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EFFECTS OF INCREASED LEADING-EDGE THICKNESS ON PERFORMANCE OF A TRANSONIC ROTOR BLADE

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16. Abstract

A single-stage transonic compressor was tested with two rotor blade leading-edge configurations to investigate the effect of increased leading-edge thickness on the performance of a transonic blade row. The original rotor blade configuration was modified by cutting back the leading edge sufficiently to double the blade leading-edge thickness and thus the blade gap blockage in the tip region. At design speed this modification resulted in a decrease in rotor overall peak efficiency of four points. The major portion of this decrement in rotor overall peak efficiency was attributed to the flow conditions in the outer 30 percent of the blade span. At 70 and 90 percent of design speed, the modification had very little effect on rotor overall performance.

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EFFECTS OF INCREASED LEADING-EDGE THICKNESS ON PERFORMANCE OF A TRANSONIC ROTOR BLADE

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SUMMARY

A single-stage transonic compressor was tested with two rotor blade leading-edge configurations to investigate the effect of increased leading-edge thickness on the performance of a transonic blade row. The original rotor configuration was tested with a blade leading-edge thickness that resulted in a blade gap blockage of approximately 3 percent at the tip and increased to about 4 percent at the rotor hub. The original rotor blade was modified by cutting back the leading edge sufficiently to double the blade leading edge thickness, and thus the blade gap blockage (3 to 6 percent), in the tip region.

At design speed this modification resulted in a decrease in rotor overall peak efficiency of four points. The major portion of this decrement in rotor overall peak efficiency could be attributed to the flow conditions in the outer 30 percent of the blade span. At 70 and 90 percent of design speed, the modifications had a small effect on the overall performance.

The suction-surface blade angles for the modified rotor blades are less than those for the original rotor blades, and thus for the same inlet-flow conditions the modified rotor operates at higher suction-surface incidence angles. The major portion of the increase in total loss for the thicker leading-edge (modified) blade configuration could be attributed to the increase in suction-surface incidence angle along the characteristic curves of losses versus suction-surface incidence angle for the original rotor configuration. This implies that lower losses could be obtained if the thicker leading-edge configuration was designed to operate at lower suction-surface incidence angles.

INTRODUCTION

A research program on axial-flow fans and compressors for advanced airbreathing engines is currently being conducted at Lewis. The basic objective of this program is to provide new technology to permit reducing the size and weight of fans and compressors while maintaining a high level of performance. In support of the program experimental studies are being conducted to determine the effects of blade shape, solidity, aspect ratio, blade loading, and choke margin on efficiency and stall margin.

Results from this research program have demonstrated that transonic rotors can operate at high inlet relative Mach numbers and still achieve good efficiency and acceptable stall margin (refs. 1 and 2). This improvement in transonic rotor performance is mainly a result of proper considerations for the blade entrance region and throat area in determining the design blade shape.

A large number of present day aircraft engine designs utilize compressors with transonic rotors. For aircraft engines designed for low thrust (less than 4000 newton), the physical dimensions of the compressors are relatively small (10 to 20 cm diam). The leading edges of the rotor blades for this class of compressors may become relatively blunt due to manufacturing tolerance. Even for compressors sufficiently large in physical dimensions such that manufacturing tolerance is not a problem, the leading edges of the rotor blades may become relatively blunt during their service life due to foreign object damage and erosion by small particles. The objective of this investigation is to determine experimentally the effect of increased leading edge thickness on the performance of a transonic rotor blade. The stage used in this investigation is designated as stage 14-10 (rotor 14, stator 10). The design rotor inlet tip speed and relative Mach number are 423 meters per second and 1.4, respectively. The aerodynamic design and the overall and blade-element performance for the original configuration of this stage is reported in reference 1. For this investigation, the leading edges of the blades for rotor 14 were modified (cut back to increase leading edge thickness), and the modified rotor is designated herein as rotor 14-mod 1.

Overall and blade-element performance are compared for the two rotor configurations (rotor 14 and rotor 14-mod 1) at 70, 90, and 100 percent of design speed. The tests were conducted in the single-stage compressor facility at Lewis.

APPARATUS AND PROCEDURE

Compressor Test Facility

The compressor stage was tested in the single-stage compressor facility (fig. 1). Atmospheric air enters the test facility at an inlet located on the roof of the building and flows through the flow measuring orifice and into the plenum chamber upstream of the rotor. The air then passes through the experimental compressor stage into the collector and is exhausted to the atmosphere.

Test Stage

The aerodynamic design of the original stage is presented in reference 1. The overall design parameters are presented in table I. The design blade-element parameters are presented in tables II and III for the rotor and stator. The blade geometry for rotor 14 and stator 10 are presented in tables IV and V. The symbols used in this report are defined in appendix A. The equations used for calculating the overall blade-element performance parameters are presented in appendix B. The flow path is the same for both rotor configurations and is shown in figure 2. Photographs of the rotor and stator are shown in figures 3 and 4.

The original rotor configuration (rotor 14) was modified by cutting back the blade leading edges. The modified rotor configuration is herein designated as rotor 14-mod 1. The axial extent of the cutback was approximately 0.325 centimeter at the tip, and the cutback decreased linearly to zero at the hub (fig. 5). This was done by machine cutting and rounding the leading edges by hand filing. The general shape of the leading edge contour is also shown in figure 5 for blade sections at approximately 5 and 70 percent span (from tip) for both rotor 14 and rotor 14-mod 1. The rotor blade leading edge was cut back sufficiently at the tip to double the leading edge thickness and thus the blade gap blockage. The blade gap blockage is defined herein as that fraction of the blade gap occupied by the leading edge thickness (fig. 6). The blade gap blockage was increased from 3 to 6 percent at the blade tip and remained at approximately 4 percent at the hub.

Instrumentation

The compressor weight flow was determined from measurements on a calibrated thin-plate orifice that was 38.9 centimeters in diameter. The orifice temperature was determined from an average of two Chromel-Alumel thermocouples. Orifice pressures were measured by calibrated transducers.

Radial surveys of the flow were made upstream of the rotor, between the rotor and stator, and downstream of the stator. The survey probes are shown in figure 7. Total pressure, total temperature, and flow angle were measured with the combination probe (fig. 7(a)), and static pressure was measured with an 8° C-shaped wedge probe (fig. 7(b)). Each probe was positioned with a null-balancing, stream-directional sensitive control system that automatically alined the probe to the direction of flow. The thermocouple was iron/constantan. The probes were calibrated in an air tunnel. Two combination probes and two wedge static probes were used at each of the three measuring stations.

Inner and outer wall static pressure taps were located at the same axial stations as the survey probes. The circumferential locations of both types of survey probes along with inner and outer wall static pressure taps, are shown in figure 8. The combination probes downstream of the stator (station 3) were circumferentially traversed one stator blade passage (7.5°) counterclockwise from the nominal values shown.

An electronic speed counter, in conjunction with a magnetic pickup, was used to measure rotative speed (rpm).

The estimated errors of the data based on inherent accuracies of the instrumentation and recording system are as follows:

Weight flow, kg/sec	±0.3
Rotative speed, rpm	±30
Flow angle, deg	±1
Temperature, K	±0.6
Rotor inlet total pressure, N/cm^2	±0.01
Rotor outlet total pressure, N/cm^2	±0.10
Stator outlet total pressure, N/cm^2	±0.10
Rotor inlet static pressure, N/cm^2	±0.04
Rotor outlet static pressure, N/cm^2	±0.07
Stator outlet static pressure, N/cm^2	±0.07

Test Procedure

The stage survey data were taken over a range of weight flows at 70, 90, and 100 percent of design speed. Radial surveys were taken at three weight flows at 70 and 90 percent of design speed and at four weight flows at 100 percent of design speed. Data were recorded at 11 radial positions for each speed and weight flow.

At each radial position the two combination probes behind the stator were circumferentially traversed to nine different locations across the stator gap. Values of pressure, temperature, and flow angle were recorded at each circumferential position. At the last circumferential position, values of pressure, temperature, and flow angle were also recorded at stations 1 and 2. The wedge probes were set at midgap because previous studies showed that the static pressure across the stator gap was essentially constant. All probes were then traversed to the next radial position and the circumferential traverse procedure repeated.

At each of the rotative speeds the back pressure on the stage was increased by closing the sleeve valve in the collector until a stalled condition was detected by a sudden drop in stage outlet total pressure. This pressure was measured by a probe located at midpassage and was recorded on an X-Y plotter. Stall was corroborated by large increases in the measured blade stresses on both rotor and stator, along with a sudden increase in noise level.

Calculation Procedure

Measured total pressures, static pressures, and temperatures were corrected for Mach number and streamline slope based on an average calibration for the type of probe used.

Because of the physical construction of the C-shaped static pressure wedges, it was not possible to obtain static pressure measurements at 5-, 10-, and 95-percent span from the blade tip. The static pressure at 95-percent span was obtained by assuming a linear variation in static pressure between the values at the inner wall and the probe measurement at 90-percent span. A linear variation was also assumed between the static-pressure measurements at the outer wall and the 30-percent span to obtain the static pressure at 5- and 10-percent span.

At each radial position averaged values of the nine circumferential measurements of pressure, temperature, and flow angle downstream of the stator (station 3) were obtained. The nine values of total temperature were mass averaged to obtain the stator outlet total temperature presented. The nine values of total pressure were energy averaged. The measured values of pressure, temperature, and flow angle were used to calculate axial and tangential velocities at each circumferential position. The flow angles presented for each radial position are calculated based on these mass-averaged axial and tangential velocities. To obtain the overall performance, the radial values of total temperature were mass averaged and the values of total pressure were energy averaged. At each measuring station, the integrated weight flow was computed based on the radial survey data.

The data, measured at the three measuring stations, have been translated to the blade leading and trailing edges by the method presented in reference 2.

Orifice weight flow, total pressures, static pressures, and temperatures were all corrected to sea-level conditions based on the rotor inlet conditions.

RESULTS AND DISCUSSION

The results of this investigation are presented in terms of overall performance, radial distributions of performance parameters and blade-element performance. The overall performance for the two rotor configurations (rotor 14 and rotor 14-mod 1) are compared at 70, 90, and 100 percent of design speed. The radial distributions of several performance parameters are compared at the peak efficiency condition for each rotor configuration at design speed. Blade-element performance for the two rotor configurations are compared at 70, 90, and 100 percent of design speed for the 5, 10, 30, and 70 percent span locations. Values of total loss coefficient are presented as a function of mean camber line incidence angle as well as suction-surface incidence angle to evaluate the effect of increased suction-surface incidence angle for the same inlet flow conditions.

Since the same stator vanes are used with both rotor configurations, no comparison of stator or stage performance is made. All of the overall performance and blade-element data for the stage 14-mod 1-10 are presented in tabular form in tables VI to VIII. The definitions and units used for the tabular data are presented in appendix C.

Performance Comparisons

Overall performance. - A comparison of the overall performance for rotor 14 and rotor 14-mod 1 at 70, 90, and 100 percent of design speed is presented in figure 9. Although the modified blade leading-edge configuration was detrimental to the rotor performance at all speeds, at 70 and 90 percent of design speed the effect was small.

At design speed the total pressure ratio, total temperature ratio, and adiabatic efficiency for rotor 14-mod 1 are significantly lower than that for rotor 14 over the entire flow range. The decrease in efficiency varies from about two points (0.84 to 0.82) at the near-stall condition to approximately four points (85 to 81) at the maximum flow condition.

The peak efficiencies for rotor 14 and rotor 14-mod 1 were 0.87 and 0.83, respectively; corresponding weight flows were 29.61 and 28.30 kilograms per second. At peak efficiency conditions the pressure ratio was approximately 1.78 for both rotor configurations.

Radial distributions. - Comparison of radial distributions of total pressure ratio, element efficiency, total temperature ratio, and incidence angle with respect to the mean camber line are presented in figure 10 for the two rotor configurations for peak efficiency conditions at design speed. This comparison is made in an effort to show how the difference in overall rotor peak efficiency for the two rotor configurations manifests itself in terms of the radial distributions of these performance parameters.

The pressure ratio for rotor 14 is slightly higher than that for rotor 14-mod 1 in the tip region, but slightly lower in the hub region. Except at the 95-percent-span location, the element efficiency for rotor 14 is higher than that for rotor 14-mod 1 over the entire blade span. This difference in efficiency is about eight points at the 5- and 10-percent span locations and about four points at 30-percent span. The total temperature ratio and the mean incidence angles for rotor 14-mod 1 are consistently higher than those for rotor 14.

These comparisons of radial distributions of performance parameters indicate that the major portion of the decrement in overall peak efficiency for rotor 14-mod 1 can be attributed to the flow conditions in the outer 30 percent of the blade span. The higher mean incidence angles for rotor 14-mod 1 are indicative of the lower weight flow.

Blade-element performance. - Blade-element performance is presented as a function of mean-camber-line incidence angle for the two rotor configurations in order to compare performance parameters of a given blade element at the same inlet flow conditions.

Total pressure ratio, total temperature ratio, adiabatic efficiency, loss coefficient, and diffusion factor are presented as a function of mean-camber-line incidence angle in figure 11 for the two rotor configurations. Data are presented for 70, 90, and 100 percent of design speed, at 5, 10, 30, and 70 percent span (from the rotor tip).

At design speed total pressure ratio and efficiency for rotor 14 (the original rotor configuration) are higher than that for rotor 14-mod 1 (increased blade leading edge thickness) at 5, 10, and 30 percent span for a given mean incidence angle. At 70 percent span, rotor 14 has a higher pressure ratio than rotor 14-mod 1 but the efficiencies are approximately the same. The peak element efficiency for rotor 14 is eight points higher than that for rotor 14-mod 1 at both 5 and 10 percent span and about three points higher at 30 percent span. Total temperature ratio for rotor 14 is higher than that for rotor 14-mod 1 for a given mean incidence angle at all corresponding elements (5, 10, 30, and 70 percent span). This difference in temperature ratio is largest at the low incidence angles and decreases as incidence angle increases. The loss coefficient for rotor 14-mod 1 is higher than that for rotor 14 at the same incidence angle (fig. 11) for both 5- and 10-percent span blade elements. For the 30- and 70-percent span elements, the loss coefficient, for a given mean incidence angle, is about the same for the two rotor configurations.

At 90 percent of design speed, there is good agreement in the comparison of blade-element total pressure and total temperature ratios and efficiencies for all of the radial locations. At 70 percent of design speed there is seemingly good agreement in the comparison of blade-element total pressure and total temperature ratios for all radial locations. However, at the 5- and 10-percent span locations, rotor 14-mod 1 has higher losses and lower efficiency than rotor 14. The lower energy level at the 70 percent design speed combined with the seemingly small differences in total pressure and total temperature ratios results in appreciable differences in total loss coefficient and efficiency.

Effects of Increased Leading Edge Thickness

Increased suction-surface incidence angles. - Because of the manner in which the blade leading edges were modified, rotor 14-mod 1 has lower leading-edge suction-surface blade angles than rotor 14 (fig. 12). Therefore, for the same inlet flow conditions, rotor 14-mod 1 operates at higher suction-surface incidence angles. To evaluate the effect of the increase in suction-surface incidence angle, the total loss coefficient is presented as a function of suction-surface incidence angle in figure 13. The data are presented for 70, 90, and 100 percent of design speed at 5, 10, 30, and 70 percent span (from rotor tip) for the two rotor configurations.

For design speed at the 5, 10, 30, and 70 percent span locations, the blade elements for rotor 14-mod 1 operate along the same general incidence angle (suction surface) loss characteristics as corresponding elements for rotor 14. For the 5- and 10-percent span blade elements, this means a substantial change in loss coefficient for a moderate (1^{o}) change in suction-surface incidence angle. This is due to the steep slope of the incidence-angle - loss curves for blade elements at these two span locations. At 30 and 70 percent span (fig. 13), the slope of the incidence angle-loss curves are small; consequently the increase in loss coefficient due to an increase in suction-surface incidence angle is reduced. Thus at design speed, the major portion of the increase in loss for rotor 14-mod 1 (increased blade leading edge thickness) as compared with rotor 14 can be attributed to operating at a higher suction-surface incidence angle for the same inlet flow conditions.

At 90 percent design speed the two rotor configurations operate along different suction-surface incidence-angle - loss curves. For a given suction-surface incidence angle (fig. 13), the loss coefficient for rotor 14-mod 1 is less than that for rotor 14. These data indicate that for the same inlet flow conditions, there is little or no increase in loss coefficient as a result of operating at the higher suction surface incidence angles.

At 70 percent design speed, the characteristic curves for the rotor configurations are the same for the 5- and 10-percent span elements, but are somewhat different at 30- and 70-percent span elements. For the same inlet flow conditions there is an increase in loss coefficient as a result of operating at a higher suction-surface incidence angle at the 5 and 10 percent spans, but at the 30 and 70 percent spans there is little change.

The largest difference in blade leading edge thickness for the two rotor configurations is in the region of the blade tip. For a given blade loading the losses are usually highest in this region of the blade due to end-wall effects. Thus it is expected that the largest difference in element performance for the two rotor configurations would occur in the tip region of the blade. At design speed there is a substantial change in total loss coefficient due to the change in suction-surface incidence angle in the tip region. The tip region. The tip inlet relative Mach number is approximately 1.4 at design speed. For this high supersonic inlet relative Mach number, it can be expected that the losses in the tip region could be very sensitive to relatively small changes in suction-surface incidence angles. At 90 percent of design speed there is little or no change in total loss coefficient in the tip region due to the increase in suction-surface incidence angle. Even though the flow is still supersonic in the tip region, the inlet relative Mach number (approximately 1.2) is apparently low enough that the losses in this region are no longer as sensitive to the relatively small changes in suction surface incidence angle. The 90-percent of design speed results lead us to expect that losses in the tip region would also be insensitive to relatively small changes in suction-surface incidence angles at 70 percent of design speed, since the inlet relative Mach number is subsonic. The fact that the data show an increase in total loss coefficient in the tip region as a result of an increase in suction-surface incidence at 70 percent design speed could be the result of measurement inaccuracies at the low level of energy input where seemingly small differences in total pressures and total temperatures can result in appreciable differences in total loss coefficient.

Increase bow-wave strength. - An increase in blade leading-edge thickness results in a stronger external bow-wave system for supersonic inlet relative Mach numbers. A technique for calculating total pressure loss due to an external bow-wave system was developed by Klapproth in reference 3. The technique is based on a hyperbolic approximation to the form of the bow-wave system caused by the blade leading edges. The calculated loss using this technique varies linearly with leading edge thickness, or blockage, for a given supersonic inlet relative Mach number. The total loss coefficient caused by an external bow-wave system was computed, based on the technique presented in reference 3, and is shown in figure 14 as a function of leading edge blockage for an inlet relatively Mach number of 1.4.

Rotor 14 and rotor 14-mod 1 have leading-edge blockages of approximately 3 and 6 percent, respectively, at the 5 percent span location. The inlet relative Mach number at 5 percent span at design speed is approximately 1.4. From figure 14 the increase in loss coefficient for the difference in blockage (3 to 6 percent) is approximately 0.006. This is a relatively small change compared with the magnitude of the total loss coefficient (0.22 to 0.37) in this region of the blade at design speed.

CONCLUDING REMARKS

In the present investigation the suction-surface leading edge blade angle, for the modified rotor blades (increased leading edge thickness), are less than those for the original blade. Thus, for the same inlet-flow conditions, the modified rotor blades operated at a higher suction-surface incidence angle. At design speed, the major portion of the increase in total loss for the thicker leading edge blade could be attributed to the increase in suction-surface incidence angle along the suction-surface incidence angle loss characteristic curves for the original blade (rotor 14). This implies that lower losses could be obtained if the thicker leading-edge blade were designed to operate at lower suction-surface incidence angles. However, experimental verification requires that a blade with the thick leading-edge configuration be tested at lower suction-surface incidence angles. The modified rotor configuration could not be tested at the lower suction-surface incidence angles because this would require a weight flow larger than the maximum flow for the original configuration. The larger weight flow could not be obtained with the modified configuration because of the higher losses.

Although the data for rotor 14-mod 1 does not cover as complete a range of suction-surface incidence angles as rotor 14, it does indicate the importance of proper selection of suction-surface incidence angle for blade elements with supersonic inlet relative Mach numbers. These data also provide some general guidelines for evaluating the change in performance of a transonic rotor that results from an alteration of the blade leading edges.

SUMMARY OF RESULTS

A compressor rotor blade row, with a design tip speed of 423 meters per second and a tip inlet relative Mach number of 1.4, was tested with two leading-edge configurations to investigate the effects of increased blade leading edge thickness on the performance of a transonic blade row. The rotor was first tested with a blade leading-edge thickness that resulted in a blade gap blockage of approximately 3 percent at the tip and increased to about 4 percent at the rotor hub. The rotor blade leading edge was then cut back to produce a leading edge thickness that resulted in a blade gap blockage of about 6 percent at the tip and decreased to about 4 percent at the hub. The investigation yielded the following principle results.

1. The increase in the blade leading-edge thickness resulted in a decrease in rotor peak efficiency of about four points at design speed, but had very little effect on efficiency at 70 and 90 percent design speed.

2. The major portion of the decrement in overall peak efficiency at design speed can be attributed to the outer 30 percent of the blade span. The decrement in blade-element efficiency was about eight points at 5 and 10 percent span and about four points at 30 percent span.

3. At design speed corresponding blade elements for both rotor configurations operated along the same general curve of loss against suction-surface incidence angle. Thus

the increase in loss as a result of increased leading-edge thickness was small compared with the increase in loss as a result of operating at larger suction-surface incidence angles.

