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MULTIPLE-CIRCULAR-ARC STATOR A

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EXPERIMENTAL EVALUATION OF TRANSONIC STATORS

DATA AND PERFORMANCE REPORT
MULTIPLE-CIRCULAR-ARC STATOR A

by

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prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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FOREWORD

This report was produced in accordance with NASA contract NAS3-7614 for NASA Lewis Research Center, Cleveland, Ohio. It describes test results and calculations on the performance of the Inlet Guide Vane, Flow Generation Rotor and Multiple-Circular-Arc Stator A.

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I. SUMMARY

A transonic stator, having multiple-circular-arc airfoils with minimum curvature at the forward portion of the airfoil consistent with flow-choking limitations, was tested over a range of flow angles and velocities. The transition point of the airfoil section was located at an assumed shock location. Stator inlet flow was generated by means of an inlet guide vane and flow generation rotor. Transonic stator inlet flow was achieved at design speed, but Mach numbers were slightly lower than the design values. Measured minimum stator losses at mid-span were lower than the NASA loss correlation for comparable Mach numbers. Near the blade ends the losses increased sharply. At mid-span, the stator exhibited a minimum total pressure loss coefficient, $\bar{\omega}$, of 0.057 at design speed. The inlet Mach number and diffusion factor at minimum loss were 0.91 and 0.53 respectively. Near the hub at 90 percent span, the stator minimum total pressure loss coefficient, inlet Mach number, and diffusion factor were 0.145, 1.00 and 0.63 respectively. At 10 percent span, the stator minimum total pressure loss coefficient, inlet Mach number and diffusion factor were 0.098, 0.84 and 0.50 respectively. At design speed, optimum stator incidence occurred at zero degrees to the suction surface at all radial stations except at 90 percent span, where minimum losses occurred at positive incidences. Stator deviations were two to five degrees greater than predicted.

Pre-swirl levels produced by the inlet guide vane were within 3° of the design values. Total pressure losses were lower than predicted.

The rotor was capable of providing the design flow angle to the stator, although 110 percent of design speed was required to produce the design stator inlet Mach number.

Maximum airflow at design speed was 134.7 lb/sec which is 0.3 lb/sec less than the design value. Over-all stage efficiency at design speed and 134.7 lb/sec airflow was one point lower than predicted.

Circumferential distortions in total pressure, static pressure, and total temperature were measured by stator inlet and stator exit instrumentation. All distortions were shown to result from inlet guide vane wakes or from a periodic rotor exit back-pressure pattern, which repeated across each stator gap. These effects were minimized by carefully selecting the circumferential location of dual instrumentation in order to average the distortions.

Inserting traverse probes in the airstream between the rotor and stator also caused large circumferential distortions and reduced the airflow when the Mach numbers in this region approached 1.0. Instrumentation blockage effects were minimized by limiting simultaneous traversing to combinations of probes which showed no mutual interference effects.

II. INTRODUCTION

Under contract NAS3-7614 to NASA, the Pratt & Whitney Aircraft Division of United Aircraft investigated blade-element performance of stators designed to operate in the transonic range.

The objective of this investigation was to obtain blade element data on a family of blade shapes which it is thought will be suitable for stator blade sections which operate at high flow Mach numbers. This new family of blade shapes is termed multiple-circular-arc (MCA) blading, defined as two double-circular-arc blades joined at a common transition point. The forward and rearward portions of the blade are circular-arc sections of different radii. These blade shapes are aimed at controlling the flow turning over the forward portion of the blade with respect to the total turning so as to minimize losses associated with flow shocks.

The contract includes testing three different stator airfoil shapes. Stator inlet flow was provided by an inlet guide vane and flow-generation rotor. Two stators have multiple-circular-arc airfoils with the supersonic turning equal to 0.6 of that for an equivalent double-circular-arc airfoil stator. One multiple-circular-arc design (MCA-A) has the transition between the low curvature forward section and the rearward section, located at the assumed passage shock position. The other design (MCA-B) has its transition point moved to the rear of the shock location. A third stator with double-circular-arc airfoils provides a basis for comparison.

The three sets of stators were designed for an inlet relative Mach number of 1.1 at the hub and an inlet flow angle of 48°. The blading was designed to turn the flow to the axial direction at all radii. A hub solidity of 1.91 was selected along with an aspect ratio of 2.06, which resulted in 63 blades having a chord of 2.155 inches. Detail design of these stators along with the design of the inlet guide vane and flow generation rotor is given in Reference 1.

This report presents blade element performance of the multiple-circular-arc stator A, inlet guide vane, and flow generation rotor. Also presented are overall performance data for the conbination of inlet guide vane and rotor and for the combined overall performance of the inlet guide vane, rotor, and MCA stator A.

III. SYMBOLS

The following symbols are used:

A	- area, ft^2
A_{an}	- annulus area, ft^2 (3.76 at the inlet guide vane leading edge)
A_f	- frontal area, ft^2 (5.241 at the inlet guide vane leading edge)
c	- chord length, in
D	- diffusion factor
g	- acceleration of gravity, 32.17 ft/sec^2
i_m	- incidence angle, angle between inlet air direction and line tangent to blade mean camber line at leading edge, degrees
i_s	- incidence angle, angle between inlet air direction and line tangent to blade suction surface at leading edge, degrees
M	- Mach number
N	- rotor speed, rpm
P	- total pressure, psfa
p	- static pressure, psfa
R	- gas constant, 53.35 ft-lbs/lb(°R)
r	- radius, ft
S	- blade spacing, in
T	- total temperature, °R
t	- static temperature, °R
t/c	- thickness-to-chord ratio
U	- rotor speed, ft/sec
V	- air velocity, ft/sec

W - weight flow, lbs/sec

β - air angle, angle between air velocity and axial direction, degrees

γ - ratio of specific heats

$\Delta\beta$ - air turning angle, degrees

δ - ratio of inlet total pressure to standard pressure of 2116.22 lbs/ft^2

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

η - efficiency, %

θ - ratio of inlet total temperature to standard temperature of 518.6°R

ρ - mass density, lbs-sec^2/ft^4

σ - solidity, ratio of chord to spacing

$\bar{\omega}$ - total pressure loss coefficient

ω - angular velocity of rotor, radians/sec

Superscripts:

$'$ - relative to moving blades

$*$ - designates blade geometry

Subscripts:

ad - adiabatic

p - polytropic

r - radial direction

z - axial direction

θ - tangential direction

0 - plenum chamber

1 - instrument plane upstream of inlet guide vane (IGV)

2 - station at IGV leading edge

3 - station at IGV trailing edge

4 - instrument plane upstream of rotor

5 - station at rotor inlet

6 - station at rotor exit

7 - instrument plane upstream of stator

8 - station at stator leading edge

9 - station at stator trailing edge

10 - instrument plane downstream of stator

IV. APPARATUS AND PROCEDURE

A. Compressor Test Facility

The compressor test facility is shown schematically in Figure 1. It is equipped with a gas-turbine-drive engine, using a 2.1:1 gearbox to give the optimum speed-range capability.

Air enters through a calibrated nozzle for flow measurements. A 72-foot straight section of 42-inch-diameter pipe runs from the nozzle to a 90-inch-diameter inlet plenum. Wire-mesh screen and an "egg-crate" structure located midway through the plenum provide a uniform pressure profile into the compressor.

The compressor airflow is exhausted into a toroidal collector and then into a six-foot-diameter discharge stack. A six-foot-diameter valve in the stack provides back pressure for the test compressor. Two smaller valves, one 24-inch and one 12-inch, in bypass lines, provide vernier control of back pressure.

B. Test Compressor

The test compressor (Figure 2) is a single-stage, axial-flow compressor with an inlet guide vane. It has a constant outside diameter of 31.0 inches and a hub/tip ratio at the stator inlet of 0.70. Complete details of the design are given in Reference 1.

C. Inlet Guide Vane

Inlet guide vanes were required to produce the necessary inlet swirl to the rotor to meet the flow requirements of the stator. The amount of turning is large, but analysis indicates that small changes from design values would not cause significant performance changes. There are 27 vanes designed as NACA M400 series airfoils. These were selected since the inlet Mach number is only about 0.46. The vanes were designed for an aspect ratio of 2.14 and a chord of 3.5 inches, which was held constant from root to tip. A summary of design values at five streamlines at which blade-element data were obtained is given in Table I. The streamlines chosen are those which pass through 10, 30, 50, 70 and 90 percent of the stator inlet passage height.

D. Rotor

The aerodynamic design of the rotor was based on the stator flow requirements and existing facilities. The resulting rotor was designed for a pressure ratio of 1.55, maximum relative velocity vector turning of 16 degrees past axial at the hub and a constant outer diameter of 31 inches. The design tip speed is 1197 ft/sec, the design inlet flow per unit annulus area is 36.0 lb/ft^2, and the rotor root inlet diameter is 16.6 inches. The rotor was designed for an aspect ratio of 1.5 and a chord of 4.2 inches, which was held constant from root to tip. Twenty-eight blades with double-circular-arc sections were used. Complete details of the rotor design are given in Reference 1. A summary of the rotor design for five streamlines at which blade-element data were obtained is given in Table II. As mentioned for the inlet guide vanes, the streamlines chosen were those which pass through 10, 30, 50, 70 and 90 percent of the stator inlet passage height.

TABLE I

INLET GUIDE VANE DESIGN DATA

(Station 2 - Station 3)

	Percent of Stator Leading Edge Span From O. D.				
	10	30	50	70	90
Inlet Dia.	29.62	26.94	23.94	20.72	17.59
Exit Dia.	29.60	26.98	24.16	21.01	17.69
β_2	0.0	0.0	0.0	0.0	0.0
β_3	21.6	23.4	26.2	30.2	36.0
M_2	0.473	0.4728	0.470	0.464	0.4593
σ	1.020	1.142	1.253	1.442	1.700
t/c	0.09	0.09	0.09	0.09	0.09
c	3.5	3.5	3.5	3.5	3.5
i_m	-6.51	-6.15	-5.75	-5.32	-4.90
$\delta°$	3.80	3.15	2.84	2.79	2.72

TABLE II

ROTOR DESIGN DATA

(Station 5 - Station 6)

Percent of Stator Leading Edge Span From O. D.

	10	30	50	70	90
Inlet Dia.	29.68	27.26	24.51	21.61	18.56
Exit Dia.	29.87	27.98	25.95	23.73	21.69
β'_5	56.3	52.7	48.88	43.7	36.5
β'_6	38.77	32.6	24.5	12.7	-1.60
M'_5	1.03	0.945	0.836	0.71	0.564
σ	1.265	1.362	1.500	1.690	1.968
t/c	0.044	0.051	0.058	0.066	0.075
c	4.2	4.2	4.2	4.2	4.2
i_m	2.8	2.73	3.58	3.47	3.55
$\delta°$	2.95	5.55	8.58	9.52	11.03
$\bar{\omega}$	0.115	0.088	0.072	0.094	0.194
D	0.416	0.398	0.367	0.320	0.209

E. Stator

The multiple-circular-arc airfoil is composed of sections of two double-circular-arc blades, joined at a common transition point (Figure 3). The two independent double-circular-arc sections allow control of the amount of supersonic turning and thus permit optimizing shock losses with respect to diffusion losses in order to obtain minimum overall losses. The transition point for the MCA-A airfoil was located at the assumed shock location, as was the maximum thickness point. Supersonic suction-surface camber was set at 0.6 that of a DCA stator having the same inlet and outlet conditions. A summary of the stator design values for five streamlines at which blade-element data were obtained is given in Table III. A photograph of the multiple-circular-arc stator A is shown in Figure 4.

TABLE III

STATOR DESIGN DATA, MCA-A

(Station 8 - Station 9)

	Percent of Stator Leading Edge Span From O.D.				
	10	30	50	70	90
Inlet Dia.	30.02	28.18	26.35	24.52	22.69
Exit Dia.	30.05	28.38	26.74	25.11	23.53
β_8	41.46	41.57	42.55	44.02	46.89
β_9	0.0	0.0	0.0	0.0	0.0
M_8	0.86	0.90	0.94	1.00	1.06
σ	1.437	1.525	1.627	1.740	1.870
t/c	0.076	0.068	0.060	0.052	0.044
c	2.155	2.155	2.155	2.155	2.155
i_m	11.1	10.3	9.3	7.9	6.2
δ°	9.2	8.6	8.5	8.7	9.7
$\bar{\omega}$	0.073	0.080	0.091	0.108	0.130
D	0.52	0.53	0.54	0.55	0.57

Stator leading and trailing edge radii are both 0.01 inch across the span. Design incidence to the suction surface is 0°.

F. Instrumentation

Airflow was measured using a flow nozzle designed to ISA flow-nozzle specifications (Reference 3). Compressor speed was measured with an impulse-type pickup, an electromagnetic device that counts the number of gear teeth passing within a time interval and converts the count to RPM.

Instrumentation was located so as to balance out the effects of the inlet guide vanes wakes, which shadow downstream through the rotor and stator, and to partially account for the effect of local back-pressuring by the stator on the rotor. The magnitude of these effects is discussed later.

Two total pressure wake rakes were used behind the inlet guide vane. A 24-element rake was used to obtain data at the 10, 30 and 50 percent streamlines and a 22-element rake was used to obtain data at the 70 and 90 percent streamlines. The rakes were fixed radially and were relocated between test runs to obtain the data at all radial locations. Each probe was rotated to align impact tubes on the rake with the design flow angle.

Three high-frequency-response total pressure probes using quartz crystal transducers as sensors were located behind the rotor near the outer case at station 6. These pressure probes were spaced circumferentially to determine the number and rotating speed of any rotating stall cells.

Two total pressure wake rakes (Figure 5), each having thirteen impact tubes equally spaced across a stator gap, were traversed radially behind the stator. These pressure rakes were spaced circumferentially to average out the effects of inlet guide vane wakes.

Five total temperature radial rakes (Figure 5), each having five shielded thermocouples, were located downstream of the stator on an extension of the mid-channel streamline between the stator vanes and were spaced circumferentially to average out the inlet guide vane wake effects.

Subsequent to the testing of the MCA Stator A, one circumferential temperature rake (Figure 5), consisting of six shielded thermocouples equally spaced across a stator gap, was installed at station 10. This temperature rake was traversed radially behind the stator to determine the circumferential variation in the total temperature across a stator gap at five radial locations. These data were used to average out the stator wake effects. The information obtained from the MCA Stator B tests was applied to the MCA Stator A analysis.

Four static pressure taps were located on the hub and on the case at each instrumentation plane. At station 7, ten additional static pressure taps were located at the hub and at the tip equally spaced across a stator vane gap. For purposes of reducing the data, four of the 14. O. D. and I. D. wall static pressures were selected which would average out any circumferential distortions caused by inlet guide vane wakes or stator blockage effects.

Disk probes (Figure 5) were used to measure the radial distributions of static and total pressure and air angle. The stator inlet and stator exit stations each had two disk probes, located on extensions of stator mid gap streamlines, and spaced circumferentially to average out any inlet guide vane wake effects. Inlet-guide-vane inlet and exit stations each had one disk probe, located on extensions of IGV mid-gap streamlines, for inlet guide vane calibration. All disk probes were calibrated for their expected Mach number operating range.

All temperature measuring rakes used chromel-alumel type "K" wire and were calibrated over full operating temperature ranges. Calibrations were also made on the lead wire. Recovery calibrations for Mach number were based on test measurements. Pressure corrections were also applied as noted in Reference 1.

Disk-probe pressures were measured with transducers. All other pressures were measured with precision-bore manometer tubes of 0-80 inches range. Water, acetylene tetrabromide, and mercury were used as manometer liquids.

Stationary and rotating parts were instrumented with strain gages to determine the levels of vibratory stress over the operating range of the compressor.

Instrumentation is listed in Table IV. Figure 6 shows station number designation and location of instrumentation and blade leading and trailing edge planes. Figure 7 shows the circumferential position of the instrumentation.

TABLE IV

INSTRUMENTATION

Instrument Location	Parameter Measured	Quantity and Description of Instrumentation
Station No. 0 (Inlet Plenum Chamber)	p	4 static pressure taps on the inlet plenum chamber wall
	T	5 bare wire thermocouples
Station No. 1	P, p,	1 disk traverse probe
	p	4 wall static pressure taps at both I. D. and O. D.
Station No. 4	P	2 wake rakes, one with 22 elements and one with 24 elements all 1/8 inch apart. Measurements made at 5 radial locations.

TABLE IV (con't)

Instrument Location	Parameter Measured	Quantity and Description of Instrumentation
Station No. 4 (con't)	P, p, β	1 disk traverse probe.
	p	4 wall static pressure taps at both I. D. and O. D.
Station No. 6	P	3 high frequency response total pressure probes at 10% of blade height from the outer case.
Station No. 7	P, p, β	2 disk traverse probes.
	P	6 total pressure probes near the outer case equally spaced across an inlet-guide-vane gap.
	p	14 wall static pressure taps at both I. D. and O. D.
Stator Suction & Pressure Surfaces & Hub Mid-Channel Surface	p	7 static pressure taps on suction surface at 90% of blade height from the tip on each of 2 blades. 5 static pressure taps on pressure surface at 90% of blade height from tip on each of 2 blades. 5 static pressure taps on suction surface at 10% of blade height on tip of each of 2 blades. 5 static pressure taps on pressure surface at 10% of blade height from tip on each of 2 blades. 8 static pressure taps on the hub along the mean passage camber line (one channel).
Station No. 10	P	2 wake rakes (13 elements per rake) centered with respect to a stator vane trailing edge. Rakes are spaced an integral number, plus 1/2 an inlet guide vane spacing, apart. Readings obtained at five radial locations.

TABLE IV (con't)

Instrument Location	Parameter Measured	Quantity and Description of Instrumentation
Station No. 10 (con't)	P, p, β	2 disk traverse probes.*
	p	4 wall static pressure taps at both I. D. and O. D.
	T	5 rakes with 5 shielded thermocouples per rake located circumferentially to provide for a good sampling of flow with respect to IGV spacing.
	T	A circumferential rake having 6 shielded thermocouples spaced across a stator blade gap. Readings obtained at five radial locations.**

*Total and static pressures were measured on only one of these disk probes.

**This temperature rake was used on subsequent tests and the information applied to MCA-A stator test analysis.

G. Test Procedure

Shakedown testing revealed that inserting traverse probes at the stator inlet caused large circumferential distortions, which affected readings of most fixed instrumentation and of other traverse probes in the airstream. As a result, it was necessary to run traverse probes at the stator inlet independent of other instrumentation.

It was also found during shakedown testing that full immersion of a traverse probe at the stator inlet reduced flow approximately three percent. In order to avoid stall while taking data, it was necessary to set the "near stall" data point with a margin of three percent above stall flow.

Testing began with a stress survey which covered a speed range up to 110% of design speed and operating conditions from open throttle to stall. No apparent mechanical limitations were evident during this test.

The stress survey was followed by a rotating stall survey in which rapid-response transducers were used to record rotor exit total pressure as a function of time.

There was no evidence of rotating stall or other flow abnormalities as back pressure was increased to the point where stall occurred. Stall at all speeds was taken as the point at which a sudden drop in flow was indicated by the flow orifice manometer. The compressor was not run into deep stall.

To evaluate inlet-guide-vane losses, two wake rakes were installed, one with the rake at 90 percent of blade length from the tip, and the other at 30 percent of blade length from the tip. Losses were measured for open-throttle operating points at 50, 70, 90, 100 and 110 percent of design speed, and for part-throttle and near-stall operating points at 50 and 100 percent of design speed. Rakes were relocated at [illegible] and 10 percent of blade length locations from the tip, and the same test points run. Finally, one rake was located at 50 percent of blade length, and the test points were repeated. The inlet-guide-vane wake rakes were removed prior to further performance testing.

Disk probes were used during the initial performance testing of the rotor and stator to measure exit air angle from the inlet guide vane. Radial distributions of exit air angle did not change with operating conditions; therefore, these traverse measurements were discontinued.

Overall and blade element performance tests for the rotor and MCA Stator A were run at 50, 70, 90, 95, 100, and 110 percent of design speed. Five data points were obtained at each speed, covering the operating range from open throttle to near-stall.

H. Calculation Procedure

The traverse measurements of stator inlet total pressure, total temperature, static pressure and flow angle were all found to be inaccurate because of flow disturbances caused by probe blockage. These inaccuracies were most severe at higher speeds. Full immersion of a traverse probe at design speed reduced airflow by approximately 3 percent, and its effect was detected on fixed instrumentation 90 degrees from the probe's circumferential position. Because of the inaccuracies of measuring flow parameters at station 7, data were reduced using a streamline-analysis computer program which calculated all static pressures and flow angles at this station. This program requires as input corrected weight flow, corrected speed, total pressure and total temperature behind rotating blade rows and total pressure, total temperature and flow angle behind fixed blade rows. Static pressure is calculated within the program from considerations of continuity of mass flow and radial equilibrium which includes curvature terms. The flow angle behind rotating blade rows is also calculated within the program. This makes analysis possible without relying on the traverse measurements of static pressure and angle between the rotor and stator where probe blockage in the transonic flow causes the serious inaccuracies. It also permitted translating the free-stream total pressure measured on wake rakes behind the stator and the total temperature measured at that location forward to the instrument plane between the rotor and stator along calculated streamlines. It is thought that these translated values of pressure and temperature are more representative of the true average conditions at station 7 than the measured values obtained from the radial traversing of the flow passage at that location. The streamline analysis computer program also permitted translating the flow conditions from the instrument planes to the blade leading and trailing edges to provide a more accurate indication of the blade inlet and outlet flow conditions such as incidence and deviation. This method of translation not only accounted for the flow path convergence but included in the calculation the effect of streamline curvature. Figures 8 and 9 show the comparison of calculated static pressures, traverse measurements, and wall static measurements at the stator inlet instrumentation plane at design speed and 50% design speed. Calculated values are in better agreement with wall statics than with measured values at high speeds, where stator inlet flow was transonic; but at low speeds little difference was found between measured and calculated values. Stator inlet angles were also measured; but again probe blockage disrupted flow, and measurements were not considered accurate. Figure 10 shows a comparison of measured and calculated angles at the stator inlet instrument plane for 100% design speed. The angle change calculated between the instrument plane and the stator leading edge due to flowpath convergence is shown in Figure 11.

Inlet guide vanes and stators both caused significant circumferential distortions in total temperature, total pressure, and static pressure. The procedure used to reduce data took these circumferential distortions into account by averaging data from appropriately-spaced dual instrumentation. Averaging techniques at each instrumentation station were:

Guide Vane Inlet - No circumferential distortions were found ahead of the guide vane, and measurements were numerically averaged.

Rotor Inlet - Total pressure was calculated at 10, 30, 50, 70, and 90 percent of span by mass-averaging the pressures measured by wake rakes behind the inlet guide vane. Values were circumferentially mass-averaged by using rake-element total pressures together with a linear interpolation between wall static pressures. Loss measurements made during the initial phases of the program were correlated against corrected airflow (see IGV section of Results), and the correlation was used to calculate a rotor inlet pressure distribution for each data point. The inlet-guide-vane discharge angle, as measured by the disk probes, was insensitive to airflow and back-pressure, so the air-angle distribution presented in the Results section was used throughout data reduction.

Stator Inlet - Severe circumferential distortion were measured at the stator inlet. These distortions, together with probe blockage effects, made it impossible to obtain an accurate measurement of total pressure and total temperature with stator inlet instrumentation. Procedures were developed to determine these values from stator exit measurements, where probe blockage effects were insignificant. The following gives an indication as to the magnitude of the distortion measured at station No. 7.

Static pressure variations which occurred at the wide-open and near-stall points at 100 percent speed are presented in Figure 12. The data were obtained from static taps located circumferentially at the outer wall. The abscissa shows the angular displacement of each static tap from the nearest guide vane upstream, in the direction of rotation. The plot can be used to show the cycle of static-pressure variation due to the guide vanes (lines a, b, or c); these lines were determined by connecting points in the same circumferential position from the nearest stator, so that the distance between lines a and c shows the magnitude of distortion caused by the stators, and the difference between maximum and minimum values on a line shows the magnitude of distortion due to the guide vanes. Figure 13 illustrates the distortion of the stator alone on wall static pressures. The curve was constructed by plotting the difference between individual static pressures and the median of the stator-variation envelope (Figure 12, line b) versus tap positions relative to the stators. Average wall static pressures were obtained by numerically-averaging measurements from four taps whose circumferential positions relative to stators and guide vanes gave a good sampling of the flow. These wall static pressures were used in conjunction with the total pressures measured in the flow stream to establish complete spanwise distribution of total pressures. These total pressure profiles were used as input for the streamline analysis program.

Total pressure variations were observed in measurements taken at the stator inlet by six total pressure probes distributed evenly across an inlet guide vane gap near the outer wall. Figure 14 shows the pressures measured at the open-throttle and near-stall points at 100 percent speed. The number of measurements taken was insufficient to separate guide vane effects from stator effects. Because of the circumferential distortion in flow parameters and the effect of probe blockage, free-stream total pressure downstream of the stator (peak wake rake values) and average values of total temperature at that location were transferred forward along design streamlines to the instrument plane between the rotor and the stator.

Two wake rakes from which the average free-stream measurements of total pressure were obtained were positioned to average-out inlet guide vane effects, and the average of their freestream pressures was considered the most accurate measurement of stator inlet total pressure. No way was found to determine accurately the stator inlet total pressure variations which probably accompanied the static pressure variation attributed to the stator and the total temperature variations which were measured across stator gaps. The total temperature variation was measured at the stator exit, but in the case of total temperature it also represents the variation in this parameter at the stator inlet. The effect of unknown stator inlet total pressure variations on stator minimum loss levels was estimated as follows: Circumferential total pressure variation at the stator inlet was estimated by calculating total pressures from measured temperatures across a stator vane gap, assuming that there was no circumferential variation in rotor efficiency. Large stator inlet total pressure variations were found to accompany large stator losses. Figure 15 compares the circumferential variation in calculated stator inlet total pressure with that measured at the stator exit. The figure shows a total pressure variation from 3130.0 to 3490.0 lbs/ft^2 for the highest loss data point at 90% span at 110% of design speed. At the near minimum loss data point, at the same speed and radial location the total pressure variation was smaller, from 3610 to 3785 lbs/ft^2. The near minimum loss point at 50% span at 110% speed shows a stator inlet total pressure variation of only 3492 to 3610 lbs/ft^2. No reason was found to explain why the peak temperature did not occur at the same circumferential location as the calculated peak pressure at the stator inlet. This study showed that the effect of the stator inlet total pressure variation was significant for the high loss data points, but was within data scatter near minimum loss. A loss coefficient was calculated for the data point shown in Figure 15c, in which the stator inlet total pressure was obtained by averaging pressures calculated from measured temperatures. Loss coefficient, $\bar{\omega}$, was 0.042, which was 17 percent lower than the loss coefficient calculated using the free stream value of stator inlet total pressure. Data accuracy is considered to be plus or minus 15 percent for stator loss coefficients. As a result, it was concluded the accuracy of stator minimum loss levels was not affected significantly by variations in stator inlet total pressure. Stator losses measured at off optimum incidence were more seriously affected, but permit obtaining relative comparisons in performance between the various stator configurations.

Stator Exit - Stator discharge total pressures were measured by two wake rakes, located circumferentially to average-out the guide vane wake effect. Radial distributions of stator exit total pressure were calculated by mass-averaging readings across stator gaps for each wake rake, and then numerically averaging the two mass-averaged pressures, for each of the radial positions.

Circumferential distortions in total temperature across stator gaps had not been anticipated, and stator exit temperatures were measured with five radial rakes located on extensions of stator mid-gap streamlines. Inconsistent performance data were shown to result from inadequate temperature sampling. During the tests of the remaining stator configurations additional stator exit instrumentation was used to measure gapwise distributions of temperature.

These measurements showed severe circumferential total-temperature distortions. Data from MCA-B stator tests are presented to illustrate this effect. Figures 16, 17, and 18 show temperatures measured at 10, 50, and 90 percent span at 110 percent of design speed with open throttle. Temperature is plotted versus position relative to guide vanes in Figures 16a, 17a, and 18a. Since fixed-rake temperatures are all measured at stator mid-gap, the variation of these temperatures is an inlet guide vane effect. Differences between the curves drawn through fixed-rake temperatures and traversing wake rake temperatures are plotted versus position relative to stators in Figures 16b, 17b, and 18b, and illustrate the effect of the stator alone. Figure 19 shows the maximum circumferential variation in total temperature attributed to the stator as a function of percent design speed. As speed was increased the circumferential variation in total temperature became significant.

Temperature was averaged at each radial location to account for both inlet guide vane and stator effects. Stator-gap effect was isolated from the inlet guide vane effect by the method explained above and illustrated in Figures 16, 17 and 18. Total temperature from the inlet-guide-vane-effect curve at the circumferential location of the circumferential rake was subtracted from the mass-averaged circumferential rake temperature. The difference obtained was added to the average of the fixed-rake temperatures.

Rotor performance obtained during the testing of MCA stator B, which included the effect of the stator on mass-average temperature rise, was used in reducing the data obtained from the MCA stator A tests. Plots of rotor-blade-element efficiency versus compressor flow were made from performance measured during the testing of MCA stator B. Total temperature rise at each radial location for MCA stator A was calculated by using the plots of efficiency versus weight flow from MCA stator B tests and the measured total pressure and weight flow from MCA stator A tests. These calculated temperatures were substituted for test values before reducing the data obtained from the MCA stator A tests. It is felt that this technique of obtaining the temperature rise for MCA stator A is satisfactory, since the primary interest is in stator performance and the temperature has only a second-order effect on this performance in that it will effect the calculated value of stator incidence angle and stator D factor only slightly. At design speed, an arbitrary temperature increase of five degrees at stator inlet increases incidence angle approximately one degree and increases D factor approximately 0.01.

Stator discharge angles were measured by disk probes spaced to average out inlet guide vane effects and their numerical average was used in the streamline-analysis program.

Vector-diagram data and performance parameters were caluclated for the inlet guide vane, rotor and stator at 10, 30, 50, 70, and 90 percent of blade height. Blade-element performance was calculated along streamlines passing through the stator leading edge at specified percentages of the stator-leading-edge span. Therefore, the percent of blade height on the inlet guide vane and rotor refer to the position where the streamline meets the stator leading edge, not to the spanwise positions of the streamlines at other axial locations.

Overall performance was calculated from mass-averaged values of pressure and temperature for each blade row and for combinations of inlet guide vane and rotor, rotor and stator, and inlet guide vane with rotor and stator.

Performance parameters are defined as follows:

a. Relative total temperature

$$T'_5 = t_5 \left[1 + \frac{\gamma - 1}{2} (M'_5)^2 \right] \qquad \text{(Rotor in)}$$

$$T'_6 = T'_5 + \left[\frac{(\omega r_5)^2 - (\omega r_6)^2}{\frac{2\gamma}{\gamma - 1} Rg} \right] \qquad \text{(Rotor out)}$$

b. Incidence angle based on mean camber line

$$i_m = \beta_2 - \beta^*_{2m} \qquad \text{(IGV)}$$

$$i_m = \beta'_5 - \beta'^*_{5m} \qquad \text{(Rotor)}$$

$$i_m = \beta_8 - \beta^*_{8m} \qquad \text{(Stator)}$$

c. Deviation

$$\delta^\circ = \beta_3 - \beta^*_3 \qquad \text{(IGV)}$$

$$\delta^\circ = \beta'_6 - \beta'^*_6 \qquad \text{(Rotor)}$$

$$\delta^\circ = \beta_9 - \beta^*_9 \qquad \text{(Stator)}$$

d. Diffusion Factor

$$D = 1 - \frac{V'_6}{V'_5} + \frac{r_6 V_{\theta 6} - r_5 V_{\theta 5}}{(r_5 + r_6)\,\sigma\, V'_5} \qquad \text{(Rotor)}$$

$$D = 1 - \frac{V_9}{V_8} + \frac{r_8 V_{\theta 8} - r_9 V_{\theta 9}}{(r_8 + r_9)\,\sigma\, V_8} \qquad \text{(Stator)}$$

e. Loss Coefficient

$$\bar{\omega} = \frac{P'_5 \left[\dfrac{T'_6}{T'_5}\right]^{\frac{\gamma}{\gamma - 1}} - P'_6}{P'_5 - p_5} \qquad \text{(Rotor)}$$

$$\bar{\omega} = \frac{P_8 - P_9}{P_8 - p_8} \qquad \text{(Stator)}$$

f. Loss Parameter

$$\frac{\bar{\omega} \cos \beta'_6}{2\,\sigma} \qquad \text{(Rotor)}$$

$$\frac{\bar{\omega} \cos \beta_9}{2\,\sigma} \qquad \text{(Stator)}$$

g. Polytropic efficiency

1. $$\eta_p = \frac{\ln\left(\dfrac{t_2}{t_3}\right)}{\dfrac{\gamma - 1}{\gamma} \ln\left(\dfrac{p_2}{p_3}\right)} \qquad \text{(IGV)}$$

2. $$\eta_p = \frac{\frac{\gamma - 1}{\gamma} \ln \left(\frac{P_6}{P_5}\right)}{\ln \left(\frac{T_6}{T_5}\right)}$$ (Rotor)

3. $$\eta_p = \frac{\frac{\gamma - 1}{\gamma} \ln \left(\frac{p_9}{p_8}\right)}{\ln \left(\frac{t_9}{t_8}\right)}$$ (Stator)

h. Adiabatic efficiency

$$\eta_{ad} = \frac{\left(\frac{P_6}{P_0}\right)^{\frac{\gamma - 1}{\gamma}} - 1}{\left(\frac{T_{10}}{T_0}\right) - 1}$$ (IGV - Rotor)

$$\eta_{ad} = \frac{\left(\frac{P_{10}}{P_0}\right)^{\frac{\gamma - 1}{\gamma}} - 1}{\left(\frac{T_{10}}{T_0}\right) - 1}$$ (IGV - Rotor - Stator)

i. Pressure Coefficients

1. $C_p = \dfrac{p_{(local)} - p_8}{\frac{1}{2}\rho_8 V_8^2}$ (Stator)

2. $S\ factor = \dfrac{P_8 - p_{(local)}}{1/2\ \rho_8\ V_8^2}$ (Stator)

note: leading edge values of local static pressure for Cp and S factor were set equal to the inlet stagnation pressure; trailing edge values for Cp and S factor were based on calculated static pressure at the stator exit plane.

V. RESULTS AND DISCUSSION

This section presents performance results of the inlet guide vane, rotor, and stator. Overall performance is presented by plotting pressure-rise and efficiency against weight flow, with corrected speed as a parameter. The blade-element performance parameters of the stator and rotor--including loss coefficient, diffusion factor, and deviation--are presented as functions of incidence. Curves have been drawn through data generated at common test speeds, and design values have been plotted for comparison. Measured Mach number ranges for each speed line were added for convenience. Static-pressure distributions for the stator surface and hub channel are plotted versus chord length. Inlet guide vane loss and turning are documented. Tabulations of velocity vectors and blade-element performance parameters for the IGV, rotor and stator may be found in Appendix A; tabulations of the over-all performance are in Appendix B. Static pressure distributions for the stator surface and hub mid-channel are tabulated in Appendix C. Performance calculations are described in detail in the Calculation Procedure section of Apparatus and Procedure.

A. Overall Performance

Overall performance is presented in terms of efficiency and pressure ratio versus corrected weight flow ($W\sqrt{\theta}/\delta$) and corrected specific weight flow ($W\sqrt{\theta}/\delta\ A_{an}$). Figures 20, 21, and 22 present the performance of IGV-rotor-stator, of IGV-rotor, and of rotor alone, respectively, at six corrected rotor speeds. Stall lines were extrapolated from the characteristic speed lines to the measured stall airflows.

