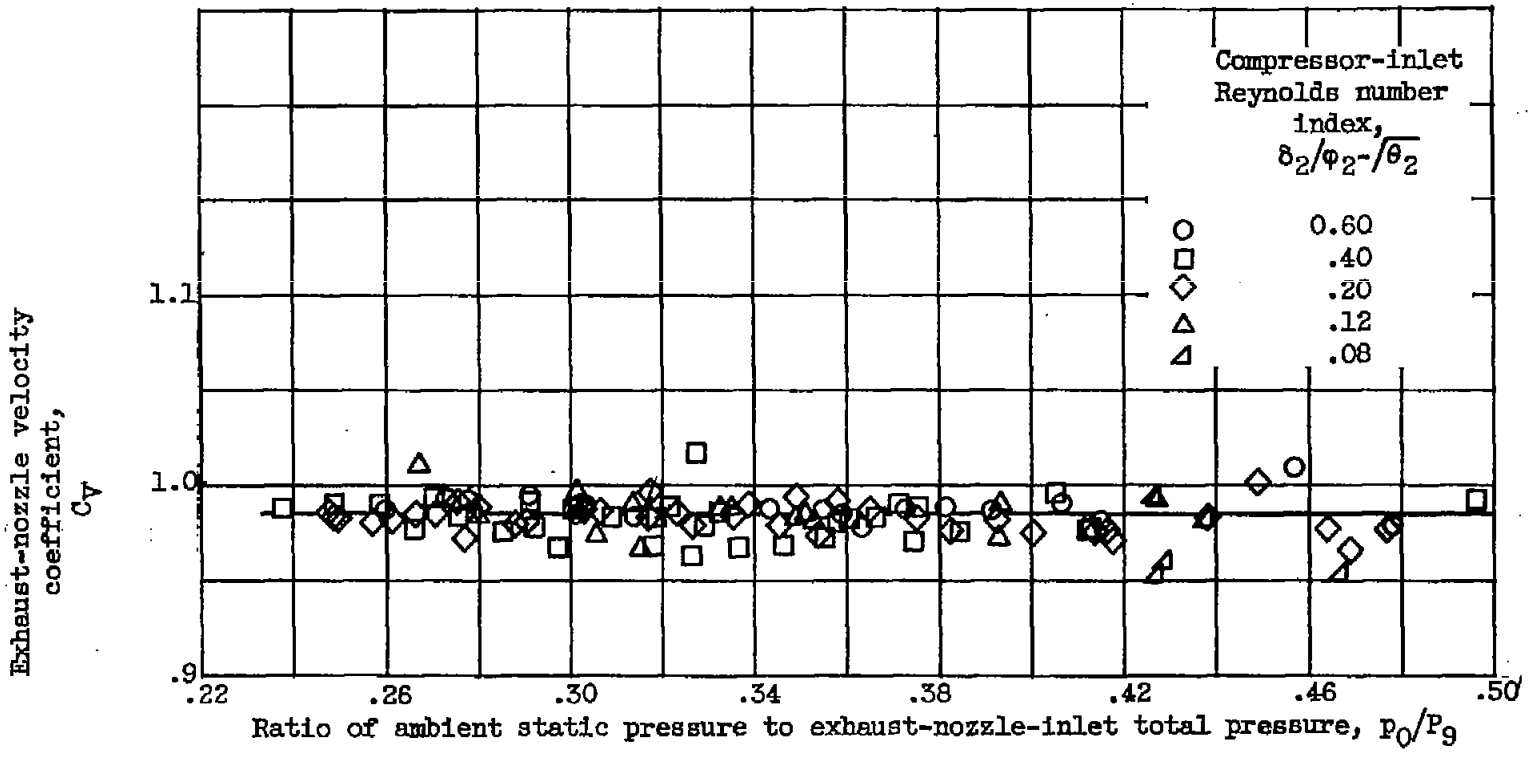


Figure 13. - Exhaust-nozzle velocity coefficient.