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APPENDIX A

SYMBOLS

A_{an} annulus area at rotor leading edge, 0.147 m^2

A_f frontal area at rotor leading edge, 0.198 m^2

C_p specific heat at constant pressure, 1004 J/(kg)(K)

D diffusion factor

g acceleration of gravity, 9.8 m/sec^2

i_{mc} mean incidence angle, angle between inlet air direction and line tangent to blade mean camber line at leading edge, deg

i_{ss} suction-surface incidence angle, angle between inlet air direction and line tangent to blade suction surface at leading edge, deg

J mechanical equivalent of heat

N rotative speed, rpm

P total pressure, N/cm^2

p static pressure, N/cm^2

r radius, cm

T total temperature, K

U wheel speed, m/sec

V air velocity, m/sec

W weight flow, kg/sec

Z axial distance reference from rotor blade hub leading edge, cm

α_c cone angle, deg

α_s slope of streamline, deg

β air angle, angle between air belocity and axial direction, deg

β'_c relative meridional air angle based on cone angle, arctan ($\tan \beta'_m \cos \alpha_c / \cos \alpha_s$), deg

γ ratio of specific heats (1.4)

δ ratio of rotor inlet total pressure to standard pressure of 10.13 N/m^2

δ deviation angle, angle between exit air direction and tangent to blade mean camber line at trailing edge, deg

θ ratio of rotor inlet total temperature to standard temperature of 288.2 K

η efficiency

κ_{mc} angle between the blade mean camber line and the meridional plane, deg

k_{ss} angle between the blade suction-surface camber line at the leading edge and the meridional plane, deg

σ solidity, ratio of chord to spacing

$\overline{\omega}$ total loss coefficient

$\overline{\omega}_p$ profile loss coefficient

$\overline{\omega}_s$ shock loss coefficient

Subscripts:

ad adiabatic (temperature rise)

id ideal

LE blade leading edge

m meridional direction

mom momentum rise

p polytropic

TE blade trailing edge

z axial direction

θ tangential direction

1 instrumentation plane upstream of rotor

2 instrumentation plane between rotor and stator

3 instrumentation plane downstream of stator

Superscript:

' relative to blade

APPENDIX B

EQUATIONS

Performance parameters are defined as follows:

Suction surface incidence angle -

$$i_{ss} = \left(\beta_c'\right)_{LE} - \kappa_{ss} \tag{B1}$$

Mean incidence angle -

$$i_{mc} = \left(\beta_c'\right)_{LE} - \left(\kappa_{mc}\right)_{LE} \tag{B2}$$

Deviation angle -

$$\delta^o = \left(\beta_c'\right)_{TE} - \left(\kappa_{mc}\right)_{TE} \tag{B3}$$

Diffusion factor -

$$D = 1 - \frac{V_{TE}'}{V_{LE}'} + \left|\frac{\left(rV_\theta\right)_{TE} - \left(rV_\theta\right)_{LE}}{\left(r_{TE} + r_{LE}\right)\sigma\left(V_{LE}'\right)}\right| \tag{B4}$$

Total loss coefficient -

$$\overline{\omega} = \frac{\left(P_{id}'\right)_{TE} - \left(P'\right)_{TE}}{\left(P'\right)_{LE} - \left(p\right)_{LE}} \tag{B5}$$

Profile loss coefficient -

$$\overline{\omega}_p = \overline{\omega} - \overline{\omega}_s \tag{B6}$$

Total loss parameter -

$$\frac{\overline{\omega}\cos\left(\beta_m'\right)_{TE}}{2\sigma} \tag{B7}$$

Profile loss parameter -

$$\frac{\overline{\omega}_p \cos\left(\beta'_m\right)_{TE}}{2\sigma} \tag{B8}$$

Adiabatic (temperature-rise) efficiency -

$$\eta_{ad} = \frac{\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/1} - 1}{\frac{T_{TE}}{T_{LE}} - 1} \tag{B9}$$

Momentum-rise efficiency -

$$\eta_{mom} = \frac{\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/1} - 1}{\frac{\left(UV_\theta\right)_{TE} - \left(UV_\theta\right)_{LE}}{T_{LE} gJC_p}} \tag{B10}$$

Equivalent weight flow -

$$\frac{W\sqrt{\theta}}{\delta} \tag{B11}$$

Equivalent rotative speed -

$$\frac{N}{\sqrt{\theta}} \tag{B12}$$

Weight flow per unit annulus area -

$$\left(\frac{W\sqrt{\theta}}{\delta}\right)\Big/A_{an} \tag{B13}$$

Weight flow per unit frontal area -

$$\left(\frac{W\sqrt{\theta}}{\delta}\right)\Big/A_f \tag{B14}$$

Head-rise coefficient -

$$\frac{gJC_pT_{LE}}{U_{tip}^2}\left[\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/\gamma} - 1\right] \tag{B15}$$

Flow coefficient -

$$\left(\frac{V_z}{U_{tip}}\right)_{LE} \tag{B16}$$

Polytropic efficiency -

$$\eta_p = \exp\left[\frac{\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/\gamma}}{\left(\frac{T_{TE}}{T_{LE}}\right)}\right] \tag{B17}$$

APPENDIX C

DEFINITIONS AND UNITS USED IN TABLES

ABS	absolute
AERO CHORD	aerodynamic chord, cm
AREA RATIO	ratio of actual flow area to critical area (where local Mach number is one)
BETAM	meridional air angle, deg
CONE ANGLE	angle between axial direction and conical surface representing blade element, deg
DELTA INC	difference between mean camber blade angle and suction-surface blade angle at leading edge, deg
DEV	deviation angle (defined by eq. (B3)), deg
D-FACT	diffusion factor (defined by eq. (B4))
EFF	adiabatic efficiency (defined by eq. (B9))
IN	inlet (leading edge of blade)
INCIDENCE	incidence angle (suction surface defined by eq. (B1) and mean defined by eq. (B2)), deg
KIC	angle between the blade mean camber line at the leading edge and the meridional plane, deg
KOC	angle between the blade mean camber line at the trailing edge and the meridional plane, deg
KTC	angle between the blade mean camber line at the transition point and the meridional plane, deg
LOSS COEFF	loss coefficient (total defined by eq. (B5) and profile defined by eq. (B6))
LOSS PARAM	loss parameter (total defined by eq. (B7) and profile defined by eq. (B8))
MERID	meridional
MERID VEL R	meridional velocity ratio
OUT	outlet (trailing edge of blade)
PERCENT SPAN	percent of blade span from tip at rotor outlet

PHISS	suction-surface camber ahead of assumed shock location, deg
PRESS	pressure, N/cm^2
PROF	profile
RADII	radius, cm
REL	relative to the blade
RI	inlet radius (leading edge of blade), cm
RO	outlet radius (trailing edge of blade), cm
RP	radial position
RPM	equivalent rotative speed, rpm
SETTING ANGLE	angle between aerodynamic chord and meridional plane, deg
SOLIDITY	ratio of aerodynamic chord to blade spacing
SPEED	speed, m/sec
SS	suction surface
STREAMLINE SLOPE	slope of streamline, deg
TANG	tangential
TEMP	temperature, K
TI	thickness of blade at leading edge, cm
TM	thickness of blade at maximum thickness, cm
TO	thickness of blade at trailing edge, cm
TOT	total
TOTAL CAMBER	difference between inlet and outlet blade mean camber lines, deg
VEL	velocity, m/sec
WT FLOW	equivalent weight flow, kg/sec
X FACTOR	ratio of suction-surface camber ahead of assumed shock location of a multiple-circular-arc blade section to that of a double-circular-arc blade section
ZIC	axial distance to blade leading edge from inlet, cm
ZMC	axial distance to blade maximum thickness point from inlet, cm
ZOC	axial distance to blade trailing edge from inlet, cm
ZTC	axial distance to transition point from inlet, cm

REFERENCES

1. Urasek, Donald C.; Moore, Royce D.; and Osborn, Walter M.: Performance of a Single-Stage Transonic Compressor with a Blade-Tip Solidity of 1.3. NASA TM X-2645, 1972.
2. Ball, Calvin L.; Janetzke, David C.; and Reid, Lonnie: Performance of 1380-Foot-Per-Second-Tip-Speed Axial-Flow Compressor Rotor with Blade Tip Solidity of 1.5. NASA TM X-2379, 1972.
3. Klapproth, John F.: Approximate Relative-Total-Pressure Losses of an Infinite Cascade of Supersonic Blades with Finite Leading-Edge Thickness. NACA RM E9L21, 1950.

TABLE I. - DESIGN OVERALL

PARAMETERS FOR

STAGE 14-10

ROTOR TOTAL PRESSURE RATIO................	1.800
STAGE TOTAL PRESSURE RATIO................	1.750
ROTOR TOTAL TEMPERATURE RATIO.............	1.205
STAGE TOTAL TEMPERATURE RATIO.............	1.205
ROTOR ADIABATIC EFFICIENCY................	0.890
STAGE ADIABATIC EFFICIENCY................	0.843
ROTOR POLYTROPIC EFFICIENCY...............	0.898
STAGE POLYTROPIC EFFICIENCY...............	0.855
ROTOR HEAD RISE COEFFICIENT...............	0.296
STAGE HEAD RISE COEFFICIENT...............	0.281
FLOW COEFFICIENT..........................	0.475
WT FLOW PER UNIT FRONTAL AREA............	149.172
WT FLOW PER UNIT ANNULUS AREA............	200.600
WT FLOW..................................	29.484
RPM..................................	16100.000
TIP SPEED................................	422.888

TABLE II. - DESIGN BLADE-ELEMENT PARAMETERS

FOR ROTOR 14

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
TIP	25.082	24.701	0.	50.1	65.6	58.7	288.2	1.252	10.13	1.800
1	24.562	24.193	-0.	47.9	64.5	57.7	288.2	1.237	10.13	1.800
2	24.016	23.685	0.	46.3	63.5	56.5	288.2	1.225	10.13	1.800
3	21.752	21.653	0.	45.1	60.0	51.1	288.2	1.206	10.13	1.800
4	20.289	20.383	0.	45.7	58.2	46.7	288.2	1.200	10.13	1.800
5	19.991	20.129	0.	45.8	57.8	45.7	288.2	1.199	10.13	1.800
6	19.692	19.875	0.	46.0	57.5	44.7	288.2	1.199	10.13	1.800
7	19.391	19.621	0.	46.3	57.1	43.6	288.2	1.198	10.13	1.800
8	19.088	19.367	0.	46.5	56.8	42.4	288.2	1.197	10.13	1.800
9	16.900	17.589	0.	48.4	54.6	32.6	288.2	1.194	10.13	1.800
10	14.191	15.557	0.	52.3	52.2	15.8	288.2	1.195	10.13	1.800
11	13.464	15.049	0.	53.7	51.6	10.0	288.2	1.197	10.13	1.800
HUB	12.700	14.541	-0.	55.2	50.9	3.4	288.2	1.199	10.13	1.800

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
TIP	192.3	228.4	464.5	282.3	192.3	146.6	0.	175.2	422.9	416.5
1	197.5	226.5	458.8	284.1	197.5	152.0	-0.	167.9	414.1	407.9
2	202.2	225.8	452.6	283.1	202.2	156.1	0.	163.2	404.9	399.3
3	212.0	230.5	423.6	259.3	212.0	162.8	0.	163.2	366.7	365.1
4	212.5	235.7	402.7	240.4	212.5	164.8	0.	168.6	342.1	343.7
5	212.1	237.0	398.3	236.5	212.1	165.1	0.	170.0	337.1	339.4
6	211.7	238.3	393.8	232.6	211.7	165.4	0.	171.5	332.0	335.1
7	211.1	239.7	389.2	228.7	211.1	165.7	0.	173.2	326.9	330.8
8	210.4	241.2	384.5	224.8	210.4	166.0	0.	174.9	321.8	326.5
9	202.4	252.9	349.5	199.1	202.4	167.7	0.	189.3	284.9	296.6
10	185.6	272.1	302.8	173.0	185.6	166.5	0.	215.2	239.3	262.3
11	180.2	278.9	289.8	167.7	180.2	165.2	0.	224.7	227.0	253.7
HUB	174.2	286.7	276.0	164.0	174.2	163.7	-0.	235.4	214.1	245.2

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	STREAMLINE SLOPE IN	STREAMLINE SLOPE OUT	MERID VEL R	PEAK SS MACH NO
TIP	0.584	0.623	1.411	0.770	0.584	0.400	-6.70	-6.64	0.762	1.588
1	0.601	0.621	1.396	0.779	0.601	0.417	-5.93	-5.60	0.770	1.570
2	0.616	0.622	1.380	0.780	0.616	0.430	-5.02	-4.53	0.772	1.558
3	0.649	0.642	1.296	0.722	0.649	0.453	-0.48	0.09	0.768	1.533
4	0.650	0.659	1.233	0.672	0.650	0.461	2.75	3.15	0.775	1.509
5	0.649	0.663	1.219	0.662	0.649	0.462	3.44	3.79	0.778	1.504
6	0.648	0.668	1.205	0.652	0.648	0.463	4.13	4.44	0.781	1.498
7	0.646	0.672	1.191	0.641	0.646	0.465	4.84	5.10	0.785	1.493
8	0.644	0.677	1.176	0.631	0.644	0.466	5.57	5.76	0.789	1.488
9	0.617	0.714	1.066	0.562	0.617	0.474	11.23	10.86	0.829	1.447
10	0.562	0.774	0.918	0.492	0.562	0.474	19.94	17.81	0.897	1.298
11	0.545	0.795	0.877	0.478	0.545	0.471	22.86	19.75	0.917	1.224
HUB	0.526	0.819	0.834	0.469	0.526	0.468	26.18	21.77	0.939	1.142

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
TIP	0.	2.5	0.0	7.9	0.537	0.725	0.255	0.154	0.051	0.031
1	5.00	2.7	-0.0	7.2	0.518	0.772	0.206	0.112	0.042	0.023
2	10.00	3.0	0.0	6.7	0.507	0.812	0.168	0.078	0.034	0.016
3	30.00	4.1	-0.0	6.0	0.517	0.888	0.102	0.031	0.022	0.006
4	42.50	4.8	-0.0	6.1	0.536	0.913	0.083	0.025	0.018	0.005
5	45.00	4.9	0.0	6.2	0.540	0.917	0.080	0.026	0.017	0.006
6	47.50	5.0	-0.0	6.3	0.544	0.920	0.078	0.026	0.017	0.006
7	50.00	5.2	-0.0	6.4	0.548	0.923	0.076	0.027	0.017	0.006
8	52.50	5.3	0.0	6.5	0.552	0.926	0.074	0.028	0.016	0.006
9	70.00	6.2	-0.0	7.6	0.577	0.943	0.065	0.038	0.015	0.009
10	90.00	7.1	-0.0	10.5	0.594	0.937	0.090	0.087	0.019	0.019
11	95.00	7.2	-0.0	11.6	0.593	0.928	0.111	0.111	0.023	0.023
HUB	100.00	7.3	-0.0	12.7	0.585	0.916	0.141	0.141	0.028	0.028

TABLE III. - DESIGN BLADE-ELEMENT PARAMETERS

FOR STATOR 10

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
TIP	24.384	24.384	45.1	0.	45.1	0.	360.8	1.001	18.24	0.956
1	23.941	23.946	42.9	-0.	42.9	-0.	356.4	1.000	18.24	0.966
2	23.503	23.537	41.3	0.	41.3	0.	353.0	1.000	18.24	0.973
3	21.742	21.900	40.0	0.	40.0	0.	347.5	1.000	18.24	0.980
4	20.637	20.882	40.4	0.	40.4	0.	345.8	1.000	18.24	0.978
5	20.416	20.680	40.5	0.	40.5	0.	345.6	1.000	18.24	0.978
6	20.195	20.479	40.7	0.	40.7	0.	345.4	1.000	18.24	0.978
7	19.975	20.278	40.8	0.	40.8	0.	345.2	1.000	18.24	0.977
8	19.755	20.078	41.0	0.	41.0	0.	345.0	1.000	18.24	0.977
9	18.227	18.714	42.3	0.	42.3	0.	344.0	1.000	18.24	0.973
10	16.531	17.252	44.8	0.	44.8	0.	344.4	1.000	18.24	0.955
11	16.121	16.904	45.8	0.	45.8	0.	344.9	1.000	18.24	0.942
HUB	15.697	16.485	46.9	-0.	46.9	-0.	345.6	1.000	18.24	0.924

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
TIP	250.6	176.4	250.6	176.4	176.7	176.4	177.6	0.	0.	0.
1	249.3	181.0	249.3	181.0	182.6	181.0	169.7	-0.	0.	0.
2	249.0	184.4	249.0	184.4	187.0	184.4	164.5	0.	0.	0.
3	252.8	190.2	252.8	190.2	193.6	190.2	162.5	0.	0.	0.
4	256.9	191.5	256.9	191.5	195.6	191.5	166.5	0.	0.	0.
5	257.9	191.8	257.9	191.8	196.0	191.8	167.6	0.	0.	0.
6	259.0	192.1	259.0	192.1	196.4	192.1	168.8	0.	0.	0.
7	260.1	192.5	260.1	192.5	196.8	192.5	170.1	0.	0.	0.
8	261.4	192.9	261.4	192.9	197.3	192.9	171.5	0.	0.	0.
9	271.5	196.8	271.5	196.8	200.9	196.8	182.6	0.	0.	0.
10	287.3	196.7	287.3	196.7	203.7	196.7	202.6	0.	0.	0.
11	292.6	194.8	292.6	194.8	203.9	194.8	209.8	0.	0.	0.
HUB	298.6	191.9	298.6	191.9	204.0	191.9	218.1	-0.	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	STREAMLINE SLOPE IN	STREAMLINE SLOPE OUT	MERID VEL R	PEAK SS MACH NO
TIP	0.689	0.473	0.689	0.473	0.486	0.473	-0.32	-0.25	0.998	1.075
1	0.689	0.490	0.689	0.490	0.505	0.490	0.30	0.07	0.991	1.046
2	0.692	0.502	0.692	0.502	0.520	0.502	0.88	0.36	0.986	1.027
3	0.710	0.523	0.710	0.523	0.544	0.523	3.13	1.55	0.982	1.022
4	0.724	0.528	0.724	0.528	0.552	0.528	4.76	2.29	0.979	1.036
5	0.728	0.529	0.728	0.529	0.553	0.529	5.12	2.44	0.978	1.040
6	0.732	0.530	0.732	0.530	0.555	0.530	5.50	2.58	0.978	1.045
7	0.735	0.531	0.735	0.531	0.556	0.531	5.88	2.73	0.978	1.049
8	0.740	0.533	0.740	0.533	0.558	0.533	6.28	2.88	0.978	1.055
9	0.773	0.545	0.773	0.545	0.572	0.545	9.59	3.93	0.980	1.144
10	0.823	0.544	0.823	0.544	0.584	0.544	14.75	5.01	0.965	1.282
11	0.840	0.538	0.840	0.538	0.585	0.538	16.33	5.16	0.955	1.332
HUB	0.858	0.529	0.858	0.529	0.586	0.529	18.08	5.28	0.941	1.394

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
TIP	0.	6.2	-0.0	14.4	0.569	0.	0.169	0.169	0.065	0.065
1	5.00	6.2	0.0	12.8	0.532	0.	0.124	0.124	0.047	0.047
2	10.00	6.2	-0.0	11.7	0.505	0.	0.098	0.098	0.036	0.036
3	30.00	6.2	0.0	10.2	0.469	0.	0.070	0.070	0.024	0.024
4	42.50	6.2	0.0	9.8	0.466	0.	0.073	0.073	0.024	0.024
5	45.00	6.2	0.0	9.8	0.466	0.	0.074	0.074	0.024	0.024
6	47.50	6.2	0.0	9.8	0.466	0.	0.075	0.075	0.024	0.024
7	50.00	6.2	0.0	9.7	0.466	0.	0.076	0.076	0.024	0.024
8	52.50	6.2	0.0	9.7	0.466	0.	0.076	0.076	0.024	0.024
9	70.00	6.1	0.0	9.1	0.468	0.	0.082	0.082	0.024	0.024
10	90.00	6.0	0.0	8.9	0.497	0.	0.125	0.125	0.033	0.033
11	95.00	6.0	0.0	8.9	0.514	0.	0.156	0.154	0.040	0.039
HUB	100.00	6.0	0.1	9.0	0.535	0.	0.201	0.195	0.050	0.049

TABLE IV. - BLADE GEOMETRY FOR ROTOR 14

RP	PERCENT SPAN	RADII RI	RADII RO	BLADE ANGLES KIC	BLADE ANGLES KTC	BLADE ANGLES KOC	DELTA INC	CONE ANGLE
TIP	0.	25.082	24.701	62.89	61.15	50.70	2.49	-9.441
1	5.	24.562	24.193	61.63	60.18	50.30	2.73	-8.828
2	10.	24.016	23.685	60.36	59.00	49.68	2.99	-7.638
3	30.	21.752	21.653	55.88	53.60	45.06	4.07	-1.988
4	43.	20.289	20.383	53.42	50.38	40.63	4.75	1.770
5	45.	19.991	20.129	52.94	49.75	39.58	4.89	2.540
6	48.	19.692	19.875	52.47	49.11	38.44	5.03	3.321
7	50.	19.391	19.621	52.01	48.47	37.24	5.16	4.108
8	53.	19.088	19.367	51.55	47.82	35.98	5.30	4.900
9	70.	16.900	17.589	48.44	43.56	24.97	6.21	10.840
10	90.	14.191	15.557	45.34	40.14	5.19	7.09	18.729
11	95.	13.464	15.049	44.72	39.86	-1.71	7.24	20.942
HUB	100.	12.700	14.541	44.16	39.81	-9.35	7.37	23.380

RP	BLADE THICKNESSES TI	BLADE THICKNESSES TM	BLADE THICKNESSES TO	AXIAL DIMENSIONS ZIC	AXIAL DIMENSIONS ZMC	AXIAL DIMENSIONS ZTC	AXIAL DIMENSIONS ZOC
TIP	0.051	0.152	0.051	1.000	2.071	2.484	3.291
1	0.051	0.162	0.051	0.955	2.071	2.451	3.329
2	0.051	0.172	0.051	0.907	2.069	2.412	3.371
3	0.051	0.216	0.051	0.715	2.054	2.209	3.556
4	0.051	0.244	0.051	0.605	2.042	2.047	3.673
5	0.051	0.250	0.051	0.583	2.039	2.012	3.698
6	0.051	0.256	0.051	0.561	2.036	1.975	3.722
7	0.051	0.262	0.051	0.539	2.032	1.937	3.748
8	0.051	0.267	0.051	0.517	2.029	1.898	3.773
9	0.051	0.309	0.051	0.357	1.999	1.593	3.958
10	0.051	0.359	0.051	0.141	1.944	1.168	4.171
11	0.051	0.373	0.051	0.075	1.923	1.044	4.217
HUB	0.051	0.387	0.051	0.000	1.899	0.909	4.259

RP	AERO CHORD	SETTING ANGLE	TOTAL CAMBER	SOLIDITY	X FACTOR	PHISS	AREA RATIO
TIP	4.713	60.12	12.20	1.296	0.529	5.16	1.037
1	4.717	59.02	11.32	1.324	0.539	5.08	1.035
2	4.714	57.78	10.68	1.353	0.566	5.21	1.034
3	4.704	52.34	10.82	1.483	0.708	6.80	1.032
4	4.704	48.72	12.78	1.583	0.748	7.80	1.029
5	4.705	47.95	13.36	1.605	0.751	7.98	1.028
6	4.706	47.15	14.03	1.628	0.755	8.18	1.027
7	4.708	46.32	14.77	1.652	0.757	8.38	1.026
8	4.711	45.47	15.58	1.677	0.759	8.57	1.025
9	4.754	38.76	23.47	1.887	0.744	9.63	1.018
10	4.900	28.66	40.14	2.254	0.639	9.42	1.013
11	4.966	25.54	46.42	2.384	0.587	8.90	1.012
HUB	5.060	22.11	53.51	2.542	0.526	8.17	1.012