Figure 20 shows that the maximum flow obtained at design speed was 134.7 lb/sec, or 0.3 lb/sec less than design flow. The stage efficiency and pressure ratio at this flow and design equivalent speed was 78.5 percent and 1.435 compared with predicted values of 79.7 percent and 1.485. Maximum efficiency obtained at design speed was 84.4 percent at a pressure ratio of 1.521 and an airflow of 131.9 lb/sec. The low value of stage efficiency can be partially attributed to the fact that the stator loading is very high compared to the rotor work input and that the high stator losses result in a high ratio of loss to work input and therefore a low efficiency.

Performance of the rotor combined with the IGV is presented in Figure 21. At design-equivalent speed and 134.7 lb/sec, efficiency is 91.5 percent and pressure ratio is 1.521 compared with predicted values of 89.3 percent and 1.550. Peak efficiency occurred at 90 percent of design speed and is 93 percent.

Performance of the rotor alone is shown in Figure 22. At design speed and 134.7 lb/sec., the efficiency is 93.3 and pressure ratio is 1.53 compared with the predicted values of 91.9 percent and 1.569. Peak efficiency occurred at 90 percent of design speed and is 94.5 percent.

Optimum rotor-stator matching was not achieved, as can be seen by comparing rotor and stage efficiency plots. Peak rotor efficiency and peak stage efficiency do not occur simultaneously because minimum stator loss was obtained at part throttle, while rotor efficiency continued to increase with increasing flow.

B. Blade Element Performance

Inlet Guide Vane: IGV performance was documented during this first test; loss and turning calibrations were assumed valid for subsequent tests. Air-angle traversing was accomplished at 50 percent and 100 percent speeds for both open-throttle and near-stall operation. Exit air angle was insensitive to throttling and speed effects (Figure 23). As shown in Figure 23 the IGV turned the flow 41, 24 and 18 degrees at the hub, mean and tip respectively. Design flow turning at the three locations were 43, 27 and 21 degrees.

IGV pressure-recovery correlated with corrected weight flow for each of five radial positions, with only moderate evidences of throttle effects (Figure 24). These data were taken by pressure wake-rakes located behind the IGV.

The circumferential distortions caused by wakes from the inlet guide vane were found at both the stator inlet and exit instrumentation stations, even though the IGV losses were generally low. The distortions could have been caused either by large wakes near end-walls or by angle variations across the vane gaps, neither of which were investigated during this test.

Rotor: Blade-element performance for six corrected speeds is presented in Figures 25, 26, and 27. Plots show loss coefficient, diffusion factor, and deviation as functions of incidence. Each plot presents data for one location along the span, and calculated design values are plotted for comparison. Data were calculated for axial locations of blade leading and trailing edges as shown in Figure 6.

The shapes of the loss-coefficient-versus-incidence curves (Figure 25) and the level of incidences, as compared with design, indicate that the rotor was operating at higher than optimum incidences. The overall plots, together with the blade-element plots, indicate that the rotor did not limit maximum flow.

The increasing magnitude of the loss coefficient from midspan to tip is consistent with the corresponding increase in Mach number. Inlet Mach numbers measured for design speed of this double-circular-arc rotor are subsonic except near the tip, where they reach Mach 1.05. Minimum loss coefficients are below those which were predicted for each radial location. End-wall losses are not severe at either the ten percent or ninety percent stations. There is an apparent decrease in rotor hub loss coefficient as the relative inlet Mach number increases to approximately 0.5. Beyond this point, losses increase with increasing Mach number.

The tendency toward lower loss coefficients at successively lower speeds is reversed near the hub for 70 and 50 percent speeds. This apparent inconsistency is probably caused by small inaccuracies in temperature measurement and by the sensitivity of rotor efficiency to temperature rise at low speed. At 50 percent of design speed, a change of 1°F changes efficiency by 5 percent and $\bar{\omega}$ by 0.08.

Diffusion loading at design incidence agree fairly well with predicted levels (Figure 26). The measured loadings for design speed are slightly higher than predicted at the hub and slightly lower than predicted at the tip.

Rotor deviations at design incidences are greater than predicted (Figure 27). At 10 percent and 30 percent from the tip, deviations are one degree higher; the remainder of the span has deviations two degrees higher than predicted.

Stator: Blade-element performance for six speeds is presented in Figures 28, 29, and 30. Plots show diffusion factor, deviation and loss coefficient versus incidence, with one figure for each radial location. Data were calculated at axial stations corresponding to the leading and trailing edges of the stator.

Measured mid-span minimum losses at design speed were lower than predicted. Near the end wall losses were higher than predicted. At design rotor speed the stator inlet Mach number was lower than design. At 110 percent of design speed the stator inlet Mach number compared more favorably with design values. At 110 percent of design speed the experimental minimum loss coefficient at mid-span was 0.08 with an inlet Mach number of 0.98 and a diffusion factor of 0.56. Design mid-span values of loss coefficient, inlet Mach number and diffusion factor were 0.091, 0.94 and 0.54 respectively. Experimental mid-span values of loss coefficient, inlet Mach number and diffusion factor at 100 percent of design speed were 0.057, 0.91 and 0.53 respectively. Near the hub, at 90 percent span, the stator minimum loss coefficient, inlet Mach number and diffusion factor were 0.145, 1.00 and 0.63 respectively. At 10 percent span, the stator minimum loss coefficient, inlet Mach number and diffusion factor were 0.098, 0.84 and 0.50 respectively. Minimum loss values at 100 percent design speed taken from the curves of Figure 30 are compared with design values in Figure 31.

The experimental range of incidence angle was sufficient to define a minimum loss point and an optimum incidence angle for all blade elements except at 90 percent of span. The optimum incidence angle at 90 percent span was not established but would be in excess of 4 degrees positive incidence to the suction surface. At mid-span sections, minimum loss at design speed occurs at zero degrees to the suction surface. At 10 percent span, the minimum loss at design speed occurs at a negative incidence of one degree.

In general the loss plots exhibit the following trends:

- An increase in minimum loss with increasing Mach number.
- A narrowing of low-loss incidence range as Mach number increases.
- Increased minimum loss incidence with increases in Mach number.

Stator loadings for design speed and design incidences agree with predicted loadings at the mid-span and tip sections but are higher than predicted at the hub. The measured D-factor at zero degrees incidence at 90 percent from the tip is 0.62 instead of the predicted 0.57. D-factors up to 0.64 were obtained at 30 percent from the tip at 110 percent design speed.

Deviations at the mid-span region are four to five degrees greater than predicted. Deviations at 10 percent and 90 percent from the stator hub are 8 and 6 degrees greater than predicted.

The stator loss parameter $\left(\frac{\bar{\omega} \cos \beta_9}{2\sigma}\right)$ is presented versus diffusion factor for each of five radial locations in Figure 32. Curves have been drawn through the points representing minimum loss for each speed. The curves shown for each radial position have been adjusted to reflect trends at other radial locations providing a smooth transition as a function of radius. Therefore, at a given radial location the curves will not necessarily represent a mean of the data points obtained at the radial location. The loss parameter as presented is calculated based on the measured total loss and thus includes any losses associated with flow shocks. As speed is increased the D factor at which minimum loss occurs increases due to compressibility. The curves drawn through the minimum loss points indicate an increase in the loss parameter with increasing D factor as might be expected. However, the magnitude of the increase in loss parameter with increase in D factor may, in part, be due to an increase in shock losses associated with the higher Mach number.

Figure 33 presents a comparison of the minimum loss parameter versus D factor for the five radial locations. The curves indicate an increase in loss parameter in the end wall regions.

Static pressures were measured along the hub, midway between two stator vanes. Chordwise distributions of the ratio of local static pressure on the hub to stator inlet pressure at 90 percent span are shown in Figure 34. Figures 34a, 34b and 34c represent wide open throttle, part throttle, and near-stall for 50, 100, and 110 percent of design speed. The pressure discontinuity at the open-throttle position at design speed indicates a shock in the channel, with a Mach number of 1.3 upstream of the shock and 1.0 on the downstream side. No shocks are indicated for the part throttle setting at 100 or 110 percent of design speed.

Chordwise distribution of pressure coefficient, C_p, on the stator surfaces is shown in Figures 35 through 40. Pressure coefficients, S factors, are shown in Figures 41 through 46. The data are presented for wide open throttle, part throttle, and near stall for 50, 100, and 110 percent design speeds. The pressure distribution which corresponds to near minimum loss is indicated in the figure subtitles. A rapid increase in C_p (rapid decrease in S factor) on the blade suction surface indicates a sharp rise in static pressure due to the presence of a passage shock. The presence of these passage shocks is more apparent at the higher speeds where the flow Mach number is higher. Data for all speeds and throttle settings are tabulated in Appendix C.

REFERENCES

1. Keenan, M.J. and Monsarrat, N.T. "Experimental Evaluation of Transonic Stators, Preliminary Analysis and Design Report." NASA CR-54620, 1967 (PWA-2749).

2. Robbins, William H.; Jackson, Robert J.; and Lieblein, Seymour. "Blade Element Flow in Annular Cascades, Aerodynamic Design of Axial-Flow Compressors." NASA SP-36, 1965, ch. VII, pp. 227-254.

3. ASME Research Committee on Fluid Meters. "Fluid Meters - Their Theory and Application." Fifth Edition, American Society of Mechanical Engineers, New York, N. Y., 1959, p. 47.

4. Glawe, George E.; Simmons, Frederick S; Stickney, Truman N. "Radiation and Recovery Corrections in Time Constants of Several Chromel-Alumel Thermocouple Probes in High Temperature, High Velocity Gas Streams." NACA Technical Note 3766, October 1956.

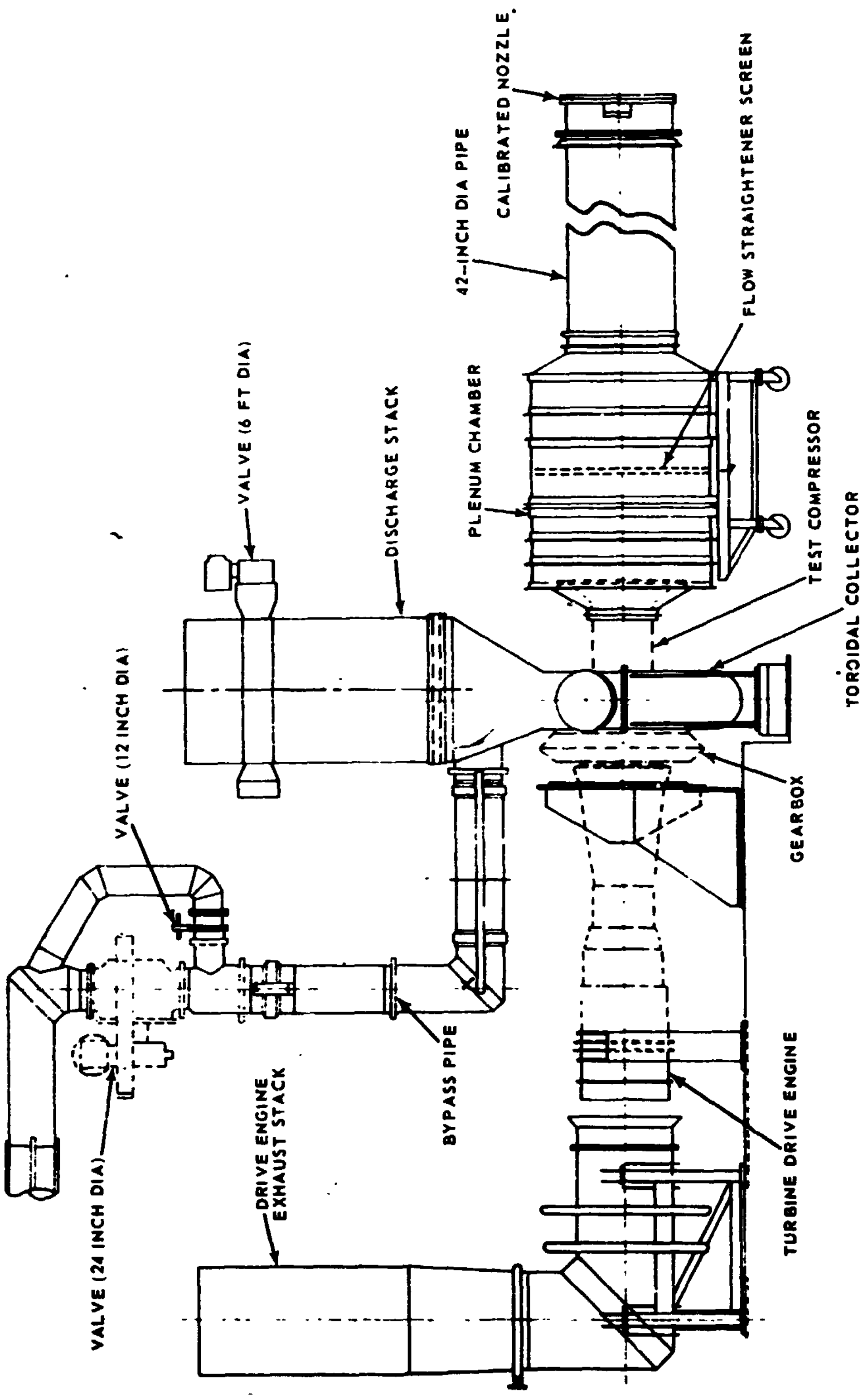


Figure 1 Schematic of Compressor Test Facility

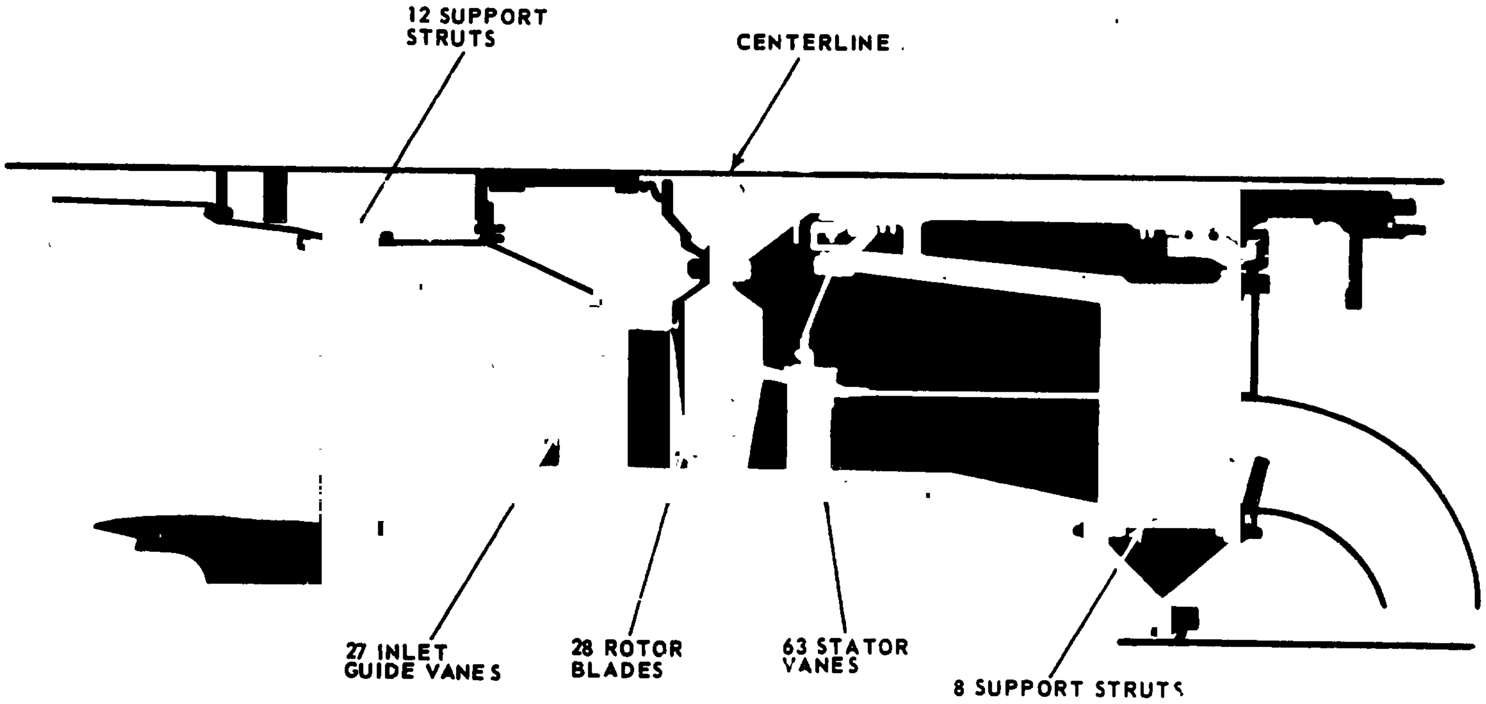


Figure 2   Cross Section of Test Compressor

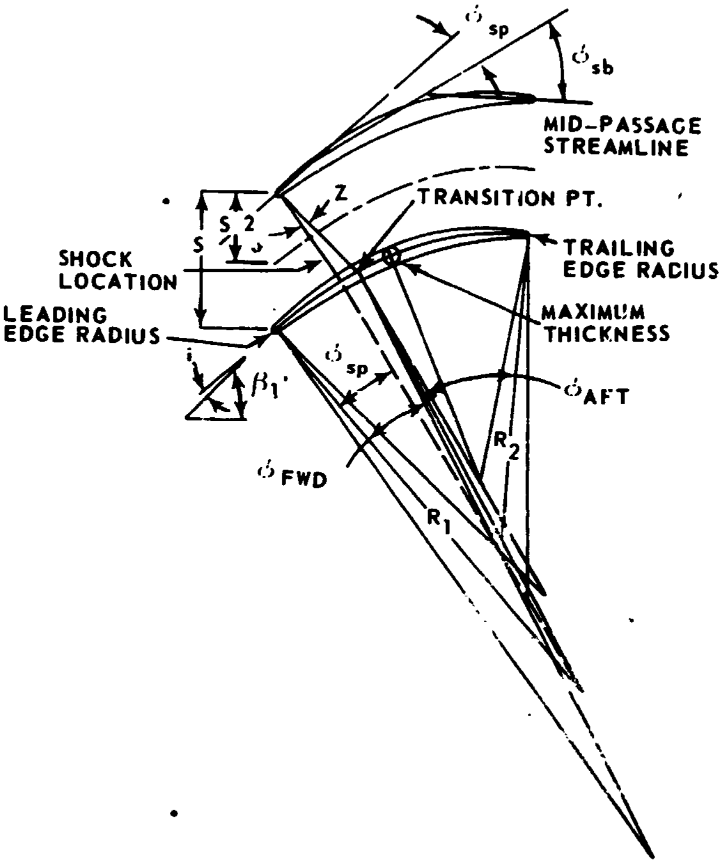


Figure 3 Multiple-Circular-Arc Blade Geometry

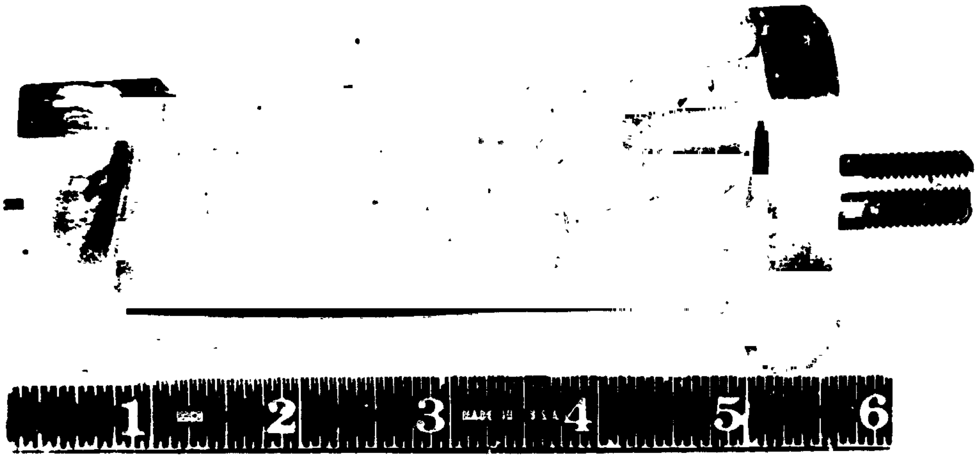


Figure 4 Multiple-Circular-Arc Stator A

Pressure Wake Rake

Circumferential Temperature Rake

Radial Temperature Rake

Disk Probe

Figure 5 Compressor Instrumentation

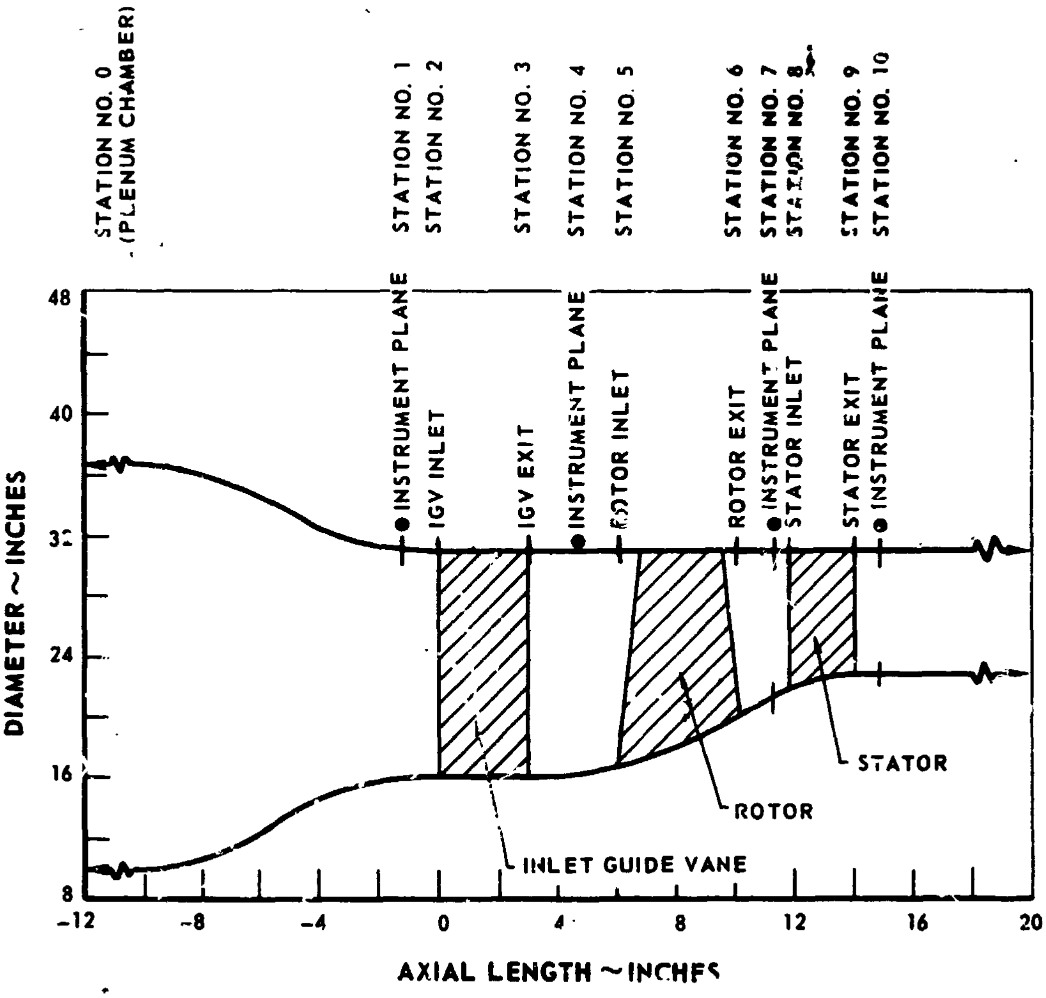


Figure 6 Station Number Designation and Location of Instrumentation and Blade Leading and Trailing Edge Planes

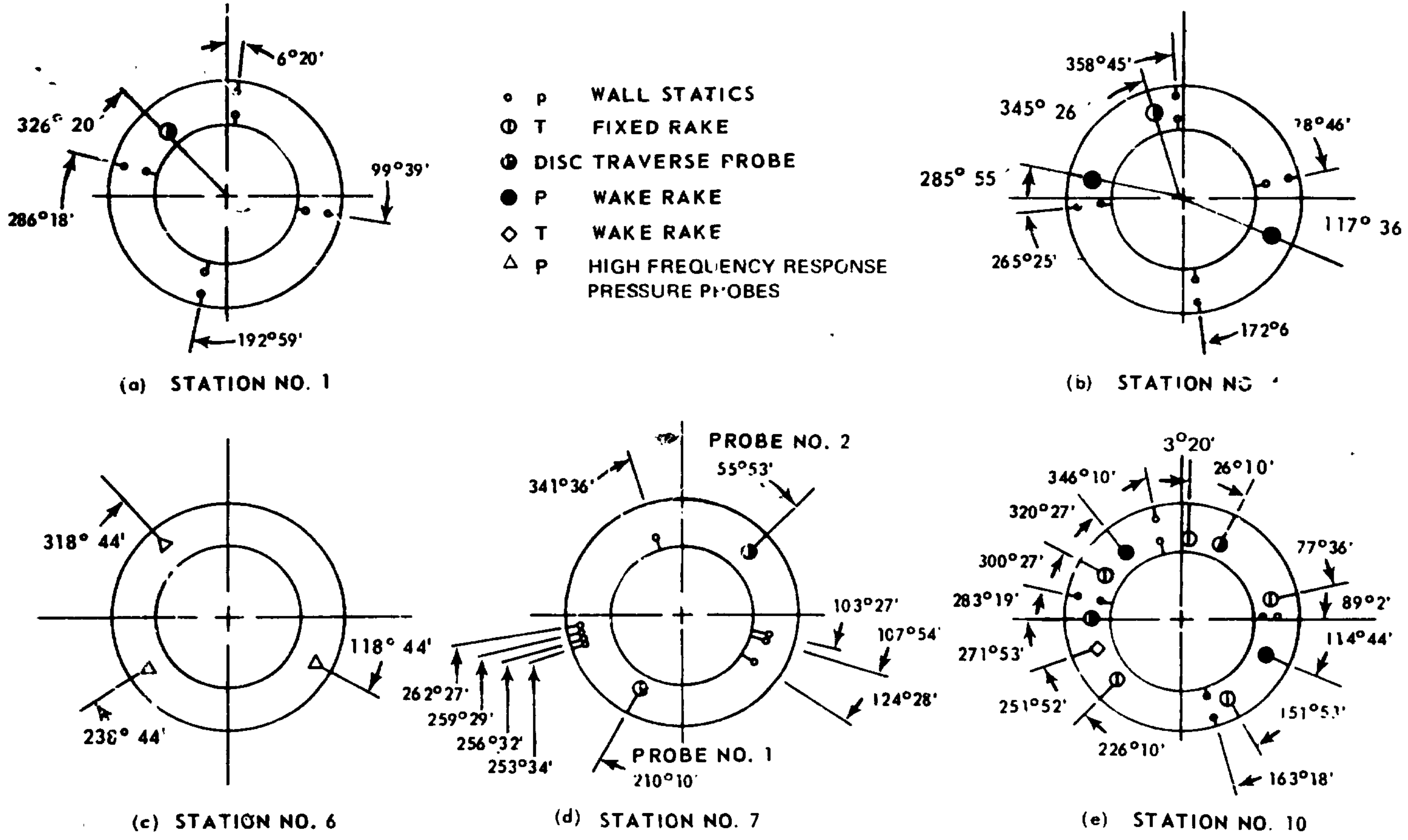


Figure 7 Circumferential Position of Instrumentation

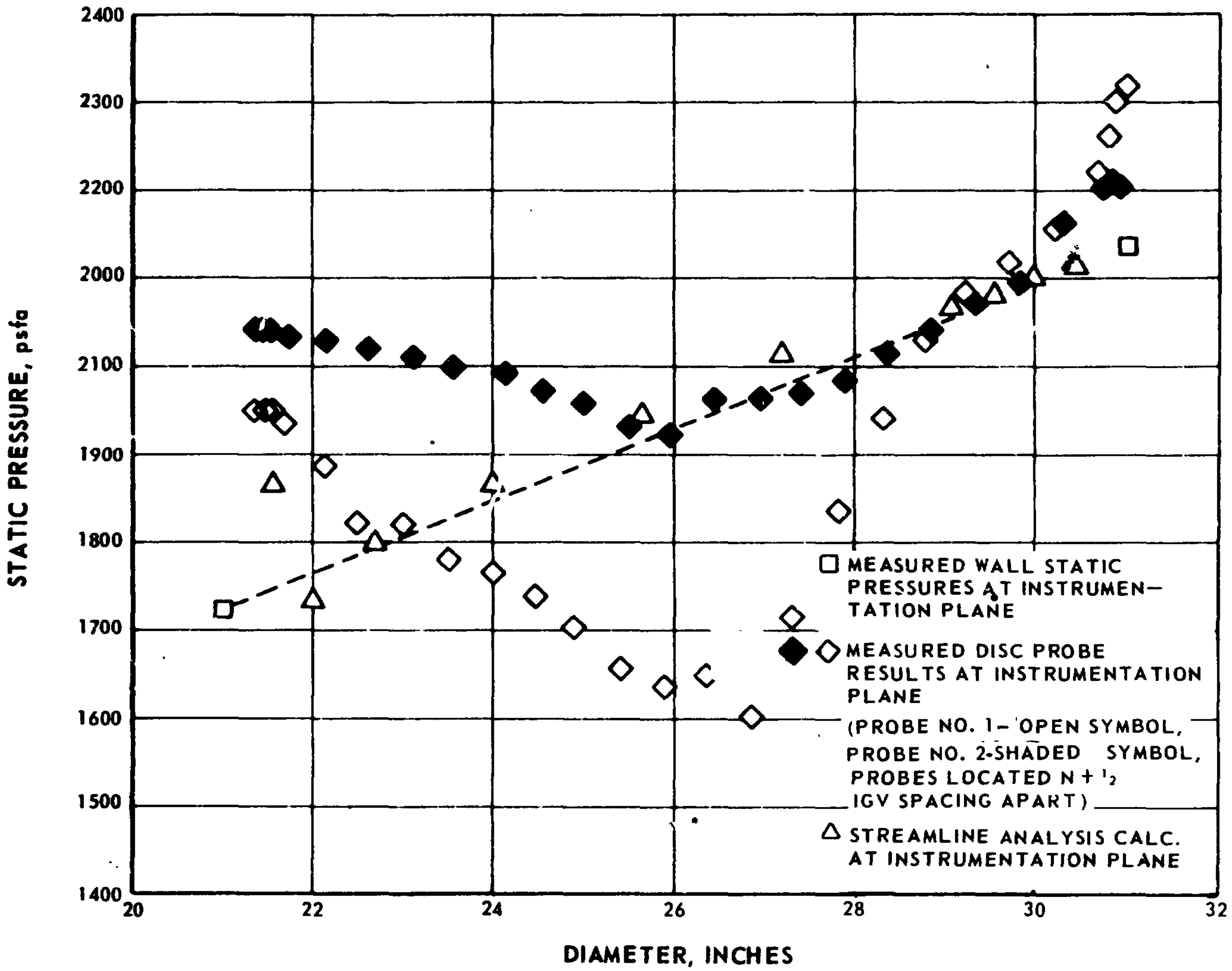


Figure 8 Comparison of Calculated Spanwise Variation of Static Pressure with Measured Values, Station 7, 100% Design Speed, Wide Open Throttle (MCA Stator A)

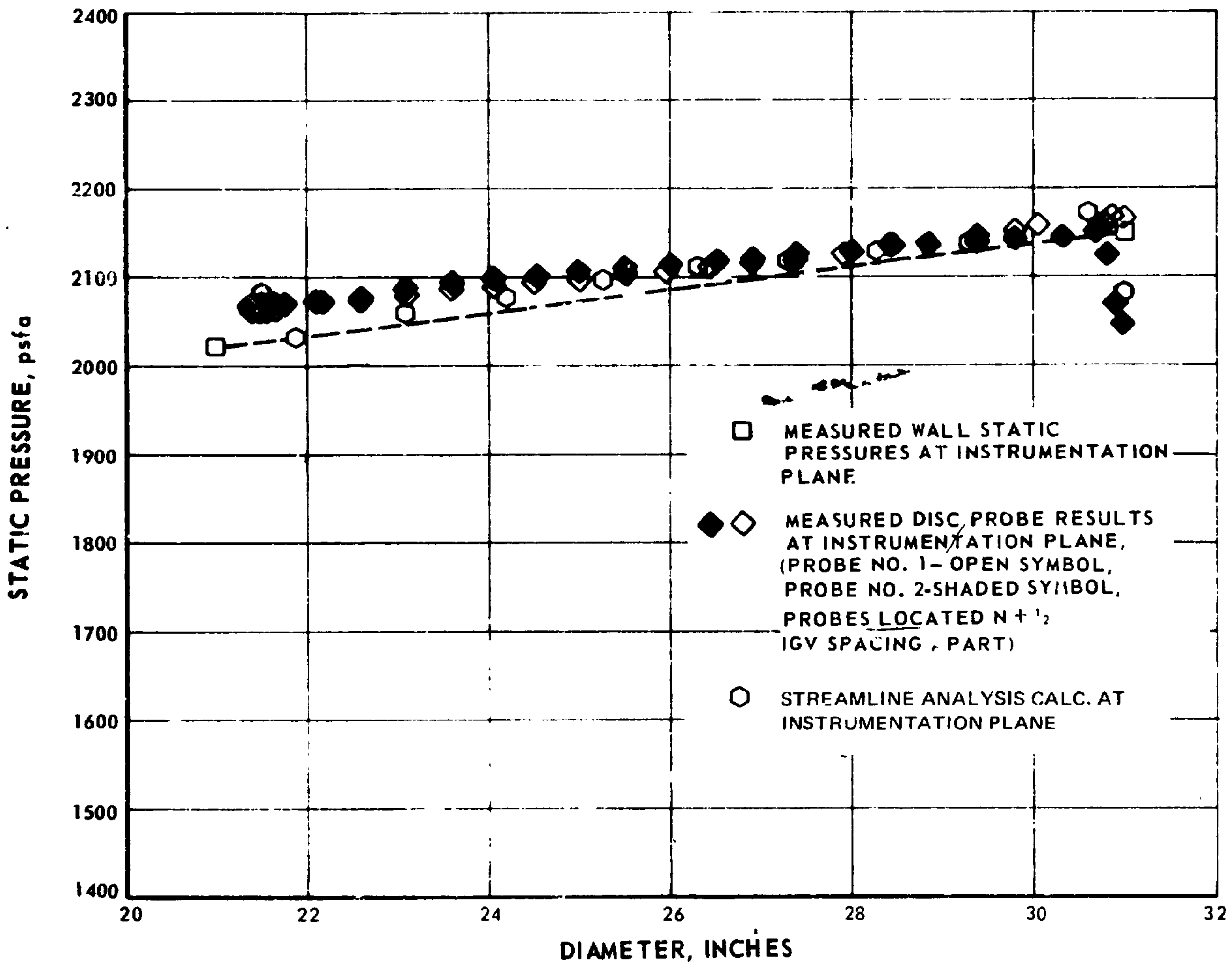


Figure 9 Comparison of Calculated Spanwise Variation of Static Pressure with Measured Values, Station 7, 50% Design Speed, Mid-Throttle (MCA Stator A)