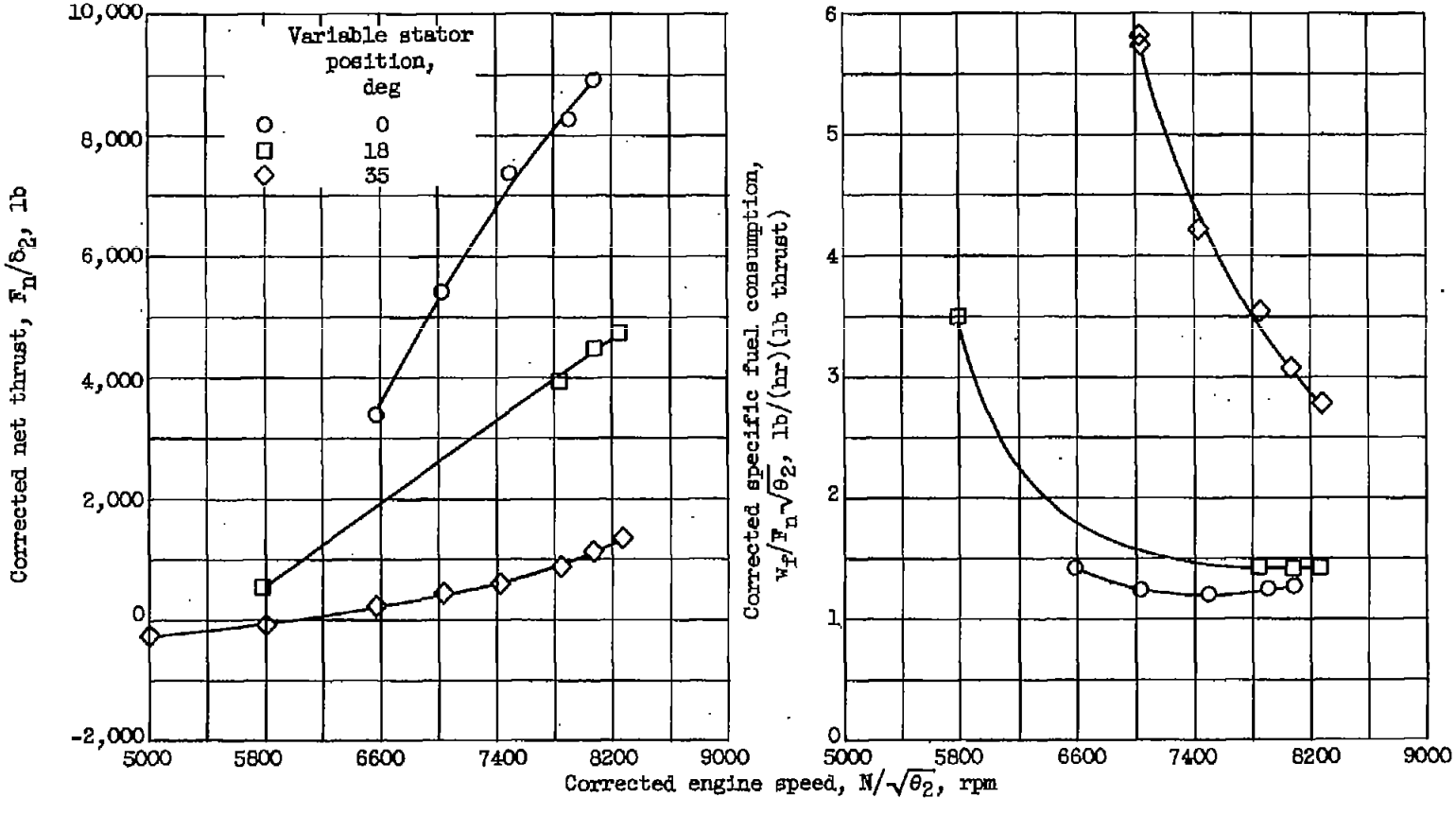