TABLE V. - BLADE GEOMETRY FOR STATOR 10

RP	PERCENT SPAN	RADII RI	RADII RO	BLADE ANGLES KIC	BLADE ANGLES KTC	BLADE ANGLES KOC	DELTA INC	CONE ANGLE
TIP	0.	24.384	24.384	38.97	30.50	-14.36	6.17	0.057
1	5.	23.941	23.946	36.70	29.29	-12.78	6.19	0.067
2	10.	23.503	23.537	35.12	28.46	-11.69	6.21	0.495
3	30.	21.742	21.900	33.81	28.04	-10.19	6.22	2.315
4	43.	20.637	20.882	34.23	28.57	-9.85	6.21	3.596
5	45.	20.416	20.680	34.37	28.71	-9.80	6.21	3.868
6	48.	20.195	20.479	34.52	28.86	-9.75	6.21	4.149
7	50.	19.975	20.278	34.69	29.02	-9.72	6.20	4.437
8	53.	19.755	20.078	34.88	29.20	-9.68	6.20	4.732
9	70.	18.227	18.714	36.32	28.72	-9.12	6.14	7.101
10	90.	16.531	17.252	39.28	29.09	-8.89	6.03	10.476
11	95.	16.121	16.904	40.43	29.26	-8.90	5.98	11.369
HUB	100.	15.697	16.485	41.77	29.48	-8.95	5.94	11.440

RP	BLADE THICKNESSES TI	BLADE THICKNESSES TM	BLADE THICKNESSES TO	AXIAL DIMENSIONS ZIC	AXIAL DIMENSIONS ZMC	AXIAL DIMENSIONS ZTC	AXIAL DIMENSIONS ZOC
TIP	0.051	0.279	0.051	7.571	9.324	9.065	11.422
1	0.051	0.279	0.051	7.543	9.331	8.974	11.423
2	0.051	0.279	0.051	7.524	9.336	8.903	11.424
3	0.051	0.279	0.051	7.507	9.340	8.766	11.424
4	0.051	0.279	0.051	7.510	9.339	8.716	11.423
5	0.051	0.279	0.051	7.511	9.339	8.708	11.422
6	0.051	0.279	0.051	7.512	9.338	8.699	11.422
7	0.051	0.279	0.051	7.514	9.338	8.691	11.422
8	0.051	0.279	0.051	7.515	9.337	8.684	11.421
9	0.051	0.279	0.051	7.511	9.338	8.598	11.422
10	0.051	0.279	0.051	7.519	9.336	8.530	11.421
11	0.051	0.279	0.051	7.524	9.335	8.517	11.421
HUB	0.051	0.279	0.051	7.529	9.333	8.506	11.420

RP	AERO CHORD	SETTING ANGLE	TOTAL CAMBER	SOLIDITY	X FACTOR	PHISS	AREA RATIO
TIP	4.138	19.58	53.33	1.297	0.600	13.73	1.178
1	4.138	18.31	49.48	1.320	0.600	12.40	1.159
2	4.139	17.45	46.81	1.344	0.600	11.44	1.144
3	4.142	16.65	44.00	1.450	0.600	10.12	1.114
4	4.146	16.81	44.08	1.526	0.600	9.85	1.101
5	4.147	16.88	44.17	1.542	0.600	9.82	1.098
6	4.149	16.94	44.28	1.558	0.600	9.79	1.095
7	4.150	17.02	44.41	1.575	0.600	9.77	1.092
8	4.152	17.10	44.56	1.592	0.600	9.75	1.089
9	4.168	16.80	45.43	1.724	0.706	11.33	1.085
10	4.203	17.11	48.16	1.901	0.825	13.58	1.091
11	4.214	17.29	49.33	1.950	0.862	14.46	1.097
HUB	4.214	17.51	50.72	2.000	0.904	15.50	1.104

TABLE VI. - OVERALL PERFORMANCE FOR STAGE 14-MOD 10

(a) 100 Percent of design speed

Parameter	Reading			
	1306	1296	1297	1298
ROTOR TOTAL PRESSURE RATIO	1.647	1.718	1.787	1.610
STAGE TOTAL PRESSURE RATIO	1.571	1.656	1.723	1.735
ROTOR TOTAL TEMPERATURE RATIO	1.189	1.203	1.217	1.226
STAGE TOTAL TEMPERATURE RATIO	1.188	1.202	1.218	1.227
ROTOR TEMP. RISE EFFICIENCY	0.811	0.823	0.830	0.816
STAGE TEMP. RISE EFFICIENCY	0.731	0.766	0.773	0.752
ROTOR MOMENTUM RISE EFFICIENCY	0.814	0.831	0.844	0.833
ROTOR HEAD RISE COEFFICIENT	0.248	0.269	0.292	0.298
STAGE HEAD RISE COEFFICIENT	0.223	0.249	0.272	0.275
FLOW COEFFICIENT	0.408	0.404	0.390	0.370
WT FLOW PER UNIT FRONTAL AREA	30.28	30.11	29.33	28.18
WT FLOW PER UNIT ANNULUS AREA	40.72	40.50	39.44	37.90
WT FLOW AT ORIFICE	64.42	64.07	62.39	59.96
WT FLOW AT ROTOR INLET	64.69	64.42	62.67	60.20
WT FLOW AT ROTOR OUTLET	65.07	64.38	62.24	59.58
WT FLOW AT STATOR OUTLET	67.23	66.38	64.53	62.44
ROTATIVE SPEED	16090.7	16142.8	16107.9	16125.8
PERCENT OF DESIGN SPEED	99.9	100.3	100.0	100.2

(b) 90 Percent of design speed

Parameter	Reading		
	1301	1302	1304
ROTOR TOTAL PRESSURE RATIO	1.617	1.633	1.635
STAGE TOTAL PRESSURE RATIO	1.574	1.590	1.593
ROTOR TOTAL TEMPERATURE RATIO	1.170	1.175	1.177
STAGE TOTAL TEMPERATURE RATIO	1.170	1.176	1.178
ROTOR TEMP. RISE EFFICIENCY	0.866	0.861	0.853
STAGE TEMP. RISE EFFICIENCY	0.812	0.806	0.799
ROTOR MOMENTUM RISE EFFICIENCY	0.878	0.869	0.866
ROTOR HEAD RISE COEFFICIENT	0.293	0.299	0.301
STAGE HEAD RISE COEFFICIENT	0.275	0.281	0.284
FLOW COEFFICIENT	0.394	0.380	0.369
WT FLOW PER UNIT FRONTAL AREA	133.22	129.52	126.27
WT FLOW PER UNIT ANNULUS AREA	179.15	174.19	169.81
WT FLOW AT ORIFICE	26.33	25.60	24.96
WT FLOW AT ROTOR INLET	26.42	25.68	25.01
WT FLOW AT ROTOR OUTLET	26.55	25.68	25.06
WT FLOW AT STATOR OUTLET	27.23	26.56	26.09
ROTATIVE SPEED	14519.7	14530.9	14486.6
PERCENT OF DESIGN SPEED	90.2	90.3	90.0

(c) 70 Percent of design speed

Parameter	Reading		
	1307	1308	1309
ROTOR TOTAL PRESSURE RATIO	1.299	1.324	1.331
STAGE TOTAL PRESSURE RATIO	1.280	1.307	1.311
ROTOR TOTAL TEMPERATURE RATIO	1.087	1.096	1.103
STAGE TOTAL TEMPERATURE RATIO	1.089	1.097	1.103
ROTOR TEMP. RISE EFFICIENCY	0.891	0.873	0.830
STAGE TEMP. RISE EFFICIENCY	0.822	0.822	0.783
ROTOR MOMENTUM RISE EFFICIENCY	0.911	0.895	0.848
ROTOR HEAD RISE COEFFICIENT	0.254	0.273	0.278
STAGE HEAD RISE COEFFICIENT	0.239	0.261	0.263
FLOW COEFFICIENT	0.407	0.371	0.332
WT FLOW PER UNIT FRONTAL AREA	111.13	102.60	93.48
WT FLOW PER UNIT ANNULUS AREA	149.44	137.97	125.71
WT FLOW AT ORIFICE	21.96	20.26	18.46
WT FLOW AT ROTOR INLET	22.09	20.34	18.45
WT FLOW AT ROTOR OUTLET	22.10	20.45	18.51
WT FLOW AT STATOR OUTLET	22.56	20.85	19.20
ROTATIVE SPEED	11331.3	11317.2	11338.0
PERCENT OF DESIGN SPEED	70.4	70.3	70.4

TABLE VII. - BLADE ELEMENT DATA AT BLADE EDGES

FOR ROTOR 14 MOD 1

(a) 100 Percent of design speed; reading 1306

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	42.7	64.9	55.4	288.7	1.229	10.08	1.654
2	24.016	23.685	0.0	40.3	63.9	54.7	288.6	1.211	10.11	1.651
3	21.753	21.653	-0.0	38.3	60.8	48.6	288.1	1.190	10.13	1.690
4	20.290	20.383	0.0	44.8	58.8	49.1	288.0	1.182	10.14	1.545
5	19.992	20.129	-0.0	44.9	58.3	49.7	288.0	1.180	10.14	1.518
6	19.693	19.875	0.0	44.9	57.9	49.0	288.1	1.179	10.14	1.518
7	19.390	19.621	-0.0	44.4	57.5	47.4	287.6	1.177	10.14	1.534
8	19.088	19.367	0.0	42.3	57.1	45.6	288.2	1.175	10.14	1.561
9	16.899	17.589	0.0	42.2	54.3	37.5	287.9	1.164	10.15	1.600
10	14.191	15.557	0.0	47.3	51.2	17.0	287.9	1.183	10.15	1.759
11	13.465	15.049	0.0	50.1	50.6	8.6	287.9	1.194	10.12	1.830

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	193.8	233.6	456.9	302.7	193.8	171.7	0.0	158.3	413.8	407.6
2	198.3	231.6	450.4	305.4	198.3	176.7	0.0	149.7	404.4	398.9
3	204.4	241.3	419.4	286.4	204.4	189.3	-0.0	149.6	366.2	364.6
4	207.3	225.7	400.0	244.4	207.3	160.2	0.0	159.0	342.1	343.6
5	207.8	220.1	396.0	241.3	207.8	156.0	-0.0	155.3	337.1	339.4
6	208.2	220.3	392.0	238.2	208.2	156.2	0.0	155.5	332.2	335.3
7	207.9	223.8	387.3	236.4	207.9	159.9	-0.0	156.6	326.8	330.7
8	208.0	228.9	383.4	241.9	208.0	169.4	0.0	154.0	322.1	326.8
9	204.3	239.1	350.4	223.1	204.3	177.1	0.0	160.7	284.8	296.4
10	192.3	277.8	306.7	196.9	192.3	188.3	0.0	204.2	238.9	261.9
11	185.9	293.0	293.1	190.1	185.9	187.9	0.0	224.8	226.6	253.2

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.588	0.644	1.387	0.834	0.588	0.473	0.886	1.616
2	0.603	0.643	1.370	0.848	0.603	0.491	0.891	1.603
3	0.624	0.679	1.280	0.806	0.624	0.533	0.926	1.590
4	0.634	0.634	1.222	0.687	0.634	0.450	0.772	1.564
5	0.635	0.618	1.210	0.678	0.635	0.438	0.750	1.556
6	0.636	0.619	1.198	0.669	0.636	0.439	0.750	1.551
7	0.636	0.631	1.184	0.666	0.636	0.451	0.769	1.543
8	0.635	0.646	1.171	0.683	0.635	0.478	0.814	1.536
9	0.624	0.681	1.070	0.635	0.624	0.504	0.867	1.478
10	0.584	0.797	0.932	0.565	0.584	0.540	0.979	1.302
11	0.564	0.842	0.889	0.546	0.564	0.540	1.011	1.221

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	3.1	1.6	5.0	0.467	0.675	0.282	0.178	0.060	0.038
2	10.00	3.4	1.6	4.8	0.444	0.730	0.226	0.128	0.048	0.027
3	30.00	4.9	2.1	3.6	0.437	0.849	0.129	0.048	0.029	0.011
4	42.50	5.4	1.9	8.5	0.515	0.728	0.233	0.166	0.048	0.034
5	45.00	5.4	1.8	10.2	0.513	0.704	0.254	0.190	0.051	0.038
6	47.50	5.5	1.7	10.6	0.515	0.707	0.253	0.193	0.051	0.039
7	50.00	5.6	1.6	10.2	0.513	0.735	0.232	0.175	0.048	0.036
8	52.50	5.6	1.5	9.6	0.490	0.775	0.200	0.146	0.042	0.030
9	70.00	5.9	0.8	12.5	0.487	0.874	0.122	0.090	0.026	0.019
10	90.00	6.0	-0.5	11.8	0.512	0.957	0.058	0.054	0.012	0.011
11	95.00	6.3	-0.7	10.3	0.521	0.971	0.044	0.043	0.009	0.009

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(b) 100 Percent of design speed; reading 1296

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	46.8	65.1	56.0	288.8	1.251	10.08	1.740
2	24.016	23.685	0.0	44.5	64.1	54.5	288.7	1.232	10.11	1.742
3	21.753	21.653	0.0	42.1	61.1	48.7	288.1	1.208	10.13	1.760
4	20.290	20.383	0.0	47.1	59.0	47.3	287.9	1.200	10.14	1.657
5	19.992	20.129	0.0	47.3	58.6	47.7	288.1	1.198	10.14	1.636
6	19.693	19.875	0.0	47.4	58.2	47.5	287.5	1.194	10.14	1.622
7	19.390	19.621	0.0	46.8	57.8	46.5	288.3	1.193	10.14	1.625
8	19.088	19.367	0.0	45.5	57.4	44.7	287.9	1.190	10.15	1.647
9	16.899	17.589	0.0	44.7	54.6	36.3	287.9	1.176	10.15	1.673
10	14.191	15.557	0.0	48.8	51.5	18.7	287.9	1.185	10.15	1.765
11	13.465	15.049	0.0	51.4	51.0	9.0	288.0	1.197	10.12	1.851

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	192.8	234.9	458.1	287.3	192.8	160.8	0.0	171.2	415.6	409.4
2	197.2	235.4	451.5	289.1	197.2	167.8	0.0	165.2	406.2	400.6
3	203.3	241.8	420.2	271.5	203.3	179.3	0.0	162.3	367.8	366.1
4	206.0	234.2	400.0	235.0	206.0	159.2	0.0	171.7	342.9	344.5
5	206.9	230.3	396.6	231.7	206.9	156.1	0.0	169.4	338.4	340.7
6	206.5	227.7	391.6	228.2	206.5	154.2	0.0	167.5	332.7	335.8
7	206.8	228.7	387.6	227.6	206.8	156.6	0.0	166.6	327.8	331.7
8	206.5	232.7	383.1	229.4	206.5	163.1	0.0	166.0	322.7	327.4
9	203.0	242.6	350.3	213.9	203.0	172.4	0.0	170.7	285.6	297.2
10	190.4	269.1	306.0	187.0	190.4	177.1	0.0	202.6	239.5	262.6
11	184.3	288.8	292.9	182.4	184.3	180.1	0.0	225.7	227.6	254.4

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.585	0.641	1.390	0.785	0.585	0.439	0.834	1.626
2	0.599	0.648	1.372	0.796	0.599	0.462	0.851	1.613
3	0.620	0.676	1.282	0.758	0.620	0.501	0.882	1.600
4	0.629	0.655	1.222	0.657	0.629	0.445	0.773	1.571
5	0.632	0.644	1.211	0.648	0.632	0.436	0.754	1.564
6	0.631	0.637	1.197	0.639	0.631	0.432	0.747	1.559
7	0.631	0.640	1.183	0.637	0.631	0.438	0.757	1.549
8	0.631	0.653	1.170	0.644	0.631	0.458	0.790	1.543
9	0.619	0.688	1.069	0.607	0.619	0.489	0.849	1.486
10	0.578	0.768	0.929	0.534	0.578	0.506	0.930	1.309
11	0.558	0.827	0.887	0.522	0.558	0.516	0.977	1.230

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	3.3	1.8	5.5	0.513	0.683	0.294	0.187	0.062	0.040
2	10.00	3.6	1.8	4.7	0.494	0.741	0.233	0.133	0.050	0.028
3	30.00	5.2	2.4	3.6	0.484	0.843	0.145	0.061	0.032	0.014
4	42.50	5.6	2.1	6.7	0.548	0.777	0.208	0.140	0.045	0.030
5	45.00	5.6	2.0	8.1	0.549	0.762	0.222	0.157	0.047	0.033
6	47.50	5.7	2.0	9.1	0.549	0.762	0.223	0.160	0.046	0.033
7	50.00	5.8	1.8	9.3	0.544	0.770	0.218	0.160	0.045	0.033
8	52.50	5.9	1.8	8.8	0.531	0.807	0.184	0.129	0.039	0.027
9	70.00	6.2	1.1	11.3	0.521	0.900	0.104	0.071	0.022	0.015
10	90.00	6.4	-0.2	13.4	0.542	0.951	0.067	0.062	0.014	0.013
11	95.00	6.7	-0.3	10.7	0.548	0.974	0.040	0.039	0.008	0.008

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(c) 100 Percent of design speed; reading 1297

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	53.0	66.1	55.5	288.7	1.281	10.08	1.856
2	24.016	23.685	0.0	49.0	65.1	53.9	288.7	1.258	10.10	1.850
3	21.753	21.653	0.0	46.6	62.1	48.7	288.1	1.225	10.13	1.832
4	20.290	20.383	0.0	48.8	60.0	46.6	288.0	1.210	10.14	1.751
5	19.992	20.129	0.0	48.9	59.7	47.2	288.1	1.207	10.14	1.724
6	19.693	19.875	0.0	49.1	59.2	47.1	288.1	1.204	10.14	1.706
7	19.390	19.621	0.0	49.1	58.8	46.4	288.0	1.203	10.14	1.706
8	19.088	19.367	0.0	49.6	58.4	45.0	287.8	1.202	10.14	1.704
9	16.899	17.589	0.0	47.6	55.6	37.2	288.0	1.182	10.15	1.712
10	14.191	15.557	0.0	50.9	52.5	19.2	287.9	1.192	10.15	1.795
11	13.465	15.049	0.0	53.1	51.8	9.3	287.7	1.199	10.13	1.868

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	183.2	243.8	452.9	259.0	183.2	146.9	0.0	194.6	414.2	408.0
2	187.8	241.3	446.2	268.7	187.8	158.2	0.0	182.1	404.8	399.2
3	193.8	242.0	414.6	252.0	193.8	166.4	0.0	175.7	366.5	364.9
4	197.1	237.0	394.7	227.4	197.1	156.1	0.0	178.3	342.0	343.6
5	197.3	231.9	390.5	224.3	197.3	152.4	0.0	174.8	337.0	339.4
6	198.4	229.6	387.2	221.0	198.4	150.3	0.0	173.6	332.5	335.6
7	198.2	229.7	382.7	217.9	198.2	150.3	0.0	173.6	327.4	331.3
8	198.3	231.5	377.9	212.2	198.3	150.0	0.0	176.3	321.7	326.4
9	195.7	237.7	346.0	201.3	195.7	160.4	0.0	175.5	285.4	297.1
10	183.9	264.0	302.2	176.3	183.9	166.4	0.0	204.9	239.9	263.0
11	178.3	282.2	288.5	171.9	178.3	169.6	0.0	225.6	226.8	253.5

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.554	0.660	1.370	0.701	0.554	0.397	0.802	1.641
2	0.569	0.658	1.352	0.733	0.569	0.432	0.843	1.627
3	0.589	0.671	1.260	0.699	0.589	0.461	0.858	1.616
4	0.600	0.660	1.201	0.634	0.600	0.435	0.792	1.589
5	0.600	0.646	1.189	0.625	0.600	0.424	0.773	1.583
6	0.604	0.640	1.179	0.616	0.604	0.419	0.758	1.578
7	0.603	0.640	1.165	0.607	0.603	0.419	0.759	1.571
8	0.604	0.646	1.151	0.593	0.604	0.419	0.757	1.561
9	0.595	0.671	1.053	0.568	0.595	0.453	0.820	1.510
10	0.557	0.750	0.916	0.501	0.557	0.473	0.905	1.322
11	0.540	0.806	0.873	0.491	0.540	0.484	0.951	1.236

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	4.4	2.9	5.0	0.589	0.689	0.318	0.211	0.068	0.045
2	10.00	4.6	2.8	4.1	0.548	0.744	0.254	0.153	0.055	0.033
3	30.00	6.2	3.4	3.6	0.535	0.841	0.158	0.075	0.035	0.017
4	42.50	6.6	3.1	6.0	0.567	0.826	0.175	0.106	0.038	0.023
5	45.00	6.7	3.1	7.7	0.566	0.814	0.186	0.120	0.039	0.025
6	47.50	6.7	3.0	8.7	0.568	0.809	0.191	0.128	0.040	0.027
7	50.00	6.8	2.9	9.2	0.569	0.813	0.189	0.129	0.040	0.027
8	52.50	6.8	2.7	9.1	0.579	0.816	0.189	0.132	0.040	0.028
9	70.00	7.2	2.1	12.2	0.555	0.911	0.098	0.063	0.021	0.013
10	90.00	7.4	0.8	13.9	0.574	0.948	0.074	0.070	0.015	0.015
11	95.00	7.5	0.5	11.0	0.577	0.980	0.032	0.031	0.007	0.006

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE EDGES FOR ROTOR 14 MOD 1

(d) 100 Percent of design speed; reading 1298

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	57.8	67.6	56.0	288.9	1.302	10.08	1.893
2	24.016	23.685	0.0	53.7	66.8	54.3	288.9	1.279	10.10	1.886
3	21.753	21.653	0.0	48.6	63.5	49.5	288.0	1.232	10.13	1.843
4	20.290	20.383	0.0	51.0	61.4	48.3	288.0	1.216	10.14	1.755
5	19.992	20.129	0.0	51.8	61.0	48.8	287.9	1.213	10.14	1.731
6	19.693	19.875	0.0	52.0	60.6	47.9	287.9	1.212	10.14	1.724
7	19.390	19.621	0.0	52.2	60.2	45.7	287.9	1.212	10.15	1.740
8	19.088	19.367	0.0	52.2	59.8	44.4	288.0	1.212	10.14	1.742
9	16.899	17.589	0.0	49.0	57.0	36.1	287.8	1.191	10.15	1.749
10	14.191	15.557	0.0	51.7	53.8	19.3	287.9	1.194	10.15	1.809
11	13.465	15.049	0.0	53.6	53.3	9.8	287.8	1.203	10.13	1.881