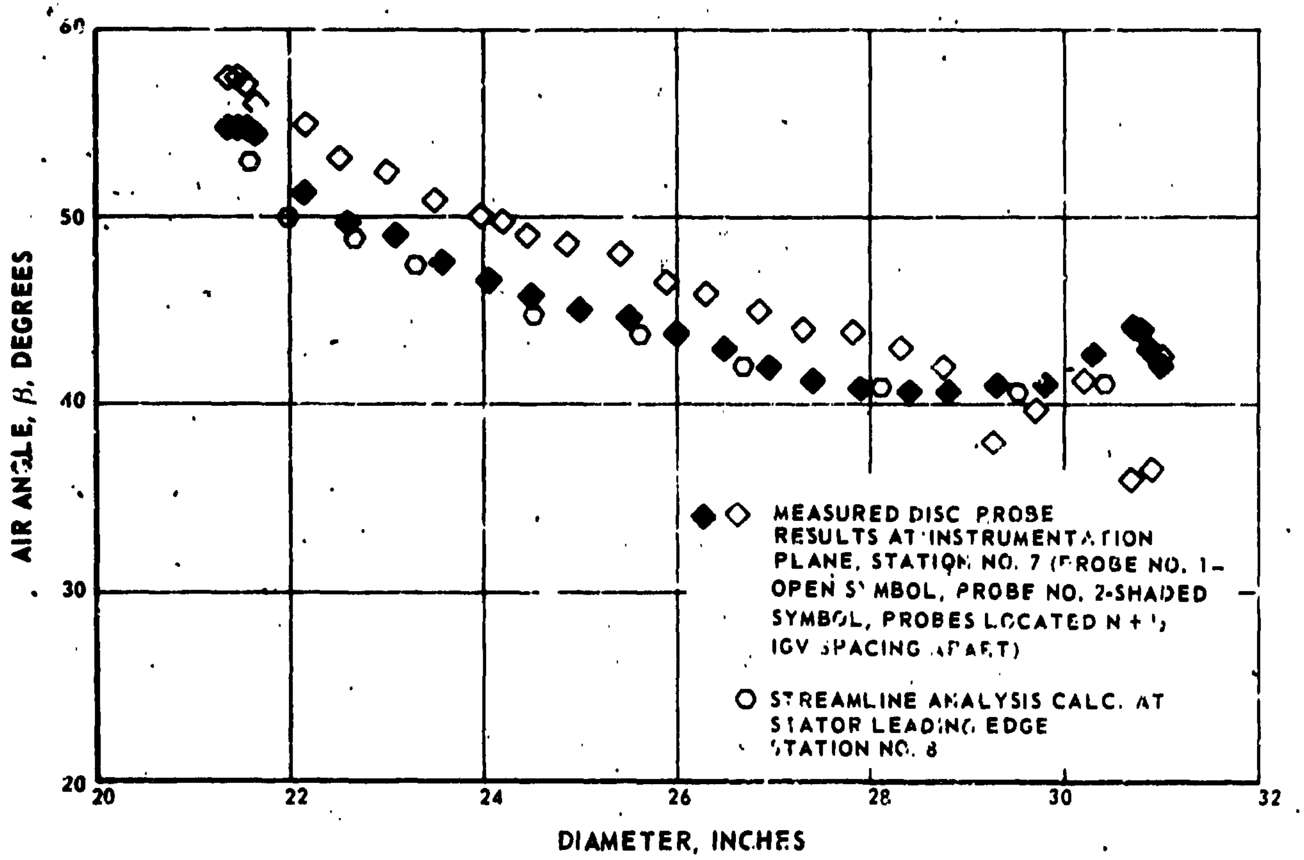


Figure 10 Comparison of Calculated Spanwise Variation of Air Angle with Measured Values, 100% Design Speed, Wide Open Throttle (MCA Stator A)

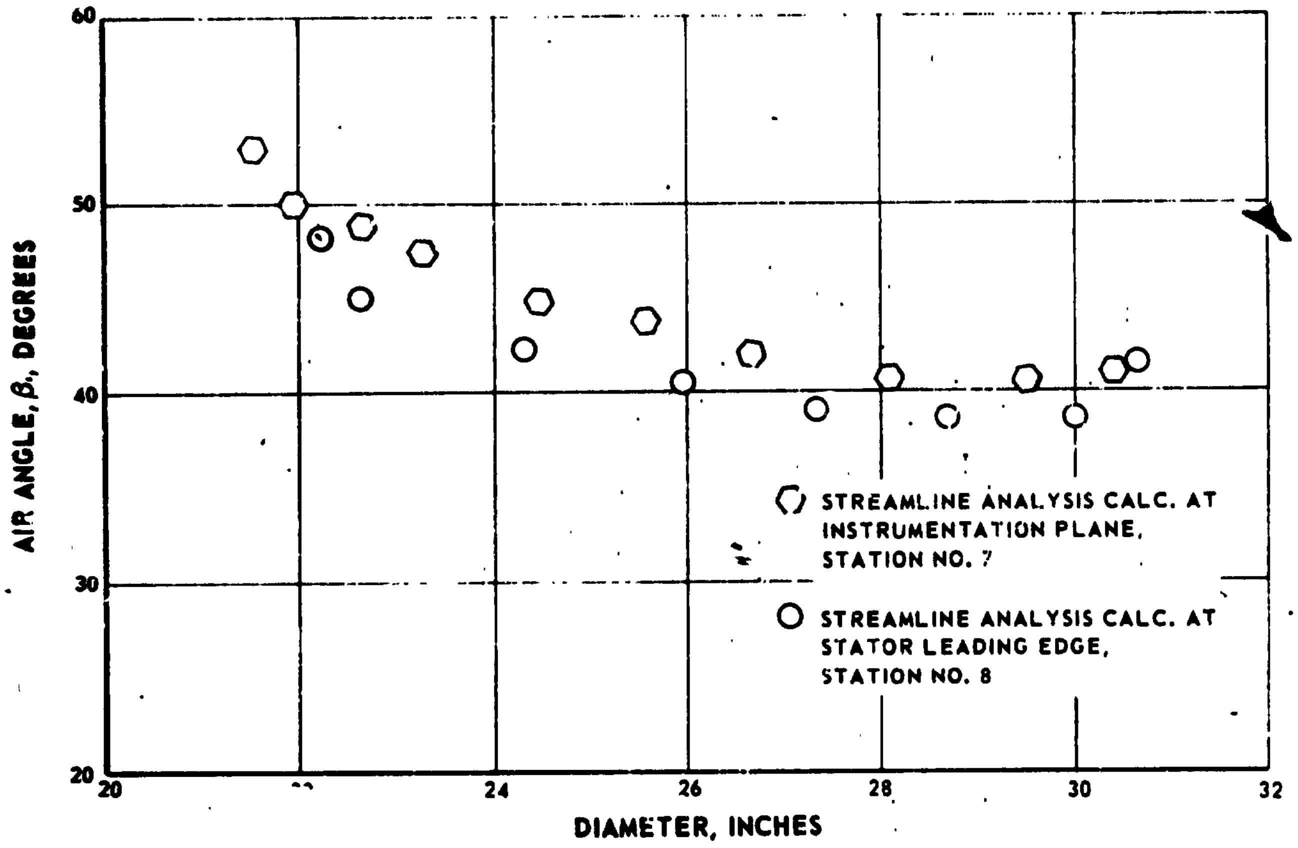


Figure 11 Comparison of Calculated Spanwise Variation of Air Angle at Instrumentation Plane and Stator Leading Edge, 100% Design Speed, Wide Open Throttle (MCA Stator A)

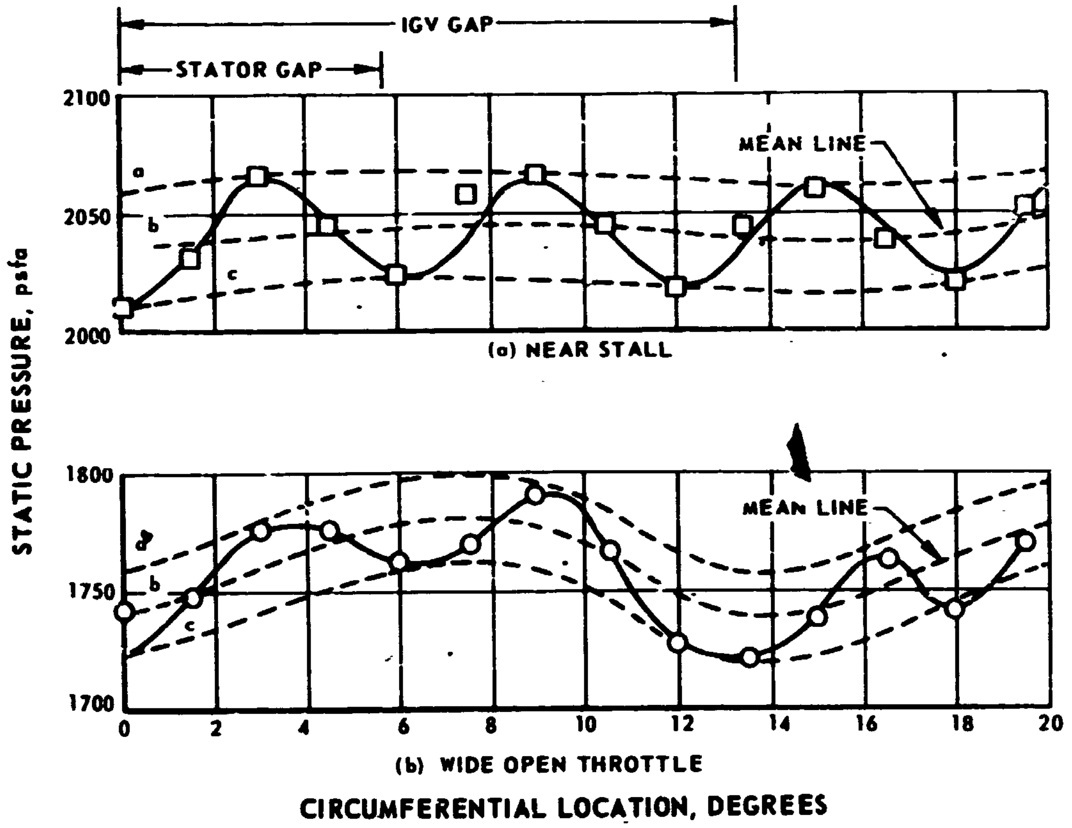


Figure 12 Circumferential Variation in Static Pressure, Outer Case, 100 ; Design Speed, Station 7 (MCA Stator A)

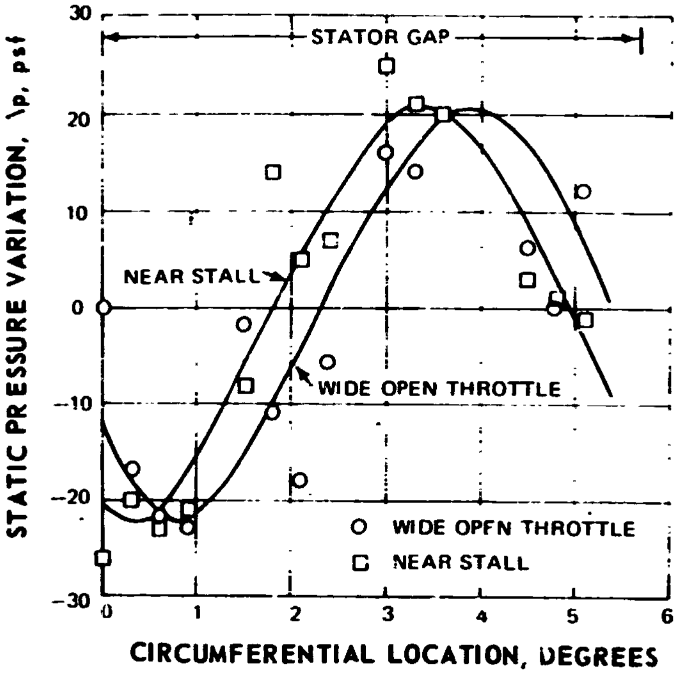


Figure 13 Wall Static Pressure Variation Attributed to Stator, Outer Case, 100% Design Speed, Station 7 (MCA Stator A)

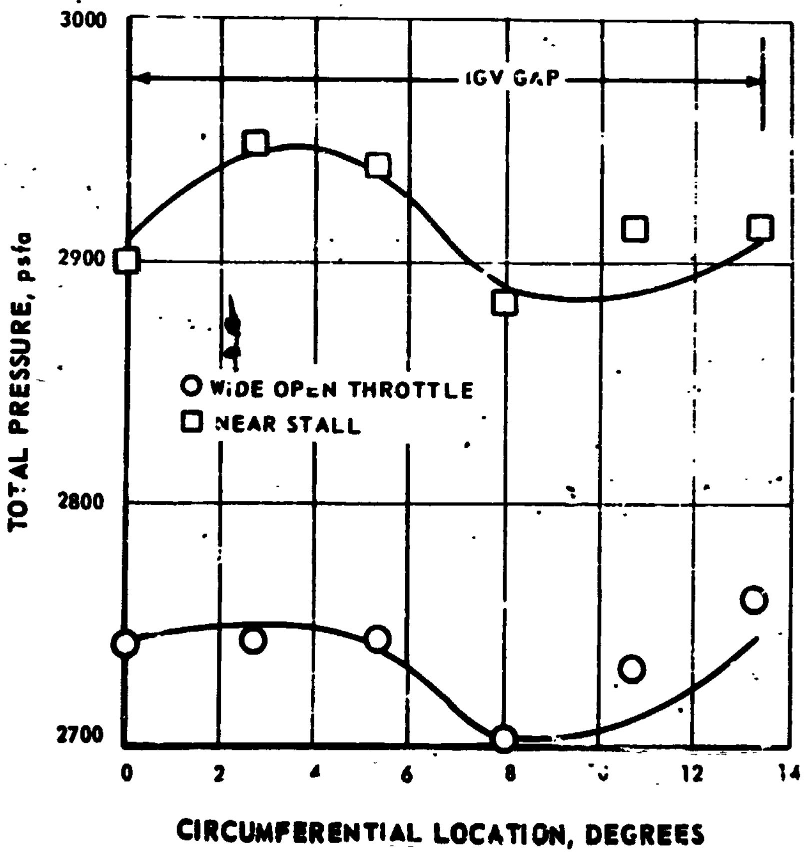
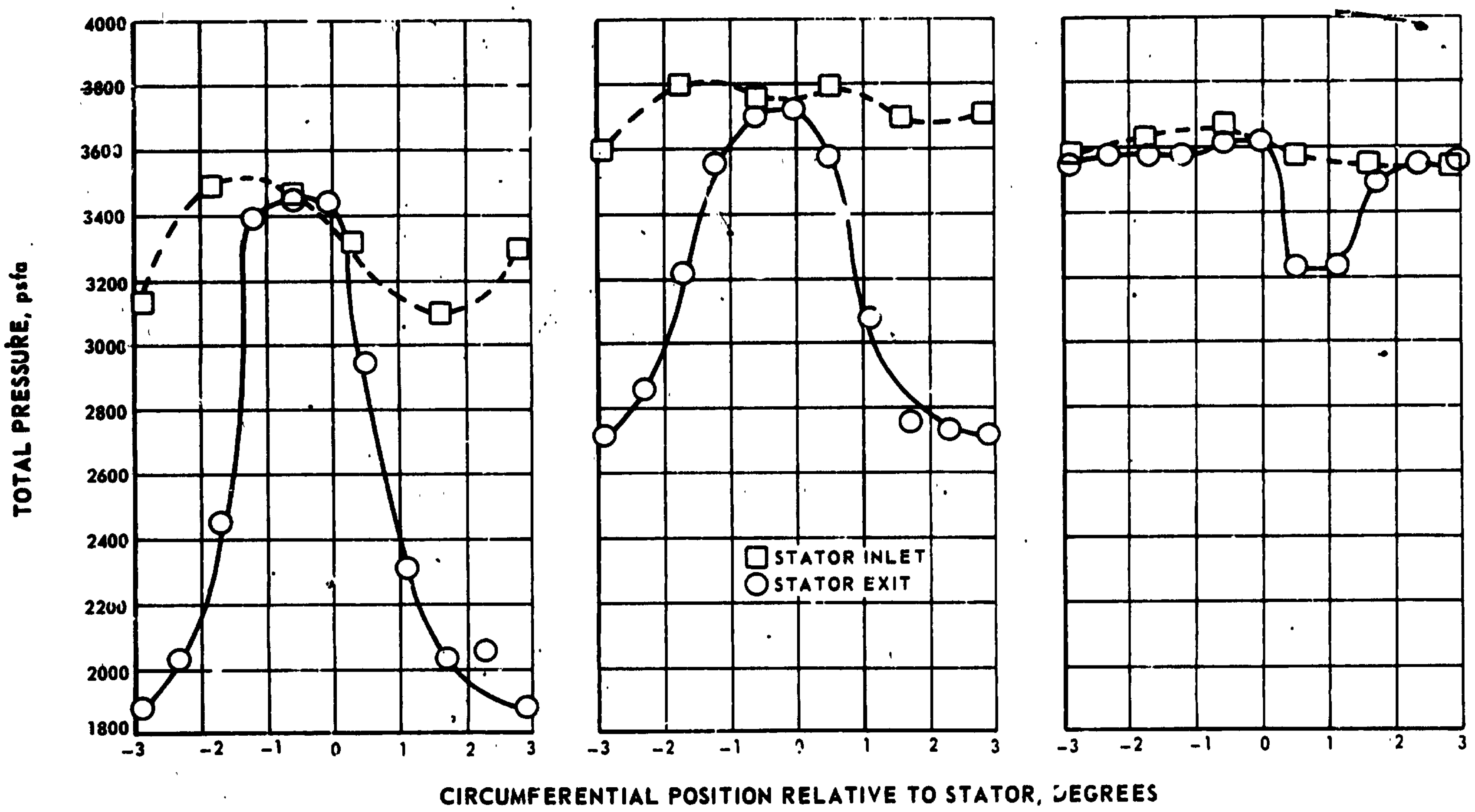


Figure 14 Circumferential Variation in Total Pressure, 10% Span, 100% Design Speed, Station 7 (MCA Stator A)

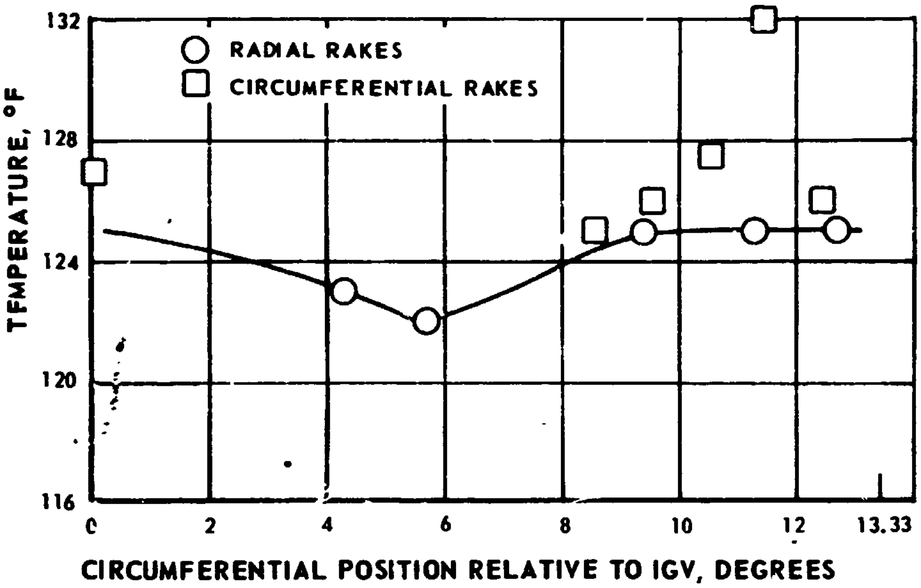


(a) HIGHEST LOSS POINT, 90% SPAN, WIDE OPEN THROTTLE

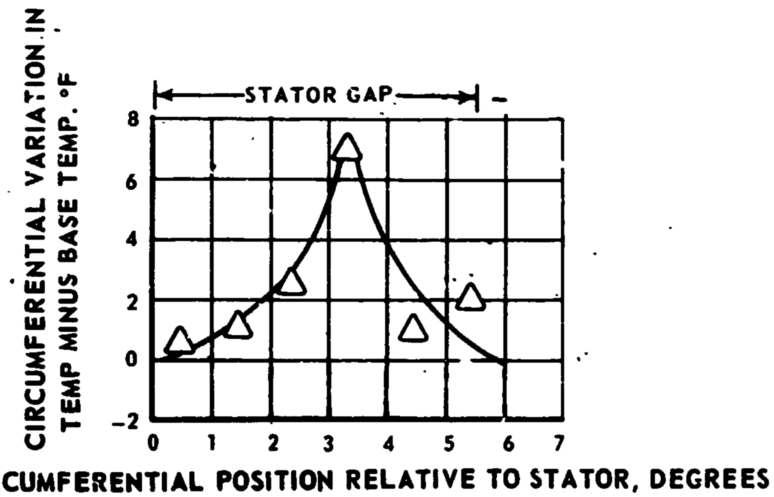
(b) NEAR MINIMUM LOSS, 90% SPAN

(c) NEAR MINIMUM LOSS, 50% SPAN

Figure 15 Estimated Circumferential Variation in Total Pressure at the Stator Inlet Plane and Measured Circumferential Variation at the Stator Exit Plane, 110% Design Speed (MCA Stator B)

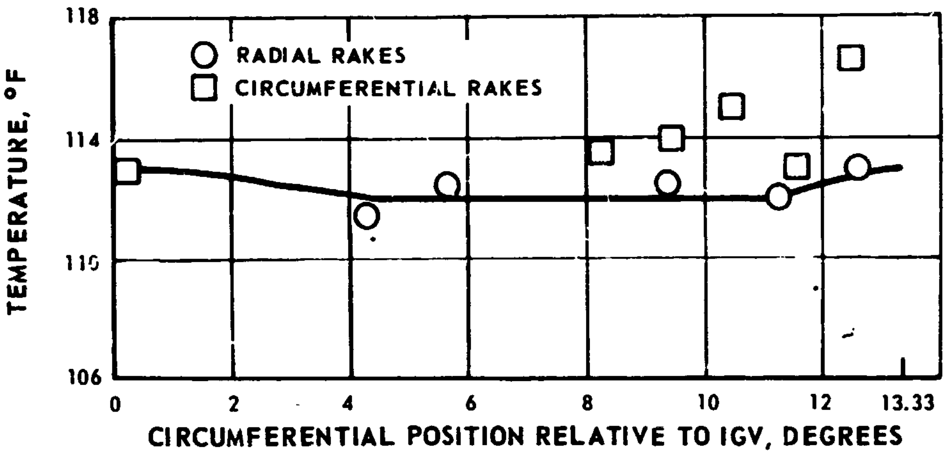


(a) OVERALL CIRCUMFERENTIAL TEMPERATURE DISTORTION

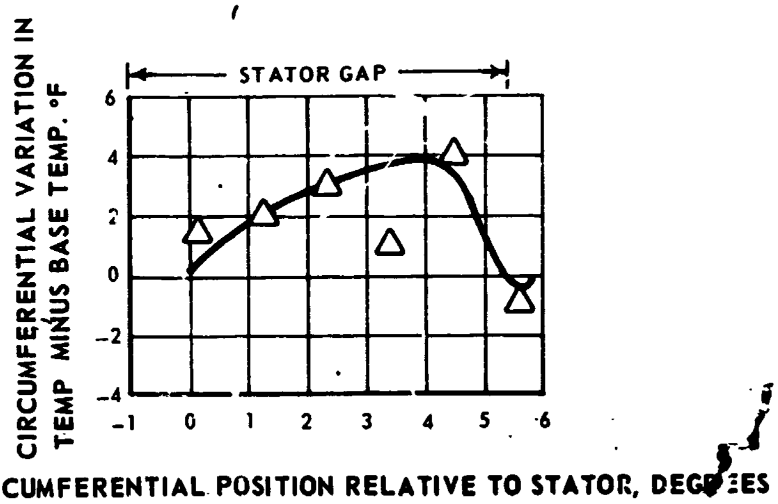


(b) TEMPERATURE DISTORTION ATTRIBUTED TO STATOR

Figure 16 Circumferential Variation in Total Temperature, 10% Span, 110% Design Speed, Wide Open Throttle, Station 10 (MCA Stator B)

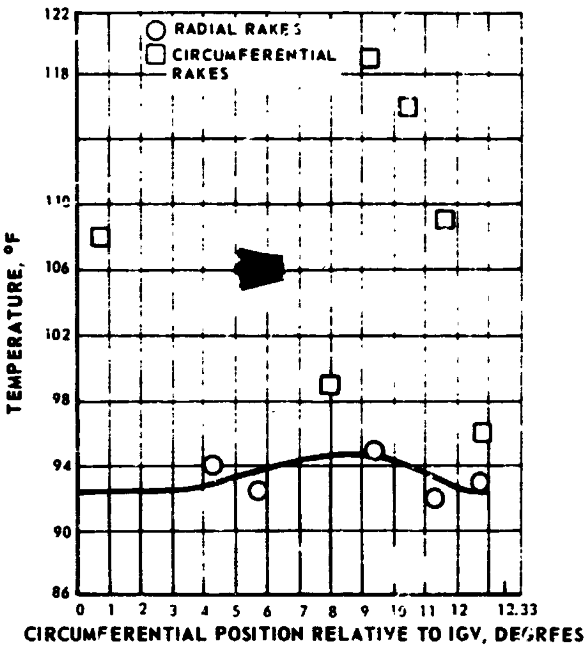


(a) OVERALL CIRCUMFERENTIAL TEMPERATURE DISTORTION

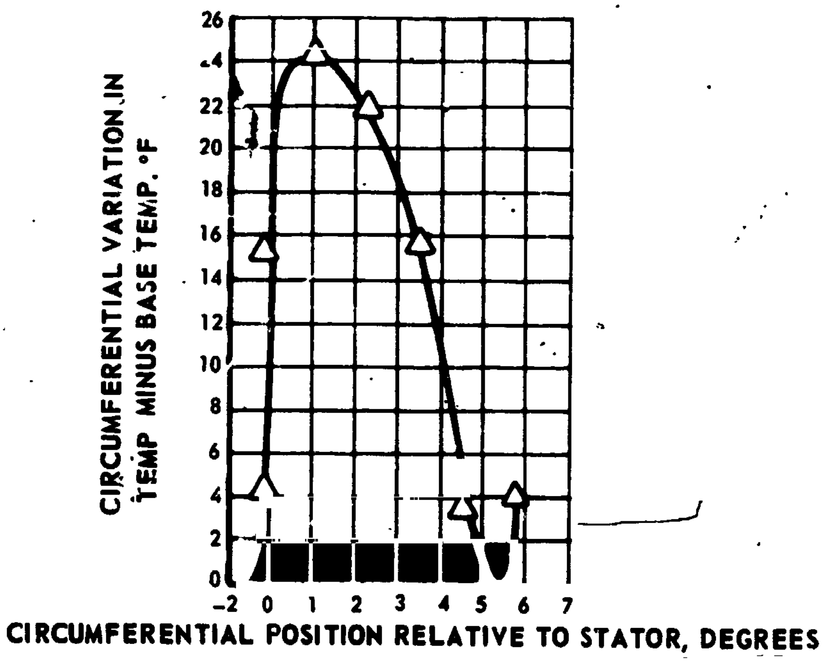


(b) TEMPERATURE DISTORTION ATTRIBUTED TO STATOR

Figure 17 Circumferential Variation in Total Temperature, 50% Span, 110% Design Speed, Wide Open Throttle, Station 10 (MCA Stator B)



(a) OVERALL CIRCUMFERENTIAL TEMPERATURE DISTORTION



(b) TEMPERATURE DISTORTION ATTRIBUTED TO STATOR

Figure 18 Circumferential Variation in Total Temperature, 90% Span, 110% Design Speed, Wide Open Throttle, Station 10 (MCA Stator B)

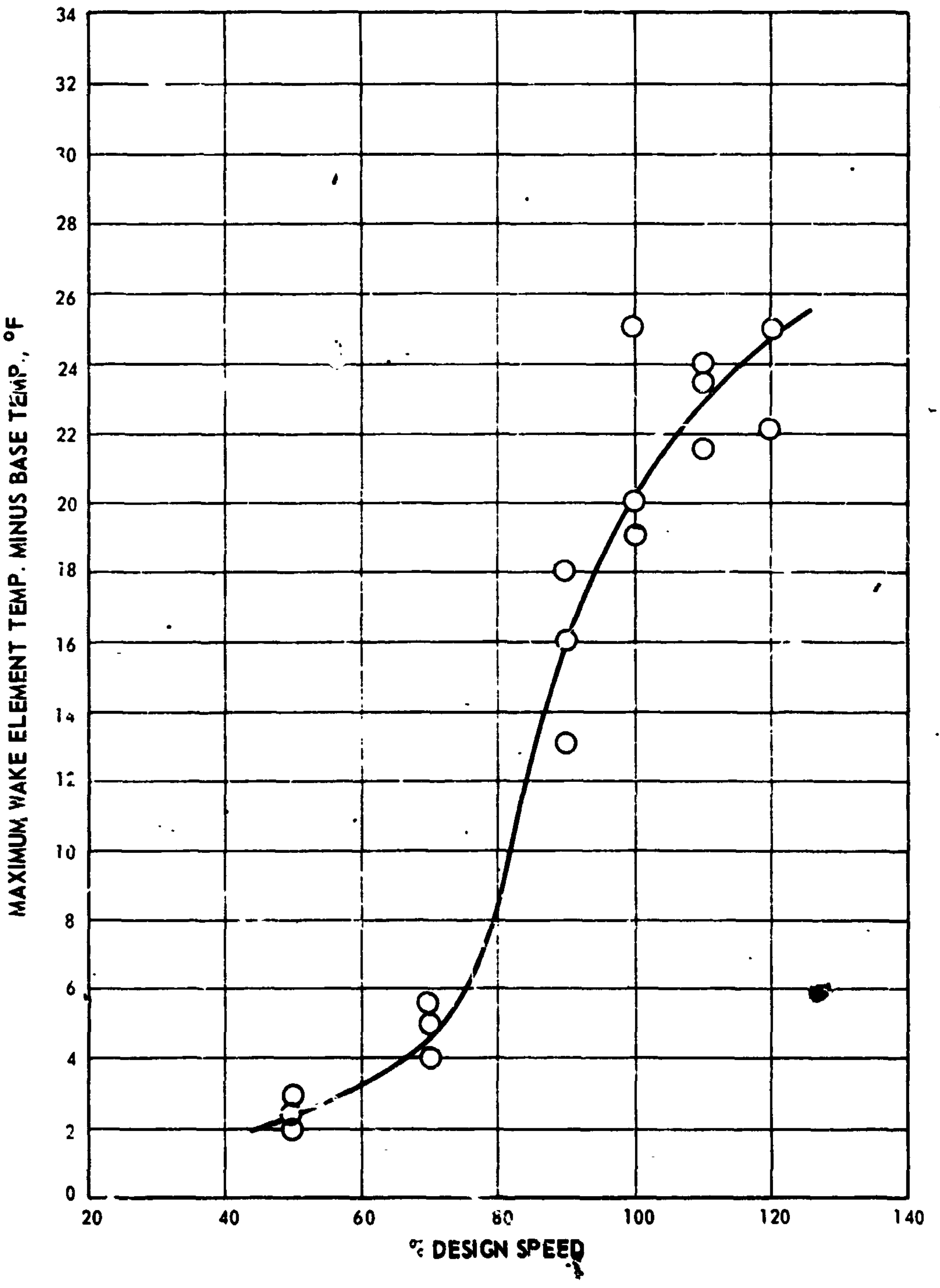


Figure 19 Maximum Circumferential Variation in Total Temperature Attributed to Stator vs. Percent Design Speed, 90% Span (MCA Stator B)