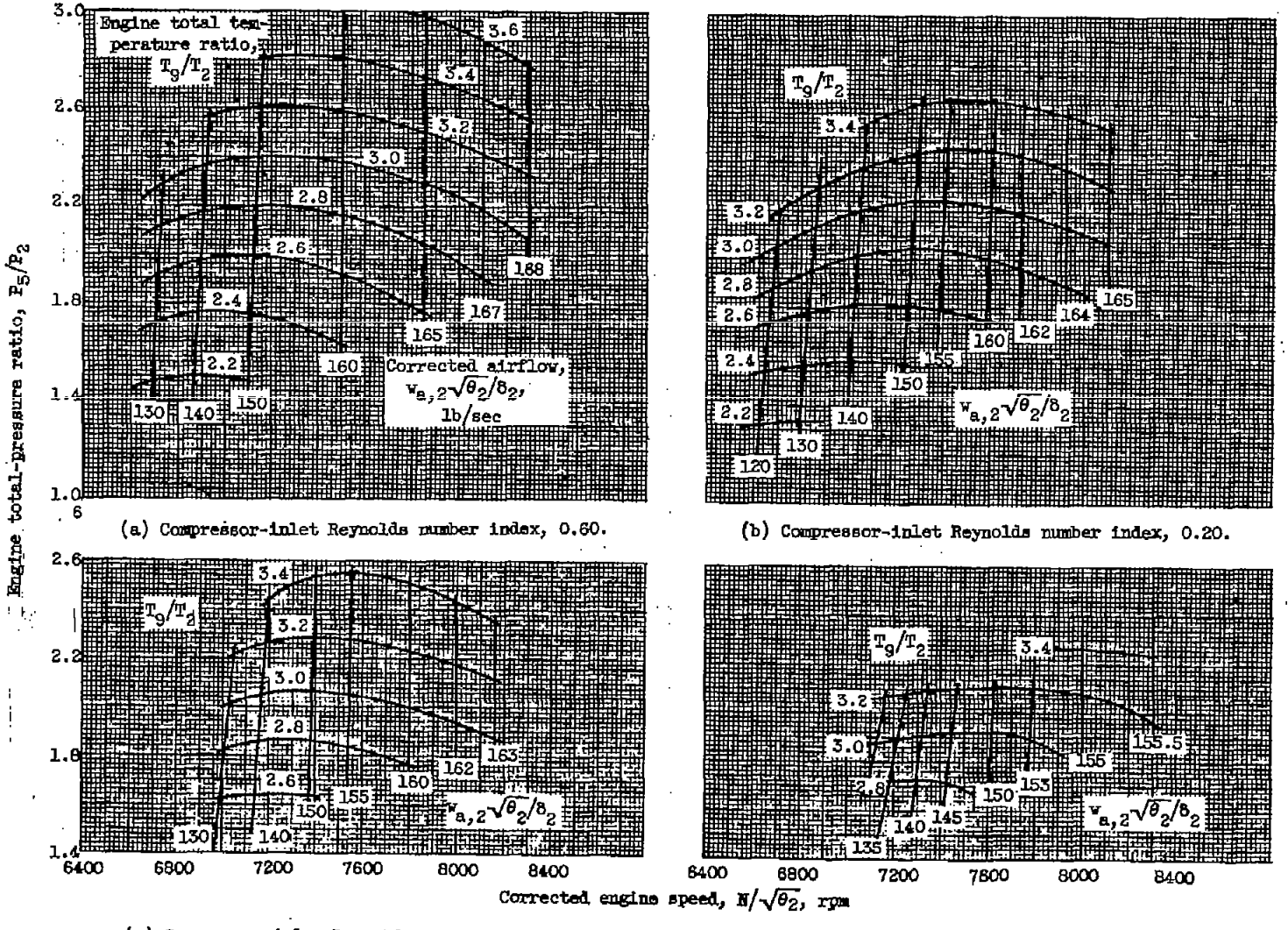