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	170.8	249.4	448.2	237.7	170.8	132.9	0.0	211.0	414.3	408.1
2	174.1	245.4	441.2	248.9	174.1	145.3	0.0	197.8	405.5	399.9
3	182.7	239.6	410.0	244.3	182.7	158.6	0.0	179.6	367.1	365.4
4	186.9	232.2	390.5	219.5	186.9	146.0	0.0	180.6	342.8	344.4
5	187.2	228.0	386.3	214.2	187.2	141.1	0.0	179.1	338.0	340.3
6	187.3	228.5	381.9	209.9	187.3	140.6	0.0	180.1	332.8	335.9
7	187.5	233.4	377.2	204.9	187.5	143.1	0.0	184.5	327.3	331.2
8	187.6	235.4	373.0	201.9	187.6	144.3	0.0	186.0	322.4	327.1
9	185.2	240.6	340.0	195.3	185.2	157.8	0.0	181.7	285.1	296.8
10	175.2	262.2	296.9	172.0	175.2	162.3	0.0	205.9	239.6	262.7
11	169.4	280.2	283.6	168.9	169.4	166.4	0.0	225.4	227.5	254.2

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.515	0.670	1.350	0.638	0.515	0.357	0.778	1.671
2	0.525	0.664	1.330	0.674	0.525	0.393	0.835	1.663
3	0.553	0.662	1.242	0.675	0.553	0.438	0.868	1.648
4	0.567	0.644	1.184	0.609	0.567	0.405	0.781	1.621
5	0.568	0.632	1.172	0.594	0.568	0.391	0.754	1.615
6	0.568	0.634	1.159	0.583	0.568	0.390	0.750	1.611
7	0.569	0.649	1.144	0.570	0.569	0.398	0.763	1.601
8	0.569	0.655	1.132	0.562	0.569	0.402	0.769	1.595
9	0.562	0.678	1.031	0.550	0.562	0.444	0.852	1.549
10	0.529	0.743	0.897	0.488	0.529	0.460	0.926	1.335
11	0.511	0.798	0.856	0.481	0.511	0.474	0.982	1.255

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	5.8	4.3	5.5	0.646	0.662	0.366	0.255	0.077	0.054
2	10.00	6.3	4.5	4.4	0.600	0.713	0.304	0.198	0.066	0.043
3	30.00	7.7	4.9	4.4	0.552	0.823	0.183	0.095	0.040	0.021
4	42.50	8.0	4.5	7.7	0.584	0.808	0.199	0.126	0.042	0.026
5	45.00	8.1	4.4	9.3	0.590	0.797	0.210	0.139	0.043	0.029
6	47.50	8.2	4.4	9.5	0.596	0.795	0.214	0.147	0.044	0.030
7	50.00	8.2	4.3	8.5	0.606	0.808	0.205	0.142	0.043	0.030
8	52.50	8.3	4.2	8.4	0.608	0.810	0.206	0.146	0.044	0.031
9	70.00	8.6	3.5	11.1	0.570	0.908	0.108	0.069	0.023	0.015
10	90.00	8.7	2.1	14.0	0.582	0.950	0.074	0.070	0.015	0.015
11	95.00	9.0	2.0	11.5	0.581	0.977	0.039	0.038	0.008	0.008

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(e) 90 Percent of design speed; reading 1301

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	-0.0	46.3	66.1	52.6	289.4	1.214	10.06	1.699
2	24.016	23.685	0.0	44.9	65.0	52.6	289.2	1.195	10.11	1.672
3	21.753	21.653	0.0	43.3	62.0	48.8	288.0	1.173	10.14	1.636
4	20.290	20.383	0.0	45.3	60.0	45.8	287.8	1.165	10.14	1.590
5	19.992	20.129	0.0	46.0	59.6	45.6	288.0	1.164	10.14	1.577
6	19.693	19.875	-0.0	46.3	59.2	44.9	287.8	1.162	10.15	1.571
7	19.390	19.621	0.0	46.6	58.8	44.7	288.0	1.161	10.15	1.561
8	19.088	19.367	0.0	46.2	58.5	43.8	287.3	1.158	10.14	1.557
9	16.899	17.589	0.0	45.7	55.8	37.0	287.9	1.144	10.15	1.546
10	14.191	15.557	-0.0	49.7	52.8	17.5	287.8	1.155	10.15	1.626
11	13.465	15.049	0.0	51.9	52.3	8.9	288.0	1.162	10.12	1.679

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	165.7	225.9	408.5	257.3	165.7	156.1	-0.0	163.3	373.4	367.8
2	170.3	220.7	402.9	257.3	170.3	156.3	0.0	155.8	365.1	360.1
3	176.3	217.2	374.9	239.9	176.3	158.1	0.0	149.0	330.9	329.4
4	178.3	216.2	356.2	217.9	178.3	152.0	0.0	153.7	308.4	309.8
5	178.6	214.1	352.5	212.7	178.6	148.8	0.0	153.9	303.9	306.0
6	178.7	213.9	348.6	208.8	178.7	147.8	-0.0	154.6	299.3	302.1
7	178.6	212.6	345.1	205.4	178.6	146.1	0.0	154.4	295.3	298.8
8	177.7	212.4	340.0	203.8	177.7	147.1	0.0	153.2	289.9	294.2
9	174.7	215.5	310.8	188.6	174.7	150.6	0.0	154.1	257.1	267.6
10	163.7	244.6	270.8	166.0	163.7	158.3	-0.0	186.5	215.7	236.4
11	158.4	259.1	258.9	161.9	158.4	160.0	0.0	203.8	204.8	228.9

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.498	0.624	1.227	0.711	0.498	0.431	0.942	1.508
2	0.513	0.614	1.213	0.716	0.513	0.435	0.918	1.497
3	0.533	0.611	1.133	0.675	0.533	0.445	0.897	1.506
4	0.539	0.611	1.078	0.616	0.539	0.429	0.853	1.496
5	0.540	0.604	1.066	0.600	0.540	0.420	0.833	1.493
6	0.541	0.604	1.055	0.590	0.541	0.418	0.827	1.493
7	0.540	0.600	1.044	0.580	0.540	0.413	0.818	1.492
8	0.538	0.602	1.029	0.577	0.538	0.417	0.828	1.492
9	0.528	0.614	0.939	0.538	0.528	0.429	0.862	1.409
10	0.493	0.702	0.815	0.476	0.493	0.454	0.967	1.185
11	0.476	0.745	0.778	0.465	0.476	0.460	1.010	1.113

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	4.3	2.8	2.1	0.520	0.764	0.224	0.168	0.051	0.038
2	10.00	4.5	2.7	2.7	0.503	0.810	0.172	0.120	0.039	0.027
3	30.00	6.1	3.3	3.7	0.494	0.873	0.116	0.072	0.026	0.016
4	42.50	6.6	3.1	5.2	0.525	0.860	0.130	0.095	0.029	0.021
5	45.00	6.6	3.0	6.1	0.533	0.849	0.142	0.108	0.031	0.024
6	47.50	6.7	3.0	6.5	0.538	0.849	0.144	0.112	0.031	0.024
7	50.00	6.9	2.9	7.5	0.541	0.843	0.151	0.120	0.032	0.026
8	52.50	7.0	2.9	7.8	0.536	0.855	0.139	0.110	0.030	0.024
9	70.00	7.4	2.3	12.0	0.527	0.919	0.084	0.073	0.018	0.015
10	90.00	7.7	1.1	12.2	0.547	0.964	0.050	0.050	0.011	0.011
11	95.00	7.9	1.0	10.5	0.549	0.986	0.022	0.022	0.004	0.004

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE EDGES FOR ROTOR 14 MOD 1

(f) 90 Percent of design speed; reading 1302

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	-0.0	50.6	67.1	53.6	289.6	1.220	10.05	1.716
2	24.016	23.685	0.0	48.0	65.9	52.9	289.3	1.203	10.11	1.694
3	21.753	21.653	0.0	45.2	62.9	49.3	287.9	1.178	10.13	1.650
4	20.290	20.383	-0.0	47.4	60.9	46.2	287.7	1.169	10.15	1.604
5	19.992	20.129	0.0	47.7	60.5	45.9	288.0	1.168	10.15	1.596
6	19.693	19.875	0.0	48.2	60.1	45.4	287.7	1.167	10.15	1.587
7	19.390	19.621	0.0	48.5	59.8	44.9	287.5	1.164	10.15	1.577
8	19.088	19.367	0.0	48.4	59.4	44.1	287.8	1.162	10.15	1.575
9	16.899	17.589	0.0	47.1	56.8	36.3	287.7	1.151	10.15	1.571
10	14.191	15.557	0.0	50.5	53.8	18.2	287.7	1.156	10.15	1.630
11	13.465	15.049	0.0	52.5	53.2	9.1	287.9	1.163	10.13	1.686

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	158.1	225.6	406.1	241.1	158.1	143.1	-0.0	174.4	374.0	368.4
2	163.2	221.3	400.1	245.3	163.2	147.9	0.0	164.6	365.3	360.3
3	169.4	215.6	371.9	233.0	169.4	152.0	0.0	152.9	331.0	329.5
4	171.6	214.9	353.0	210.0	171.6	145.4	-0.0	158.3	308.5	309.9
5	172.0	213.6	349.4	206.4	172.0	143.8	0.0	158.0	304.1	306.2
6	172.2	212.9	345.7	202.0	172.2	141.8	0.0	158.8	299.8	302.5
7	171.5	211.9	341.1	198.2	171.5	140.5	0.0	158.6	294.9	298.4
8	171.8	212.1	337.6	196.1	171.8	140.9	0.0	158.5	290.6	294.9
9	168.4	217.1	307.4	183.4	168.4	147.7	0.0	159.1	257.2	267.7
10	158.2	241.4	267.6	161.8	158.2	153.7	0.0	186.2	215.9	236.7
11	153.6	257.3	256.2	158.5	153.6	156.5	0.0	204.2	205.0	229.2

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.474	0.621	1.217	0.664	0.474	0.394	0.905	1.533
2	0.490	0.614	1.201	0.680	0.490	0.410	0.907	1.519
3	0.511	0.605	1.121	0.654	0.511	0.426	0.897	1.529
4	0.518	0.606	1.066	0.592	0.518	0.410	0.847	1.521
5	0.519	0.602	1.054	0.581	0.519	0.405	0.836	1.519
6	0.520	0.600	1.044	0.569	0.520	0.400	0.824	1.520
7	0.518	0.598	1.030	0.559	0.518	0.397	0.819	1.520
8	0.519	0.599	1.019	0.554	0.519	0.398	0.820	1.519
9	0.508	0.618	0.927	0.522	0.508	0.420	0.877	1.422
10	0.476	0.691	0.805	0.463	0.476	0.440	0.972	1.196
11	0.461	0.739	0.769	0.455	0.461	0.449	1.019	1.123

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	5.3	3.8	3.1	0.567	0.757	0.238	0.178	0.053	0.040
2	10.00	5.5	3.7	3.1	0.538	0.799	0.190	0.135	0.042	0.030
3	30.00	7.0	4.2	4.2	0.512	0.865	0.127	0.081	0.028	0.018
4	42.50	7.5	4.0	5.6	0.547	0.856	0.139	0.101	0.030	0.022
5	45.00	7.6	3.9	6.3	0.551	0.849	0.148	0.112	0.032	0.024
6	47.50	7.7	3.9	7.0	0.557	0.844	0.154	0.118	0.033	0.025
7	50.00	7.8	3.9	7.7	0.560	0.847	0.151	0.117	0.032	0.025
8	52.50	7.9	3.8	8.1	0.560	0.855	0.145	0.113	0.031	0.024
9	70.00	8.4	3.3	11.4	0.543	0.914	0.094	0.082	0.020	0.018
10	90.00	8.6	2.1	12.9	0.557	0.962	0.055	0.055	0.012	0.012
11	95.00	8.8	1.9	10.7	0.558	0.985	0.024	0.024	0.005	0.005

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(g) 90 Percent of design speed; reading 1304

	RADII		ABS BETAM		REL BETAM		TOTAL TEMP		TOTAL PRESS	
RP	IN	OUT	IN	OUT	IN	OUT	IN	RATIO	IN	RATIO
1	24.562	24.193	0.0	51.9	67.7	54.2	289.7	1.225	10.07	1.709
2	24.016	23.685	0.0	49.3	66.7	53.2	289.4	1.209	10.10	1.700
3	21.753	21.653	0.0	46.6	63.6	49.4	287.9	1.180	10.13	1.657
4	20.290	20.383	0.0	47.8	61.7	46.6	287.8	1.170	10.14	1.609
5	19.992	20.129	0.0	48.7	61.3	46.4	287.5	1.168	10.14	1.598
6	19.693	19.875	0.0	49.0	60.9	45.2	287.8	1.169	10.14	1.592
7	19.390	19.621	0.0	49.4	60.6	44.6	287.6	1.168	10.15	1.587
8	19.088	19.367	0.0	49.0	60.2	43.7	287.8	1.166	10.15	1.583
9	16.899	17.589	0.0	48.4	57.6	37.4	287.7	1.150	10.15	1.561
10	14.191	15.557	0.0	51.1	54.5	18.0	287.7	1.156	10.15	1.634
11	13.465	15.049	0.0	53.0	54.0	9.1	287.9	1.163	10.12	1.686

	ABS VEL		REL VEL		MERID VEL		TANG VEL		WHEEL SPEED	
RP	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
1	152.5	223.6	402.6	235.6	152.5	137.9	0.0	176.0	372.6	367.0
2	157.0	220.9	397.1	240.4	157.0	144.1	0.0	167.4	364.8	359.7
3	163.8	215.3	368.9	227.5	163.8	148.0	0.0	156.3	330.6	329.1
4	165.7	213.2	349.6	208.4	165.7	143.2	0.0	157.9	307.9	309.3
5	165.7	211.3	345.4	202.1	165.7	139.4	0.0	158.8	303.1	305.2
6	166.0	212.5	341.2	198.0	166.0	139.4	0.0	160.4	298.2	301.0
7	165.8	212.2	337.4	194.0	165.8	138.1	0.0	161.2	293.9	297.4
8	165.8	212.4	333.4	192.6	165.8	139.2	0.0	160.4	289.3	293.5
9	162.7	212.5	303.7	177.8	162.7	141.1	0.0	158.9	256.4	266.9
10	153.3	240.0	264.2	158.4	153.3	150.6	0.0	186.9	215.2	235.9
11	148.4	255.3	252.6	155.5	148.4	153.5	0.0	203.9	204.4	228.5

	ABS MACH NO		REL MACH NO		MERID MACH NO		MERID VEL R	PEAK SS MACH NO
RP	IN	OUT	IN	OUT	IN	OUT		
1	0.456	0.614	1.204	0.647	0.456	0.379	0.904	1.545
2	0.470	0.611	1.190	0.665	0.470	0.399	0.918	1.536
3	0.493	0.604	1.111	0.638	0.493	0.415	0.904	1.547
4	0.499	0.600	1.054	0.587	0.499	0.403	0.864	1.542
5	0.500	0.595	1.041	0.569	0.500	0.393	0.841	1.541
6	0.500	0.598	1.028	0.557	0.500	0.392	0.840	1.540
7	0.500	0.598	1.017	0.547	0.500	0.389	0.833	1.541
8	0.500	0.599	1.005	0.543	0.500	0.393	0.840	1.542
9	0.490	0.604	0.914	0.505	0.490	0.401	0.867	1.428
10	0.460	0.687	0.794	0.453	0.460	0.431	0.982	1.200
11	0.445	0.732	0.757	0.446	0.445	0.440	1.035	1.129

	PERCENT	INCIDENCE		DEV	D-FACT	EFF	LOSS COEFF		LOSS PARAM	
RP	SPAN	MEAN	SS				TOT	PROF	TOT	PROF
1	5.00	6.0	4.5	3.7	0.579	0.737	0.264	0.203	0.058	0.045
2	10.00	6.2	4.4	3.3	0.549	0.784	0.210	0.153	0.047	0.034
3	30.00	7.8	5.0	4.3	0.526	0.860	0.135	0.086	0.030	0.019
4	42.50	8.3	4.8	6.0	0.547	0.856	0.142	0.102	0.031	0.022
5	45.00	8.4	4.8	6.8	0.559	0.852	0.147	0.109	0.032	0.023
6	47.50	8.5	4.7	6.8	0.565	0.841	0.162	0.125	0.035	0.027
7	50.00	8.6	4.6	7.4	0.570	0.840	0.164	0.129	0.035	0.028
8	52.50	8.6	4.5	7.8	0.567	0.844	0.162	0.128	0.035	0.028
9	70.00	9.2	4.1	12.5	0.556	0.904	0.107	0.096	0.022	0.020
10	90.00	9.4	2.8	12.8	0.565	0.964	0.053	0.053	0.011	0.011
11	95.00	9.7	2.7	10.7	0.563	0.986	0.023	0.023	0.005	0.005

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(h) 70 Percent of design speed; reading 1307

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	33.8	65.4	53.9	288.5	1.099	10.11	1.302
2	24.016	23.685	0.0	34.2	64.3	52.9	288.3	1.092	10.13	1.300
3	21.753	21.653	-0.0	33.3	61.4	50.5	288.1	1.083	10.13	1.286
4	20.290	20.383	0.0	35.0	59.5	46.4	288.1	1.083	10.13	1.285
5	19.992	20.129	0.0	36.6	59.1	45.1	288.2	1.085	10.13	1.287
6	19.693	19.875	0.0	38.0	58.8	44.1	288.0	1.087	10.14	1.284
7	19.390	19.621	0.0	38.3	58.4	43.8	288.0	1.087	10.14	1.278
8	19.088	19.367	0.0	36.8	58.1	42.9	288.2	1.085	10.13	1.283
9	16.899	17.589	0.0	38.6	55.6	35.6	288.0	1.080	10.14	1.287
10	14.191	15.557	0.0	43.9	52.4	17.5	288.0	1.090	10.13	1.341
11	13.465	15.049	0.0	47.3	51.8	9.6	288.1	1.095	10.12	1.368

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	133.6	169.2	320.7	238.7	133.6	140.5	0.0	94.2	291.6	287.2
2	137.2	169.7	316.2	232.8	137.2	140.4	0.0	95.3	285.0	281.0
3	140.7	164.5	293.9	215.8	140.7	137.4	0.0	90.4	258.0	256.8
4	141.6	168.6	279.0	200.2	141.6	138.1	0.0	96.6	240.4	241.6
5	141.8	170.4	276.4	194.0	141.8	136.9	0.0	101.5	237.3	238.9
6	141.5	171.0	273.4	187.9	141.5	134.8	0.0	105.2	233.9	236.1
7	141.4	169.9	270.3	184.5	141.4	133.2	0.0	105.4	230.3	233.0
8	141.1	171.3	267.0	187.1	141.1	137.1	0.0	102.6	226.6	229.9
9	137.4	176.4	243.0	169.5	137.4	137.9	0.0	110.0	200.5	208.7
10	129.5	200.3	212.3	151.3	129.5	144.3	0.0	138.9	168.2	184.4
11	125.9	210.3	203.4	144.8	125.9	142.7	0.0	154.5	159.8	178.6

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.399	0.485	0.957	0.684	0.399	0.403	1.052	1.279
2	0.410	0.488	0.945	0.670	0.410	0.404	1.024	1.264
3	0.421	0.475	0.879	0.623	0.421	0.397	0.976	1.246
4	0.424	0.487	0.835	0.579	0.424	0.399	0.976	1.209
5	0.424	0.492	0.827	0.560	0.424	0.395	0.965	1.202
6	0.423	0.494	0.818	0.543	0.423	0.389	0.953	1.196
7	0.423	0.490	0.808	0.533	0.423	0.385	0.942	1.185
8	0.422	0.495	0.798	0.541	0.422	0.396	0.972	1.174
9	0.411	0.512	0.726	0.492	0.411	0.400	1.003	1.085
10	0.386	0.583	0.633	0.440	0.386	0.420	1.115	0.912
11	0.375	0.613	0.606	0.422	0.375	0.416	1.134	0.857

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	3.6	2.1	3.4	0.366	0.789	0.145	0.141	0.032	0.031
2	10.00	3.8	2.0	3.1	0.374	0.845	0.102	0.099	0.023	0.022
3	30.00	5.5	2.7	5.4	0.369	0.899	0.068	0.067	0.015	0.014
4	42.50	6.1	2.6	5.8	0.392	0.891	0.080	0.080	0.017	0.017
5	45.00	6.2	2.6	5.6	0.413	0.880	0.090	0.090	0.020	0.020
6	47.50	6.4	2.6	5.7	0.431	0.854	0.114	0.114	0.025	0.025
7	50.00	6.5	2.5	6.6	0.436	0.836	0.130	0.130	0.028	0.028
8	52.50	6.6	2.5	6.9	0.415	0.866	0.107	0.107	0.023	0.023
9	70.00	7.2	2.1	10.6	0.425	0.932	0.060	0.060	0.013	0.013
10	90.00	7.3	0.7	12.2	0.439	0.972	0.035	0.035	0.007	0.007
11	95.00	7.4	0.5	11.2	0.457	0.987	0.018	0.018	0.004	0.004

TABLE VII. - Continued. BLADE ELEMENT DATA AT BLADE EDGES FOR ROTOR 14 MOD 1

(i) 70 Percent of design speed; reading 1308

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	24.562	24.193	0.0	42.5	67.5	55.0	288.5	1.114	10.10	1.328
2	24.016	23.685	0.0	39.4	66.5	54.0	288.4	1.106	10.13	1.328
3	21.753	21.653	-0.0	38.7	63.7	51.1	288.2	1.092	10.13	1.315
4	20.290	20.383	0.0	40.2	61.9	46.3	288.1	1.092	10.13	1.319
5	19.992	20.129	-0.0	41.4	61.6	45.8	288.2	1.093	10.13	1.314
6	19.693	19.875	0.0	42.7	61.2	45.2	288.0	1.094	10.14	1.308
7	19.390	19.621	0.0	43.7	60.9	44.6	288.1	1.094	10.14	1.303
8	19.088	19.367	-0.0	43.1	60.5	43.3	287.9	1.093	10.14	1.306
9	16.899	17.589	0.0	43.2	58.0	35.2	288.0	1.087	10.14	1.313
10	14.191	15.557	0.0	47.3	54.8	17.2	288.0	1.093	10.14	1.353
11	13.465	15.049	0.0	49.7	54.2	9.8	288.0	1.097	10.12	1.374