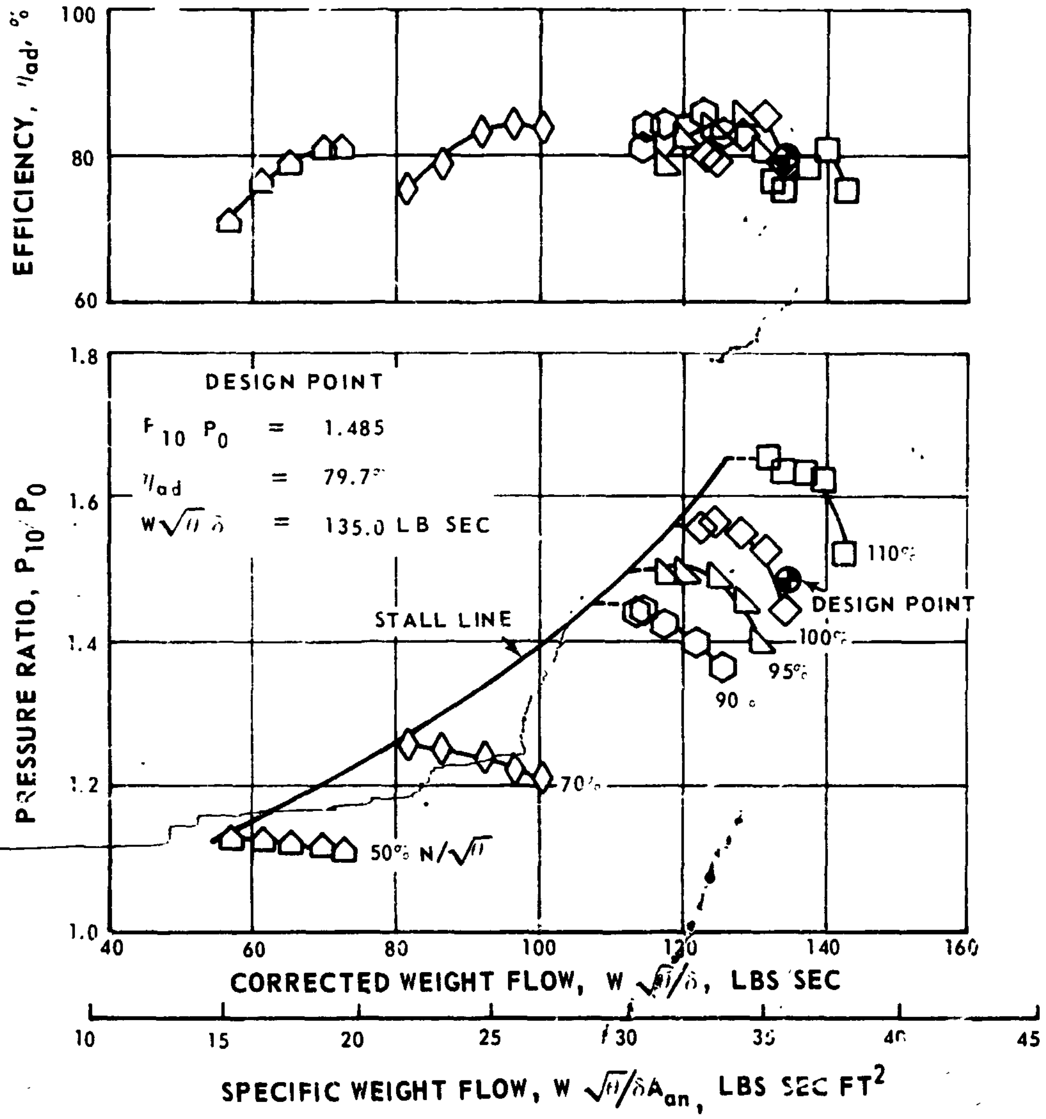


Figure 20 Over-All Performance of Inlet Guide Vane, Rotor and MCA Stator A

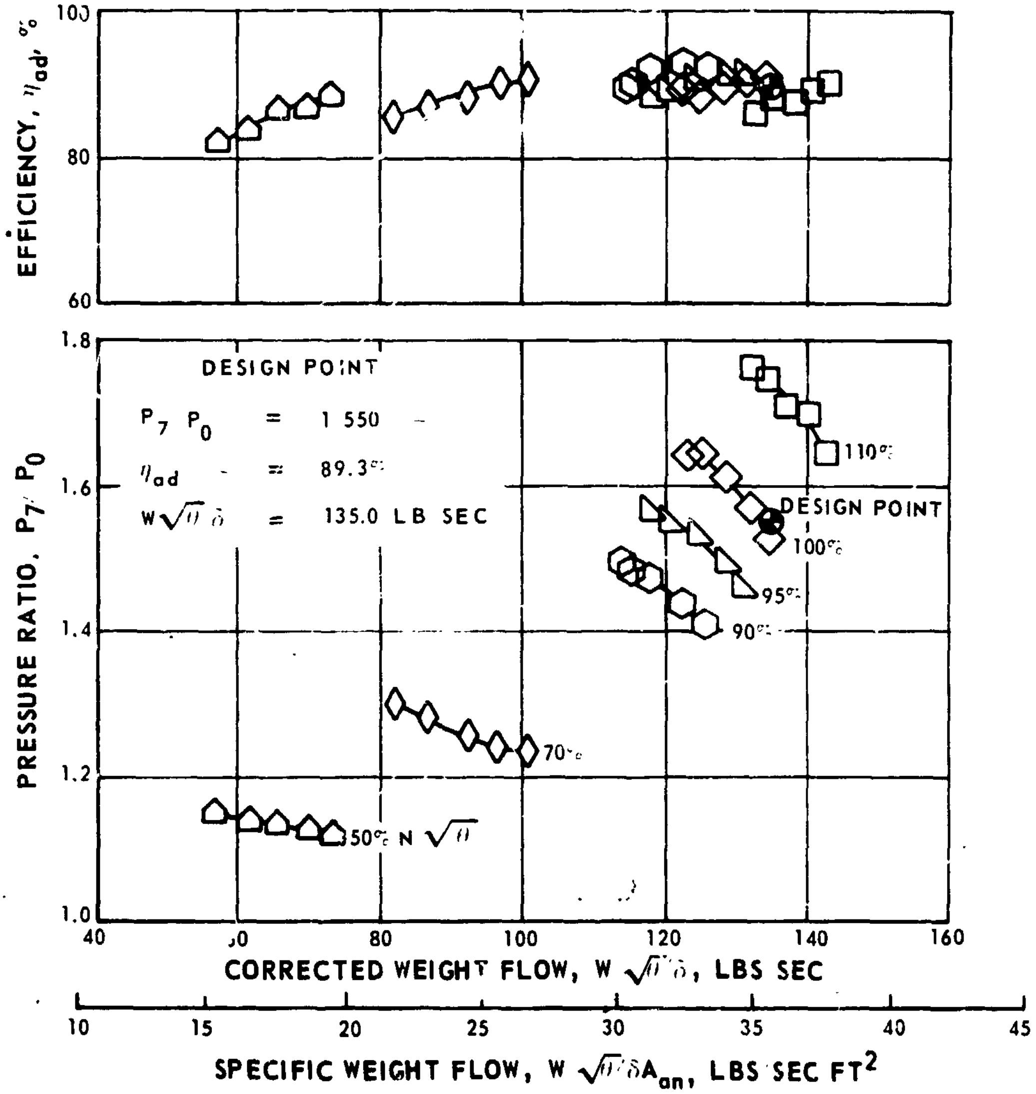


Figure 21 Over-All Performance of Inlet Guide Vane and Rotor

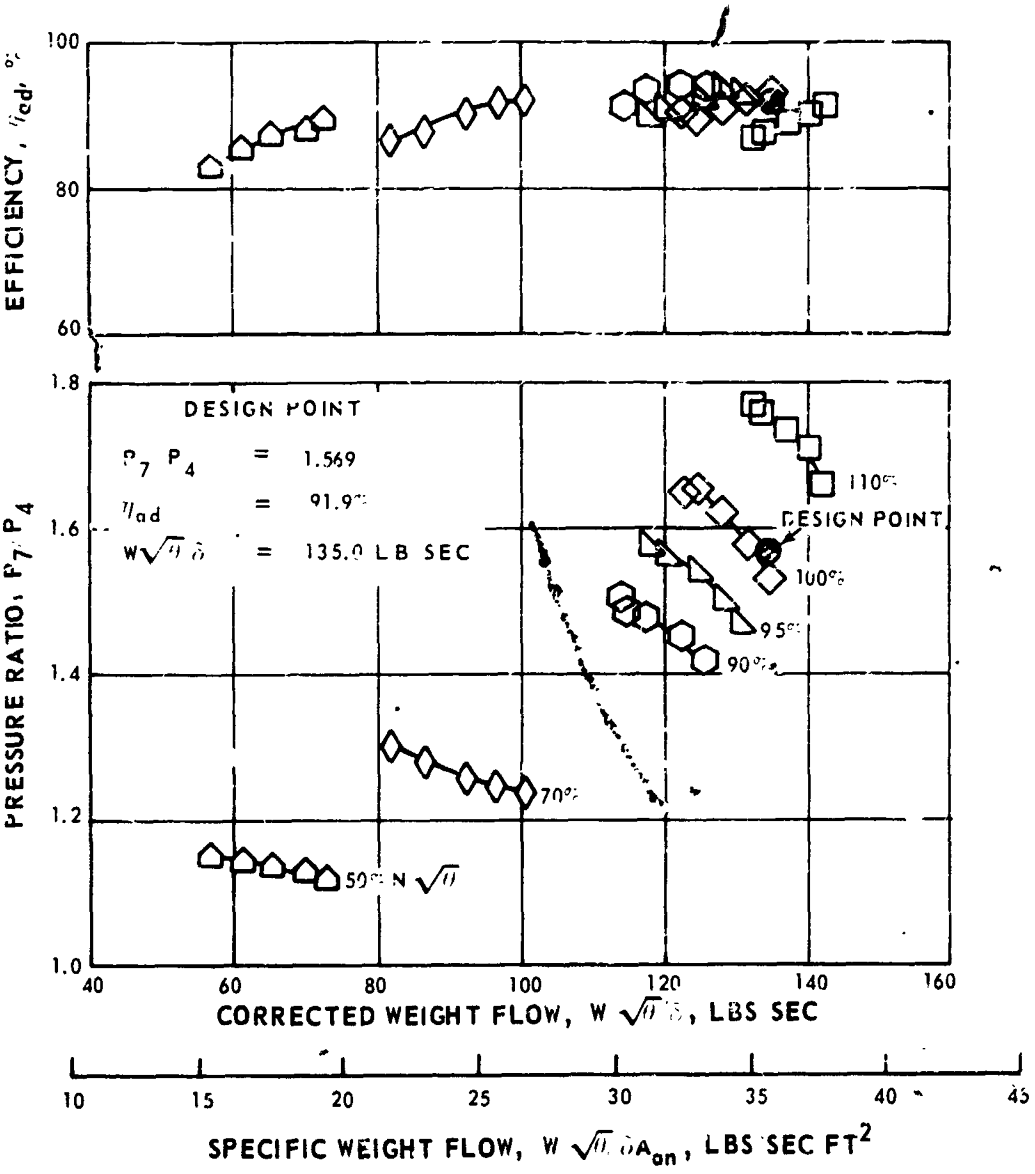


Figure 22 Over-All Performance of Rotor

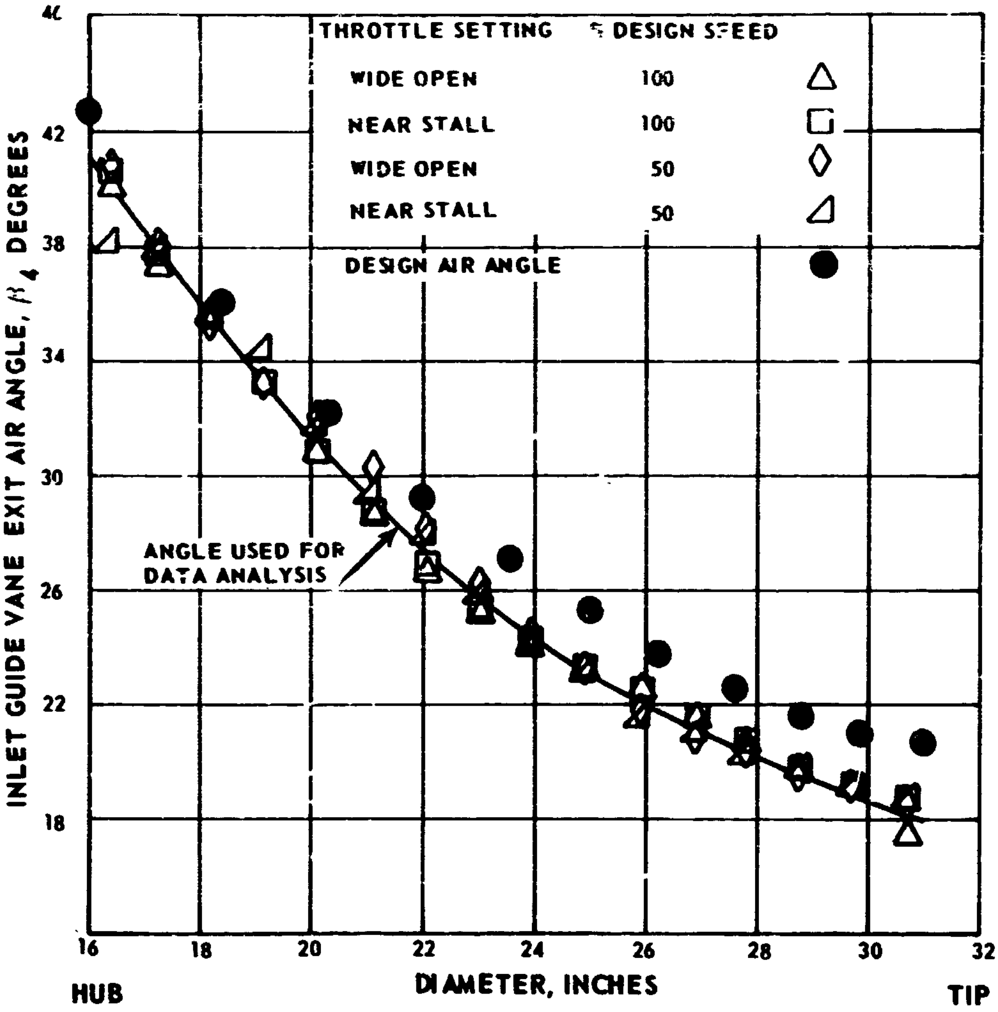


Figure 23 Inlet Guide Vane Exit Air Angle Distribution

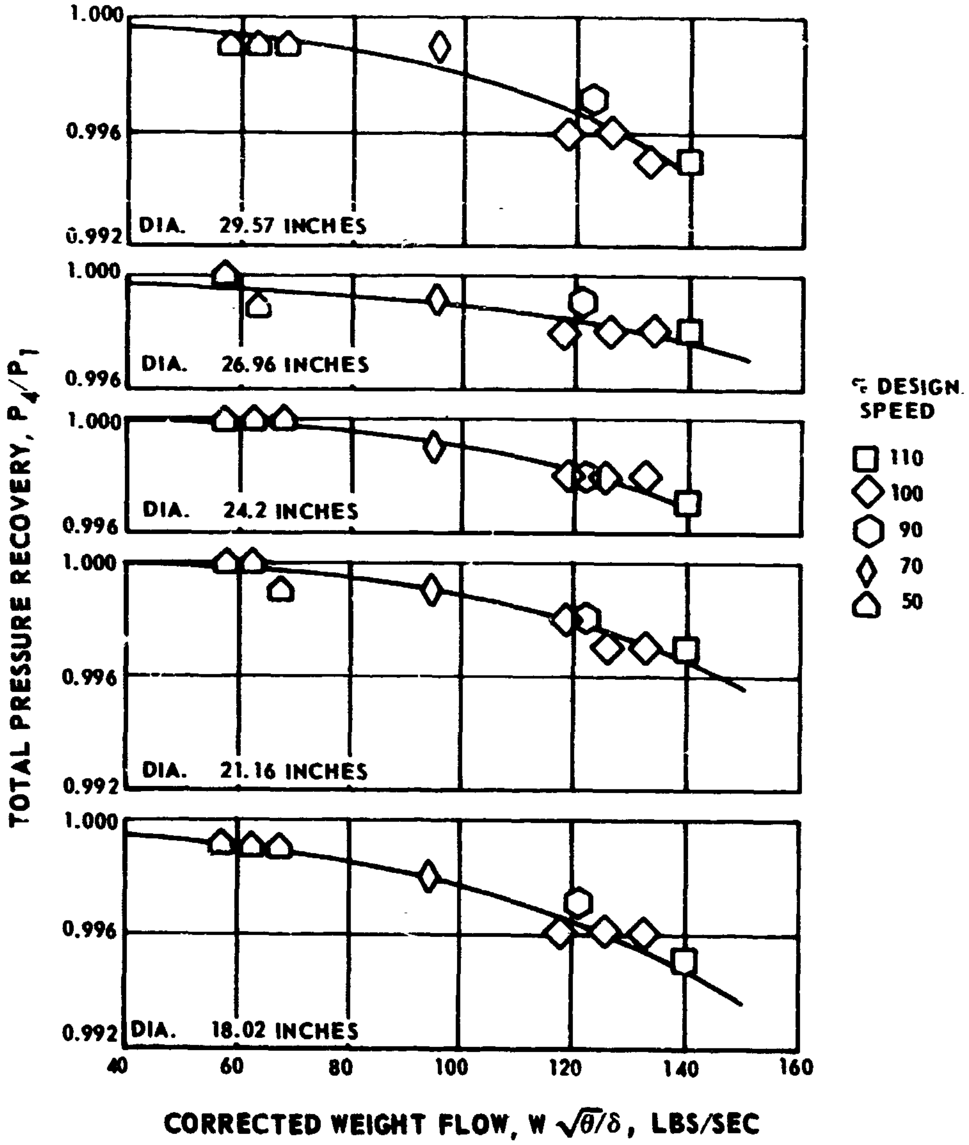
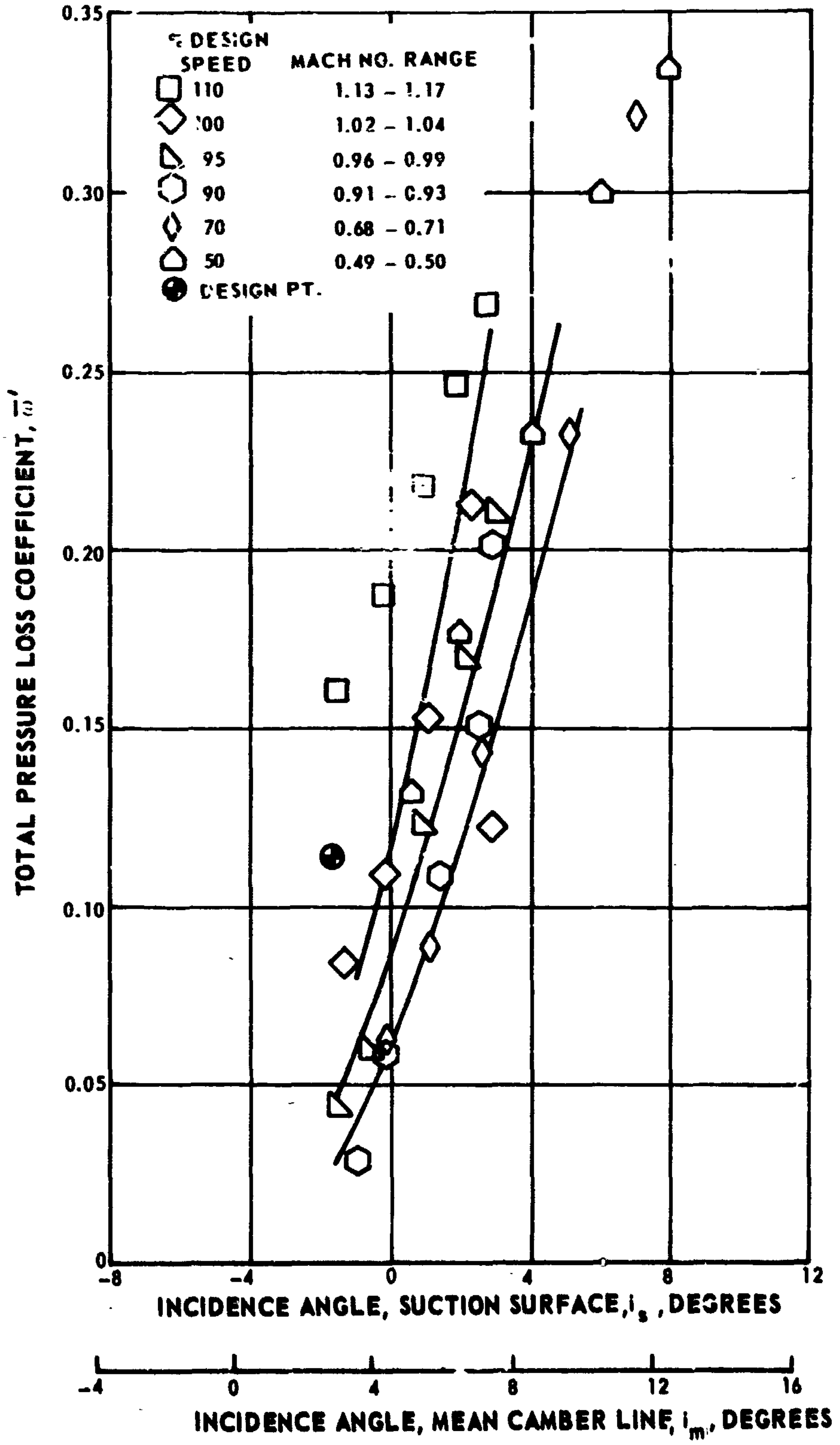
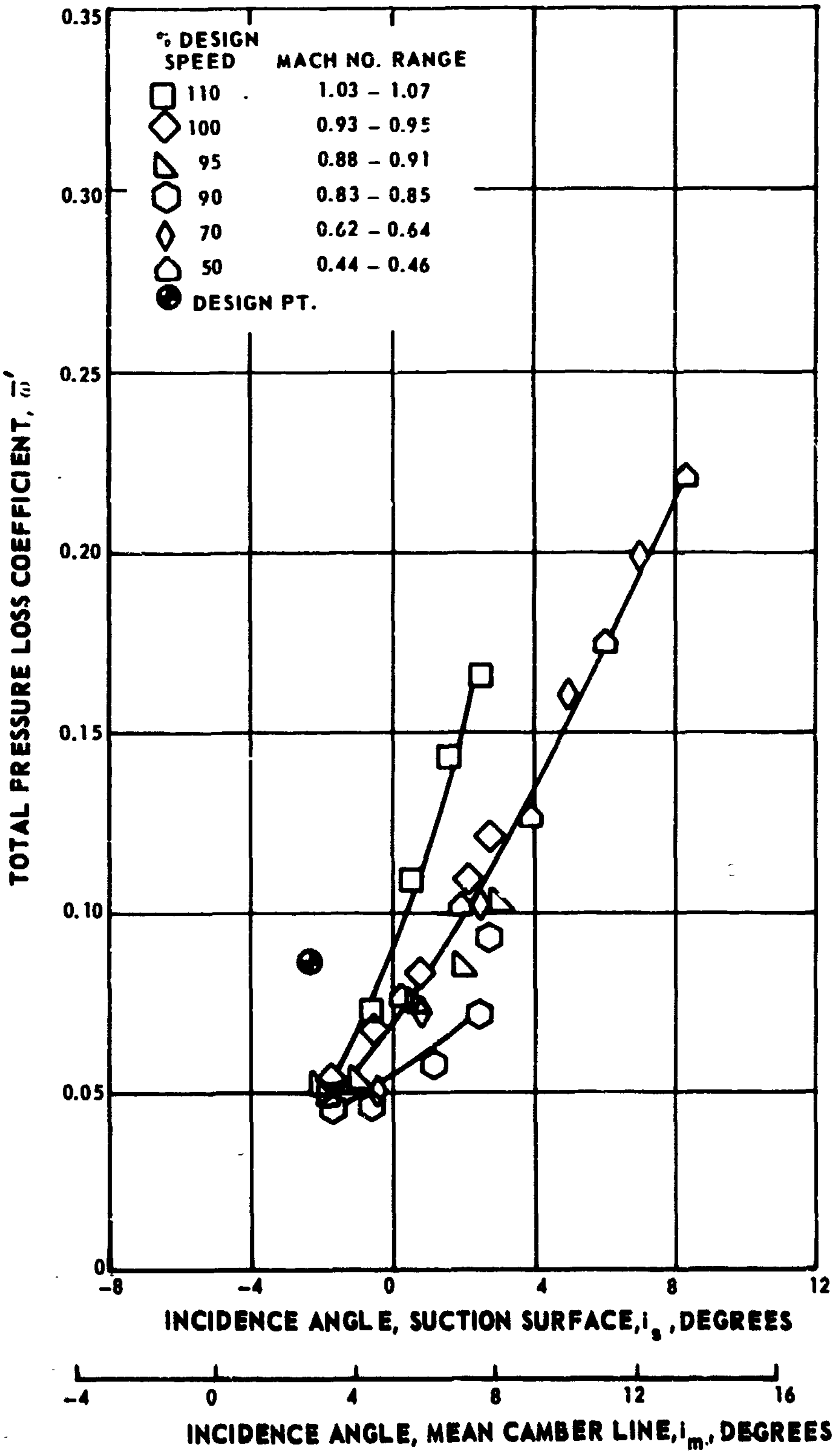