Figure 14. - Effect of variable stator position on engine performance. Flight Mach number, 0.77; exhaust-nozzle area, 2.83 square feet.



(a) Compressor-inlet Reynolds number index, 0.60.

(b) Compressor-inlet Reynolds number index, 0.20.

(c) Compressor-inlet Reynolds number index, 0.12.

(d) Compressor-inlet Reynolds number index, 0.08.

Figure 15. - Engine pumping characteristics.

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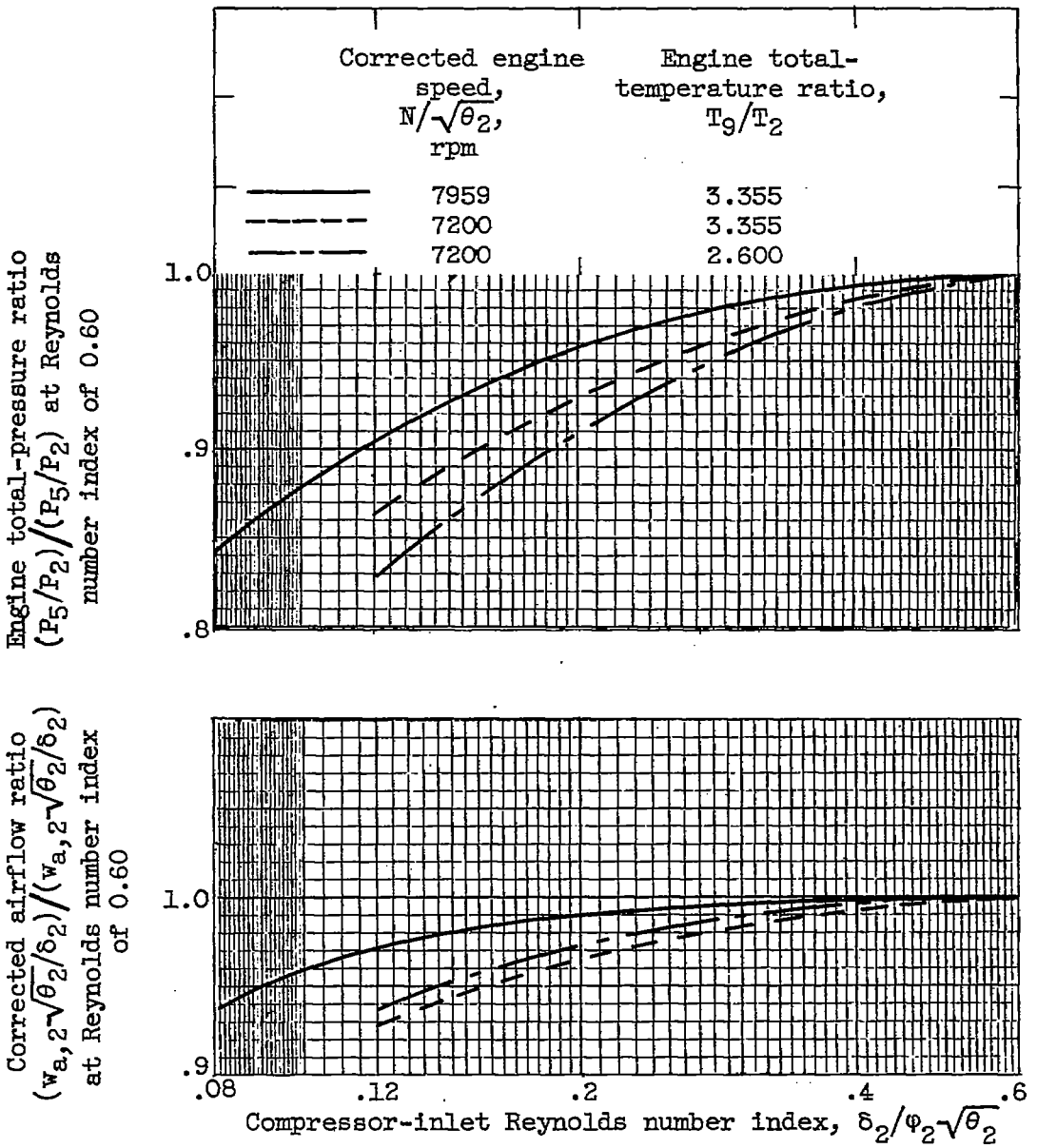

Figure 16. - General trend of engine pumping data with Reynolds number index.