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	120.2	165.6	314.4	212.7	120.2	122.0	0.0	111.9	290.5	286.1
2	123.9	165.1	310.0	216.9	123.9	127.5	0.0	104.8	284.2	280.3
3	127.3	161.3	287.7	200.3	127.3	125.8	-0.0	101.0	258.0	256.8
4	128.2	167.1	272.5	184.9	128.2	127.7	0.0	107.8	240.4	241.5
5	128.2	166.4	269.3	178.9	128.2	124.7	-0.0	110.1	236.8	238.5
6	128.1	166.2	266.3	173.2	128.1	122.1	0.0	112.8	233.5	235.6
7	128.1	165.9	263.4	168.4	128.1	119.9	0.0	114.6	230.2	232.9
8	127.8	167.2	259.7	168.0	127.8	122.2	-0.0	114.1	226.1	229.4
9	125.2	174.0	236.1	155.3	125.2	126.9	0.0	119.0	200.2	208.4
10	118.6	195.3	205.9	138.8	118.6	132.5	0.0	143.5	168.3	184.6
11	115.3	204.2	197.0	134.0	115.3	132.1	0.0	155.7	159.7	178.5

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.358	0.471	0.935	0.605	0.358	0.347	1.015	1.320
2	0.369	0.471	0.923	0.619	0.369	0.364	1.029	1.305
3	0.379	0.463	0.858	0.575	0.379	0.361	0.989	1.285
4	0.382	0.481	0.812	0.532	0.382	0.367	0.996	1.244
5	0.382	0.478	0.803	0.514	0.382	0.358	0.973	1.234
6	0.382	0.478	0.794	0.498	0.382	0.351	0.953	1.227
7	0.382	0.477	0.785	0.484	0.382	0.344	0.936	1.216
8	0.381	0.481	0.775	0.483	0.381	0.351	0.956	1.203
9	0.373	0.503	0.704	0.449	0.373	0.367	1.014	1.108
10	0.353	0.567	0.613	0.403	0.353	0.384	1.118	0.933
11	0.343	0.593	0.586	0.389	0.343	0.384	1.146	0.876

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	5.8	4.3	4.5	0.457	0.742	0.204	0.199	0.044	0.043
2	10.00	6.0	4.2	4.2	0.424	0.798	0.154	0.151	0.033	0.033
3	30.00	7.9	5.1	6.0	0.422	0.882	0.090	0.089	0.019	0.019
4	42.50	8.5	5.0	5.7	0.446	0.893	0.089	0.089	0.019	0.019
5	45.00	8.7	5.0	6.3	0.463	0.873	0.108	0.108	0.023	0.023
6	47.50	8.8	5.0	6.8	0.480	0.852	0.129	0.129	0.028	0.028
7	50.00	8.9	5.0	7.4	0.493	0.837	0.145	0.145	0.031	0.031
8	52.50	9.0	4.9	7.4	0.485	0.855	0.131	0.131	0.028	0.028
9	70.00	9.6	4.5	10.2	0.479	0.928	0.073	0.073	0.016	0.016
10	90.00	9.7	3.2	11.9	0.488	0.973	0.038	0.038	0.008	0.008
11	95.00	9.8	2.9	11.4	0.495	0.983	0.025	0.025	0.005	0.005

TABLE VII. - Concluded. BLADE ELEMENT DATA AT BLADE

EDGES FOR ROTOR 14 MOD 1

(j) 70 Percent of design speed; reading 1309

	RADII		ABS BETAM		REL BETAM		TOTAL TEMP		TOTAL PRESS	
RP	IN	OUT	IN	OUT	IN	OUT	IN	RATIO	IN	RATIO
1	24.562	24.193	-0.0	59.8	70.4	59.7	288.7	1.139	10.10	1.331
2	24.016	23.685	0.0	53.1	69.4	57.6	288.5	1.128	10.13	1.320
3	21.753	21.653	0.0	41.1	66.5	51.4	288.1	1.099	10.13	1.322
4	20.290	20.383	0.0	43.7	64.5	47.1	288.1	1.096	10.14	1.324
5	19.992	20.129	-0.0	44.9	64.1	47.0	288.1	1.096	10.13	1.318
6	19.693	19.875	0.0	46.0	63.7	46.1	288.0	1.096	10.14	1.312
7	19.390	19.621	0.0	47.2	63.4	45.2	288.1	1.097	10.14	1.311
8	19.088	19.367	-0.0	46.9	63.0	43.5	288.0	1.098	10.14	1.317
9	16.899	17.589	0.0	45.0	60.3	34.6	288.0	1.092	10.14	1.330
10	14.191	15.557	-0.0	48.4	57.1	17.5	287.9	1.095	10.14	1.360
11	13.465	15.049	0.0	50.8	56.4	9.4	288.0	1.098	10.13	1.384

	ABS VEL		REL VEL		MERID VEL		TANG VEL		WHEEL SPEED	
RP	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
1	103.5	166.3	309.0	165.7	103.5	83.6	-0.0	143.7	291.2	286.8
2	107.5	161.2	304.8	180.5	107.5	96.8	0.0	128.9	285.2	281.3
3	112.4	160.4	281.6	193.8	112.4	120.9	0.0	105.5	258.2	257.0
4	114.9	164.7	266.8	175.1	114.9	119.1	0.0	113.7	240.9	242.0
5	115.2	163.1	263.9	169.4	115.2	115.5	-0.0	115.1	237.4	239.0
6	115.4	163.5	260.4	163.7	115.4	113.5	0.0	117.7	233.4	235.6
7	115.4	164.3	257.4	158.4	115.4	111.6	0.0	120.5	230.1	232.9
8	115.6	167.1	254.8	157.5	115.6	114.2	-0.0	122.0	227.1	230.4
9	114.6	175.0	231.2	150.4	114.6	123.8	0.0	123.7	200.8	209.0
10	109.1	192.9	200.8	134.2	109.1	128.0	-0.0	144.4	168.6	184.8
11	106.3	203.3	192.1	130.2	106.3	128.5	0.0	157.5	159.9	178.8

	ABS MACH NO		REL MACH NO		MERID MACH NO		MERID VEL R	PEAK SS MACH NO
RP	IN	OUT	IN	OUT	IN	OUT		
1	0.307	0.467	0.916	0.466	0.307	0.235	0.808	1.385
2	0.319	0.455	0.904	0.509	0.319	0.273	0.900	1.369
3	0.334	0.459	0.837	0.555	0.334	0.346	1.075	1.331
4	0.342	0.472	0.793	0.502	0.342	0.342	1.037	1.284
5	0.343	0.468	0.785	0.486	0.343	0.331	1.003	1.273
6	0.343	0.469	0.774	0.469	0.343	0.325	0.983	1.260
7	0.343	0.471	0.765	0.454	0.343	0.320	0.968	1.249
8	0.344	0.479	0.758	0.452	0.344	0.328	0.988	1.241
9	0.341	0.505	0.687	0.434	0.341	0.357	1.080	1.136
10	0.324	0.559	0.596	0.389	0.324	0.371	1.173	0.953
11	0.316	0.590	0.570	0.378	0.316	0.373	1.208	0.895

	PERCENT	INCIDENCE		DEV	D-FACT	EFF	LOSS COEFF		LOSS PARAM	
RP	SPAN	MEAN	SS				TOT	PROF	TOT	PROF
1	5.00	8.7	7.2	9.2	0.638	0.615	0.364	0.356	0.069	0.068
2	10.00	8.9	7.1	7.8	0.563	0.644	0.323	0.317	0.064	0.063
3	30.00	10.6	7.8	6.4	0.438	0.841	0.134	0.132	0.028	0.028
4	42.50	11.1	7.6	6.5	0.479	0.870	0.116	0.116	0.025	0.025
5	45.00	11.2	7.5	7.5	0.494	0.853	0.133	0.133	0.028	0.028
6	47.50	11.2	7.5	7.7	0.511	0.838	0.151	0.151	0.032	0.032
7	50.00	11.4	7.4	8.0	0.527	0.827	0.165	0.165	0.035	0.035
8	52.50	11.5	7.4	7.6	0.526	0.835	0.161	0.161	0.035	0.035
9	70.00	11.9	6.8	9.6	0.494	0.924	0.083	0.083	0.018	0.018
10	90.00	11.9	5.4	12.2	0.498	0.969	0.045	0.045	0.010	0.010
11	95.00	12.0	5.1	11.0	0.504	0.988	0.019	0.019	0.004	0.004

TABLE VIII. - BLADE-ELEMENT DATA AT BLADE EDGES

FOR STATOR 10

(a) 100 Percent of design speed; reading 1306

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	37.3	5.0	37.3	5.0	354.8	0.995	16.67	0.943
2	23.503	23.538	35.0	2.9	35.0	2.9	349.6	1.000	16.69	0.978
3	21.742	21.900	32.7	0.9	32.7	0.9	342.9	1.001	17.12	0.960
4	20.637	20.881	39.6	-0.7	39.6	-0.7	340.3	0.997	15.66	0.991
5	20.417	20.681	39.7	-1.4	39.7	-1.4	339.8	0.996	15.39	1.003
6	20.196	20.480	39.7	-1.7	39.7	-1.7	339.7	0.996	15.40	1.002
7	19.975	20.279	39.1	-1.7	39.1	-1.7	338.5	0.996	15.55	0.996
8	19.754	20.079	36.7	-1.7	36.7	-1.7	338.7	0.996	15.84	0.982
9	18.227	18.715	35.8	-2.3	35.8	-2.3	335.2	1.001	16.23	0.981
10	16.530	17.252	38.8	4.5	38.8	4.5	340.6	1.005	17.86	0.878
11	16.121	16.904	41.2	5.8	41.2	5.8	343.8	1.008	18.53	0.822

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	263.8	216.9	263.8	216.9	209.7	216.1	160.0	18.9	0.	0.
2	263.3	231.4	263.3	231.4	215.7	231.1	150.9	11.5	0.	0.
3	275.6	237.8	275.6	237.8	231.8	237.8	149.0	3.7	0.	0.
4	246.2	219.3	246.2	219.3	189.7	219.2	157.0	-2.7	0.	0.
5	239.5	217.5	239.5	217.5	184.2	217.4	153.1	-5.2	0.	0.
6	239.6	217.9	239.6	217.9	184.4	217.8	153.0	-6.6	0.	0.
7	244.0	220.5	244.0	220.5	189.4	220.4	153.8	-6.6	0.	0.
8	252.5	223.6	252.5	223.6	202.3	223.5	151.0	-6.5	0.	0.
9	265.2	244.5	265.2	244.5	215.2	244.3	155.0	-9.8	0.	0.
10	306.4	261.7	306.4	261.7	238.6	260.9	192.2	20.5	0.	0.
11	318.8	260.1	318.8	260.1	239.9	258.7	209.9	26.2	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.735	0.596	0.735	0.596	0.585	0.594	1.030	0.974
2	0.740	0.642	0.740	0.642	0.606	0.641	1.071	0.932
3	0.787	0.668	0.787	0.668	0.662	0.668	1.026	0.921
4	0.698	0.616	0.698	0.616	0.537	0.616	1.156	0.979
5	0.677	0.611	0.677	0.611	0.521	0.611	1.180	0.949
6	0.678	0.613	0.678	0.613	0.522	0.613	1.181	0.944
7	0.693	0.622	0.693	0.622	0.538	0.621	1.163	0.946
8	0.719	0.631	0.719	0.631	0.576	0.631	1.104	0.916
9	0.764	0.698	0.764	0.698	0.620	0.697	1.135	0.954
10	0.892	0.743	0.892	0.743	0.694	0.741	1.093	1.205
11	0.929	0.733	0.929	0.733	0.699	0.730	1.078	1.327

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	0.6	-5.5	17.8	0.380	0.	0.189	0.189	0.071	0.071
2	10.00	-0.1	-6.4	14.5	0.318	0.	0.074	0.074	0.027	0.027
3	30.00	-1.1	-7.3	11.1	0.318	0.	0.119	0.119	0.041	0.041
4	42.50	5.4	-0.8	9.1	0.321	0.	0.031	0.031	0.010	0.010
5	45.00	5.4	-0.8	8.4	0.305	0.	-0.012	-0.012	-0.004	-0.004
6	47.50	5.2	-1.0	8.0	0.303	0.	-0.008	-0.008	-0.002	-0.002
7	50.00	4.5	-1.7	8.0	0.304	0.	0.016	0.016	0.005	0.005
8	52.50	1.9	-4.3	8.0	0.309	0.	0.061	0.061	0.019	0.019
9	70.00	-0.4	-6.5	6.8	0.256	0.	0.058	0.058	0.017	0.017
10	90.00	0.0	-6.0	13.3	0.290	0.	0.303	0.302	0.079	0.079
11	95.00	1.3	-4.6	14.6	0.327	0.	0.418	0.413	0.107	0.105

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE EDGES FOR STATOR 10

(b) 100 Percent of design speed; reading 1296

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	41.7	6.5	41.7	6.5	361.2	0.994	17.54	0.962
2	23.503	23.538	39.4	4.7	39.4	4.7	355.7	0.999	17.61	0.981
3	21.742	21.900	36.7	2.9	36.7	2.9	348.0	1.000	17.84	0.966
4	20.637	20.881	42.0	1.0	42.0	1.0	345.5	0.995	16.81	0.982
5	20.417	20.681	42.2	0.4	42.2	0.4	345.1	0.996	16.59	0.991
6	20.196	20.480	42.2	0.1	42.2	0.1	343.4	0.997	16.45	0.997
7	19.975	20.279	41.5	0.1	41.5	0.1	344.0	0.995	16.48	0.997
8	19.754	20.079	40.1	0.4	40.1	0.4	342.6	0.998	16.71	0.988
9	18.227	18.715	38.4	-0.8	38.4	-0.8	338.6	0.998	16.98	0.979
10	16.530	17.252	40.9	4.3	40.9	4.3	341.3	1.006	17.91	0.919
11	16.121	16.904	42.9	5.6	42.9	5.6	344.9	1.006	18.74	0.846

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	260.2	205.3	260.2	205.3	194.3	204.0	173.0	23.3	0.	0.
2	262.4	215.7	262.4	215.7	202.9	215.0	166.4	17.5	0.	0.
3	270.2	217.4	270.2	217.4	216.5	217.1	161.6	11.0	0.	0.
4	253.3	202.6	253.3	202.6	188.2	202.6	169.6	3.6	0.	0.
5	248.6	201.1	248.6	201.1	184.1	201.1	167.0	1.4	0.	0.
6	245.3	200.8	245.3	200.8	181.7	200.8	164.9	0.4	0.	0.
7	246.9	202.7	246.9	202.7	184.8	202.7	163.7	0.3	0.	0.
8	252.9	205.9	252.9	205.9	193.5	205.9	162.8	1.4	0.	0.
9	265.4	217.7	265.4	217.7	208.1	217.7	164.7	-3.1	0.	0.
10	291.5	231.5	291.5	231.5	220.5	230.8	190.7	17.2	0.	0.
11	309.4	219.5	309.4	219.5	226.5	218.5	210.7	21.4	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.717	0.557	0.717	0.557	0.536	0.553	1.050	1.058
2	0.730	0.590	0.730	0.590	0.565	0.588	1.060	1.035
3	0.764	0.602	0.764	0.602	0.612	0.601	1.003	1.011
4	0.714	0.562	0.714	0.562	0.530	0.562	1.076	1.060
5	0.699	0.558	0.699	0.558	0.518	0.558	1.092	1.040
6	0.691	0.558	0.691	0.558	0.512	0.558	1.106	1.024
7	0.695	0.564	0.695	0.564	0.521	0.564	1.097	1.009
8	0.716	0.573	0.716	0.573	0.548	0.573	1.064	0.998
9	0.760	0.613	0.760	0.613	0.596	0.613	1.046	1.022
10	0.841	0.649	0.841	0.649	0.636	0.647	1.047	1.195
11	0.895	0.609	0.895	0.609	0.655	0.607	0.964	1.333

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	5.0	-1.2	19.3	0.429	0.	0.131	0.131	0.049	0.049
2	10.00	4.2	-2.0	16.4	0.389	0.	0.064	0.064	0.024	0.024
3	30.00	2.9	-3.3	13.1	0.387	0.	0.107	0.107	0.037	0.037
4	42.50	7.8	1.6	10.9	0.414	0.	0.061	0.061	0.020	0.020
5	45.00	7.9	1.7	10.2	0.406	0.	0.033	0.033	0.011	0.011
6	47.50	7.8	1.6	9.9	0.395	0.	0.011	0.011	0.003	0.003
7	50.00	6.9	0.7	9.8	0.387	0.	0.012	0.012	0.004	0.004
8	52.50	5.3	-0.9	10.1	0.385	0.	0.040	0.040	0.013	0.013
9	70.00	2.2	-3.9	8.3	0.361	0.	0.067	0.067	0.019	0.019
10	90.00	2.1	-4.0	13.1	0.358	0.	0.218	0.218	0.057	0.057
11	95.00	3.1	-2.9	14.4	0.443	0.	0.379	0.376	0.097	0.096

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE EDGES FOR STATOR 10

(c) 100 Percent of design speed; reading 1297

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	48.2	8.1	48.2	8.1	369.7	0.991	18.71	0.958
2	23.503	23.538	44.0	6.4	44.0	6.4	363.3	0.999	18.69	0.973
3	21.742	21.900	41.4	4.8	41.4	4.8	352.8	1.000	18.57	0.971
4	20.637	20.881	43.7	1.4	43.7	1.4	348.5	0.998	17.75	0.970
5	20.417	20.681	43.9	0.8	43.9	0.8	347.7	0.996	17.48	0.979
6	20.196	20.480	44.1	0.4	44.1	0.4	346.9	0.998	17.30	0.985
7	19.975	20.279	44.0	0.4	44.0	0.4	346.4	0.998	17.30	0.985
8	19.754	20.079	44.4	1.4	44.4	1.4	345.8	1.000	17.28	0.988
9	18.227	18.715	41.5	0.4	41.5	0.4	340.5	0.999	17.38	0.986
10	16.530	17.252	43.4	5.8	43.4	5.8	343.2	1.004	18.22	0.914
11	16.121	16.904	45.1	6.2	45.1	6.2	345.1	1.006	18.93	0.860

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	263.8	198.9	263.8	198.9	175.8	196.9	196.7	27.9	0.	0.
2	264.0	206.4	264.0	206.4	189.7	205.1	183.5	23.0	0.	0.
3	264.5	204.8	264.5	204.8	198.3	204.1	174.9	17.1	0.	0.
4	254.7	187.7	254.7	187.7	184.0	187.7	176.1	4.5	0.	0.
5	248.6	184.8	248.6	184.8	179.2	184.8	172.3	2.4	0.	0.
6	245.7	184.1	245.7	184.1	176.5	184.1	170.9	1.2	0.	0.
7	245.5	184.3	245.5	184.3	176.6	184.3	170.6	1.2	0.	0.
8	246.9	187.4	246.9	187.4	176.2	187.3	172.9	4.5	0.	0.
9	255.4	197.0	255.4	197.0	191.3	196.9	169.3	1.5	0.	0.
10	280.9	197.9	280.9	197.9	204.2	196.9	192.9	19.9	0.	0.
11	297.6	189.9	297.6	189.9	210.2	188.8	210.6	20.4	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.719	0.533	0.719	0.533	0.479	0.528	1.120	1.220
2	0.726	0.557	0.726	0.557	0.522	0.554	1.081	1.145
3	0.740	0.561	0.740	0.561	0.555	0.559	1.029	1.100
4	0.714	0.515	0.714	0.515	0.516	0.515	1.020	1.103
5	0.697	0.508	0.697	0.508	0.502	0.508	1.031	1.075
6	0.689	0.506	0.689	0.506	0.495	0.506	1.043	1.063
7	0.689	0.507	0.689	0.507	0.495	0.507	1.044	1.057
8	0.693	0.516	0.693	0.516	0.495	0.516	1.063	1.070
9	0.726	0.548	0.726	0.548	0.544	0.548	1.030	1.056
10	0.804	0.548	0.804	0.548	0.584	0.545	0.964	1.211
11	0.856	0.522	0.856	0.522	0.604	0.519	0.898	1.336

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	11.5	5.3	20.8	0.488	0.	0.145	0.145	0.055	0.055
2	10.00	8.9	2.7	18.1	0.444	0.	0.091	0.091	0.033	0.033
3	30.00	7.6	1.4	15.0	0.431	0.	0.097	0.097	0.033	0.033
4	42.50	9.5	3.3	11.2	0.432	0.	0.103	0.103	0.034	0.034
5	45.00	9.6	3.3	10.6	0.477	0.	0.077	0.077	0.025	0.025
6	47.50	9.6	3.4	10.1	0.471	0.	0.057	0.057	0.018	0.018
7	50.00	9.4	3.2	10.1	0.467	0.	0.057	0.057	0.018	0.018
8	52.50	9.6	3.4	11.0	0.453	0.	0.042	0.042	0.013	0.013
9	70.00	5.4	-0.8	9.6	0.417	0.	0.048	0.048	0.014	0.014
10	90.00	4.6	-1.5	14.6	0.453	0.	0.247	0.247	0.065	0.065
11	95.00	5.2	-0.7	15.0	0.521	0.	0.369	0.366	0.094	0.093

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE

EDGES FOR STATOR 10

(d) 100 Percent of design speed; reading 1298

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	53.5	9.5	53.5	9.5	376.2	0.988	19.08	0.950
2	23.503	23.538	49.1	8.1	49.1	8.1	369.5	0.995	19.06	0.958
3	21.742	21.900	43.6	4.7	43.6	4.7	354.8	1.001	18.67	0.964
4	20.637	20.881	46.2	1.5	46.2	1.5	350.2	1.000	17.80	0.974
5	20.417	20.681	47.0	1.5	47.0	1.5	349.2	1.001	17.56	0.983
6	20.196	20.480	47.2	1.9	47.2	1.9	348.9	0.999	17.49	0.987
7	19.975	20.279	47.3	2.3	47.3	2.3	349.0	0.999	17.66	0.978
8	19.754	20.079	47.2	2.8	47.2	2.8	349.1	0.997	17.67	0.981
9	18.227	18.715	43.1	1.3	43.1	1.3	342.7	0.998	17.75	0.978
10	16.530	17.252	44.3	6.4	44.3	6.4	343.8	1.003	18.36	0.913
11	16.121	16.904	45.7	6.1	45.7	6.1	346.1	1.005	19.05	0.869