Figure 24 Inlet Guide Vane Total Pressure Recovery



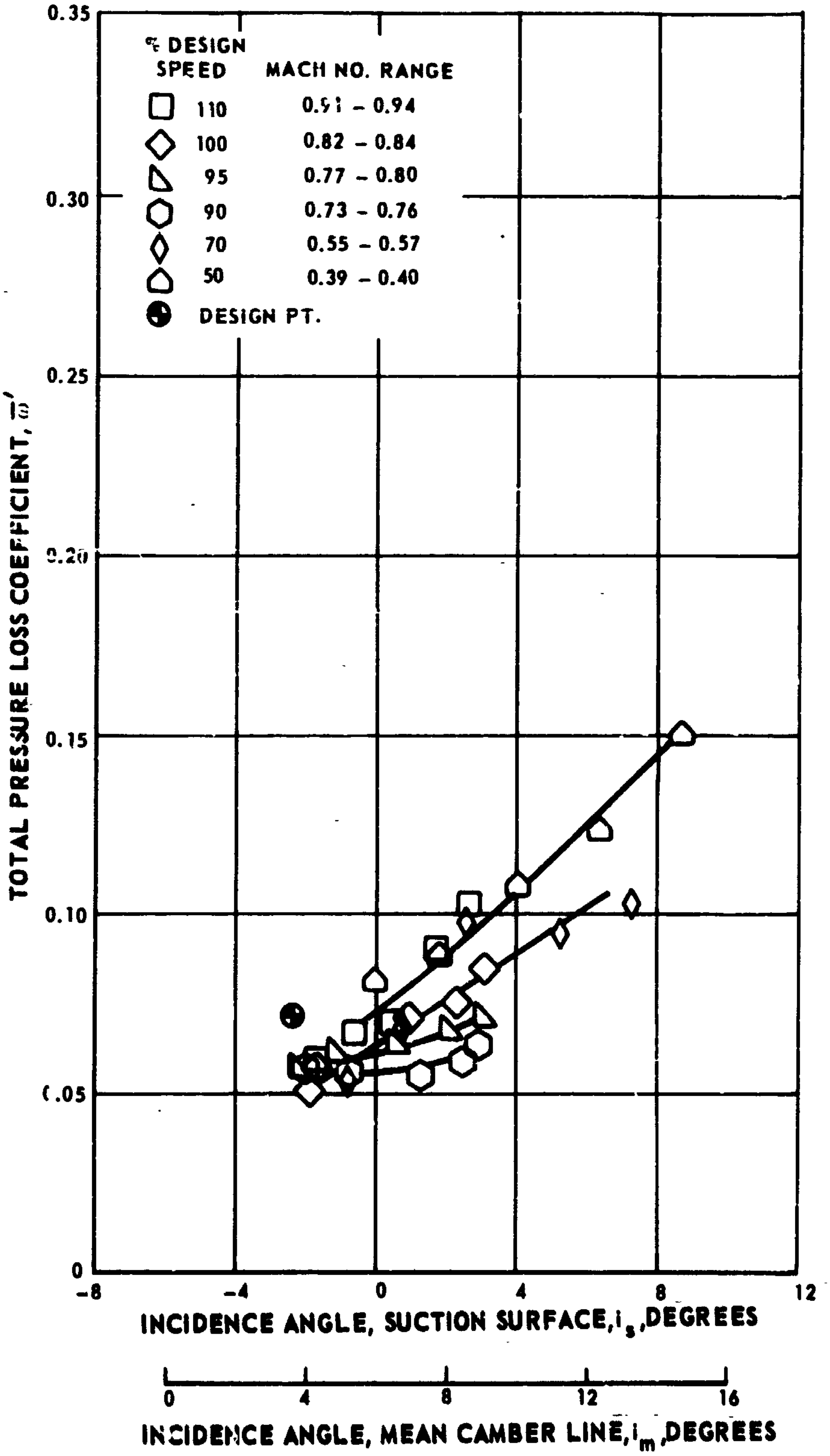
a) 10% SPAN

Figure 25 Rotor Total Pressure Loss Coefficient vs. Incidence



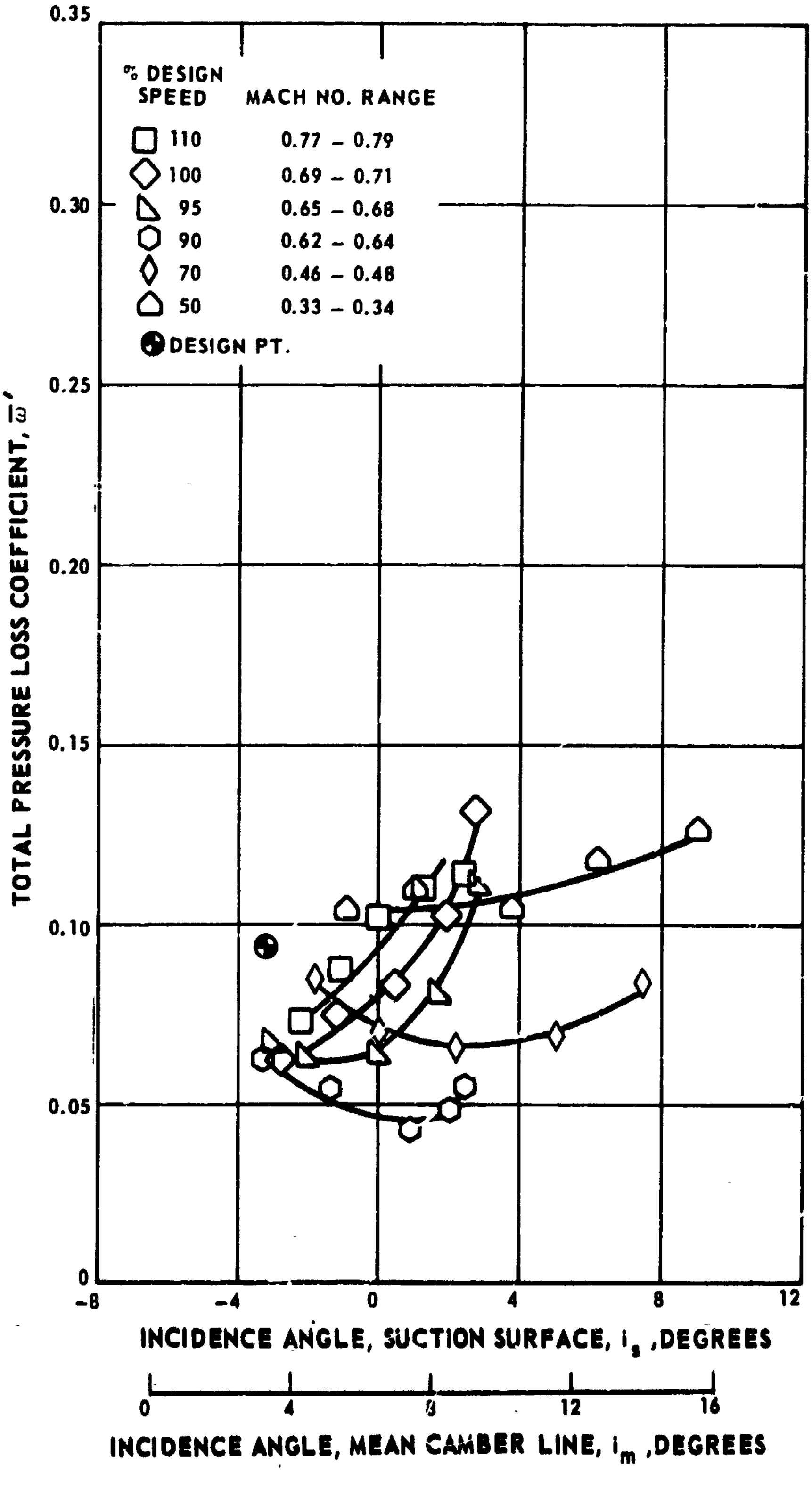
b) 30% SPAN

Figure 25 Rotor Total Pressure Loss Coefficient vs. Incidence



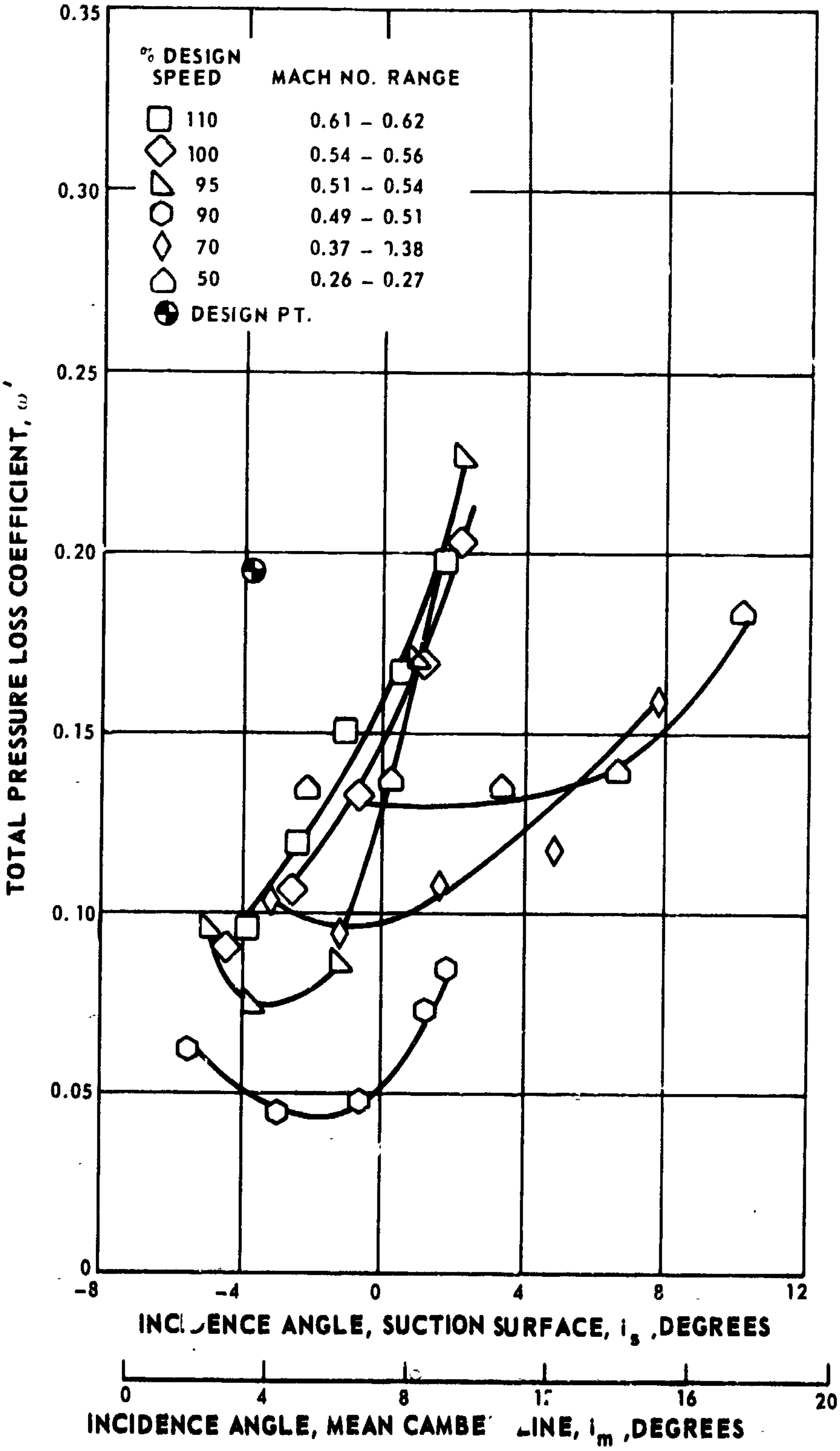
c) 50% SPAN

Figure 25 Rotor Total Pressure Loss Coefficient vs. Incidence



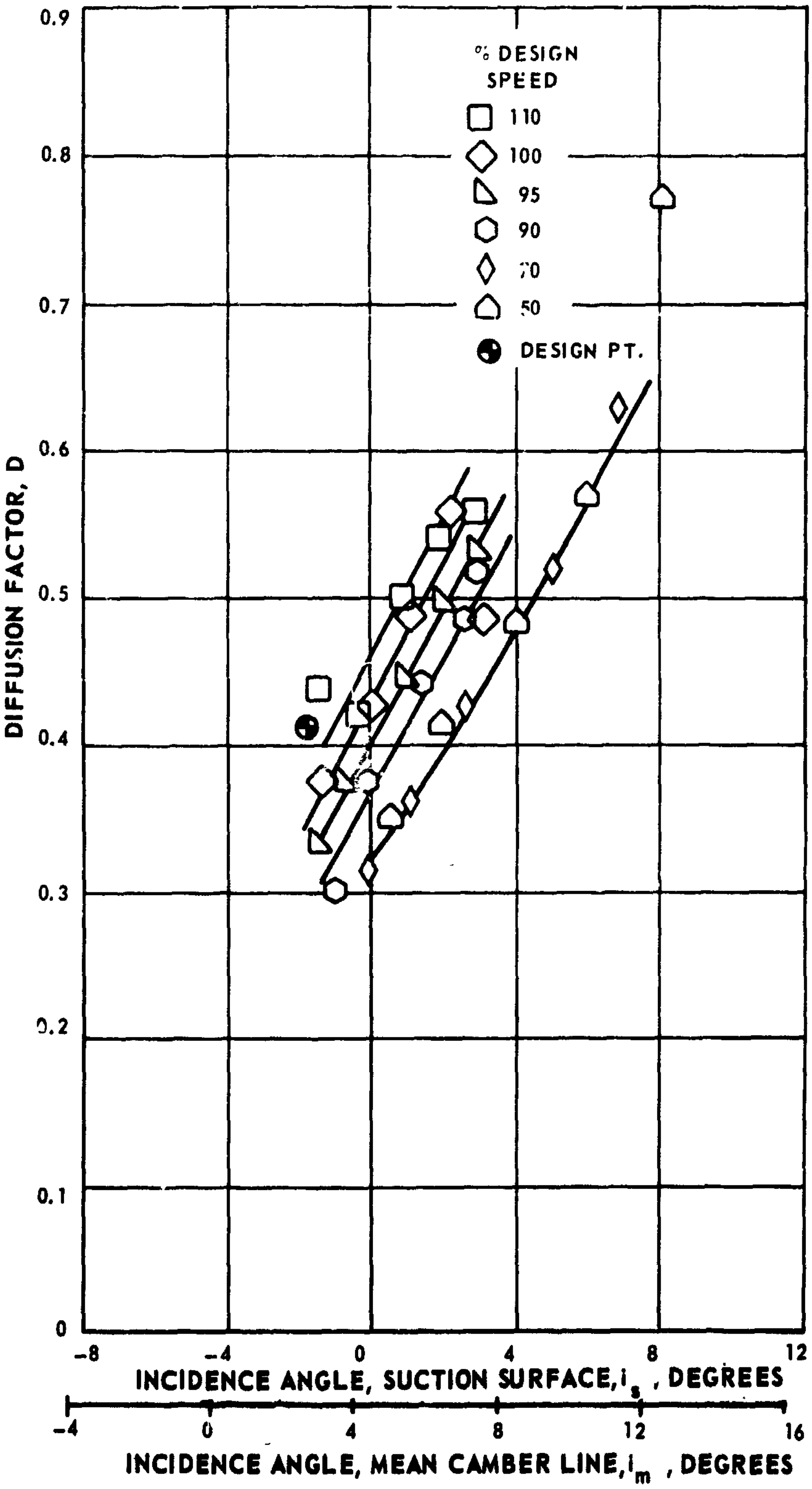
d) 70% SPAN

Figure 25 Rotor Total Pressure Loss Coefficient vs. Incidence



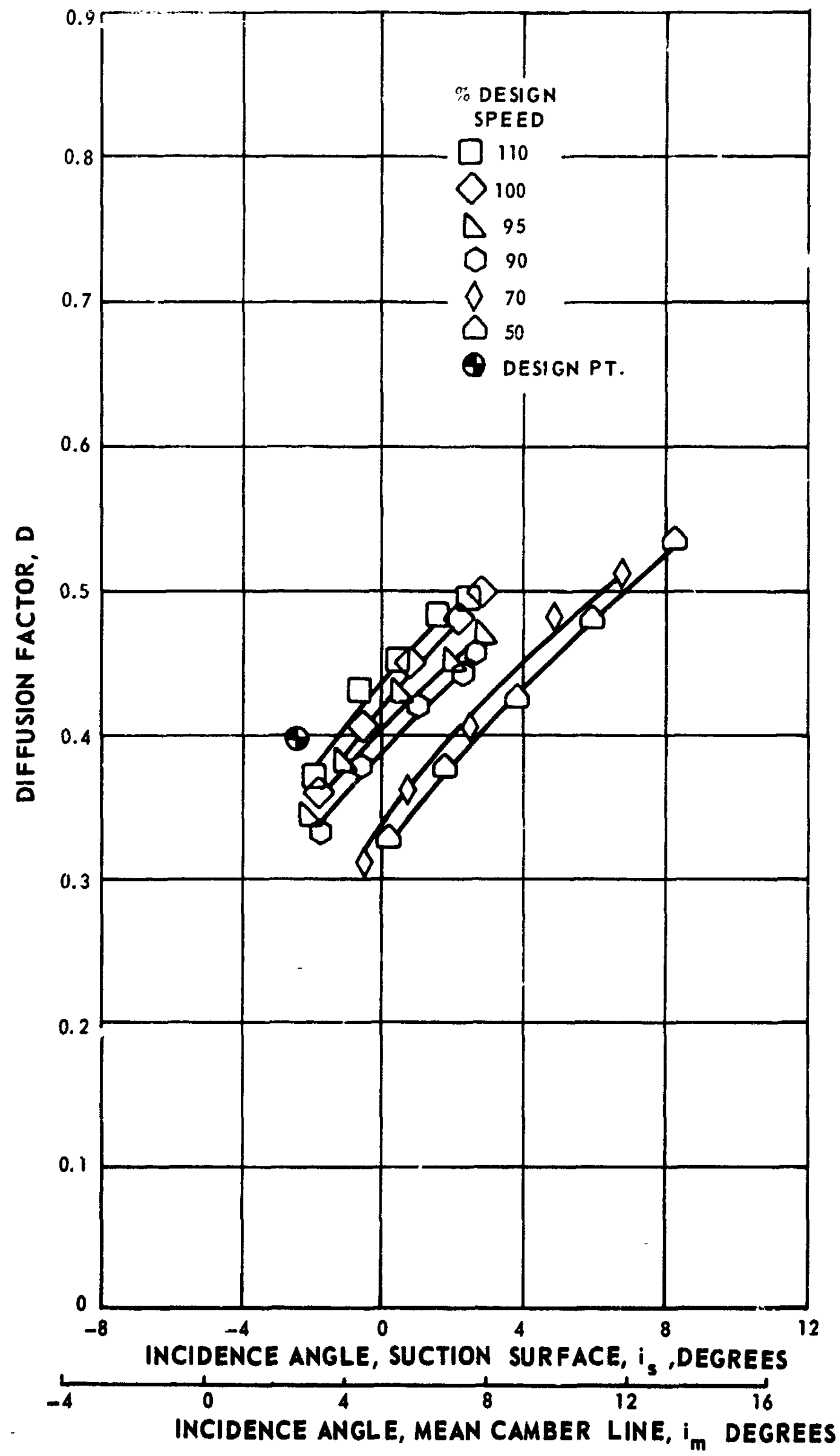
e) 90% SPAN

Figure 25 Rotor Total Pressure Loss Coefficient vs. Incidence



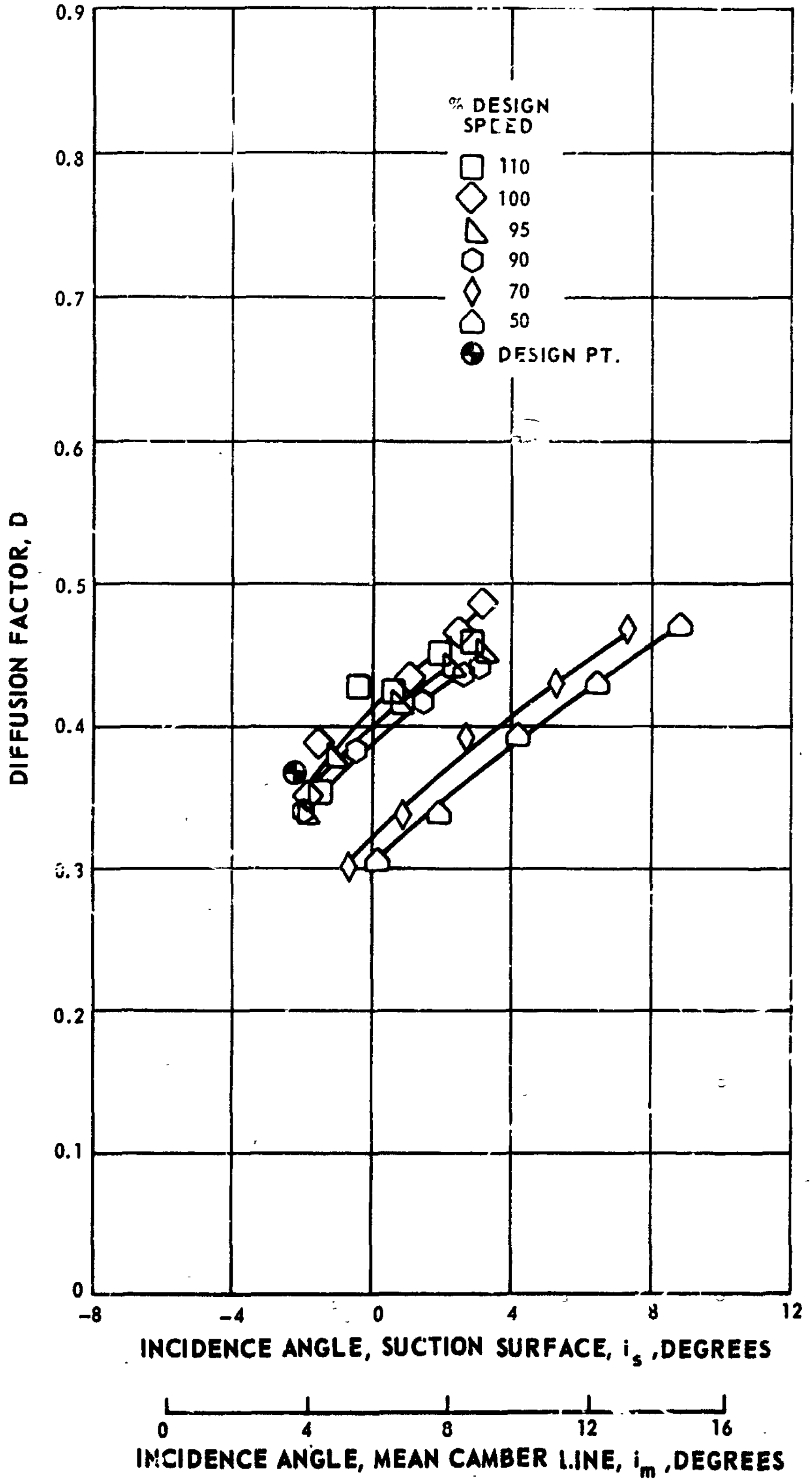
a) 10% SPAN

Figure 26 Rotor Diffusion Factor vs. Incidence



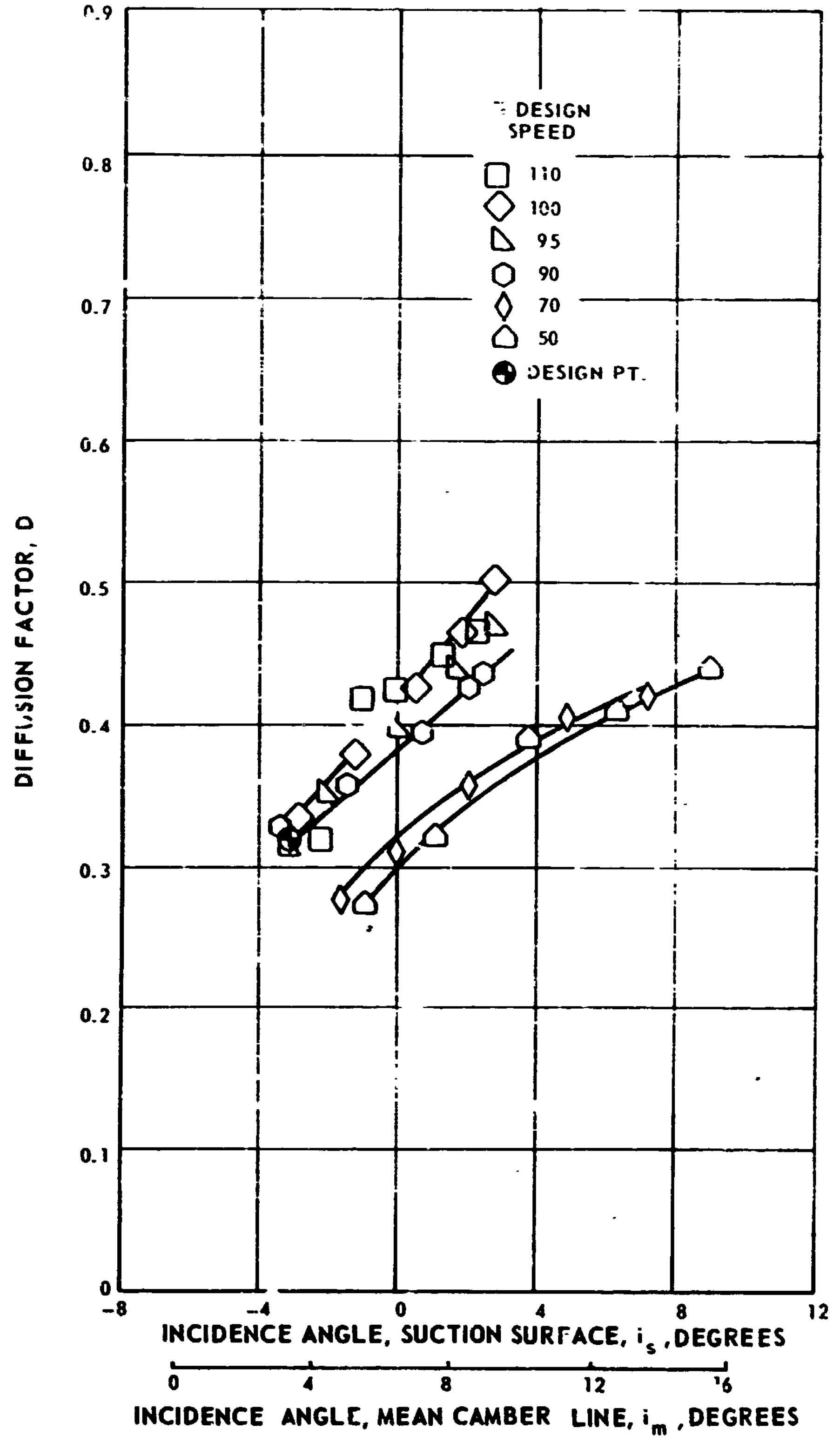
b) 30% SPAN

Figure 26 Rotor Diffusion Factor vs. Incidence



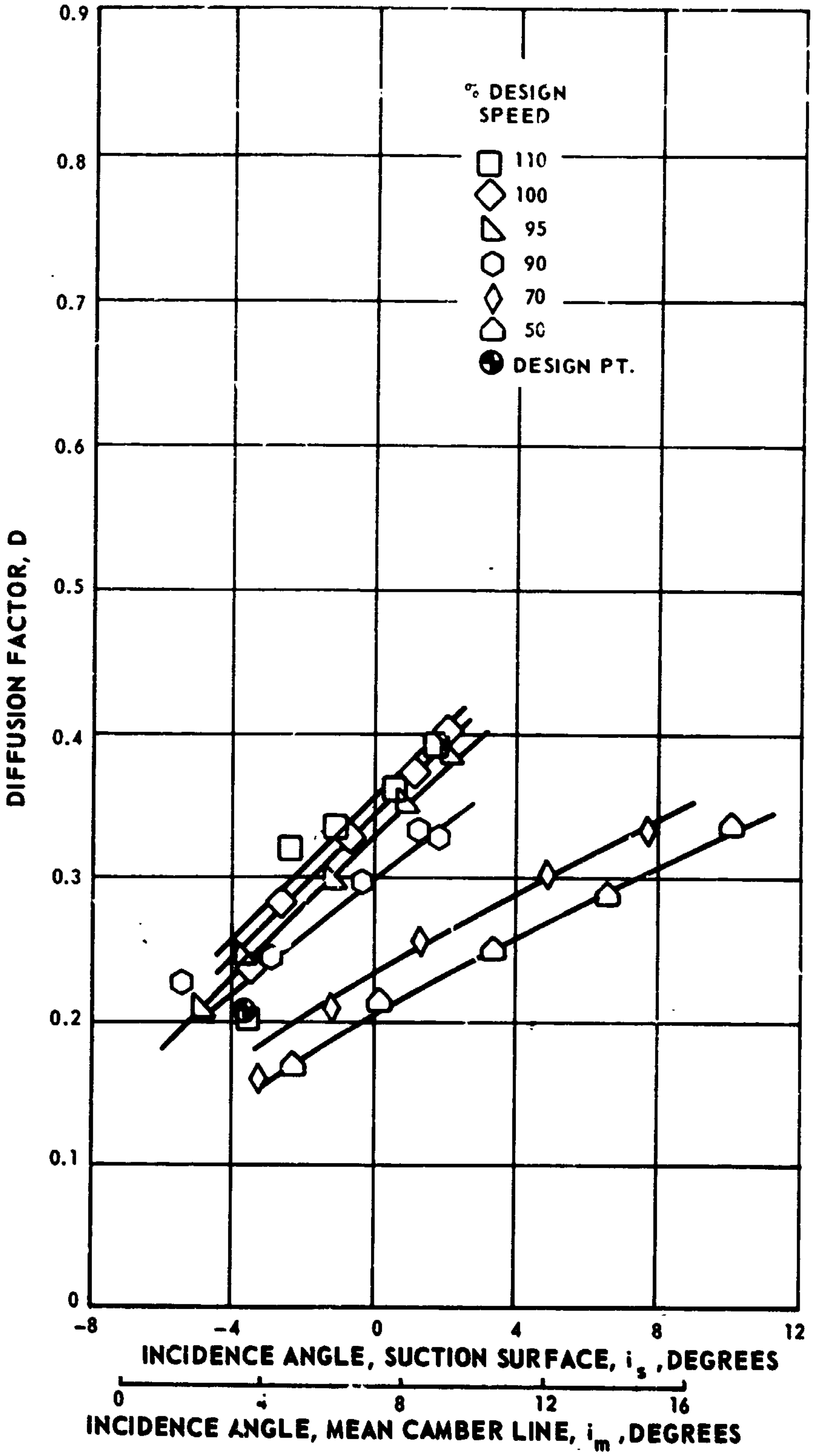
c) 50% SPAN

Figure 26 Rotor Diffusion Factor vs. Incidence



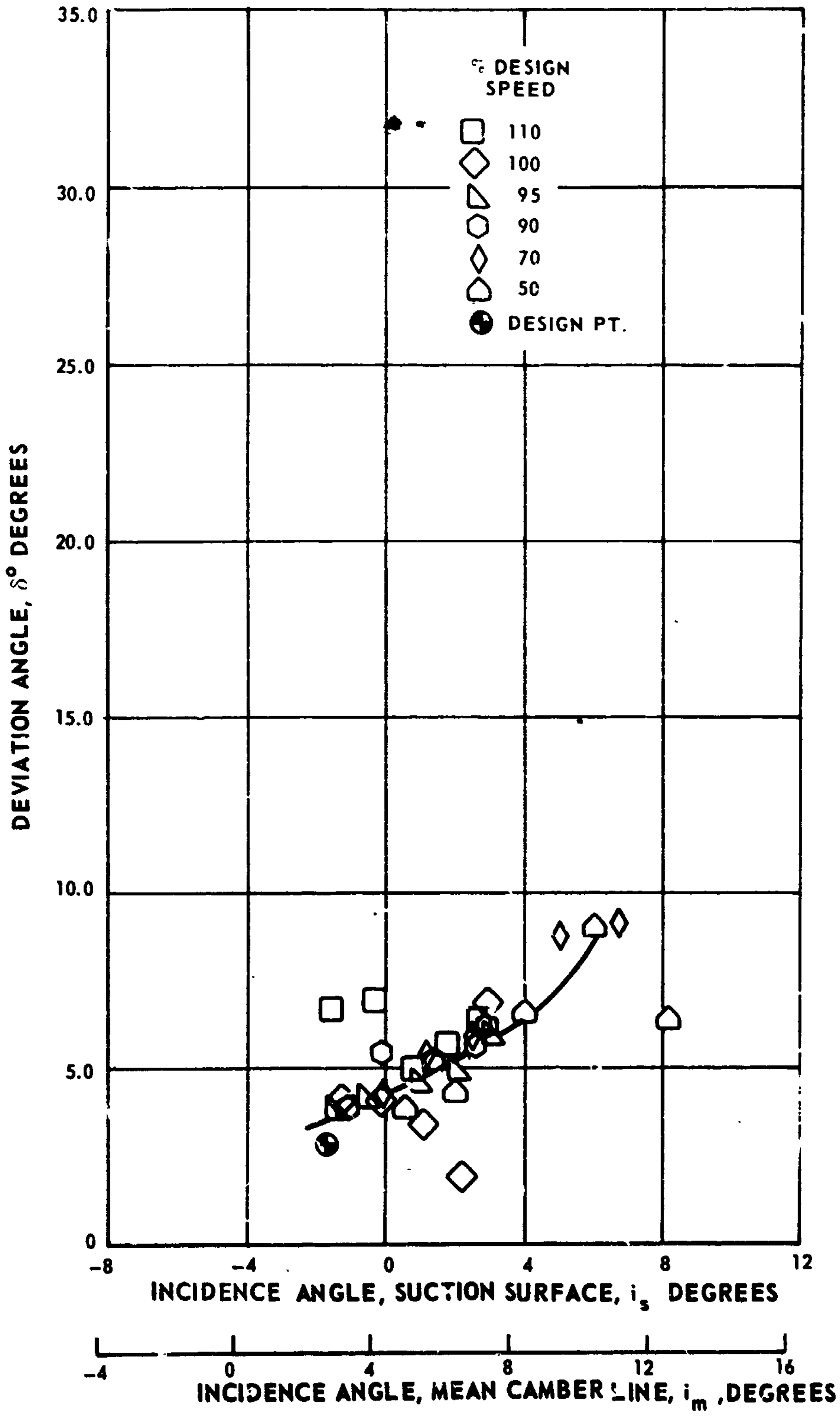
d) 70% SPAN

Figure 26 Rotor Diffusion Factor vs. Incidence



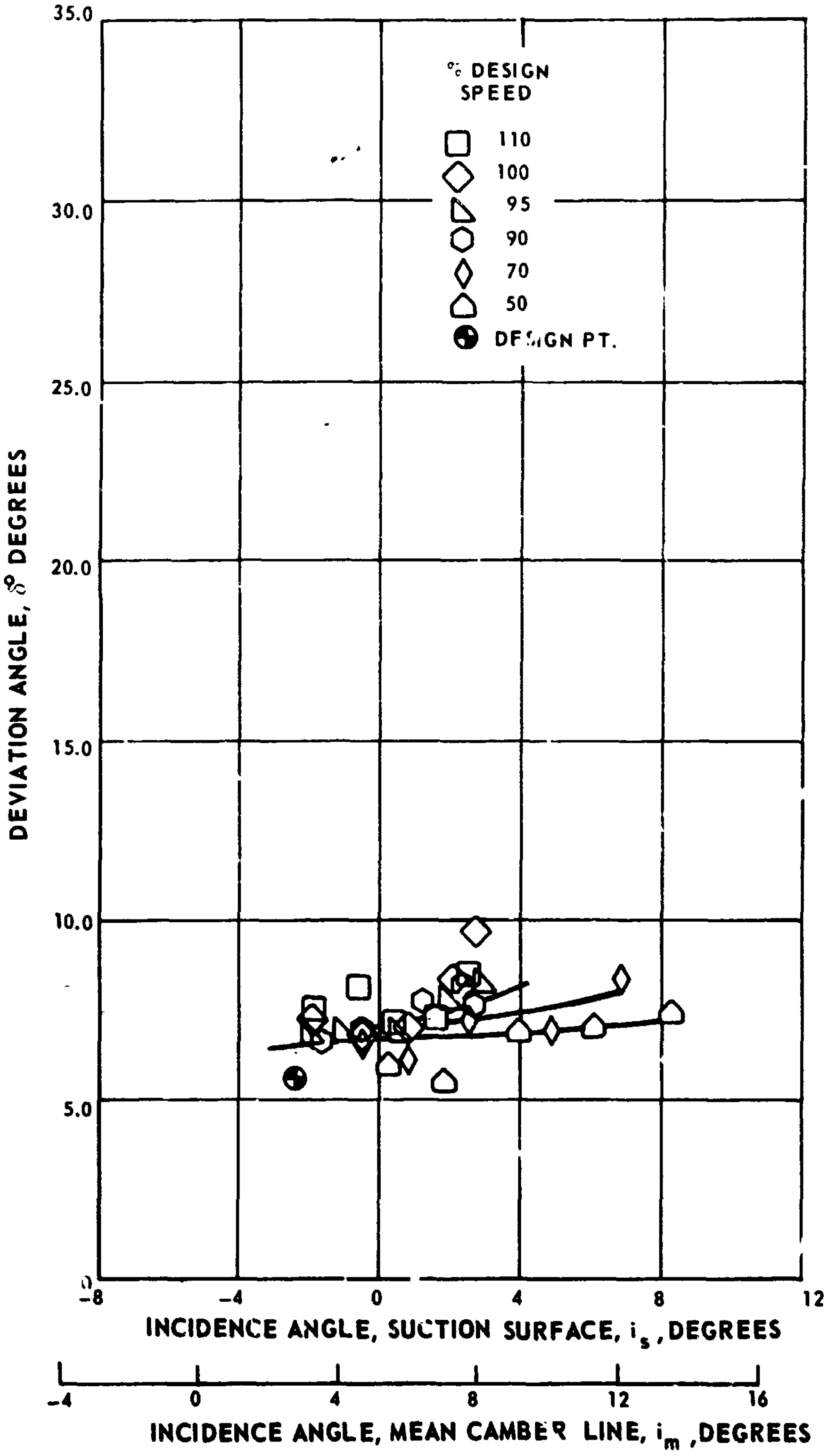
e) 90% SPAN

Figure 26 Rotor Diffusion Factor vs. Incidence



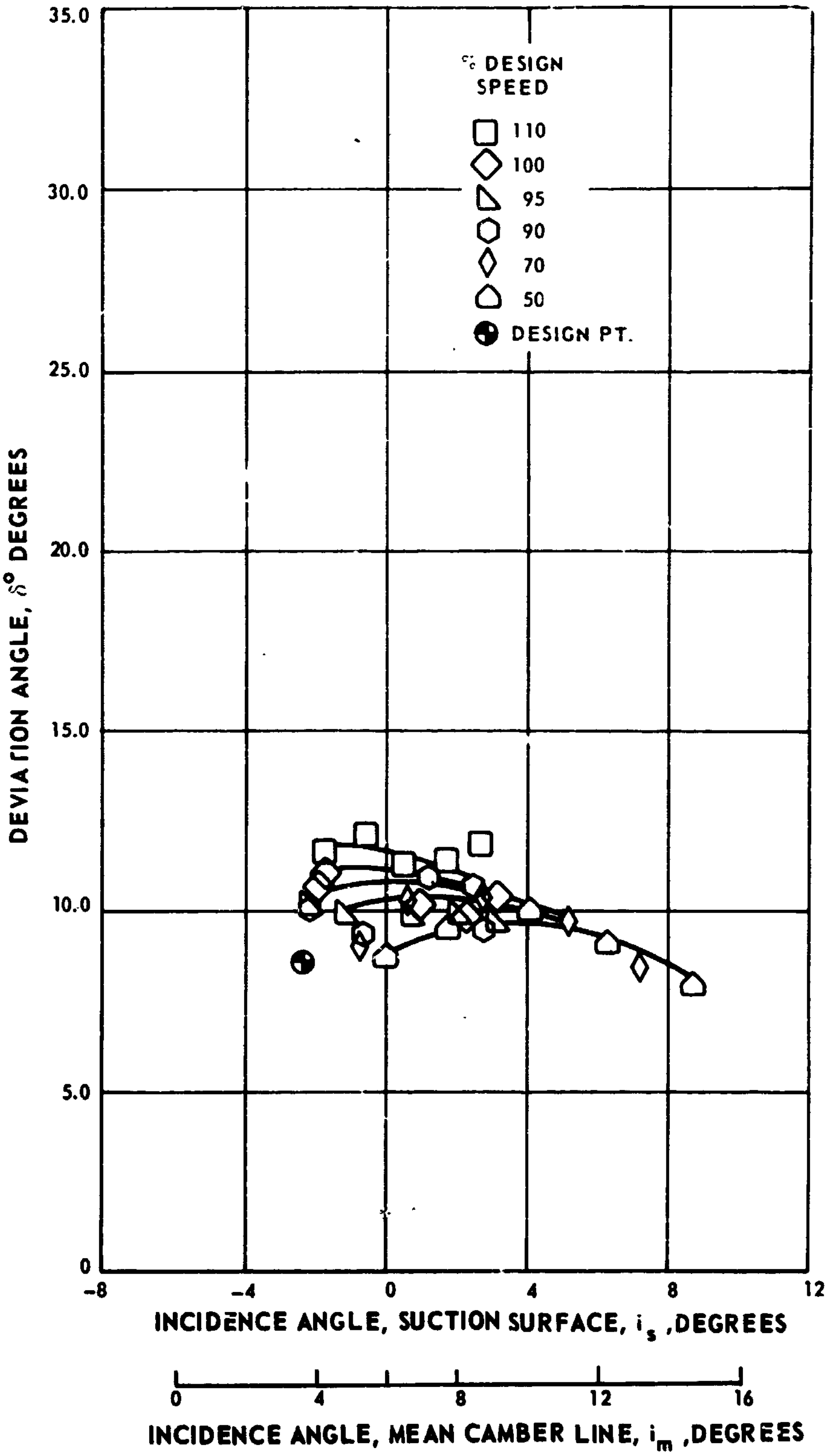
a) 10% SPAN

Figure 27 Rotor Deviation vs. Incidence



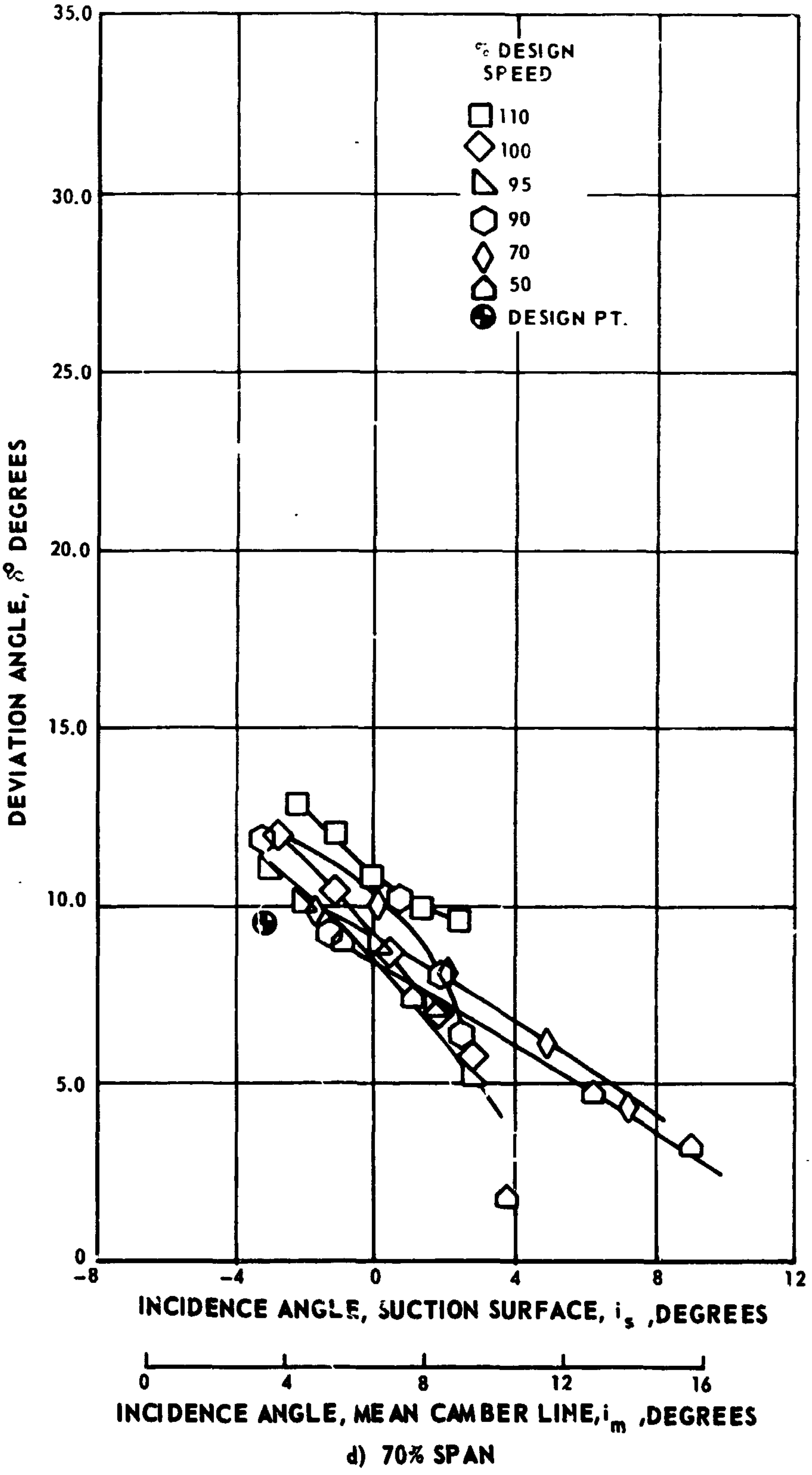
b) 30% SPAN