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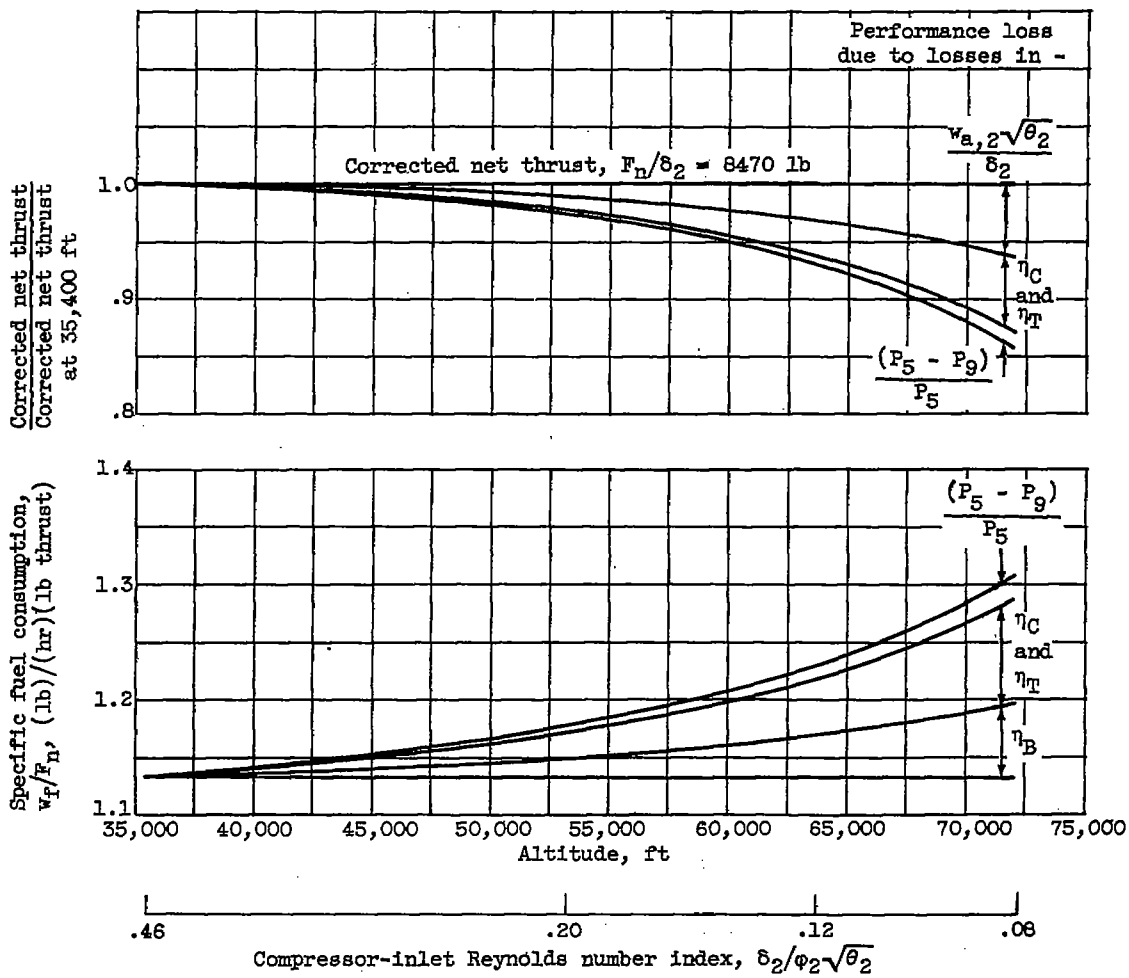

Figure 17. - Effect of individual component performance on over-all engine performance over range of altitudes. Flight Mach number, 0.9; engine speed, 7460 rpm; exhaust-gas total temperature, 1530° R.