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	265.3	195.5	265.3	195.5	157.8	192.8	213.3	32.4	0.	0.
2	263.8	199.0	263.8	199.0	172.7	197.0	199.3	28.2	0.	0.
3	259.4	193.4	259.4	193.4	187.8	192.7	178.9	15.9	0.	0.
4	247.1	177.4	247.1	177.4	171.0	177.3	178.3	4.8	0.	0.
5	241.5	175.0	241.5	175.0	164.8	174.9	176.6	4.6	0.	0.
6	241.6	176.1	241.6	176.1	164.2	176.0	177.3	5.9	0.	0.
7	246.6	177.3	246.6	177.3	167.2	177.2	181.2	7.1	0.	0.
8	248.5	180.2	248.5	180.2	168.9	180.0	182.3	8.9	0.	0.
9	256.8	188.2	256.8	188.2	187.6	188.2	175.3	4.1	0.	0.
10	277.3	185.4	277.3	185.4	198.3	184.3	193.8	20.7	0.	0.
11	294.1	182.9	294.1	182.9	205.5	181.9	210.4	19.5	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.716	0.519	0.716	0.519	0.426	0.512	1.222	1.347
2	0.719	0.532	0.719	0.532	0.471	0.527	1.140	1.257
3	0.722	0.526	0.722	0.526	0.523	0.524	1.026	1.127
4	0.689	0.484	0.689	0.484	0.477	0.484	1.037	1.121
5	0.673	0.478	0.673	0.478	0.459	0.477	1.062	1.109
6	0.674	0.481	0.674	0.481	0.458	0.481	1.072	1.112
7	0.689	0.485	0.689	0.485	0.467	0.484	1.060	1.135
8	0.695	0.493	0.695	0.493	0.472	0.493	1.066	1.137
9	0.728	0.521	0.728	0.521	0.532	0.521	1.003	1.097
10	0.791	0.511	0.791	0.511	0.566	0.508	0.929	1.219
11	0.843	0.501	0.843	0.501	0.589	0.499	0.885	1.334

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	16.8	10.6	22.3	0.521	0.	0.171	0.171	0.064	0.064
2	10.00	14.0	7.8	19.8	0.487	0.	0.144	0.144	0.053	0.053
3	30.00	9.8	3.6	14.9	0.470	0.	0.122	0.122	0.042	0.042
4	42.50	12.0	5.8	11.4	0.511	0.	0.094	0.094	0.031	0.031
5	45.00	12.7	6.4	11.3	0.505	0.	0.066	0.066	0.021	0.021
6	47.50	12.7	6.5	11.7	0.497	0.	0.051	0.051	0.016	0.016
7	50.00	12.7	6.5	12.0	0.503	0.	0.082	0.082	0.026	0.026
8	52.50	12.4	6.2	12.5	0.492	0.	0.070	0.070	0.022	0.022
9	70.00	6.9	0.8	10.4	0.458	0.	0.074	0.074	0.022	0.022
10	90.00	5.5	-0.5	15.2	0.491	0.	0.257	0.257	0.067	0.067
11	95.00	5.9	-0.1	14.9	0.540	0.	0.353	0.351	0.090	0.090

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE

EDGES FOR STATOR 10

(e) 90 Percent of design speed; reading 1301

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	41.2	7.6	41.2	7.6	351.2	0.995	17.09	0.960
2	23.503	23.538	39.9	6.1	39.9	6.1	345.6	1.001	16.90	0.981
3	21.742	21.900	38.3	3.0	38.3	3.0	337.8	1.001	16.59	0.985
4	20.637	20.881	40.3	1.7	40.3	1.7	335.2	0.999	16.12	0.983
5	20.417	20.681	40.9	1.3	40.9	1.3	335.2	0.998	15.99	0.984
6	20.196	20.480	41.2	1.0	41.2	1.0	334.5	0.998	15.94	0.984
7	19.975	20.279	41.5	0.9	41.5	0.9	334.4	0.996	15.84	0.989
8	19.754	20.079	41.0	0.8	41.0	0.8	332.7	1.000	15.80	0.990
9	18.227	18.715	39.7	-0.3	39.7	-0.3	329.5	1.000	15.69	0.991
10	16.530	17.252	42.2	4.9	42.2	4.9	332.2	1.004	16.50	0.933
11	16.121	16.904	43.9	6.2	43.9	6.2	334.5	1.005	16.99	0.882

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	250.3	195.9	250.3	195.9	188.2	194.2	165.0	25.9	0.	0.
2	244.6	200.6	244.6	200.6	187.5	199.4	157.0	21.2	0.	0.
3	239.3	196.8	239.3	196.8	187.7	196.5	148.4	10.3	0.	0.
4	234.8	186.6	234.8	186.6	179.2	186.5	151.8	5.5	0.	0.
5	231.6	184.0	231.6	184.0	175.0	184.0	151.8	4.3	0.	0.
6	230.9	183.5	230.9	183.5	173.7	183.4	152.1	3.1	0.	0.
7	229.0	183.2	229.0	183.2	171.5	183.2	151.7	2.9	0.	0.
8	229.1	183.3	229.1	183.3	173.0	183.2	150.2	2.5	0.	0.
9	232.7	188.6	232.7	188.6	179.0	188.6	148.7	-0.9	0.	0.
10	261.5	199.0	261.5	199.0	193.8	198.3	175.5	16.9	0.	0.
11	274.5	189.2	274.5	189.2	197.8	188.1	190.3	20.4	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.698	0.538	0.698	0.538	0.525	0.533	1.032	1.020
2	0.686	0.554	0.686	0.554	0.526	0.551	1.064	0.986
3	0.679	0.550	0.679	0.550	0.532	0.549	1.047	0.937
4	0.668	0.522	0.668	0.522	0.510	0.522	1.041	0.952
5	0.658	0.515	0.658	0.515	0.497	0.515	1.052	0.949
6	0.656	0.514	0.656	0.514	0.494	0.514	1.056	0.949
7	0.651	0.514	0.651	0.514	0.487	0.514	1.068	0.943
8	0.653	0.514	0.653	0.514	0.493	0.514	1.059	0.930
9	0.667	0.533	0.667	0.533	0.513	0.533	1.054	0.930
10	0.755	0.560	0.755	0.560	0.560	0.558	1.023	1.107
11	0.795	0.529	0.795	0.529	0.573	0.526	0.951	1.209

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	4.5	-1.6	20.4	0.428	0.	0.145	0.145	0.054	0.054
2	10.00	4.8	-1.4	17.8	0.386	0.	0.071	0.071	0.026	0.026
3	30.00	4.5	-1.7	13.2	0.376	0.	0.057	0.057	0.019	0.019
4	42.50	6.1	-0.1	11.5	0.408	0.	0.066	0.066	0.022	0.022
5	45.00	6.6	0.4	11.1	0.410	0.	0.063	0.063	0.021	0.021
6	47.50	6.7	0.5	10.7	0.411	0.	0.062	0.062	0.020	0.020
7	50.00	6.9	0.7	10.6	0.405	0.	0.044	0.044	0.014	0.014
8	52.50	6.2	-0.0	10.5	0.401	0.	0.041	0.041	0.013	0.013
9	70.00	3.6	-2.6	8.9	0.373	0.	0.034	0.034	0.010	0.010
10	90.00	3.4	-2.7	13.7	0.394	0.	0.212	0.212	0.056	0.056
11	95.00	4.1	-1.9	15.0	0.465	0.	0.348	0.348	0.089	0.089

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE EDGES FOR STATOR 10

(f) 90 Percent of design speed; reading 1302

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	45.9	8.7	45.9	8.7	353.3	0.997	17.25	0.965
2	23.503	23.538	43.2	7.1	43.2	7.1	348.1	1.001	17.12	0.979
3	21.742	21.900	40.3	3.4	40.3	3.4	339.1	1.002	16.72	0.986
4	20.637	20.881	42.5	1.9	42.5	1.9	336.3	1.000	16.28	0.983
5	20.417	20.681	42.8	1.5	42.8	1.5	336.6	0.997	16.19	0.983
6	20.196	20.480	43.3	1.5	43.3	1.5	335.8	0.999	16.10	0.985
7	19.975	20.279	43.5	1.4	43.5	1.4	334.7	0.999	16.00	0.988
8	19.754	20.079	43.3	1.4	43.3	1.4	334.5	0.999	15.99	0.989
9	18.227	18.715	41.2	0.2	41.2	0.2	331.0	0.999	15.94	0.987
10	16.530	17.252	43.1	5.4	43.1	5.4	332.6	1.004	16.55	0.931
11	16.121	16.904	44.7	6.3	44.7	6.3	334.9	1.004	17.08	0.885

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	245.6	191.3	245.6	191.3	171.1	189.1	176.2	29.0	0.	0.
2	242.1	195.1	242.1	195.1	176.4	193.7	165.8	24.0	0.	0.
3	235.5	189.6	235.5	189.6	179.6	189.2	152.3	11.2	0.	0.
4	231.4	178.8	231.4	178.8	170.5	178.7	156.3	6.0	0.	0.
5	229.5	176.8	229.5	176.8	168.5	176.7	155.8	4.7	0.	0.
6	228.0	176.1	228.0	176.1	166.1	176.1	156.3	4.5	0.	0.
7	226.5	175.7	226.5	175.7	164.4	175.7	155.8	4.3	0.	0.
8	226.7	175.9	226.7	175.9	165.0	175.8	155.4	4.2	0.	0.
9	232.9	180.9	232.9	180.9	175.1	180.9	153.5	0.6	0.	0.
10	256.6	184.4	256.6	184.4	187.4	183.5	175.2	17.3	0.	0.
11	271.1	178.2	271.1	178.2	192.8	177.2	190.6	19.4	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.681	0.522	0.681	0.522	0.475	0.516	1.106	1.102
2	0.676	0.536	0.676	0.536	0.493	0.532	1.098	1.048
3	0.666	0.527	0.666	0.527	0.508	0.526	1.054	0.964
4	0.656	0.498	0.656	0.498	0.483	0.498	1.048	0.985
5	0.650	0.493	0.650	0.493	0.477	0.493	1.049	0.978
6	0.646	0.491	0.646	0.491	0.471	0.491	1.060	0.980
7	0.643	0.491	0.643	0.491	0.467	0.491	1.068	0.975
8	0.643	0.491	0.643	0.491	0.468	0.491	1.065	0.968
9	0.666	0.509	0.666	0.509	0.501	0.509	1.033	0.963
10	0.739	0.517	0.739	0 517	0.540	0.514	0.979	1.107
11	0.783	0.497	0.783	0.497	0.557	0.494	0.919	1.213

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	9.2	3.0	21.5	0.448	0.	0.130	0.130	0.049	0.049
2	10.00	8.1	1.9	18.8	0.412	0.	0.079	0.079	0.029	0.029
3	30.00	6.5	0.3	13.6	0.401	0.	0.054	0.054	0.019	0.019
4	42.50	8.3	2.1	11.8	0.439	0.	0.068	0.068	0.022	0.022
5	45.00	8.4	2.2	11.3	0.442	0.	0.069	0.069	0.022	0.022
6	47.50	8.8	2.6	11.2	0.440	0.	0.061	0.061	0.020	0.020
7	50.00	8.8	2.6	11.1	0.435	0.	0.048	0.048	0.015	0.015
8	52.50	8.5	2.3	11.0	0.432	0.	0.047	0.047	0.015	0.015
9	70.00	5.1	-1.0	9.3	0.411	0.	0.051	0.051	0.015	0.015
10	90.00	4.3	-1.8	14.2	0.439	0.	0.228	0.228	0.060	0.060
11	95.00	4.9	-1.1	15.1	0.500	0.	0.345	0.345	0.088	0.088

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE EDGES FOR STATOR 10

(g) 90 Percent of design speed; reading 1304

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	47.3	9.0	47.3	9.0	354.7	0.997	17.21	0.970
2	23.503	23.538	44.5	7.4	44.5	7.4	349.8	1.000	17.17	0.981
3	21.742	21.900	41.7	3.5	41.7	3.5	339.8	1.001	16.79	0.981
4	20.637	20.881	42.9	2.1	42.9	2.1	336.7	1.001	16.32	0.981
5	20.417	20.681	43.8	2.0	43.8	2.0	335.8	1.000	16.20	0.983
6	20.196	20.480	44.1	2.0	44.1	2.0	336.4	0.998	16.15	0.983
7	19.975	20.279	44.5	2.0	44.5	2.0	335.9	0.997	16.10	0.983
8	19.754	20.079	44.0	1.9	44.0	1.9	335.7	0.997	16.07	0.984
9	18.227	18.715	42.6	0.7	42.6	0.7	330.9	1.001	15.85	0.998
10	16.530	17.252	43.8	5.6	43.8	5.6	332.6	1.004	16.58	0.929
11	16.121	16.904	45.3	6.3	45.3	6.3	334.9	1.004	17.06	0.889

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	242.1	188.7	242.1	188.7	164.2	186.4	177.9	29.5	0.	0.
2	240.5	192.8	240.5	192.8	171.4	191.3	168.7	24.7	0.	0.
3	233.9	184.5	233.9	184.5	174.5	184.1	155.7	11.3	0.	0.
4	229.1	173.3	229.1	173.3	167.8	173.2	156.0	6.4	0.	0.
5	226.0	171.7	226.0	171.7	163.0	171.6	156.6	6.1	0.	0.
6	226.9	171.0	226.9	171.0	163.0	170.9	157.8	6.1	0.	0.
7	226.0	170.5	226.0	170.5	161.3	170.4	158.3	6.0	0.	0.
8	226.4	170.4	226.4	170.4	162.9	170.3	157.3	5.6	0.	0.
9	226.4	177.5	226.4	177.5	166.6	177.5	153.3	2.3	0.	0.
10	253.9	177.7	253.9	177.7	183.1	176.8	175.9	17.5	0.	0.
11	268.0	173.0	268.0	173.0	188.6	171.9	190.4	19.0	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.669	0.514	0.669	0.514	0.454	0.507	1.135	1.115
2	0.670	0.529	0.670	0.529	0.477	0.524	1.116	1.067
3	0.660	0.512	0.660	0.512	0.492	0.511	1.055	0.989
4	0.649	0.482	0.649	0.482	0.475	0.481	1.032	0.983
5	0.640	0.478	0.640	0.478	0.462	0.477	1.053	0.987
6	0.642	0.476	0.642	0.476	0.461	0.476	1.049	0.991
7	0.640	0.475	0.640	0.475	0.457	0.475	1.056	0.992
8	0.641	0.475	0.641	0.475	0.461	0.475	1.046	0.980
9	0.646	0.498	0.646	0.498	0.476	0.498	1.065	0.964
10	0.731	0.497	0.731	0.497	0.527	0.495	0.965	1.113
11	0.773	0.481	0.773	0.481	0.544	0.478	0.911	1.212

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	10.6	4.4	21.8	0.453	0.	0.115	0.115	0.043	0.043
2	10.00	9.4	3.2	19.0	0.421	0.	0.074	0.074	0.027	0.027
3	30.00	8.0	1.7	13.7	0.423	0.	0.074	0.074	0.026	0.026
4	42.50	8.7	2.5	12.0	0.456	0.	0.078	0.078	0.026	0.026
5	45.00	9.5	3.3	11.8	0.455	0.	0.070	0.070	0.023	0.023
6	47.50	9.6	3.4	11.8	0.459	0.	0.072	0.072	0.023	0.023
7	50.00	9.8	3.6	11.7	0.458	0.	0.070	0.070	0.022	0.022
8	52.50	9.2	3.0	11.5	0.456	0.	0.066	0.066	0.021	0.021
9	70.00	6.5	0.3	9.9	0.407	0.	0.008	0.008	0.002	0.002
10	90.00	5.0	-1.0	14.5	0.460	0.	0.236	0.236	0.062	0.062
11	95.00	5.4	-0.5	15.1	0.514	0.	0.339	0.339	0.086	0.086

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE

EDGES FOR STATOR 10

(h) 70 Percent of design speed; reading 1307

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	29.6	4.0	29.6	4.0	317.1	1.000	13.16	0.973
2	23.503	23.538	29.9	2.4	29.9	2.4	314.9	1.001	13.17	0.990
3	21.742	21.900	29.2	-1.7	29.2	-1.7	312.0	1.001	13.03	0.994
4	20.637	20.881	30.5	-1.4	30.5	-1.4	312.1	1.001	13.02	0.992
5	20.417	20.681	32.0	-1.3	32.0	-1.3	312.7	1.000	13.04	0.991
6	20.196	20.480	33.3	-1.1	33.3	-1.1	313.0	0.999	13.02	0.993
7	19.975	20.279	33.6	-1.2	33.6	-1.2	313.1	0.998	12.96	0.998
8	19.754	20.079	32.0	-1.5	32.0	-1.5	312.7	1.000	13.00	0.995
9	18.227	18.715	33.0	-2.6	33.0	-2.6	311.1	1.003	13.05	0.999
10	16.530	17.252	36.5	1.9	36.5	1.9	313.9	1.005	13.59	0.964
11	16.121	16.904	39.3	4.6	39.3	4.6	315.4	1.005	13.84	0.923

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	193.0	165.2	193.0	165.2	167.9	164.8	95.2	11.4	0.	0.
2	192.6	174.6	192.6	174.6	166.9	174.5	96.0	7.2	0.	0.
3	184.8	173.4	184.8	173.4	161.4	173.3	90.0	-5.0	0.	0.
4	188.1	174.8	188.1	174.8	162.1	174.7	95.4	-4.3	0.	0.
5	189.1	176.1	189.1	176.1	160.4	176.0	100.1	-3.9	0.	0.
6	188.8	176.9	188.8	176.9	157.9	176.9	103.5	-3.4	0.	0.
7	187.2	177.5	187.2	177.5	155.9	177.4	103.5	-3.8	0.	0.
8	189.9	178.4	189.9	178.4	161.0	178.3	100.6	-4.8	0.	0.
9	194.9	188.5	194.9	188.5	163.4	188.3	106.2	-8.6	0.	0.
10	219.8	206.7	219.8	206.7	176.7	206.6	130.8	6.7	0.	0.
11	227.7	199.2	227.7	199.2	176.2	198.6	144.2	15.9	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.557	0.473	0.557	0.473	0.485	0.472	0.982	0.557
2	0.558	0.503	0.558	0.503	0.484	0.502	1.045	0.562
3	0.537	0.502	0.537	0.502	0.469	0.501	1.074	0.537
4	0.547	0.506	0.547	0.506	0.471	0.506	1.078	0.547
5	0.549	0.510	0.549	0.510	0.466	0.509	1.097	0.601
6	0.548	0.512	0.548	0.512	0.458	0.512	1.120	0.630
7	0.543	0.514	0.543	0.514	0.452	0.514	1.138	0.628
8	0.552	0.517	0.552	0.517	0.468	0.516	1.108	0.589
9	0.569	0.548	0.569	0.548	0.477	0.548	1.153	0.645
10	0.644	0.601	0.644	0.601	0.518	0.601	1.170	0.815
11	0.668	0.576	0.668	0.576	0.517	0.575	1.127	0.910

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	-7.1	-13.3	16.7	0.309	0.	0.143	0.143	0.054	0.054
2	10.00	-5.2	-11.4	14.0	0.265	0.	0.052	0.052	0.019	0.019
3	30.00	-4.6	-10.9	8.5	0.239	0.	0.034	0.034	0.012	0.012
4	42.50	-3.7	-9.9	8.5	0.243	0.	0.045	0.045	0.015	0.015
5	45.00	-2.4	-8.6	8.5	0.246	0.	0.047	0.047	0.015	0.015
6	47.50	-1.2	-7.4	8.6	0.244	0.	0.036	0.036	0.011	0.011
7	50.00	-1.1	-7.3	8.5	0.232	0.	0.011	0.011	0.003	0.003
8	52.50	-2.8	-9.0	8.2	0.233	0.	0.027	0.027	0.009	0.009
9	70.00	-3.1	-9.3	6.5	0.201	0.	0.006	0.006	0.002	0.002
10	90.00	-2.3	-8.3	10.7	0.204	0.	0.147	0.147	0.039	0.039
11	95.00	-0.5	-6.5	13.4	0.266	0.	0.298	0.298	0.076	0.076

TABLE VIII. - Continued. BLADE-ELEMENT DATA AT BLADE EDGES FOR STATOR 10

(i) 70 Percent of design speed; reading 1308

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	38.1	5.9	38.1	5.9	321.4	0.999	13.41	0.982
2	23.503	23.538	35.1	4.2	35.1	4.2	318.9	1.002	13.45	0.991
3	21.742	21.900	34.4	0.7	34.4	0.7	314.8	1.001	13.33	0.996
4	20.637	20.881	35.6	1.0	35.6	1.0	314.7	1.000	13.36	0.988
5	20.417	20.681	36.8	0.9	36.8	0.9	315.0	0.999	13.31	0.990
6	20.196	20.480	38.0	0.8	38.0	0.8	315.0	0.999	13.26	0.995
7	19.975	20.279	38.9	0.8	38.9	0.8	315.2	0.998	13.21	0.998
8	19.754	20.079	38.2	0.8	38.2	0.8	314.6	0.999	13.24	0.997
9	18.227	18.715	37.6	-0.1	37.6	-0.1	313.1	1.002	13.31	1.000
10	16.530	17.252	40.1	3.2	40.1	3.2	314.7	1.004	13.72	0.968
11	16.121	16.904	42.0	5.7	42.0	5.7	315.9	1.004	13.92	0.932

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	183.3	149.9	183.3	149.9	144.3	149.1	113.1	15.5	0.	0.
2	183.8	156.5	183.8	156.5	150.4	156.0	105.6	11.6	0.	0.
3	178.0	155.3	178.0	155.3	146.9	155.3	100.6	1.8	0.	0.
4	183.0	154.6	183.0	154.6	148.9	154.5	106.4	2.6	0.	0.
5	181.3	154.3	181.3	154.3	145.2	154.3	108.6	2.5	0.	0.
6	180.2	155.0	180.2	155.0	142.0	154.9	111.0	2.2	0.	0.
7	179.2	155.3	179.2	155.3	139.4	155.3	112.6	2.3	0.	0.
8	181.0	156.3	181.0	156.3	142.3	156.3	111.9	2.3	0.	0.
9	188.4	166.6	188.4	166.6	149.4	166.6	114.9	-0.4	0.	0.
10	209.8	178.5	209.8	178.5	160.6	178.2	135.0	10.1	0.	0.
11	217.4	168.9	217.4	168.9	161.6	168.0	145.4	16.8	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.524	0.425	0.524	0.425	0.412	0.422	1.033	0.708
2	0.528	0.445	0.528	0.445	0.432	0.444	1.038	0.667
3	0.514	0.445	0.514	0.445	0.424	0.445	1.058	0.635
4	0.529	0.443	0.529	0.443	0.430	0.443	1.038	0.665
5	0.523	0.442	0.523	0.442	0.419	0.442	1.062	0.679
6	0.520	0.444	0.520	0.444	0.410	0.444	1.091	0.694
7	0.517	0.446	0.517	0.446	0.402	0.446	1.114	0.703
8	0.523	0.449	0.523	0.449	0.411	0.449	1.099	0.694
9	0.547	0.480	0.547	0.480	0.434	0.480	1.115	0.720
10	0.612	0.514	0.612	0.514	0.468	0.513	1.110	0.852
11	0.634	0.484	0.634	0.484	0.472	0.481	1.039	0.924