Figure 27 Rotor Deviation vs. Incidence



c) 50% SPAN

Figure 27 Rotor Deviation vs. Incidence



d) 70% SPAN

Figure 27 Rotor Deviation vs. Incidence

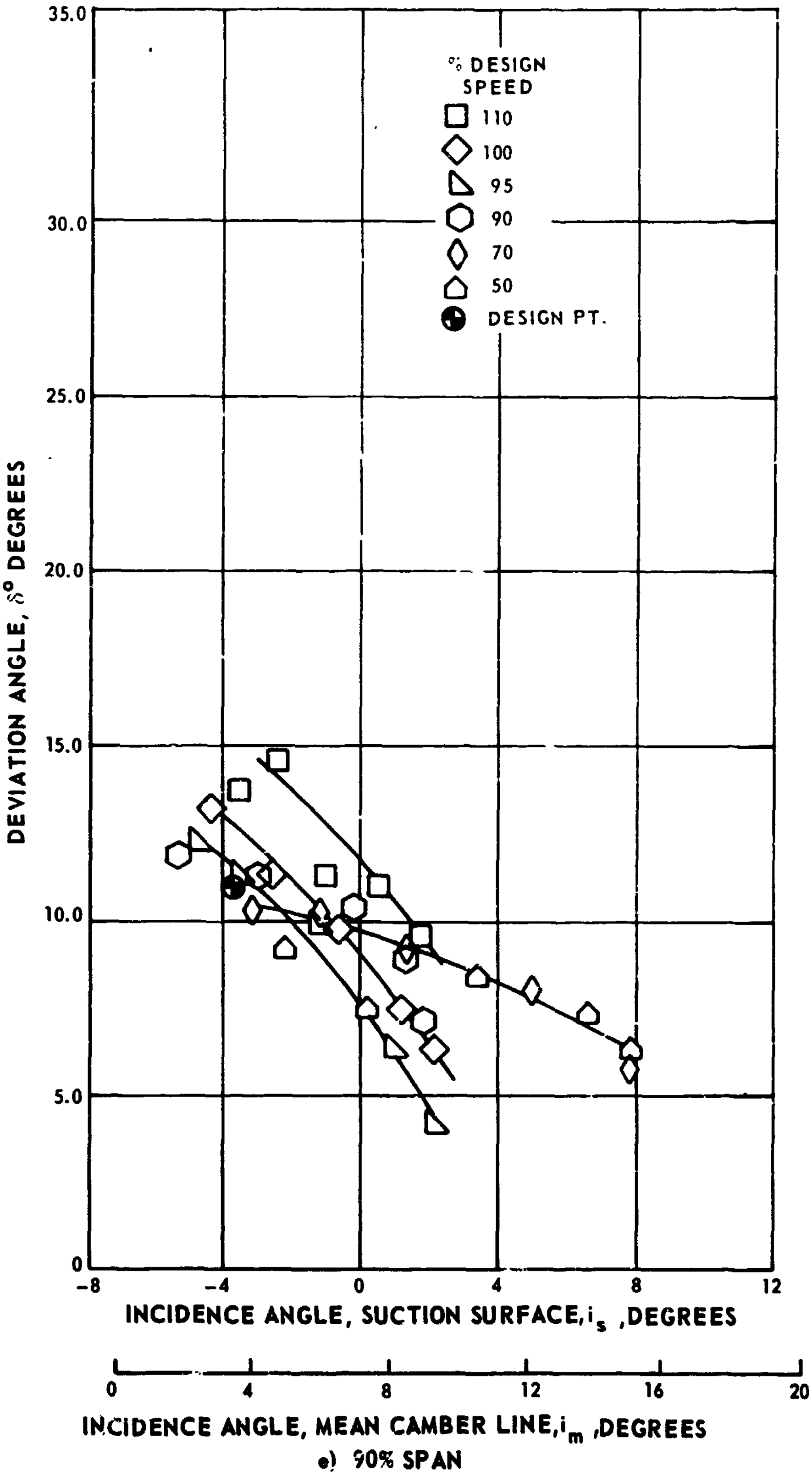
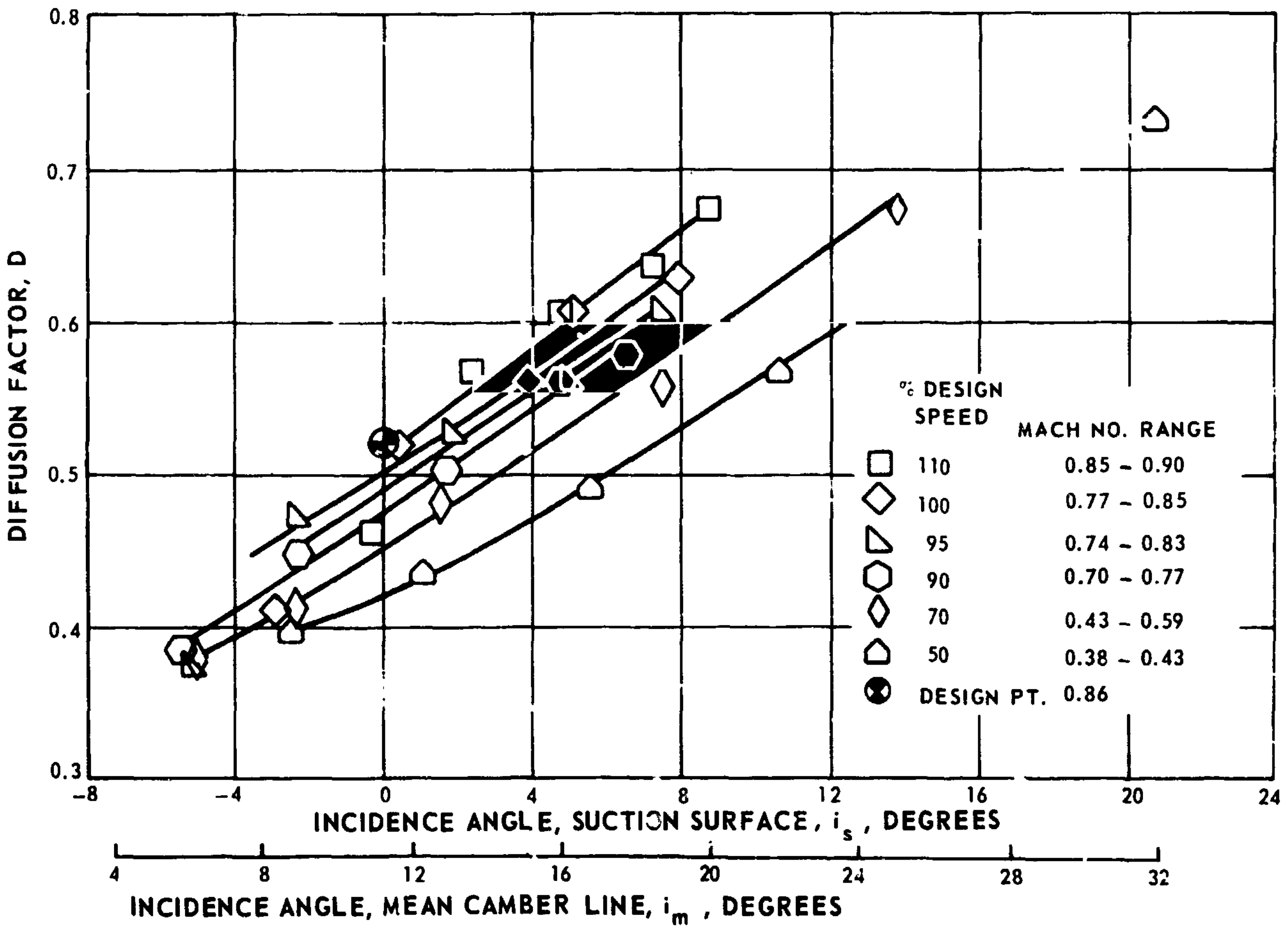
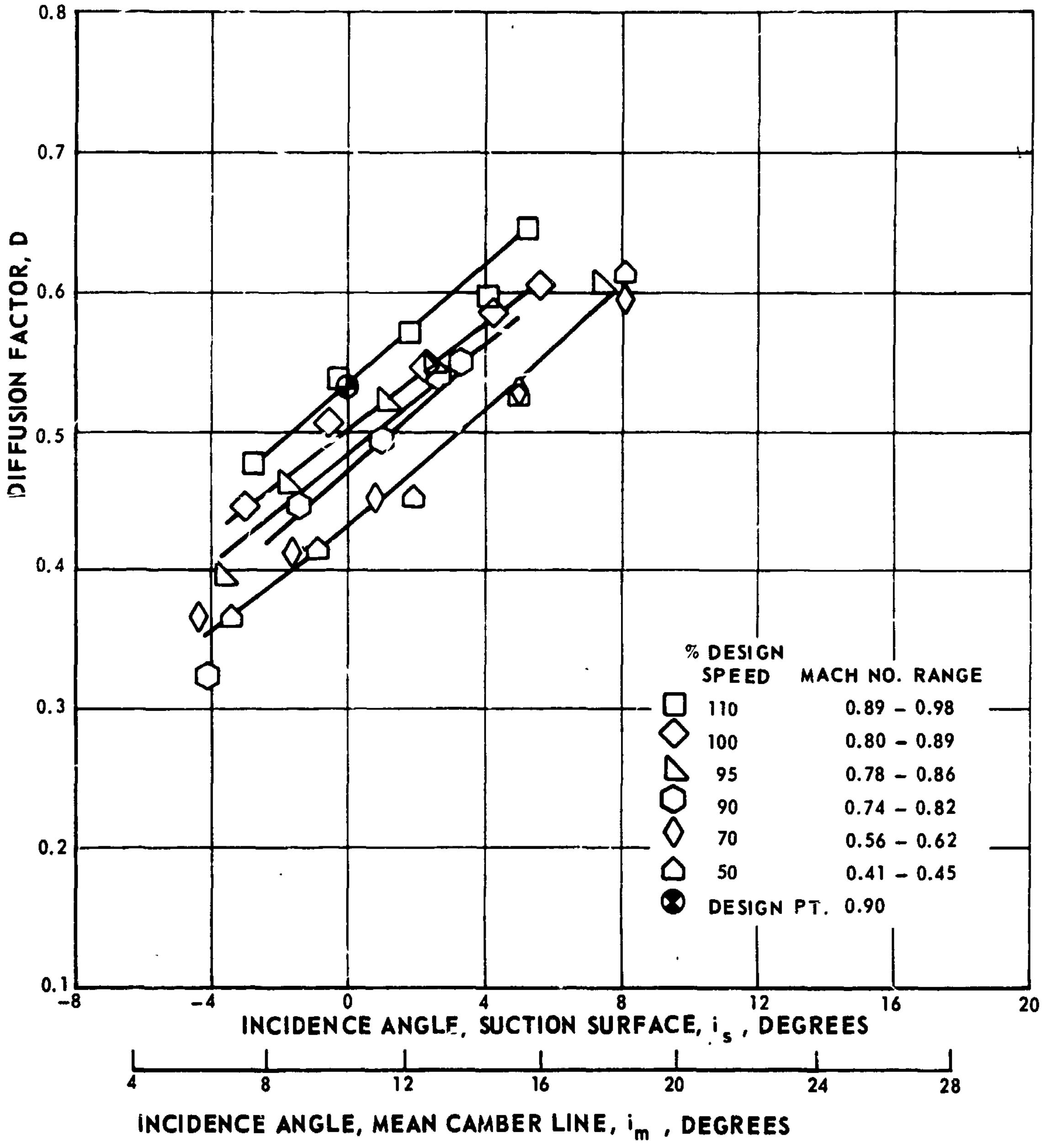


Figure 27 Rotor Deviation vs. Incidence



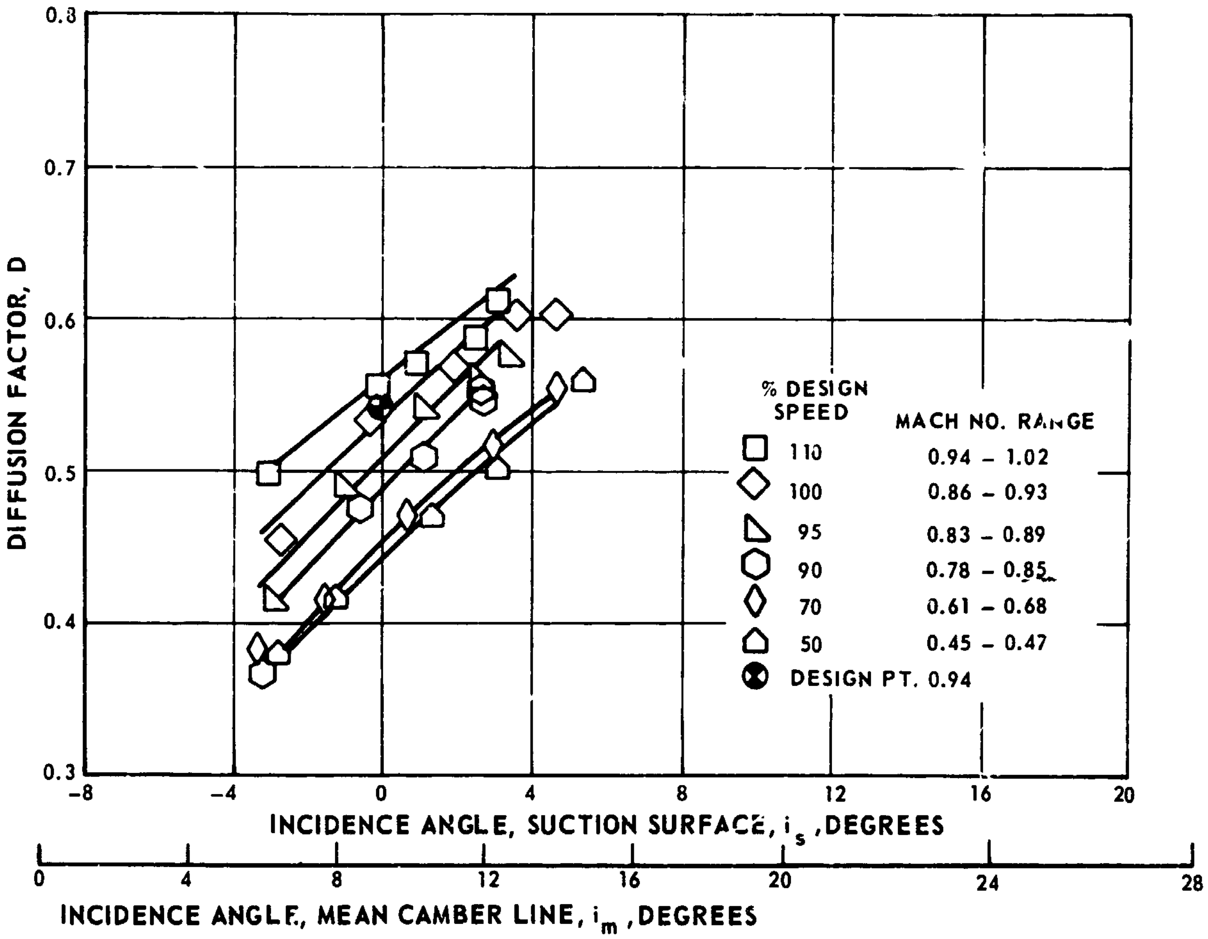
a) 10% SPAN

Figure 28 MCA Stator A, Diffusion Factor vs. Incidence



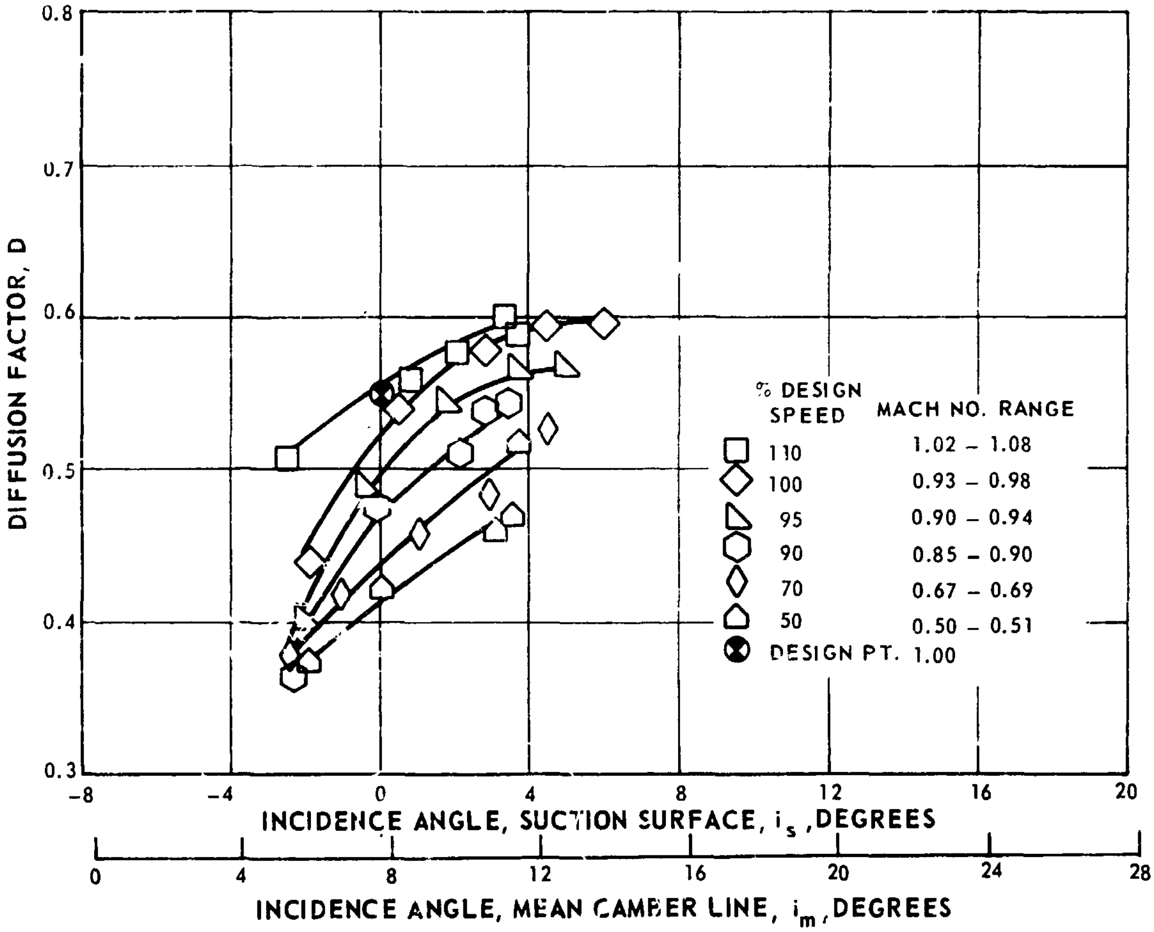
b) 30% SPAN

Figure 28 MCA Stator A, Diffusion Factor vs. Incidence



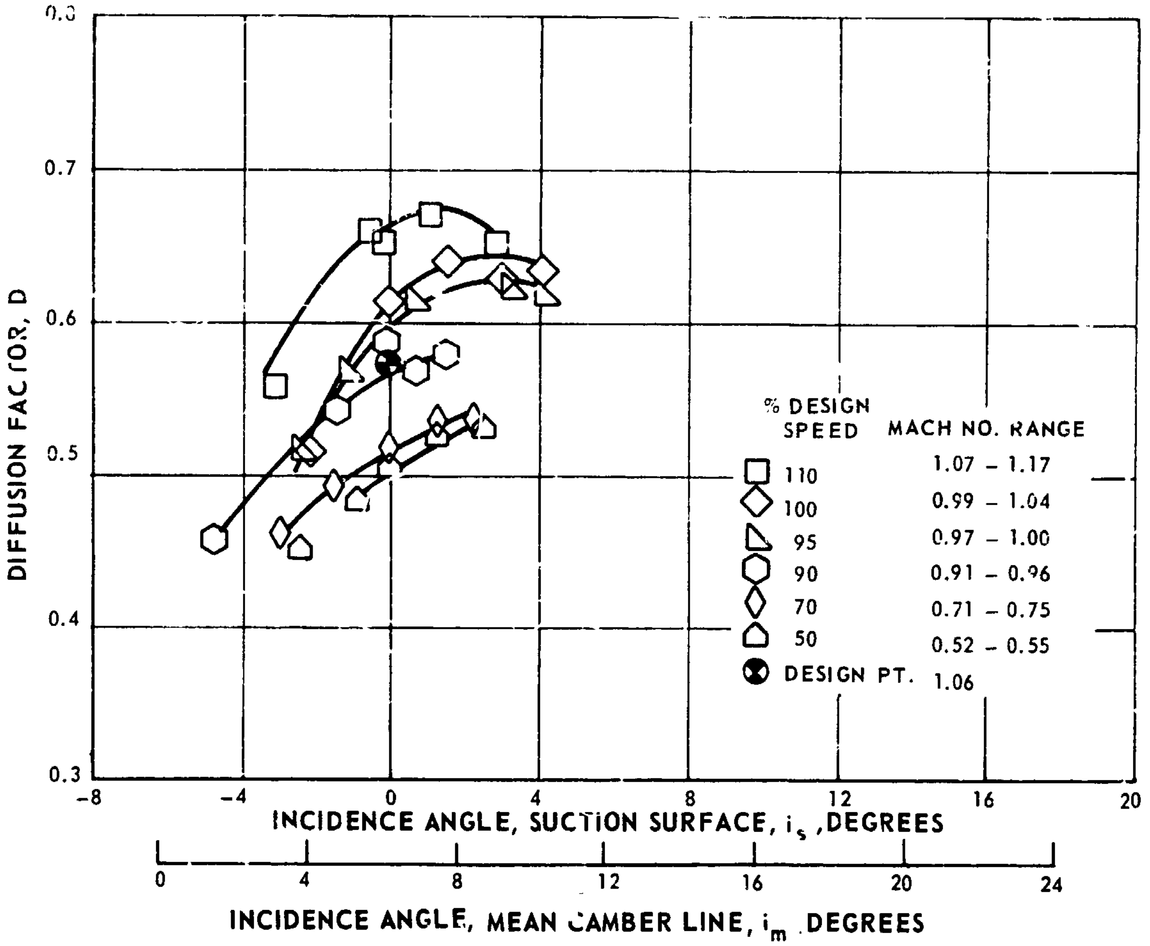
c) 50% SPAN

Figure 28 MCA Stator A, Diffusion Factor vs, Incidence



d) 70% SPAN

Figure 28 MCA Stator A, Diffusion Factor vs. Incidence



e) 90% SPAN

Figure 28 MCA Stator A, Diffusion Factor vs. Incidence

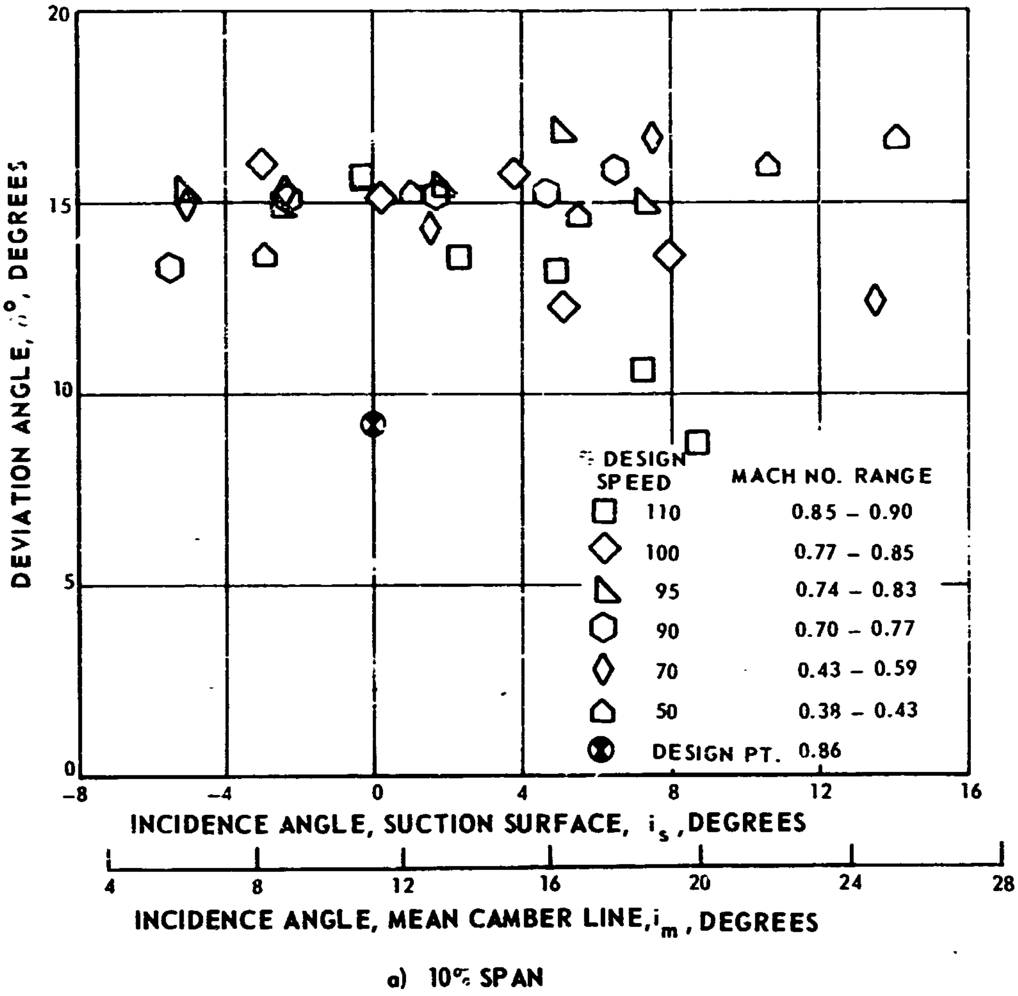
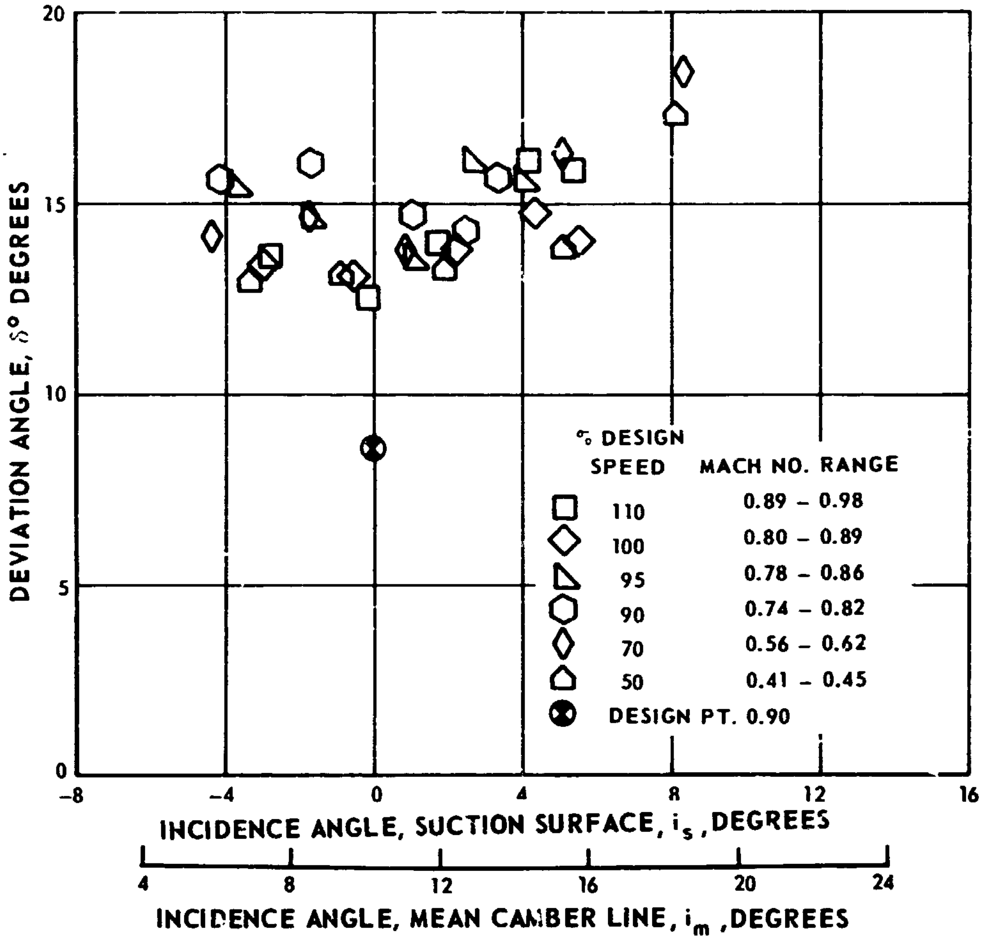
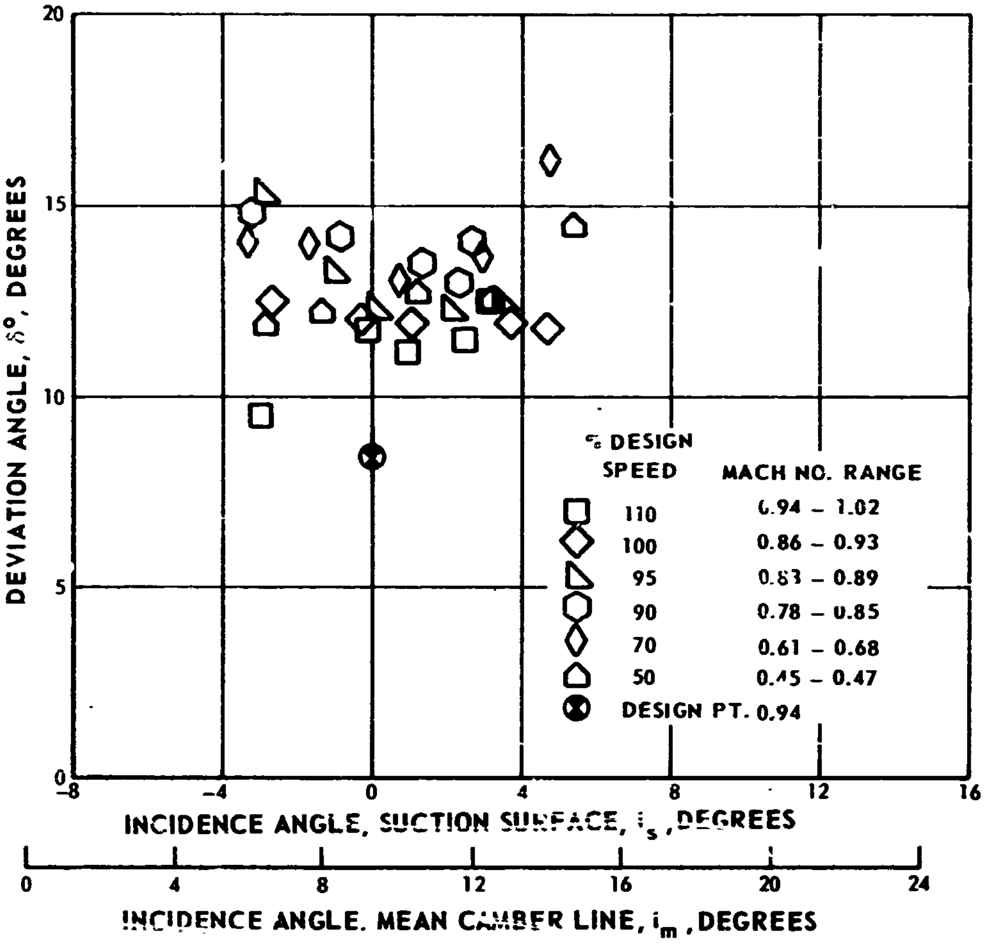


Figure 29 MCA Stator A, Deviation vs. Incidence



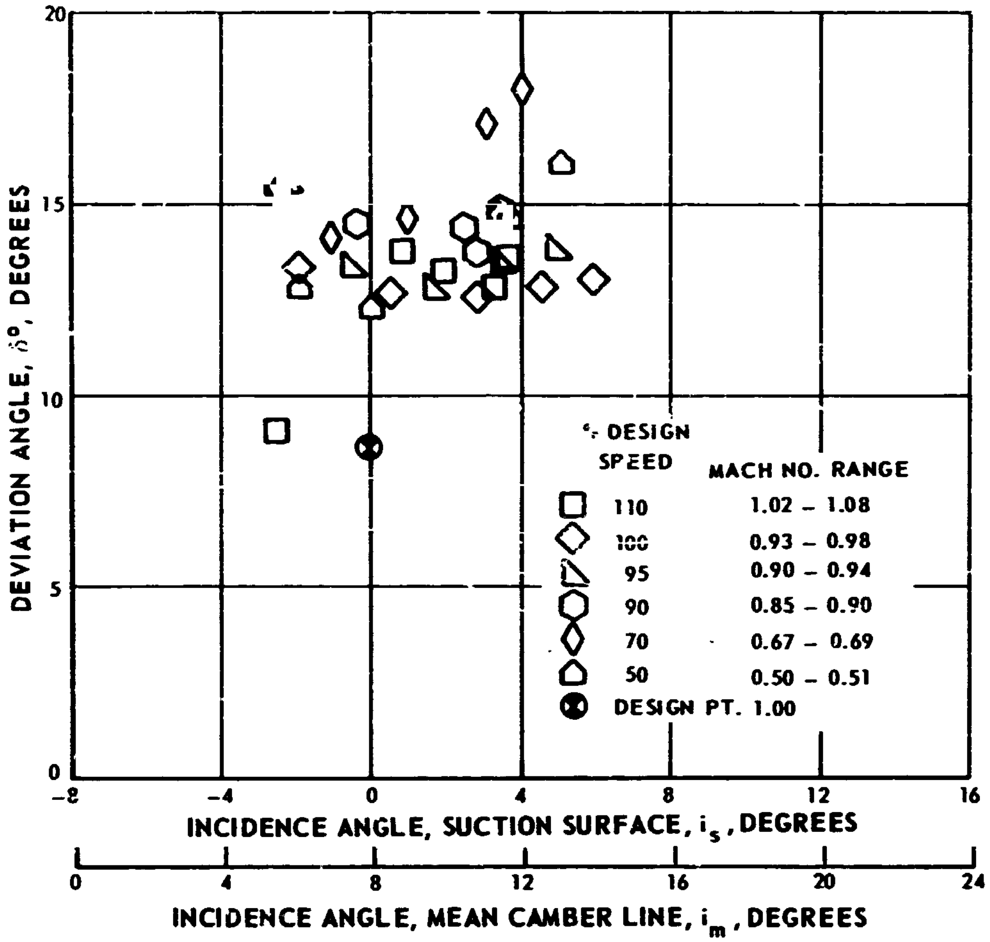
b) 30% SPAN

Figure 29 MCA Stator A, Deviation vs. Incidence



c) 50% SPAN

Figure 29 MCA Stator A, Deviation vs. Incidence



d) 70% SPAN

Figure 29 MCA Stator A, Deviation vs. Incidence

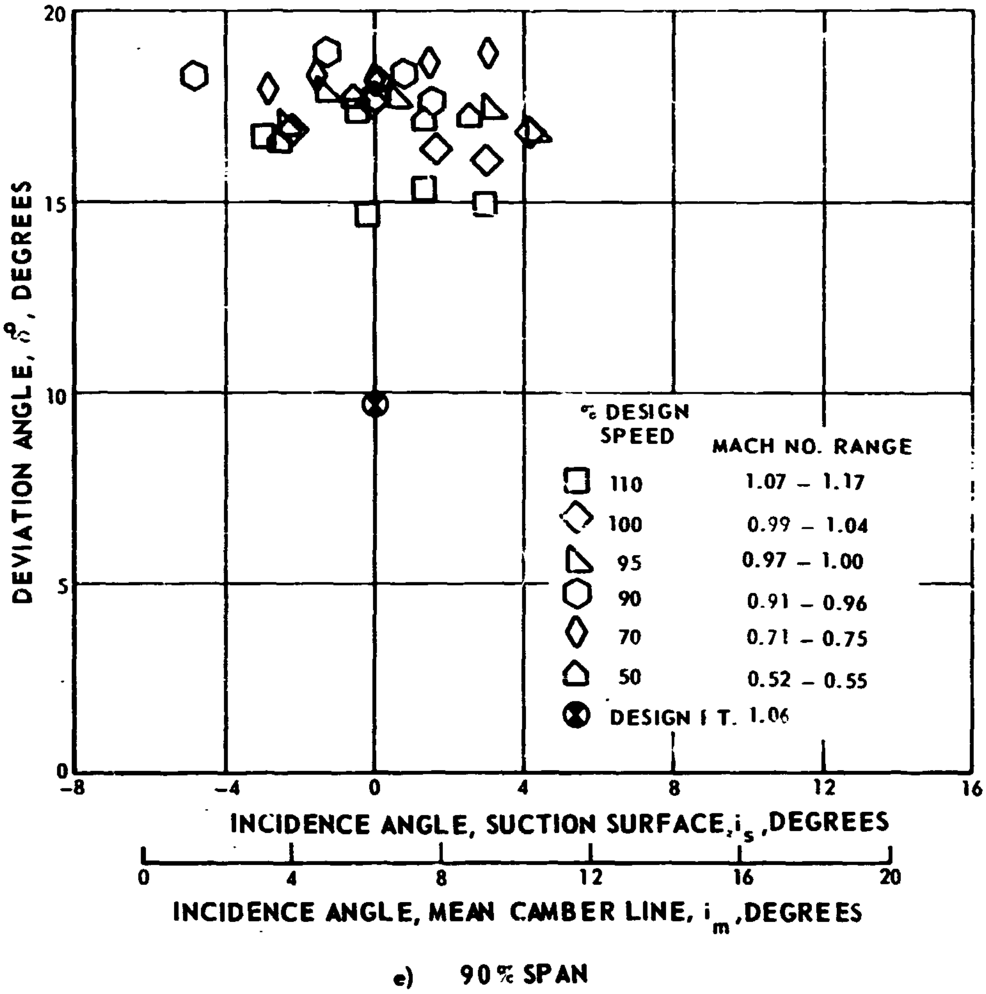
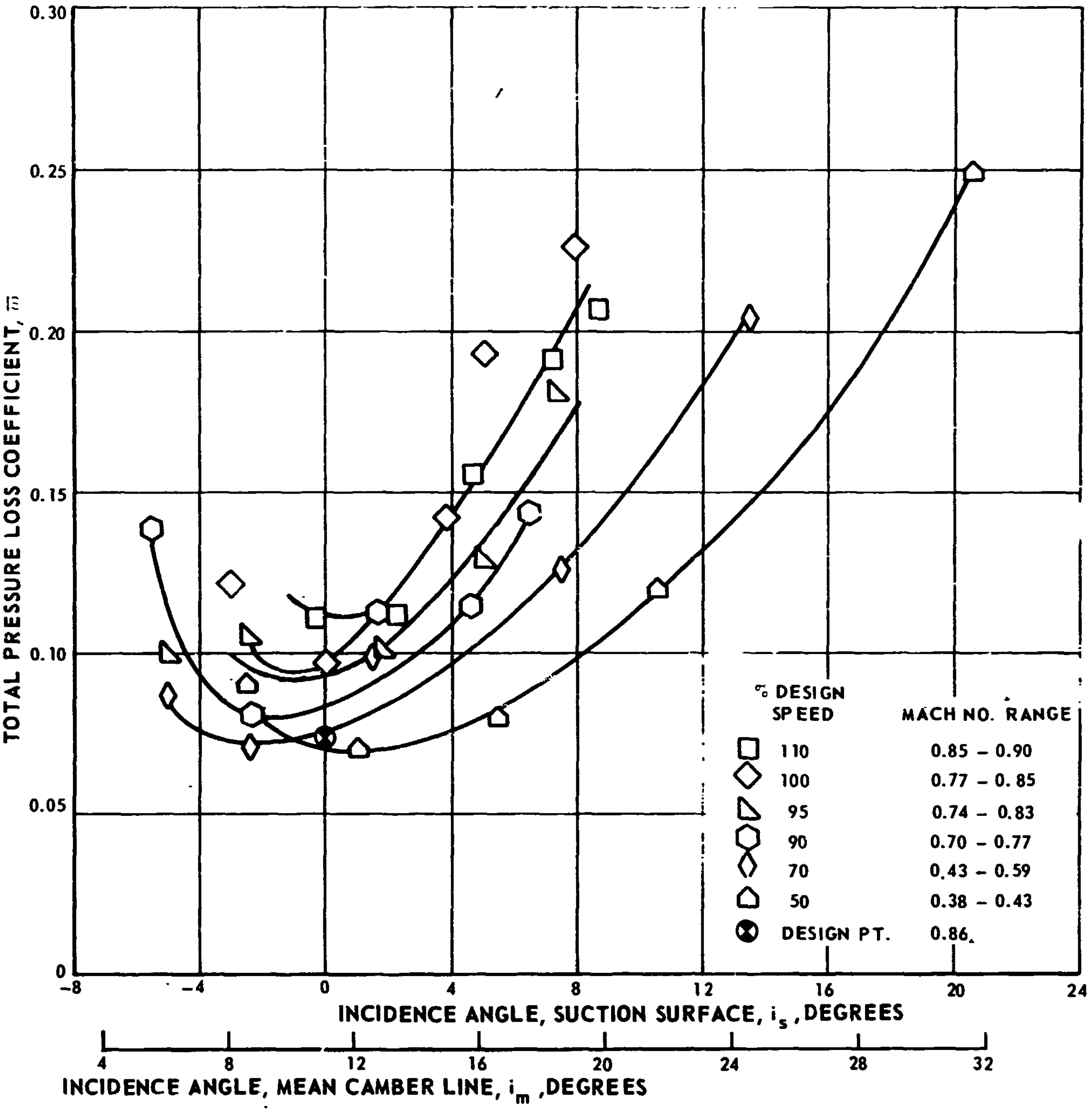
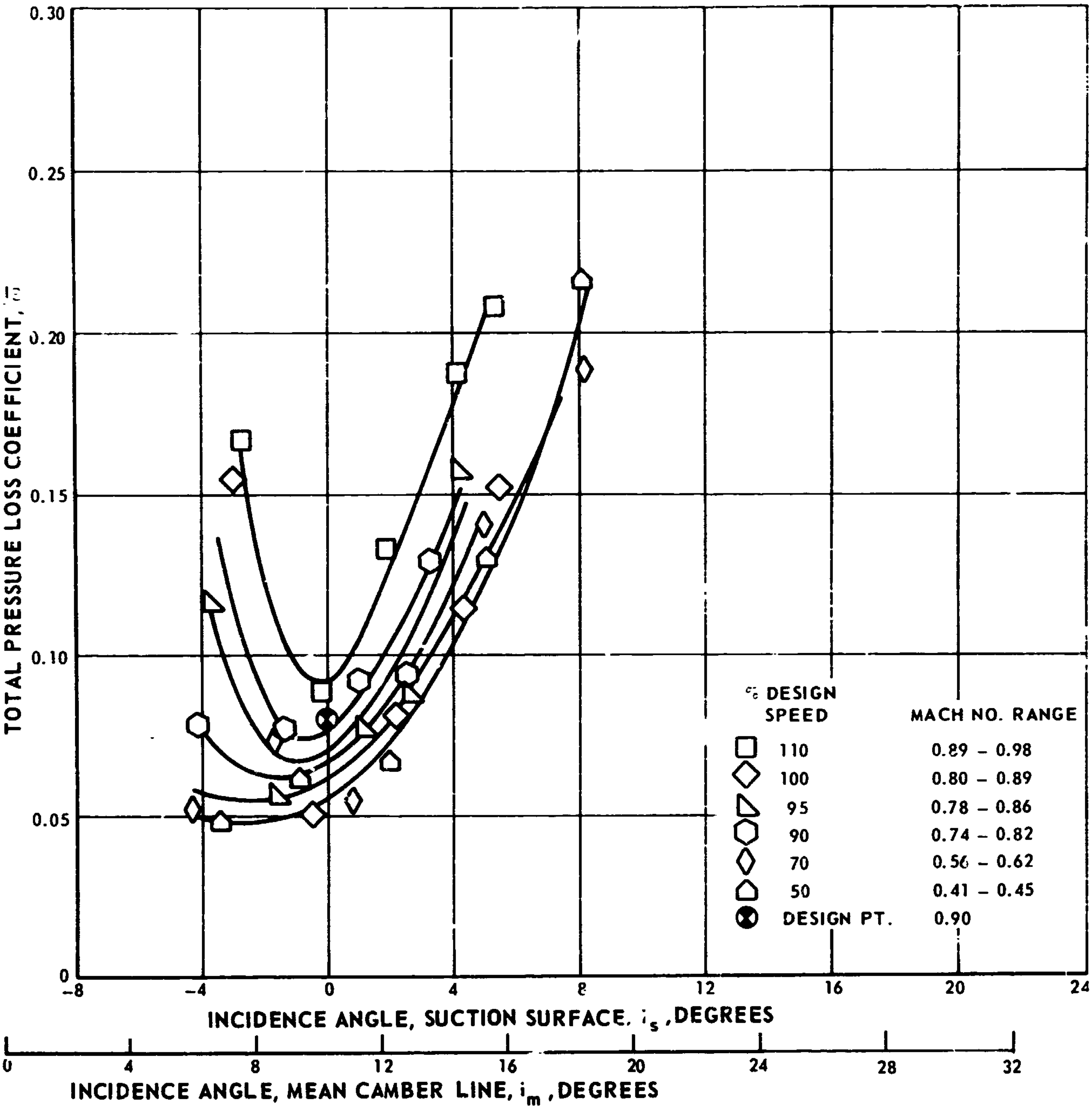