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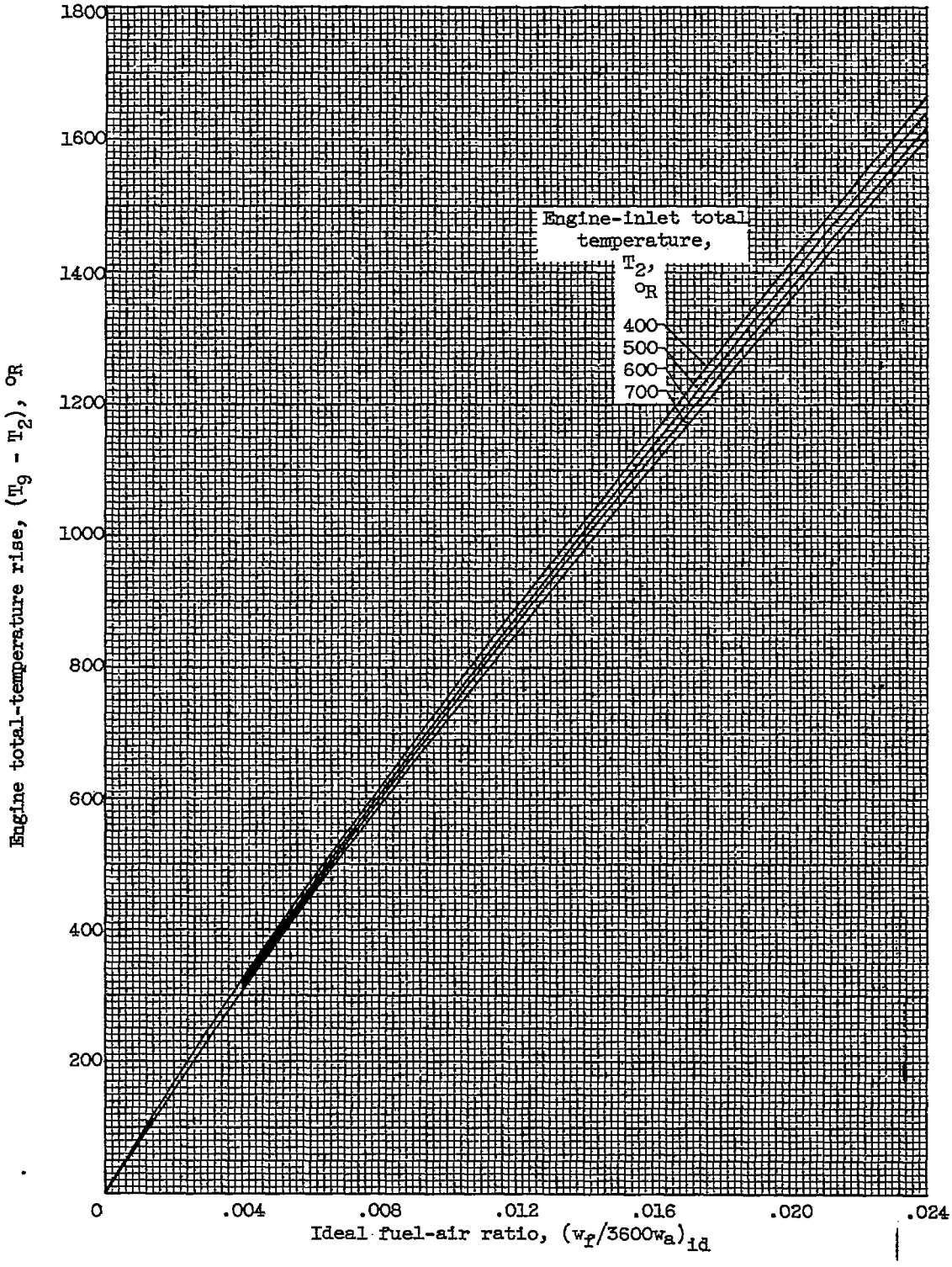

Figure 18. - Ideal fuel-air ratio for fuel used in this investigation.