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	1.4	-4.8	18.7	0.384	0.	0.108	0.108	0.041	0.041
2	10.00	-0.0	-6.2	15.9	0.339	0.	0.053	0.053	0.020	0.020
3	30.00	0.6	-5.6	10.9	0.318	0.	0.027	0.027	0.009	0.009
4	42.50	1.4	-4.8	10.8	0.340	0.	0.071	0.071	0.023	0.023
5	45.00	2.5	-3.7	10.7	0.337	0.	0.056	0.056	0.018	0.018
6	47.50	3.5	-2.7	10.6	0.333	0.	0.032	0.032	0.010	0.010
7	50.00	4.3	-1.9	10.6	0.327	0.	0.011	0.011	0.004	0.004
8	52.50	3.4	-2.8	10.5	0.325	0.	0.019	0.019	0.006	0.006
9	70.00	1.4	-4.7	9.0	0.291	0.	-0.002	-0.002	-0.001	-0.001
10	90.00	1.2	-4.8	12.1	0.302	0.	0.142	0.142	0.037	0.037
11	95.00	2.1	-3.8	14.5	0.370	0.	0.286	0.286	0.073	0.073

TABLE VIII. - Concluded. BLADE-ELEMENT DATA AT BLADE

EDGES FOR STATOR 10

(j) 70 Percent of design speed; reading 1309

RP	RADII IN	RADII OUT	ABS BETAM IN	ABS BETAM OUT	REL BETAM IN	REL BETAM OUT	TOTAL TEMP IN	TOTAL TEMP RATIO	TOTAL PRESS IN	TOTAL PRESS RATIO
1	23.942	23.945	56.1	9.2	56.1	9.2	328.7	0.989	13.45	0.976
2	23.503	23.538	49.0	7.1	49.0	7.1	325.4	0.994	13.37	0.989
3	21.742	21.900	36.7	1.9	36.7	1.9	316.6	1.003	13.40	0.995
4	20.637	20.881	39.1	1.3	39.1	1.3	315.7	1.000	13.42	0.986
5	20.417	20.681	40.3	1.2	40.3	1.2	315.8	0.999	13.35	0.992
6	20.196	20.480	41.4	1.4	41.4	1.4	315.8	0.999	13.30	0.996
7	19.975	20.279	42.5	1.6	42.5	1.6	316.1	0.998	13.29	0.997
8	19.754	20.079	42.1	1.8	42.1	1.8	316.2	0.998	13.35	0.996
9	18.227	18.715	39.4	1.0	39.4	1.0	314.4	1.001	13.48	0.997
10	16.530	17.252	41.3	4.1	41.3	4.1	315.2	1.003	13.79	0.964
11	16.121	16.904	43.2	5.7	43.2	5.7	316.3	1.004	14.02	0.929

RP	ABS VEL IN	ABS VEL OUT	REL VEL IN	REL VEL OUT	MERID VEL IN	MERID VEL OUT	TANG VEL IN	TANG VEL OUT	WHEEL SPEED IN	WHEEL SPEED OUT
1	174.9	131.4	174.9	131.4	97.5	129.7	145.2	21.1	0.	0.
2	172.0	136.9	172.0	136.9	112.7	135.9	129.9	16.8	0.	0.
3	175.6	142.5	175.6	142.5	140.7	142.4	105.0	4.6	0.	0.
4	178.2	140.2	178.2	140.2	138.3	140.1	112.3	3.3	0.	0.
5	175.6	140.3	175.6	140.3	134.0	140.2	113.5	3.0	0.	0.
6	175.2	141.3	175.2	141.3	131.5	141.3	115.8	3.4	0.	0.
7	175.3	142.1	175.3	142.1	129.3	142.1	118.4	3.9	0.	0.
8	178.5	144.1	178.5	144.1	132.5	144.0	119.6	4.4	0.	0.
9	188.2	155.6	188.2	155.6	145.4	155.6	119.4	2.8	0.	0.
10	205.8	161.5	205.8	161.5	154.6	161.0	135.9	11.6	0.	0.
11	214.9	151.8	214.9	151.8	156.7	151.0	147.0	15.1	0.	0.

RP	ABS MACH NO IN	ABS MACH NO OUT	REL MACH NO IN	REL MACH NO OUT	MERID MACH NO IN	MERID MACH NO OUT	MERID VEL R	PEAK SS MACH NO
1	0.493	0.369	0.493	0.369	0.275	0.364	1.331	0.973
2	0.487	0.385	0.487	0.385	0.319	0.382	1.205	0.850
3	0.505	0.405	0.505	0.405	0.405	0.405	1.012	0.668
4	0.513	0.400	0.513	0.400	0.398	0.400	1.013	0.710
5	0.505	0.400	0.505	0.400	0.386	0.400	1.047	0.717
6	0.504	0.403	0.504	0.403	0.378	0.403	1.074	0.732
7	0.504	0.406	0.504	0.406	0.372	0.406	1.099	0.748
8	0.514	0.412	0.514	0.412	0.381	0.411	1.087	0.752
9	0.545	0.446	0.545	0.446	0.421	0.446	1.070	0.752
10	0.599	0.462	0.599	0.462	0.450	0.461	1.042	0.860
11	0.626	0.433	0.626	0.433	0.457	0.431	0.964	0.938

RP	PERCENT SPAN	INCIDENCE MEAN	INCIDENCE SS	DEV	D-FACT	EFF	LOSS COEFF TOT	LOSS COEFF PROF	LOSS PARAM TOT	LOSS PARAM PROF
1	5.00	19.4	13.2	22.0	0.517	0.	0.159	0.159	0.060	0.060
2	10.00	13.9	7.7	18.7	0.449	0.	0.071	0.071	0.026	0.026
3	30.00	2.9	-3.3	12.1	0.385	0.	0.033	0.033	0.011	0.011
4	42.50	4.9	-1.3	11.2	0.412	0.	0.083	0.083	0.027	0.027
5	45.00	5.9	-0.3	11.0	0.404	0.	0.053	0.053	0.017	0.017
6	47.50	6.9	0.7	11.1	0.398	0.	0.025	0.025	0.008	0.008
7	50.00	7.8	1.6	11.3	0.395	0.	0.017	0.017	0.005	0.005
8	52.50	7.3	1.1	11.4	0.393	0.	0.027	0.027	0.009	0.009
9	70.00	3.2	-2.9	10.2	0.350	0.	0.018	0.018	0.005	0.005
10	90.00	2.5	-3.5	13.0	0.370	0.	0.166	0.166	0.044	0.044
11	95.00	3.4	-2.6	14.5	0.447	0.	0.306	0.306	0.078	0.078

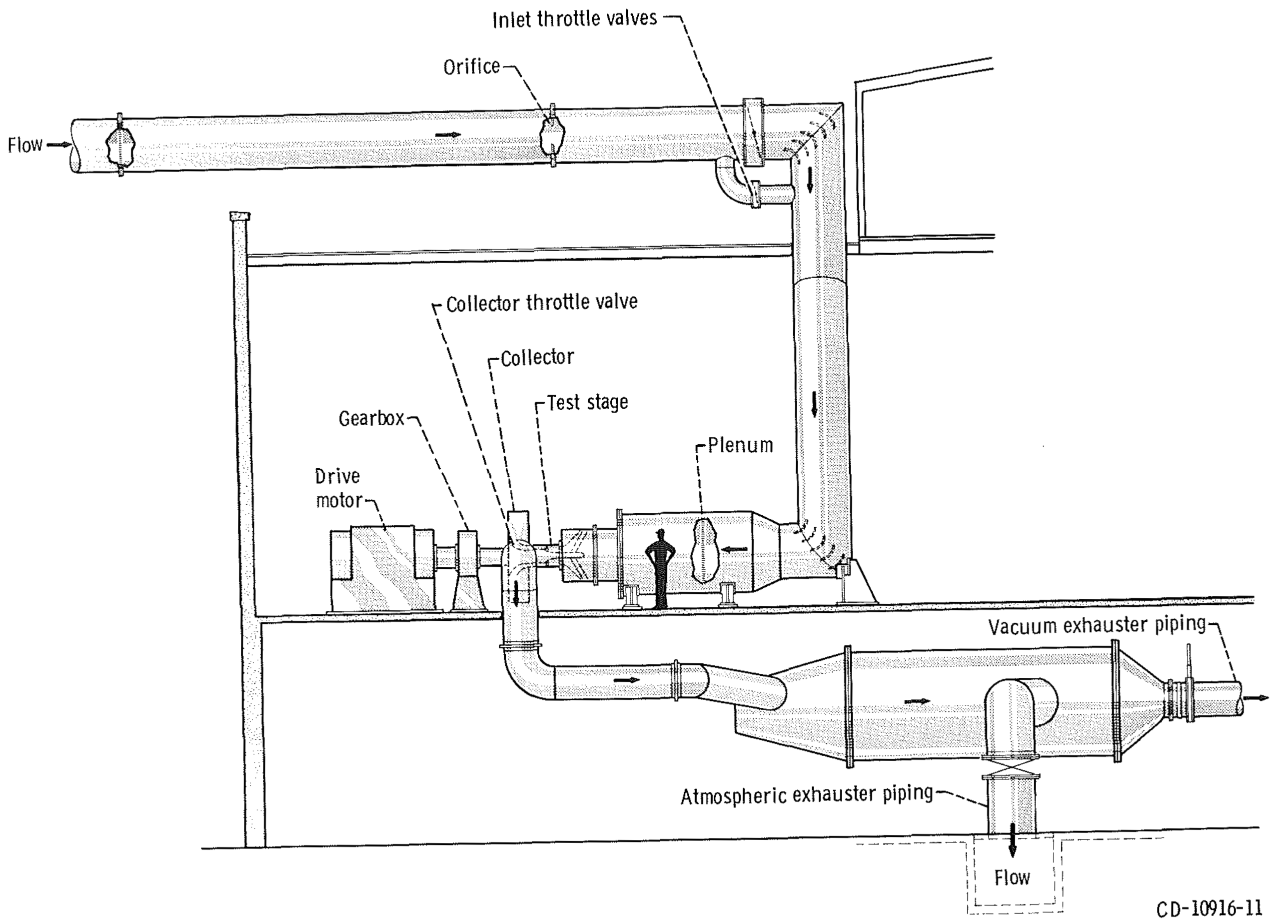
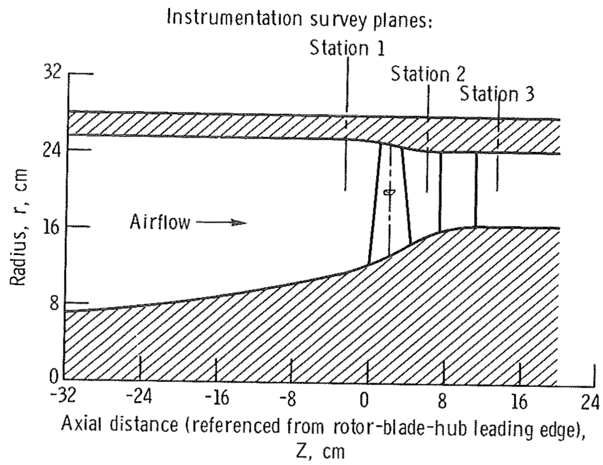


Figure 1. - Test facility schematic.



Flow path coordinates		
Axial distance, Z, cm	Radius, r, cm	
	Inner	Outer
-30.480	7.303	25.400
-25.400	7.493	↓
-22.860	7.874	↓
-20.320	8.255	↓
-15.240	9.144	↓
-10.160	10.097	↓
-5.080	10.922	↓
[a]-2.540	11.659	↓
0	12.668	25.273
4.572	14.605	24.511
[a]6.096	15.240	24.397
7.620	15.748	24.384
11.176	16.510	↓
[a]13.462	↓	↓
15.240	↓	↓
20.320	↓	↓

[a]Instrumentation survey plane.

Figure 2. - Flow path for stage 14-10 showing axial location of instrumentation.

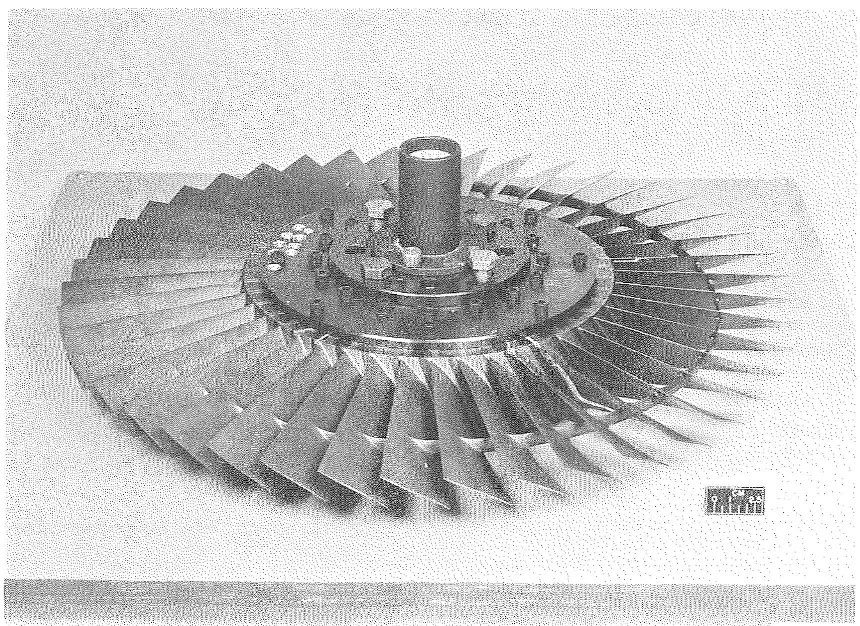


Figure 3. - Rotor 14.

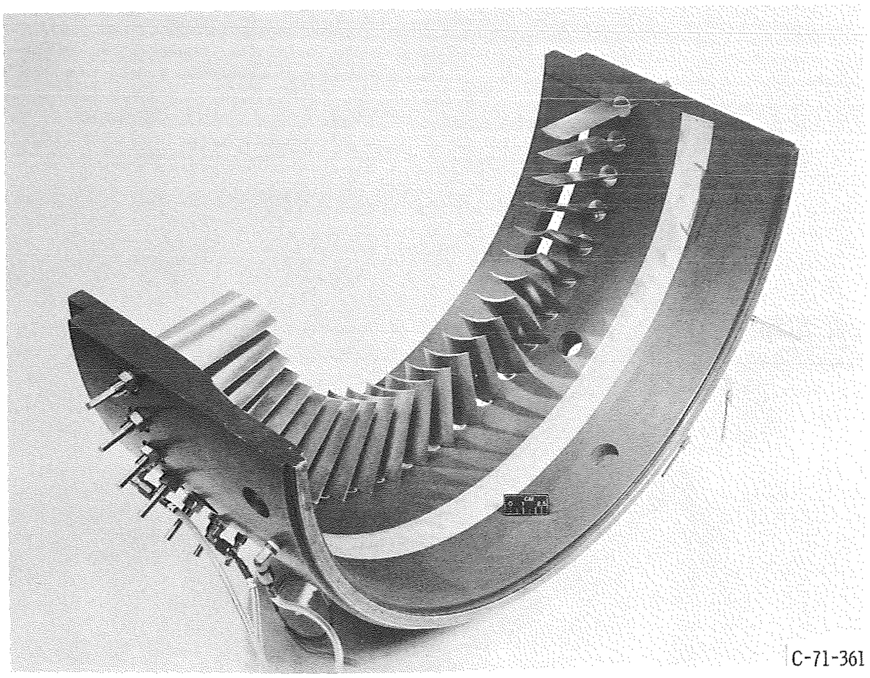


Figure 4. - Stator 10.

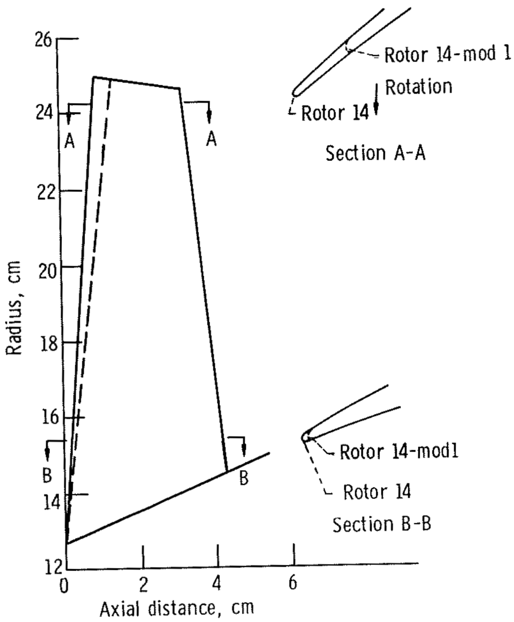
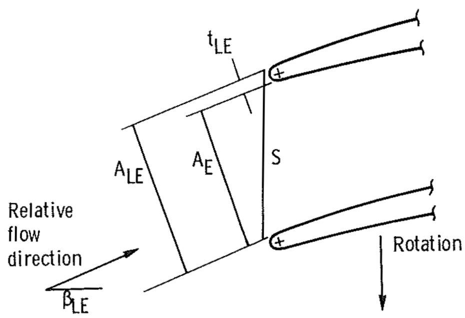
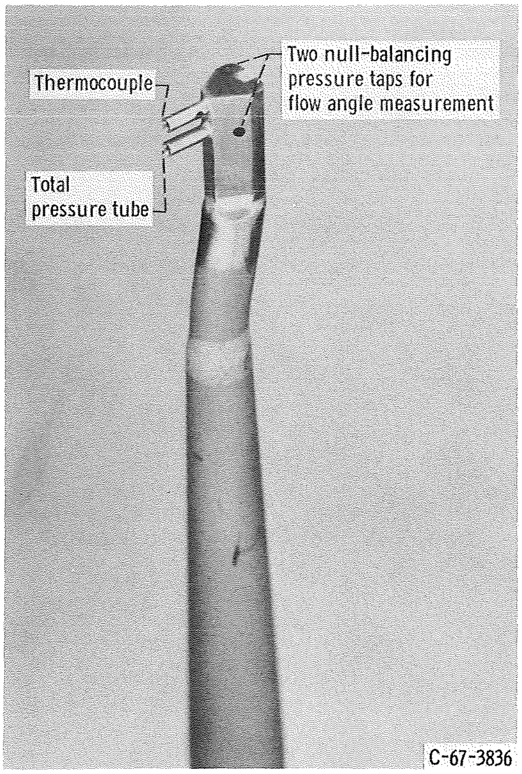


Figure 5. - Axial projection of rotor blade.

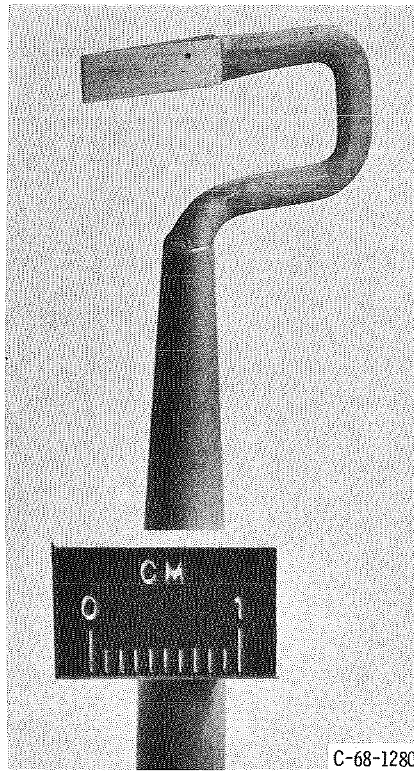


$$\text{Blockage} = \frac{A_{LE} - A_E}{A_{LE}} = \frac{A_{LE} - (A_{LE} - t_{LE})}{A_{LE}} = \frac{t_{LE}}{S \cos \beta_{LE}}$$

Figure 6. - Blockage due to leading-edge thickness.

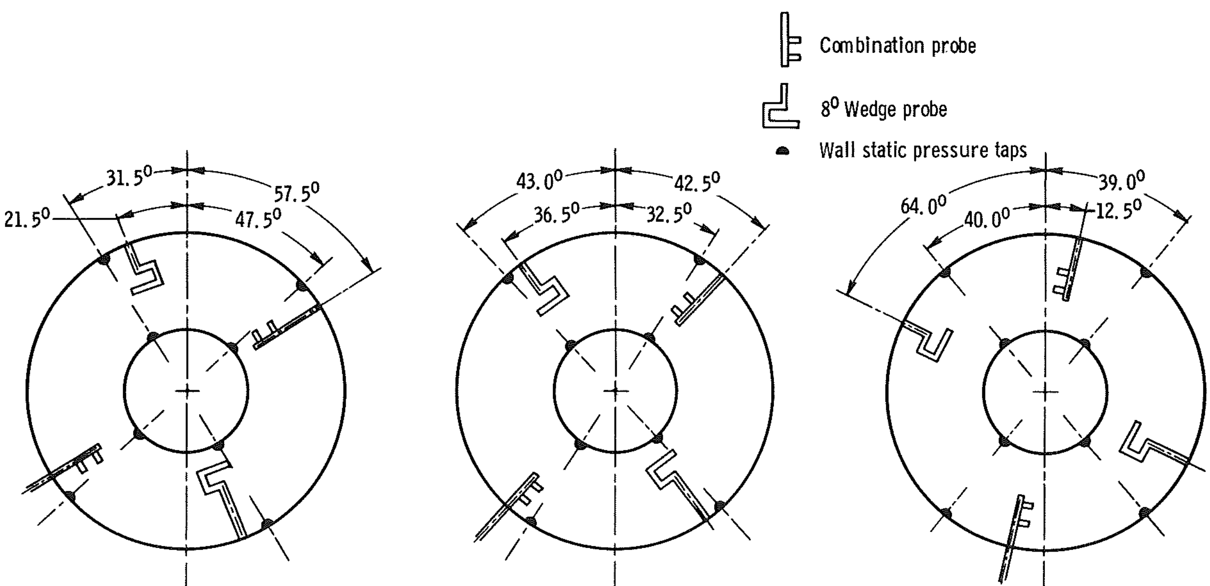


(a) Combination total pressure, total temperature, and flow angle probe (double barrel).