Figure 29 MCA Stator A, Deviation vs. Incidence



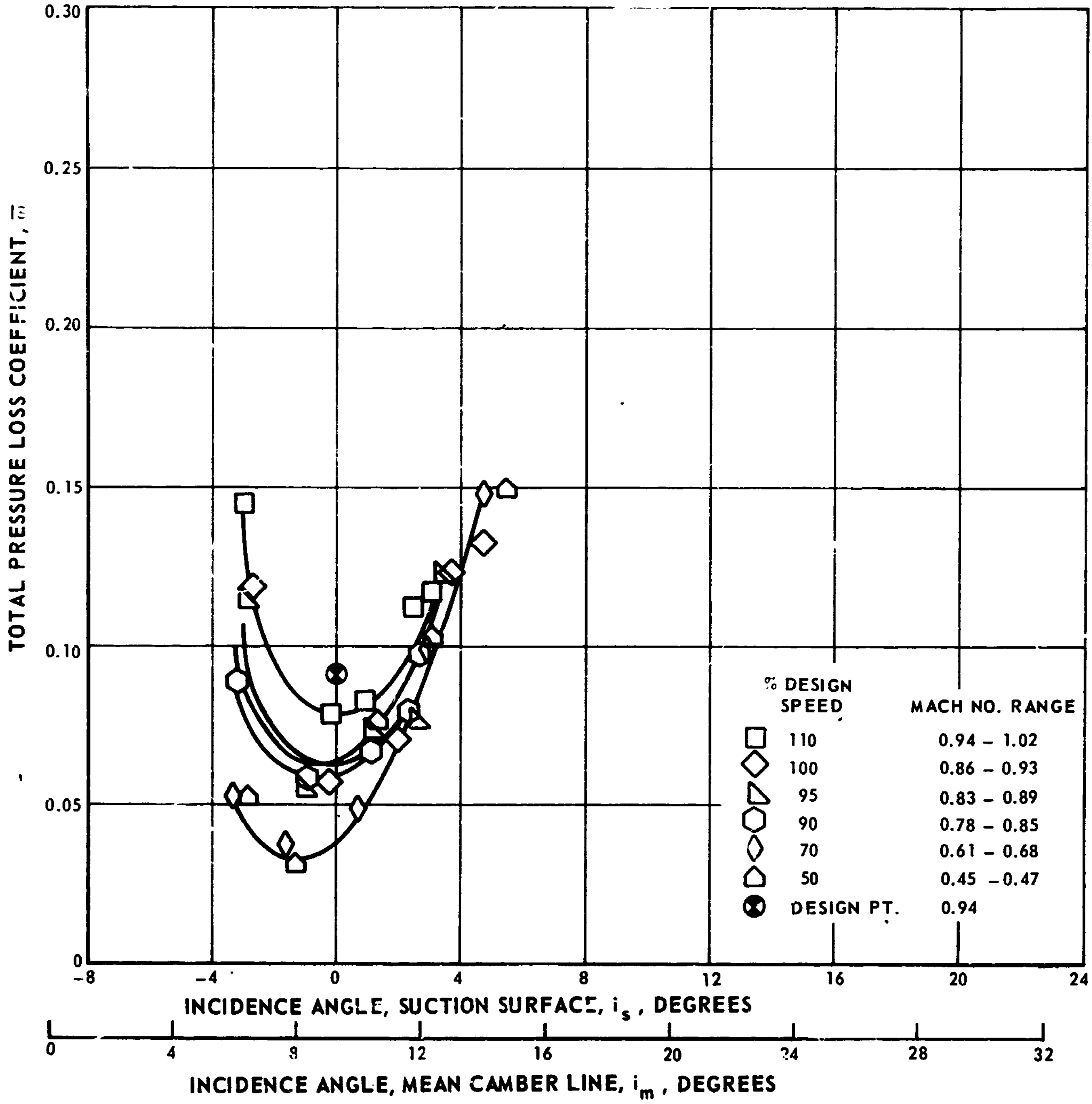
a) 10% SPAN

Figure 30 MCA Stator A, Total Pressure Loss Coefficient vs. Incidence



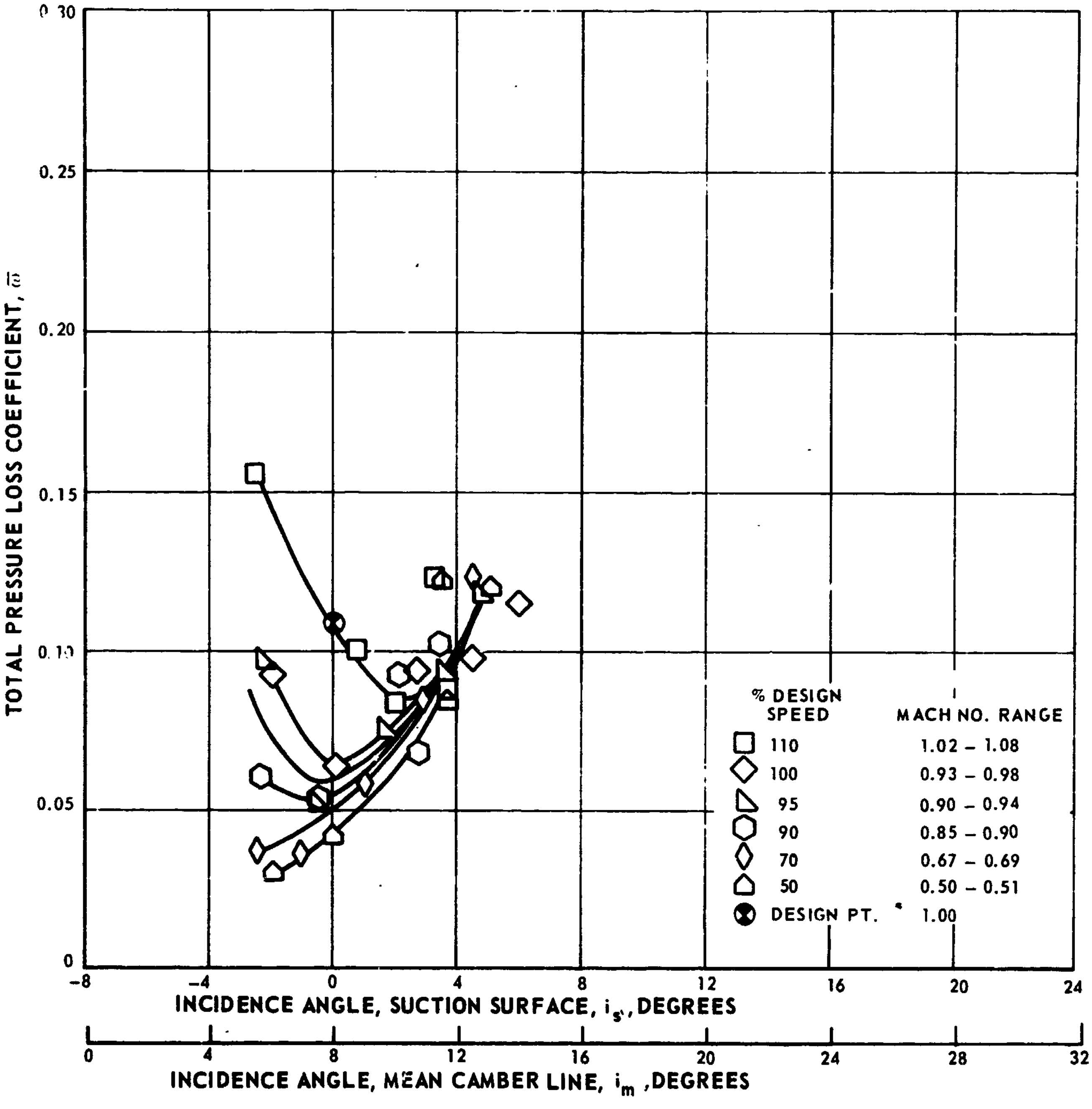
b) 30% SPAN

Figure 30 MCA Stator A, Total Pressure Loss Coefficient vs. Incidence



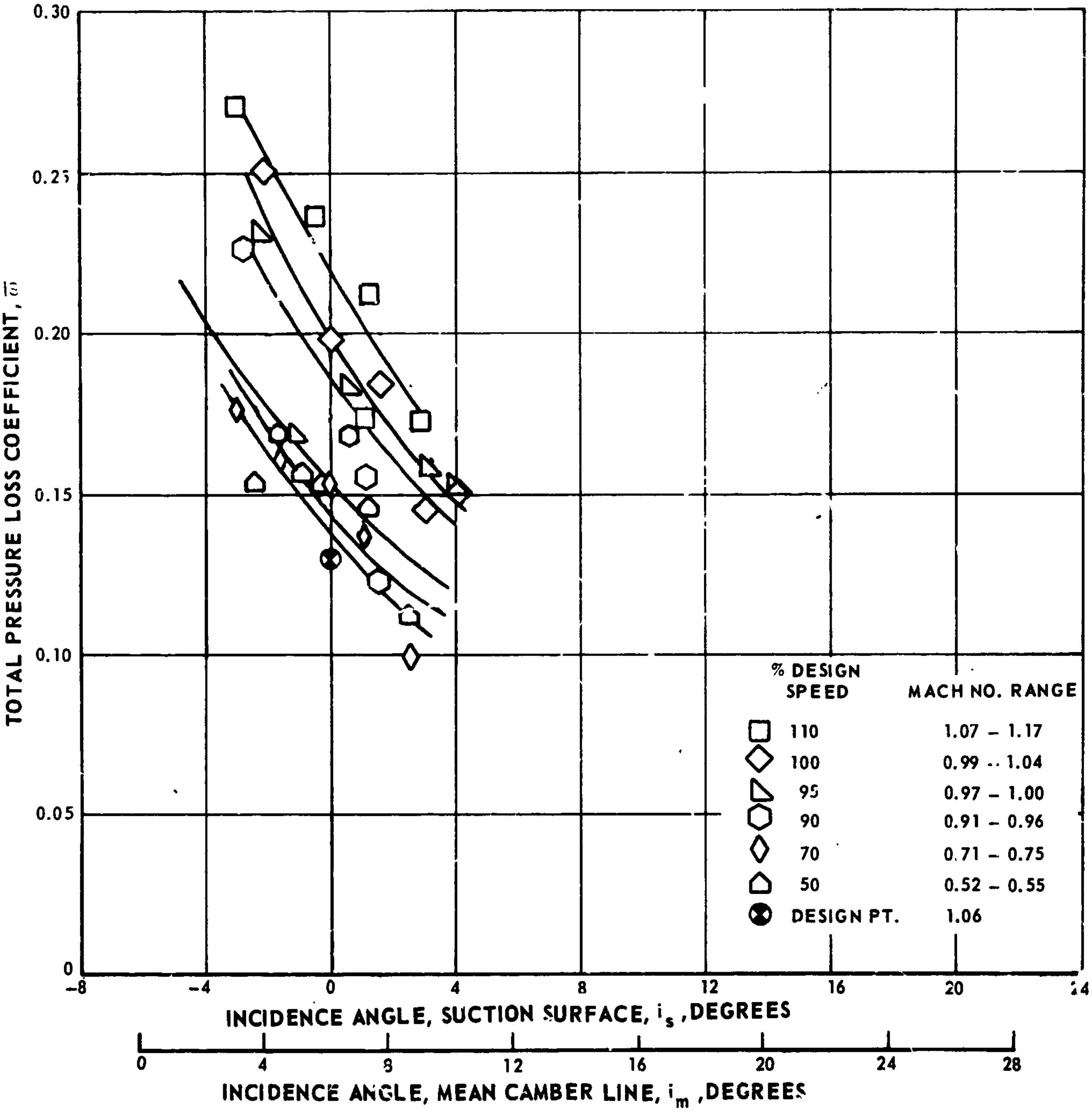
c) 50% SPAN

Figure 30 MCA Stator A, Total Pressure Loss Coefficient vs. Incidence



d) 70% SPAN

Figure 30 MCA Stator A, Total Pressure Loss Coefficient vs. Incidence



e) 90% SPAN

Figure 30 MCA Stator A, Total Pressure Loss Coefficient vs. Incidence

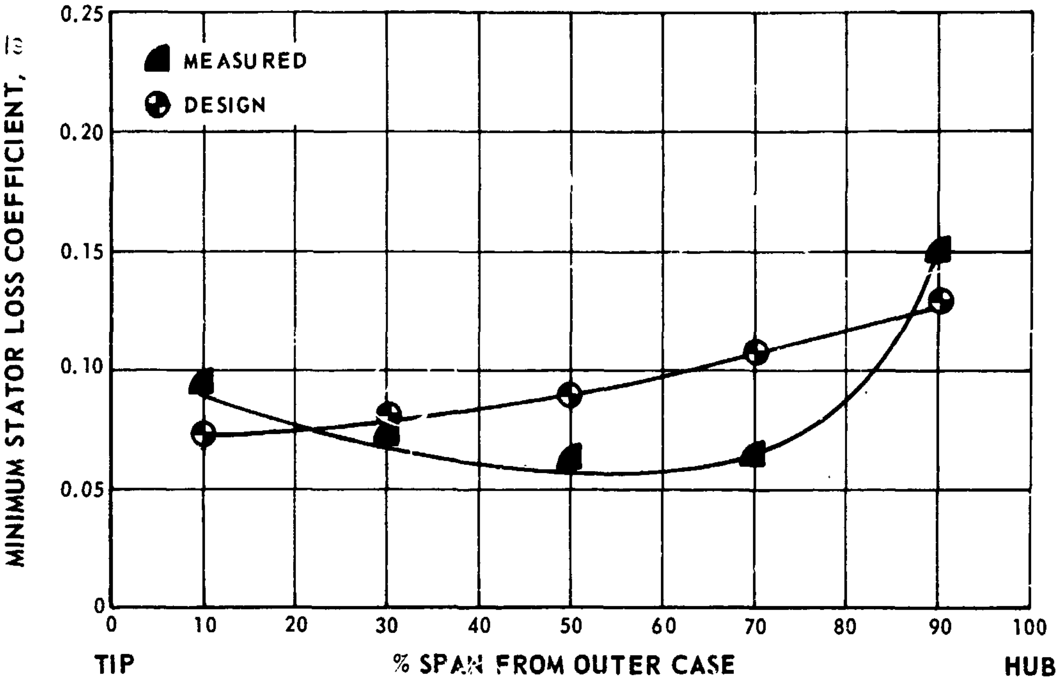
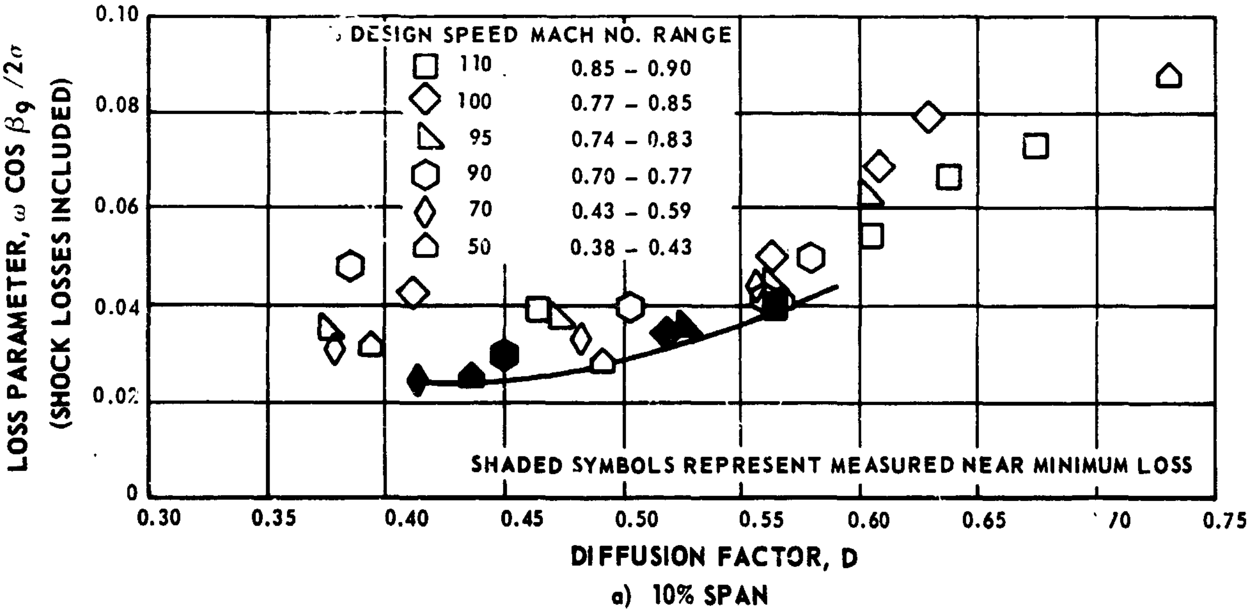
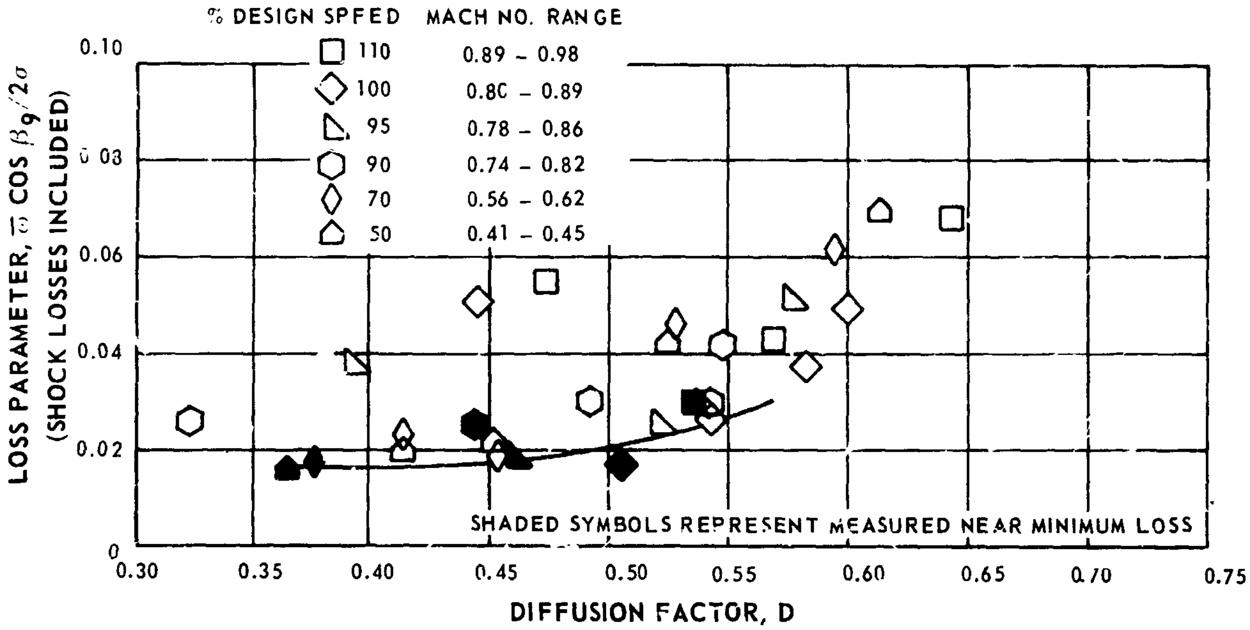


Figure 31 MCA Stator A, Minimum Loss Coefficient vs. Percent Span, 100% Design Speed