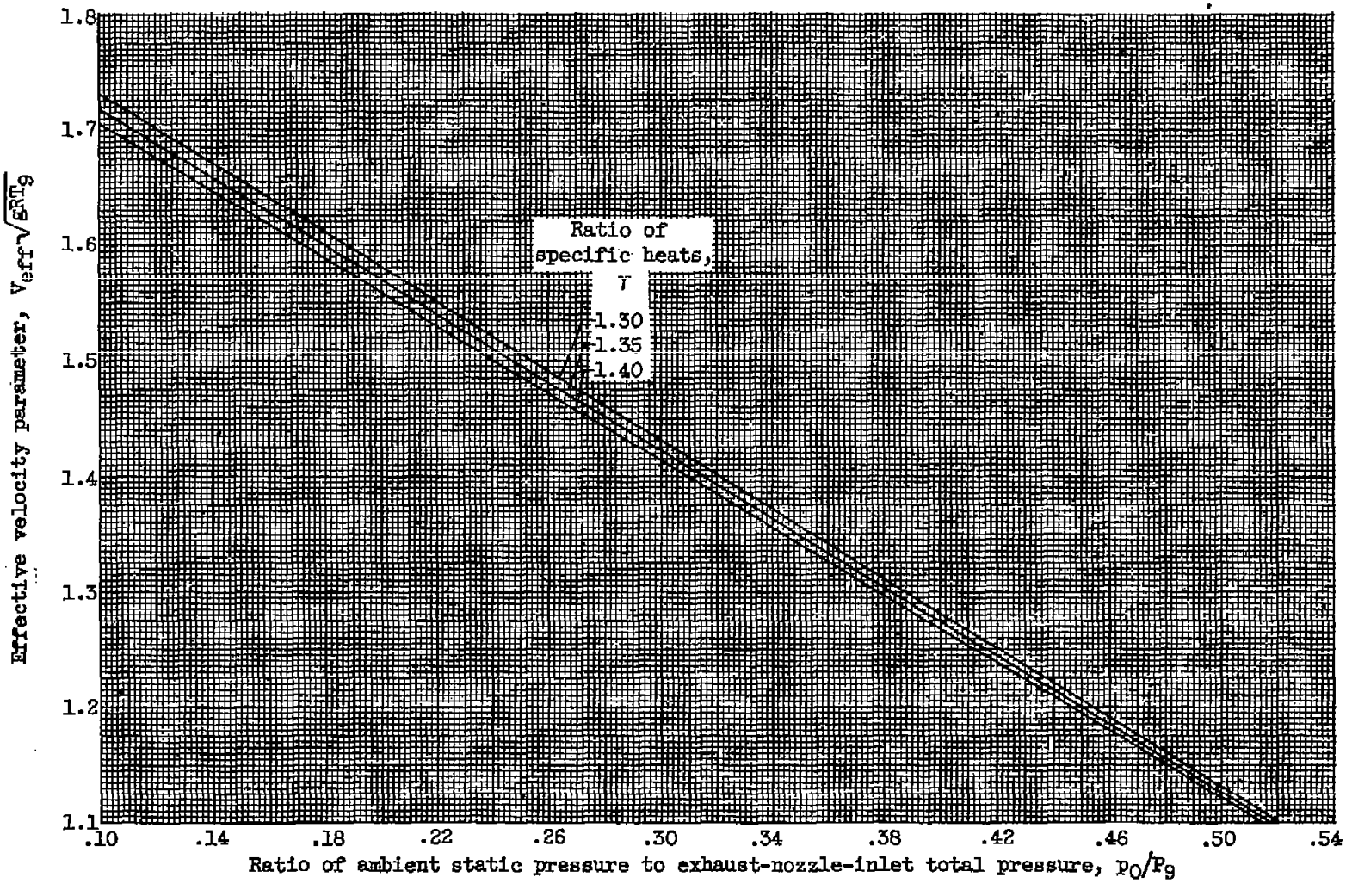

Figure 19. - Effective velocity parameter.

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