(b) Static pressure probe.

Figure 7. - Survey probes.



(a) Station 1. (b) Station 2. (c) Station 3.

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Figure 8. - Circumferential location of instrumentation at measuring stations (facing downstream).

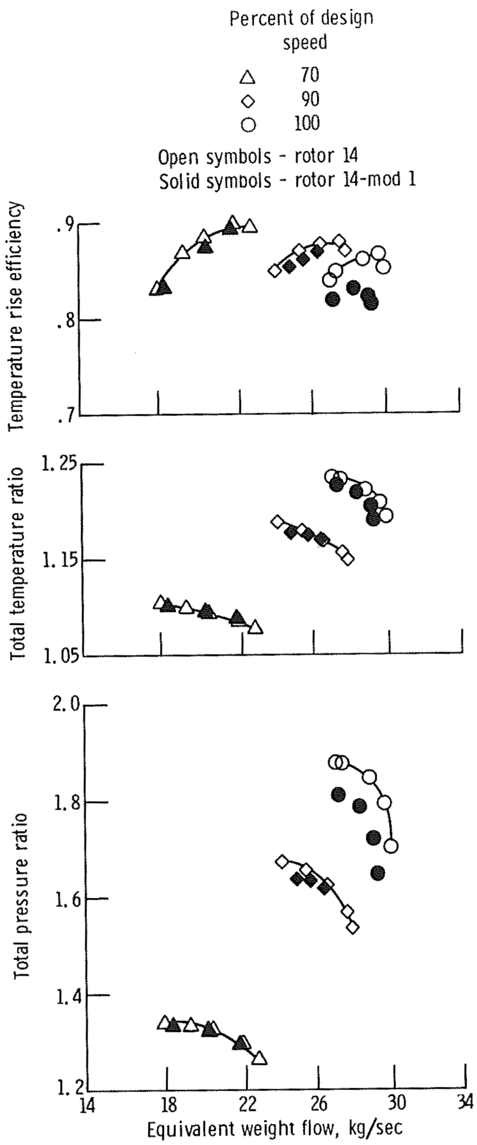


Figure 9. - Overall performance for rotor.

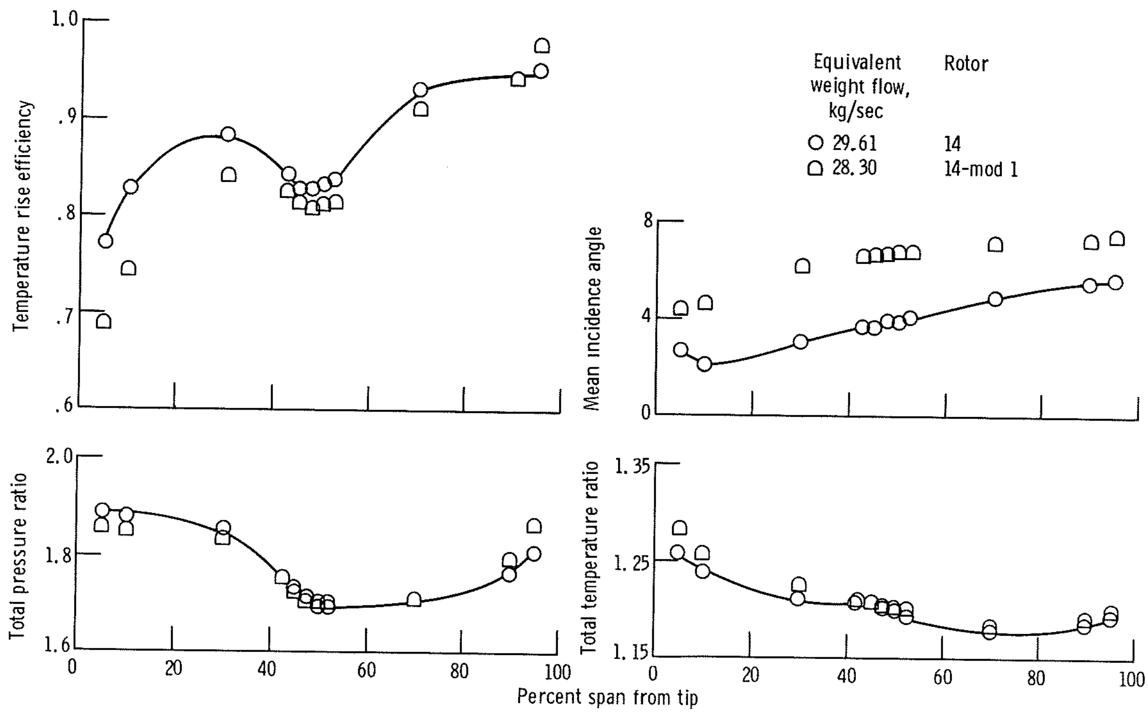
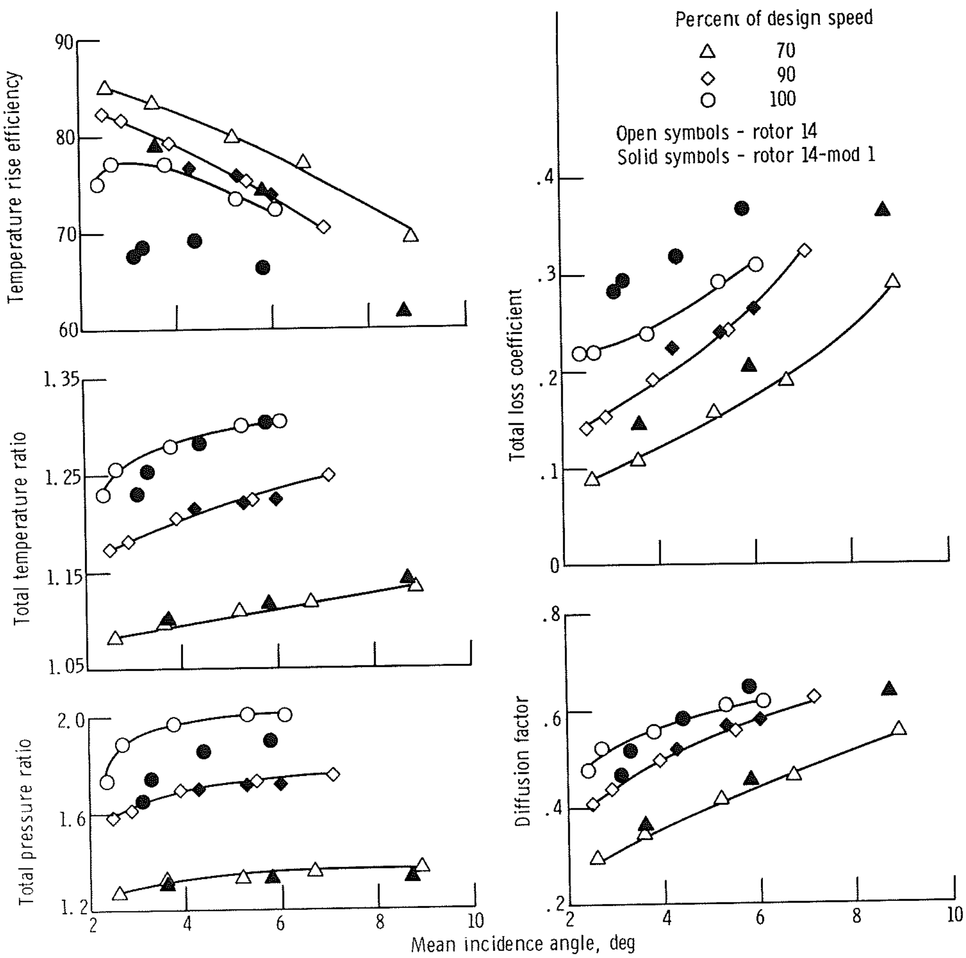
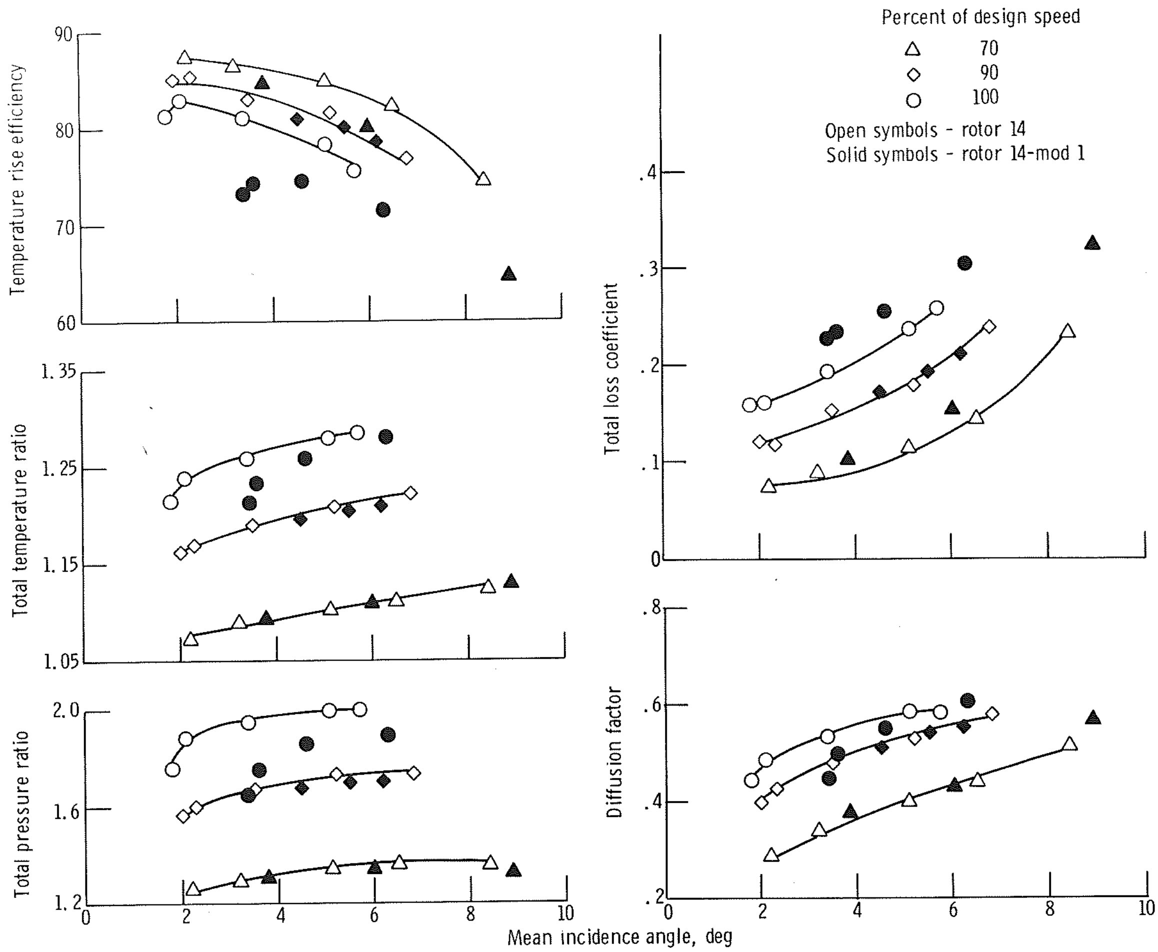


Figure 10. - Radial distribution of performance for peak efficiency at design speed.



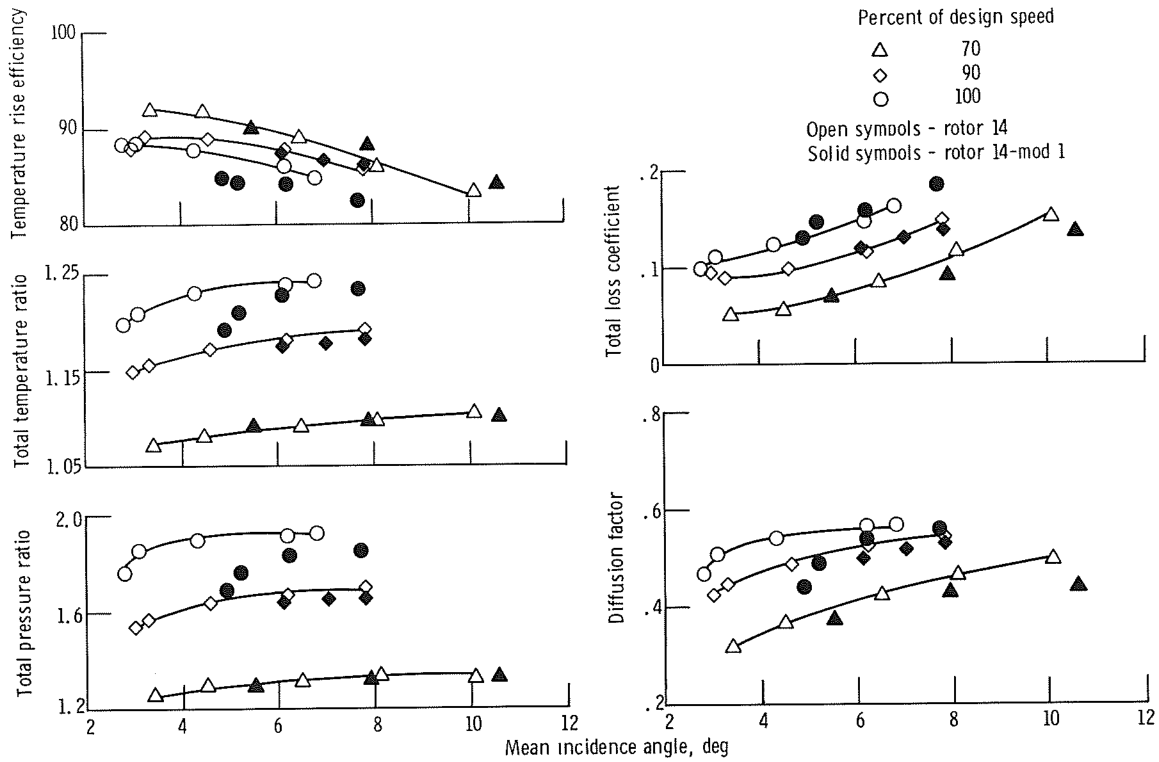
(a) 5 Percent span.

Figure 11. - Blade-element performance.



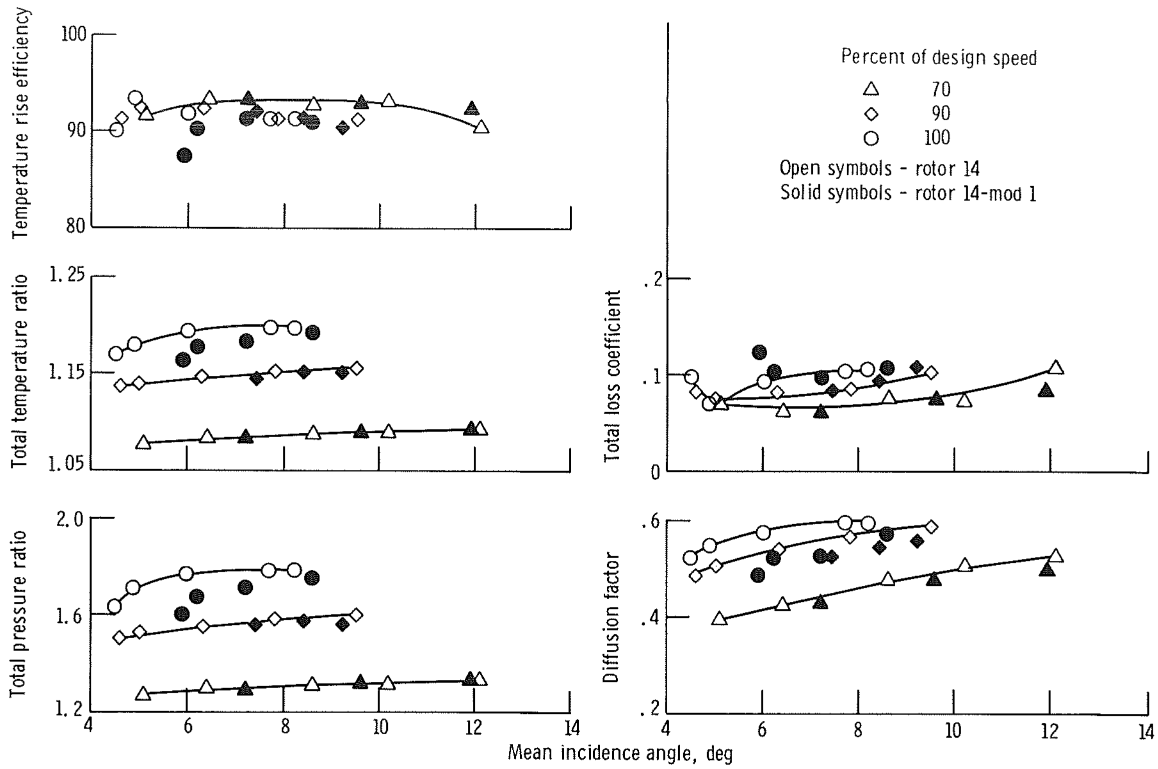
(b) 10 Percent span.

Figure 11. - Continued.



(c) 30 Percent span.

Figure 11. - Continued.



(d) 70 Percent span.

Figure 11. - Concluded.

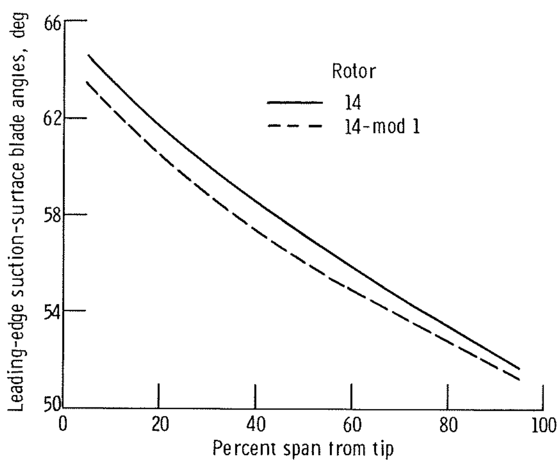


Figure 12. - Leading-edge suction surface blade angle as function of percent span.

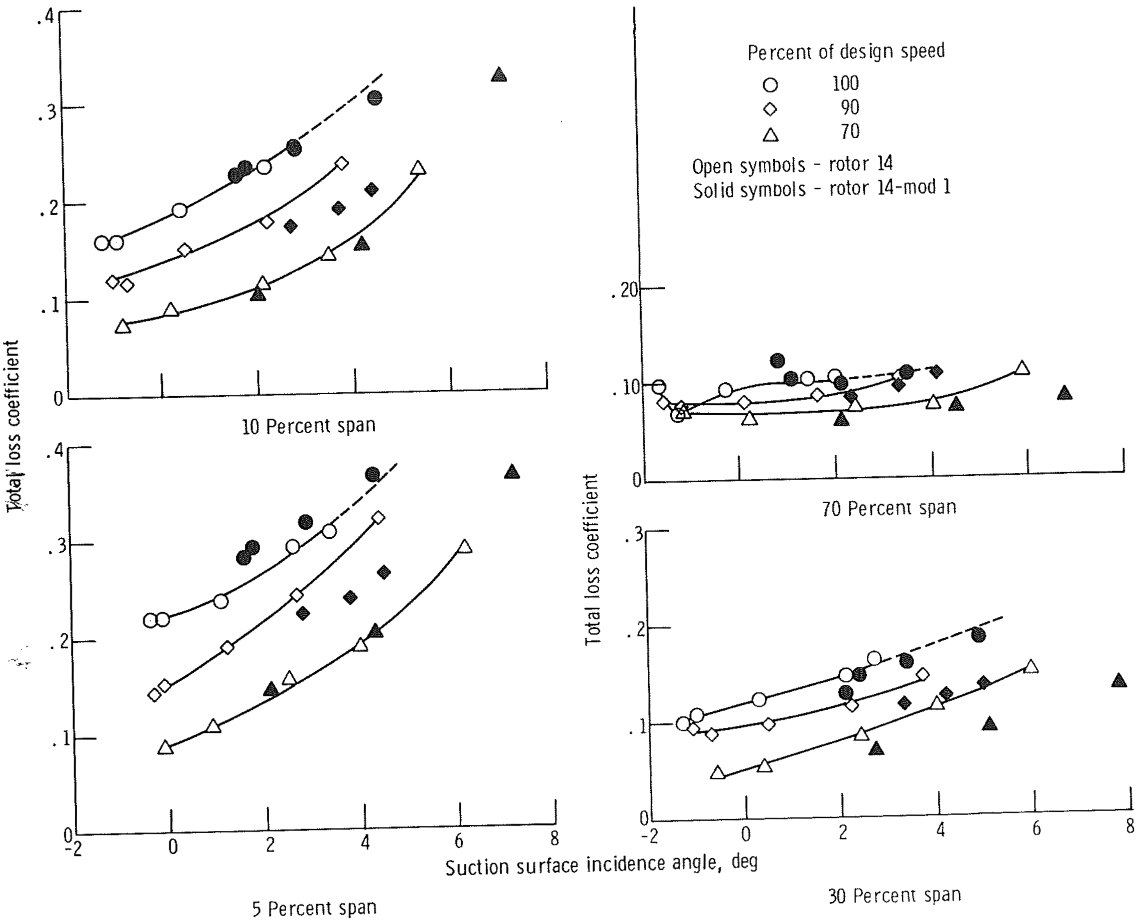


Figure 13. - Total loss coefficient as function of suction-surface incidence angle.

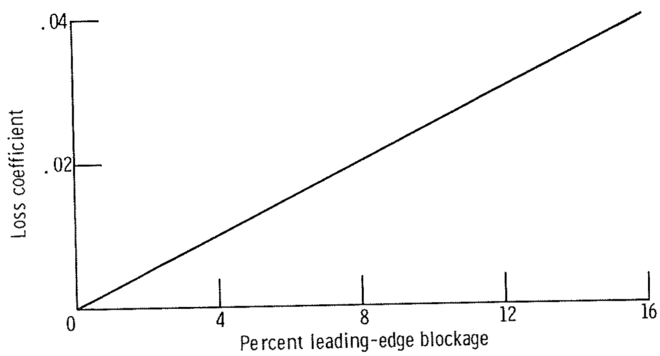


Figure 14. - Calculated loss coefficient as function of leading-edge blockage for Mach 1.4 (based on technique from ref. 3).

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