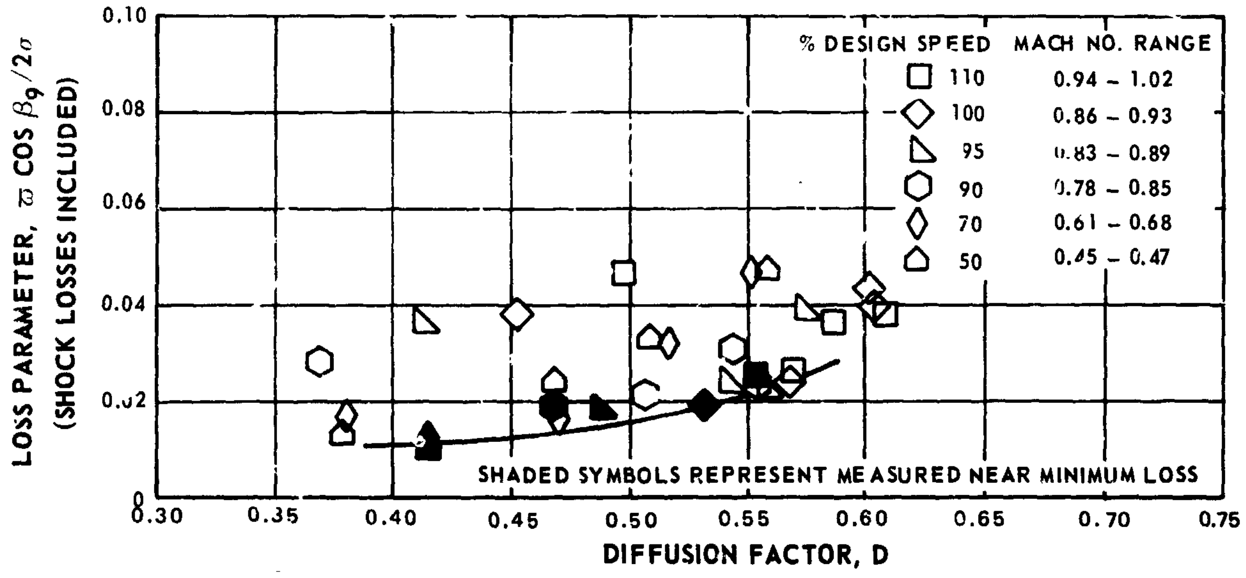
a) 10% SPAN

Figure 32 MCA Stator A, Loss Parameter vs. Diffusion Factor



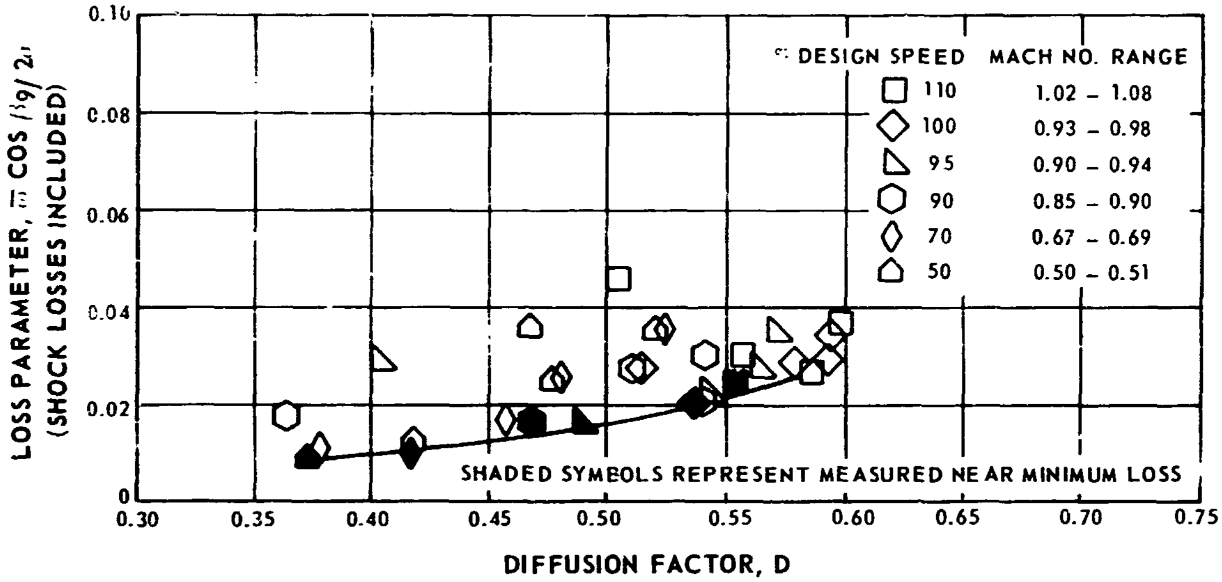
b) 30% SPAN

Figure 32 MCA Stator A, Loss Parameter vs. Diffusion Factor



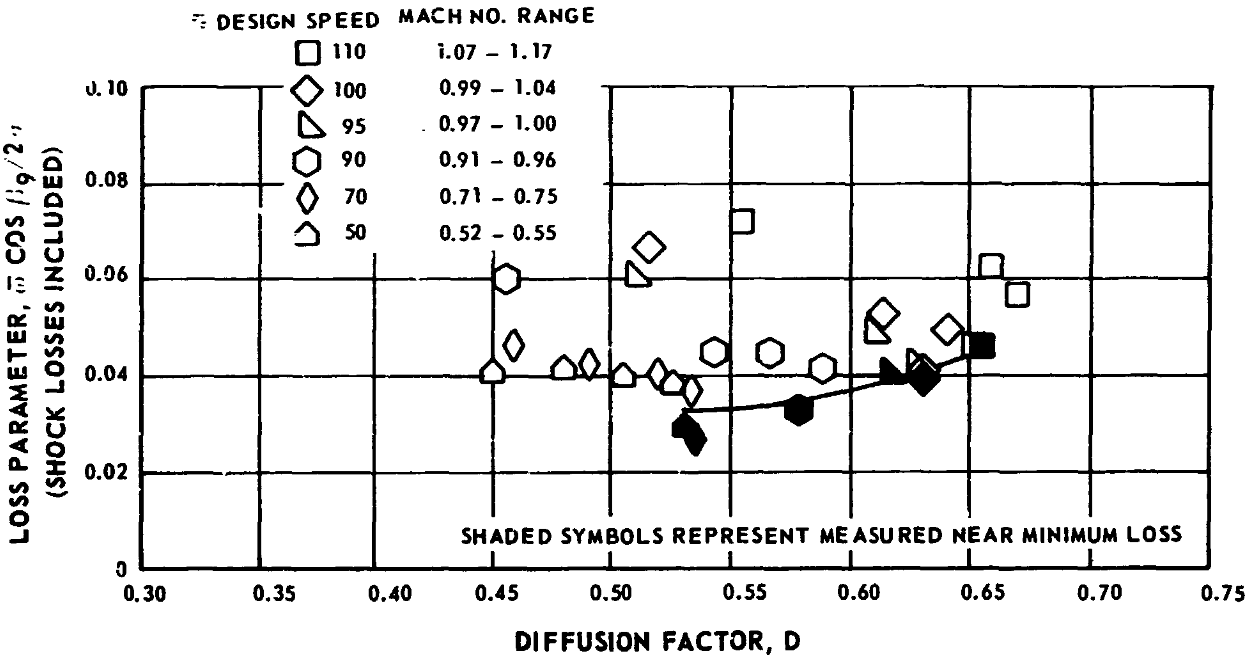
c) 50% SPAN

Figure 32 MCA Stator A, Loss Parameter vs. Diffusion Factor



d) 70% SPAN

Figure 32 MCA Stator A, Loss Parameter vs. Diffusion Factor



e) 90% SPAN

Figure 32 MCA Stator A, Loss Parameter vs. Diffusion Factor

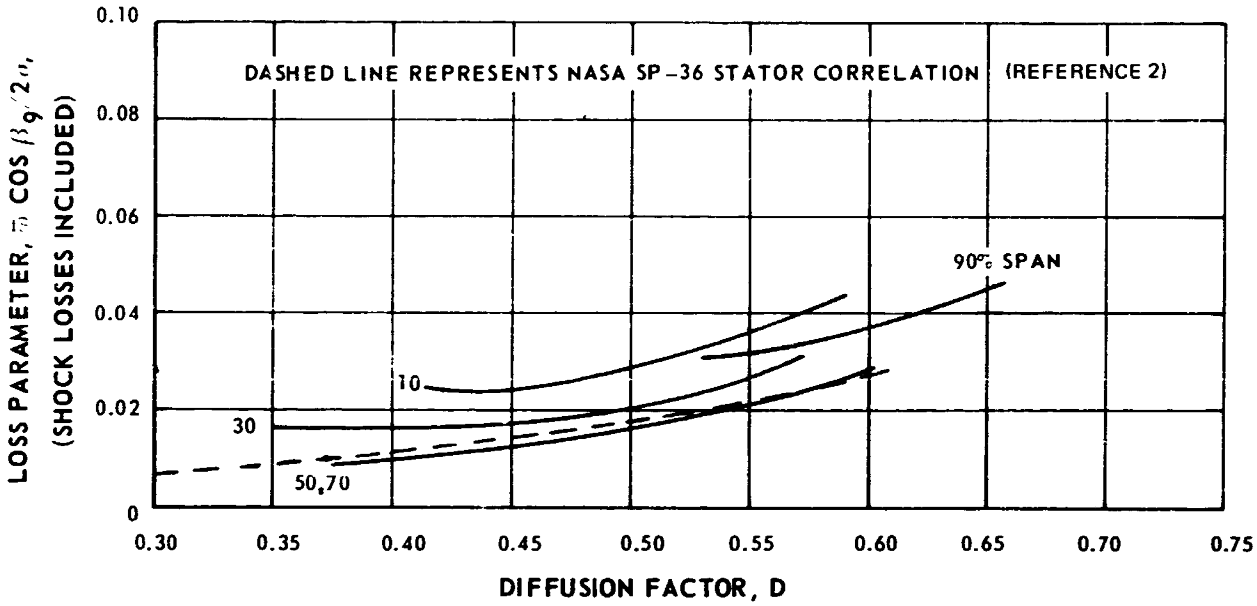


Figure 33 MCA Stator A, Minimum Loss Parameter vs. Diffusion Factor

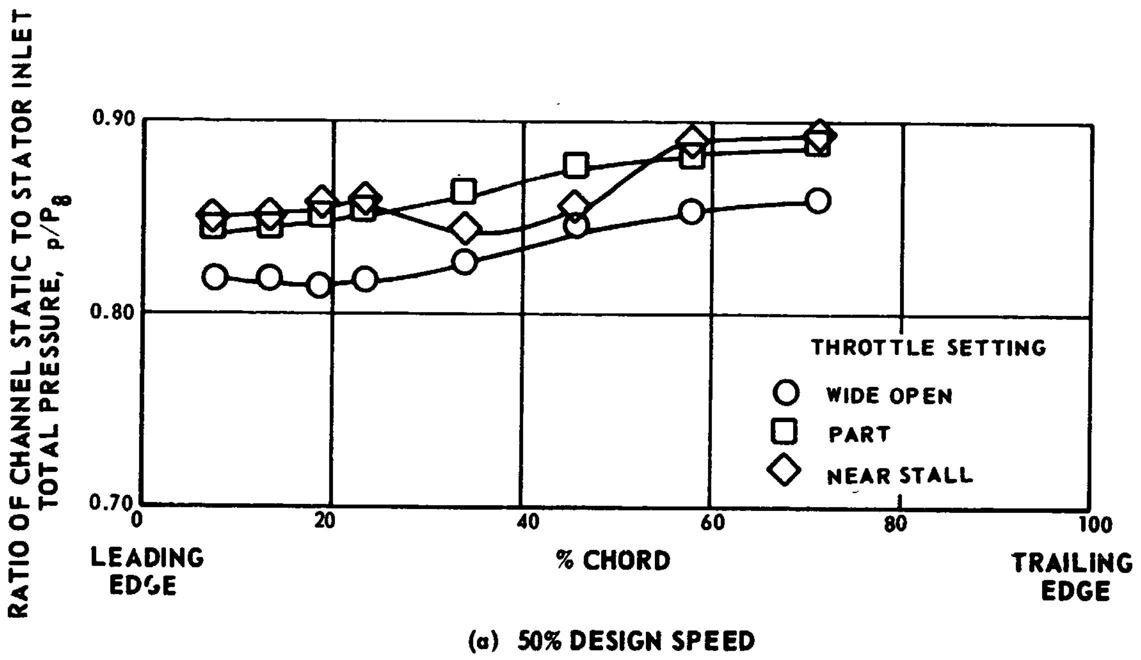
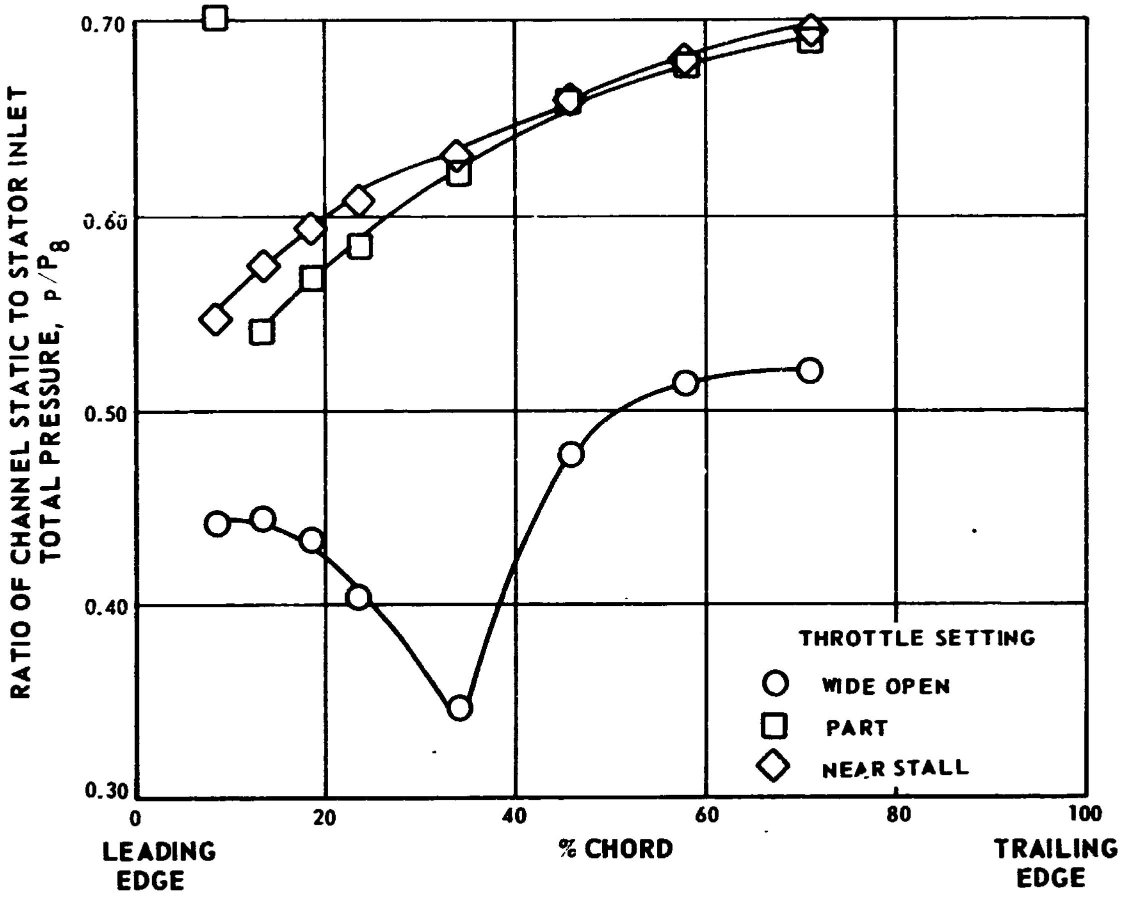
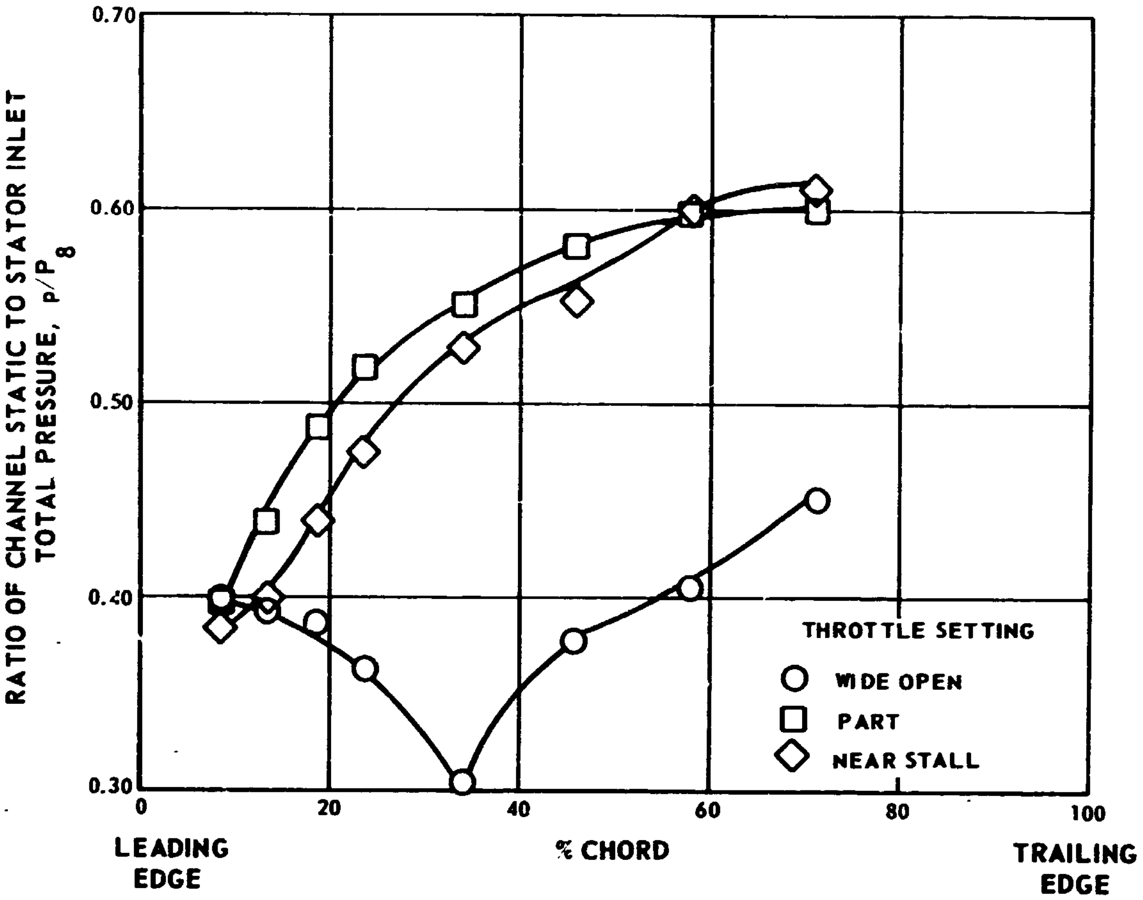


Figure 34 MCA Stator A, Hub Mid-Channel Static Pressure Gradient



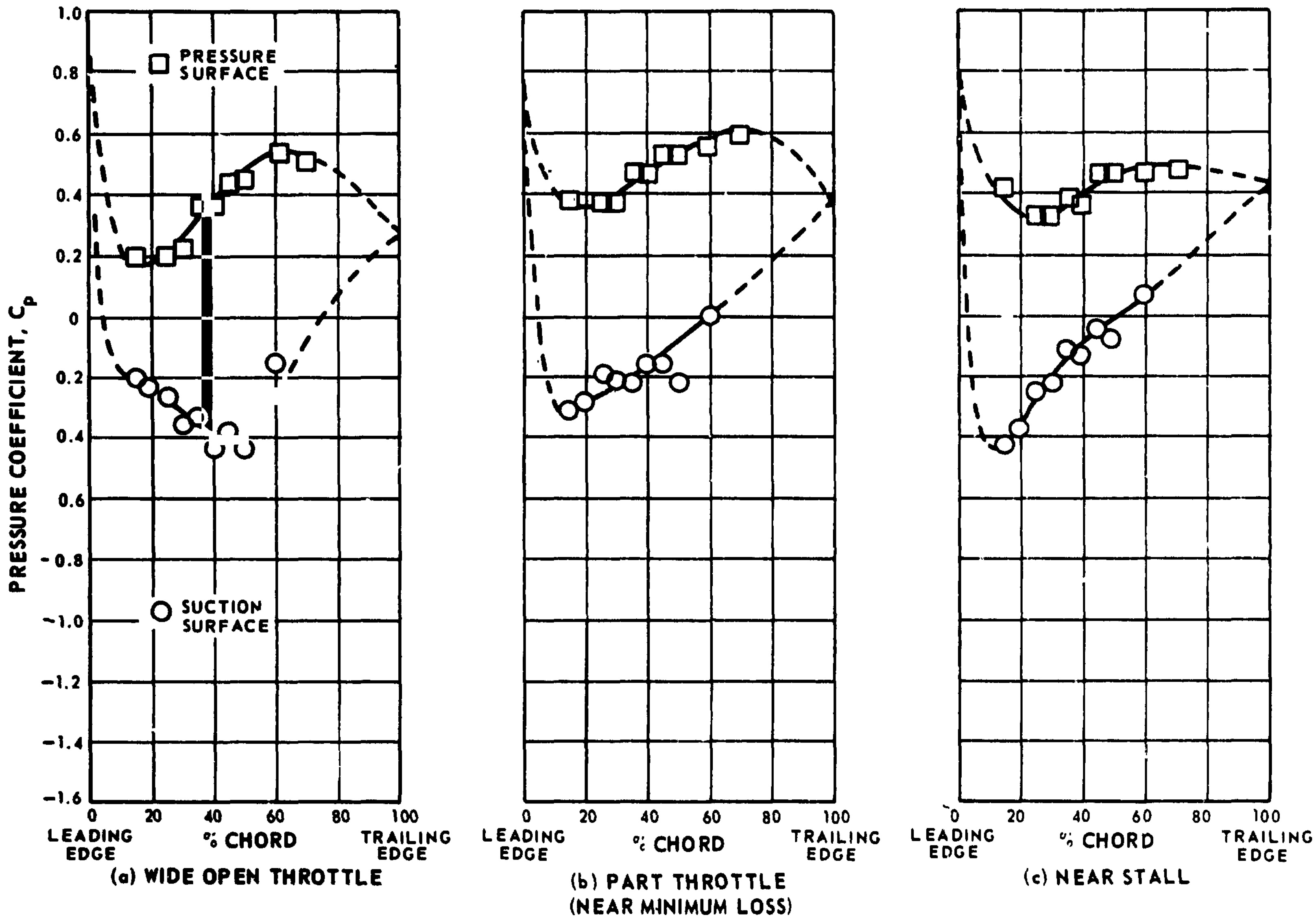
(b) 100% DESIGN SPEED

Figure 34 MCA Stator A, Hub Mid-Channel Static Pressure Gradient



(c) 110% DESIGN SPEED

Figure 34 MCA Stator A, Hub Mid-Channel Static Pressure Gradient

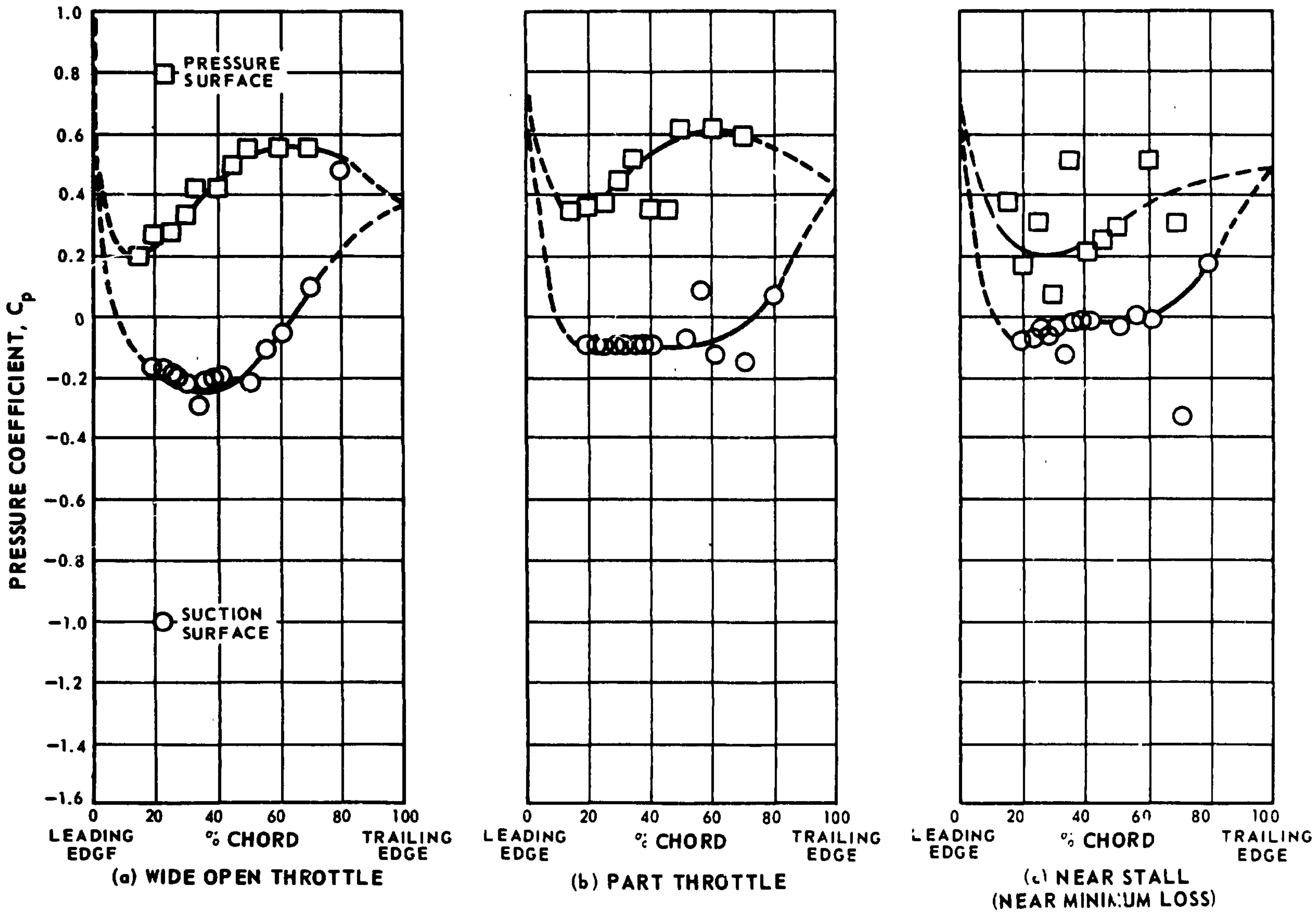


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE (NEAR MINIMUM LOSS)

(c) NEAR STALL

Figure 35 MCA Stator A, Pressure Coefficient (C_p) vs. Percent Chord, 50% Design Speed, 10% Span

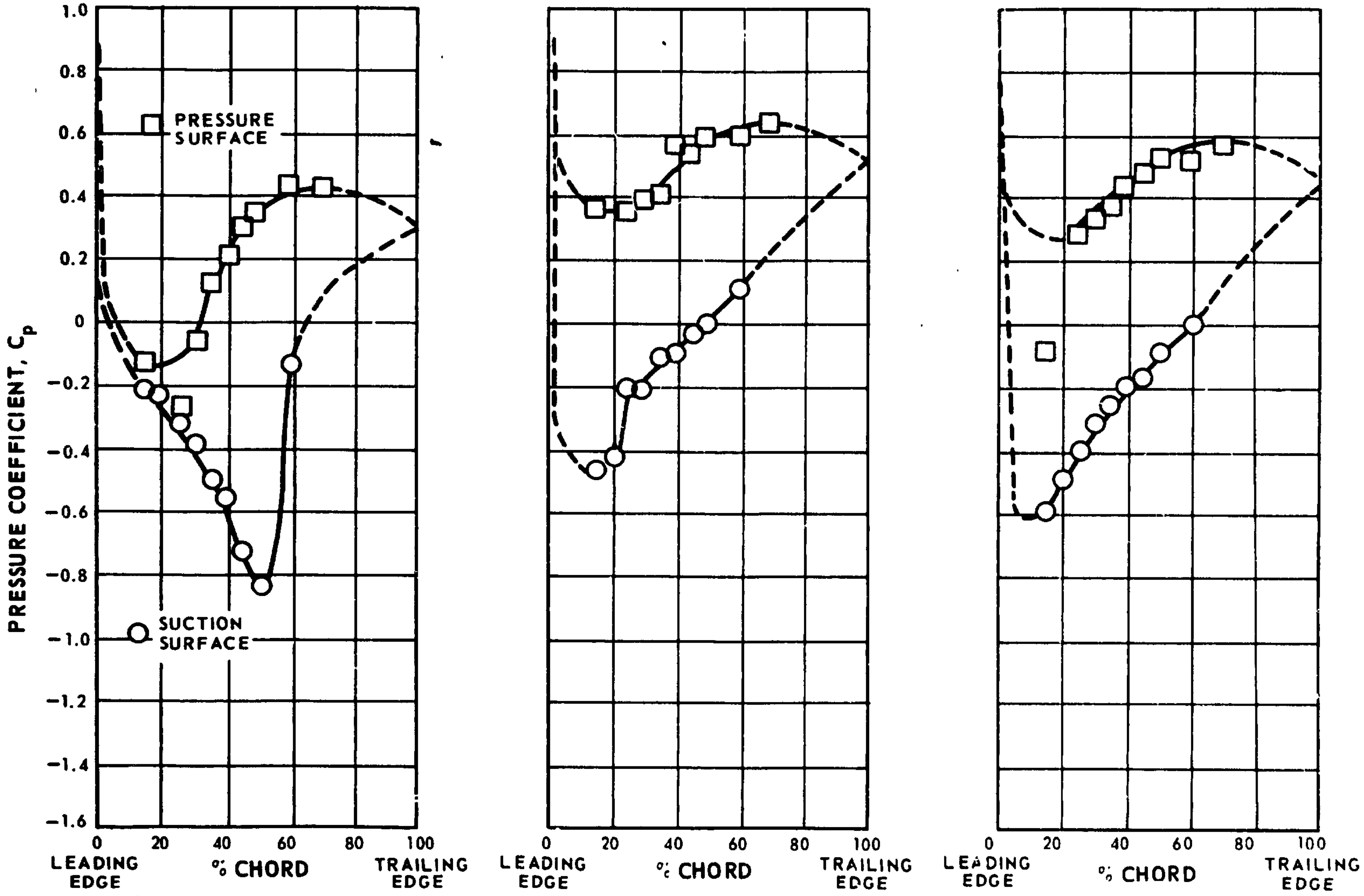


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL (NEAR MINIMUM LOSS)

Figure 36 MCA Stator A, Pressure Coefficient (C_p) vs. Percent Chord, 50% Design Speed, 90% Span

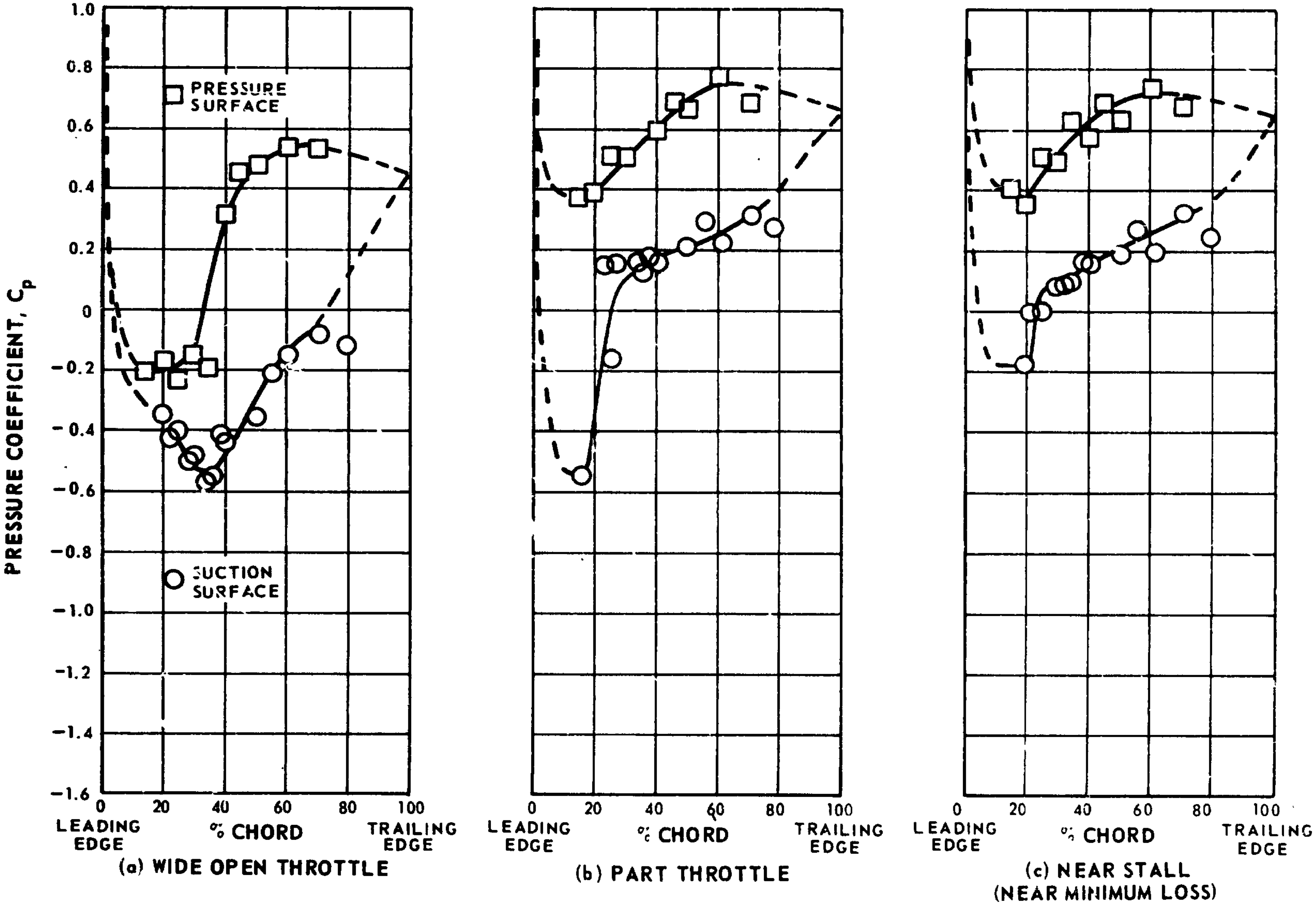


(a) WIDE OPEN THROTTLE (NEAR MINIMUM LOSS)

(b) PART THROTTLE

(c) NEAR STALL

Figure 37 MCA Stator A, Pressure Coefficient (C_p) vs. Percent Chord, 100% Design Speed, 10% Span

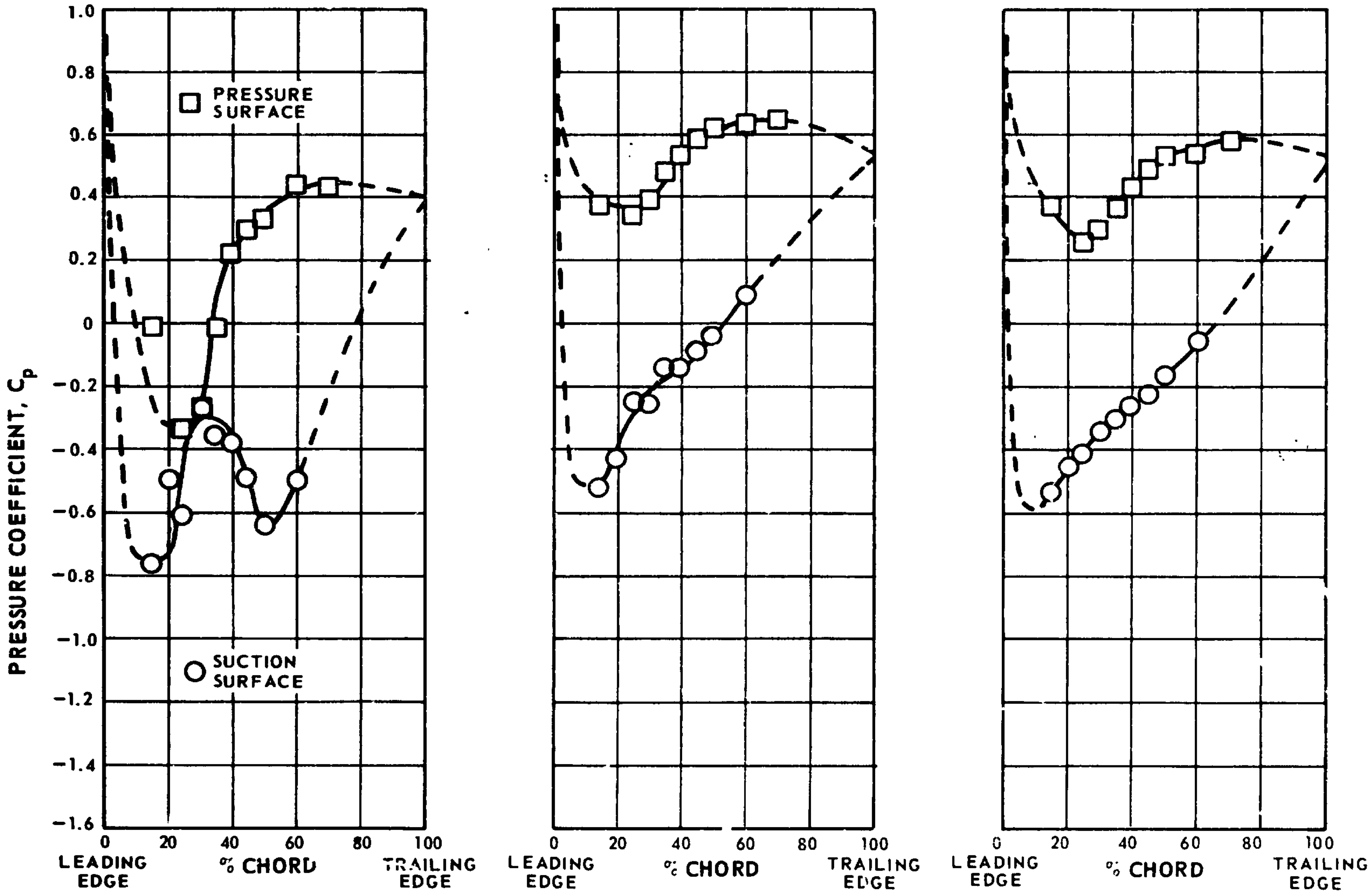


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL (NEAR MINIMUM LOSS)

Figure 38 MCA Stator A, Pressure Coefficient (Cp) vs. Percent Chord, 100% Design Speed, 90% Span

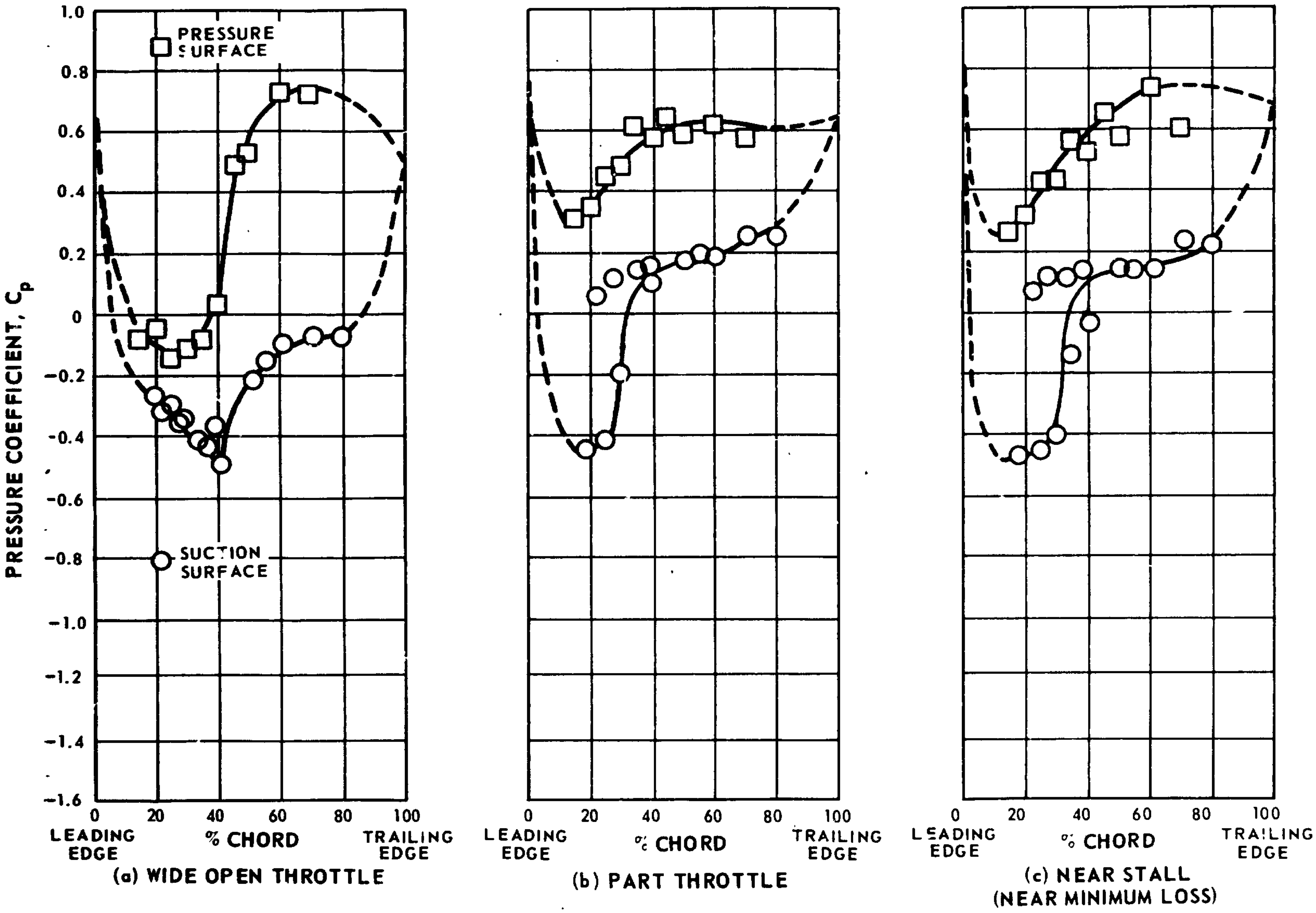


(a) WIDE OPEN THROTTLE (NEAR MINIMUM LOSS)

(b) PART THROTTLE

(c) NEAR STALL

Figure 39 MCA Stator A, Pressure Coefficient (Cp) vs. Percent Chord, 110% Design Speed, 10% Span

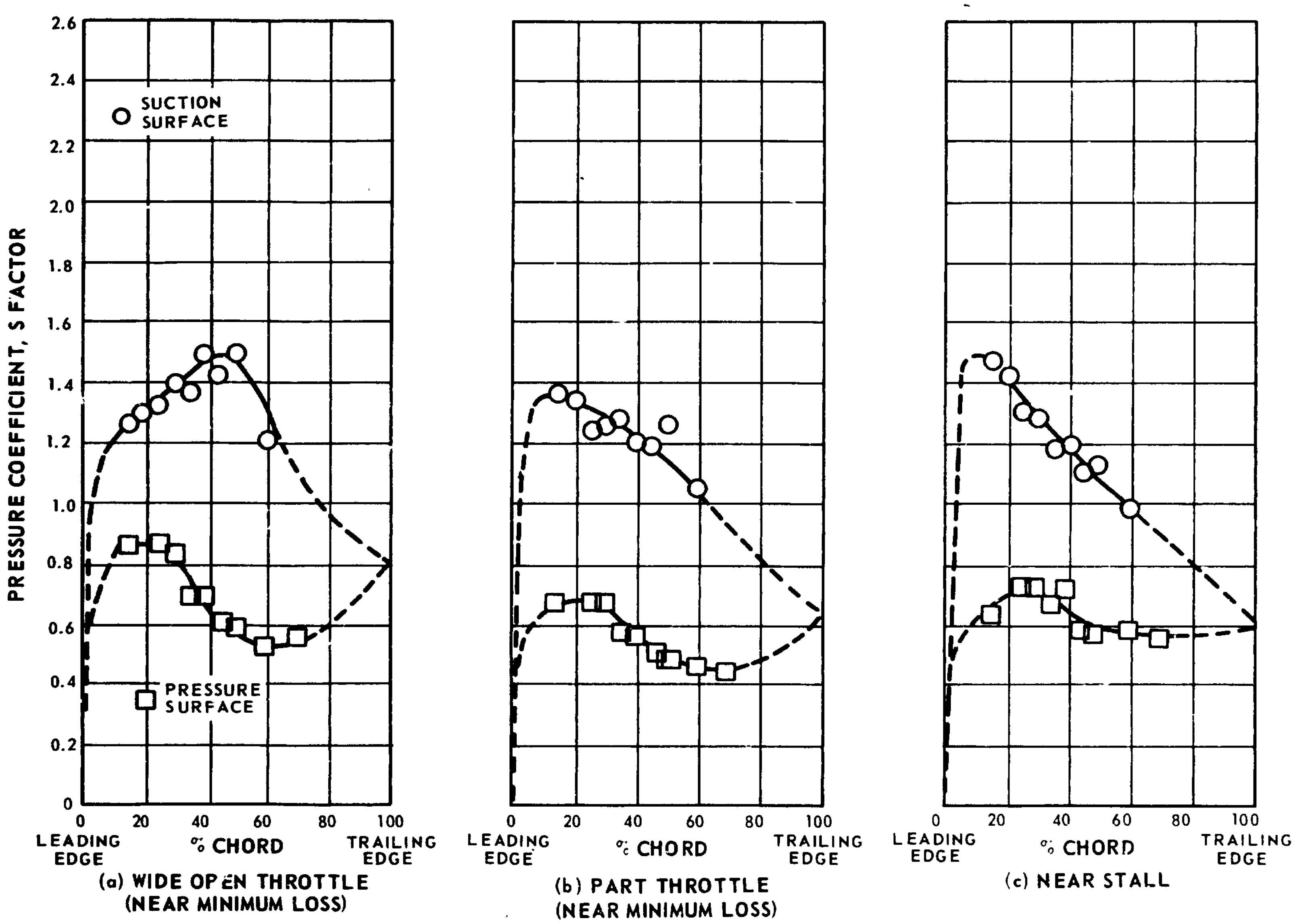


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL (NEAR MINIMUM LOSS)

Figure 40 MCA Stator A, Pressure Coefficient (Cp) vs. Percent Chord, 110% Design Speed, 90% Span

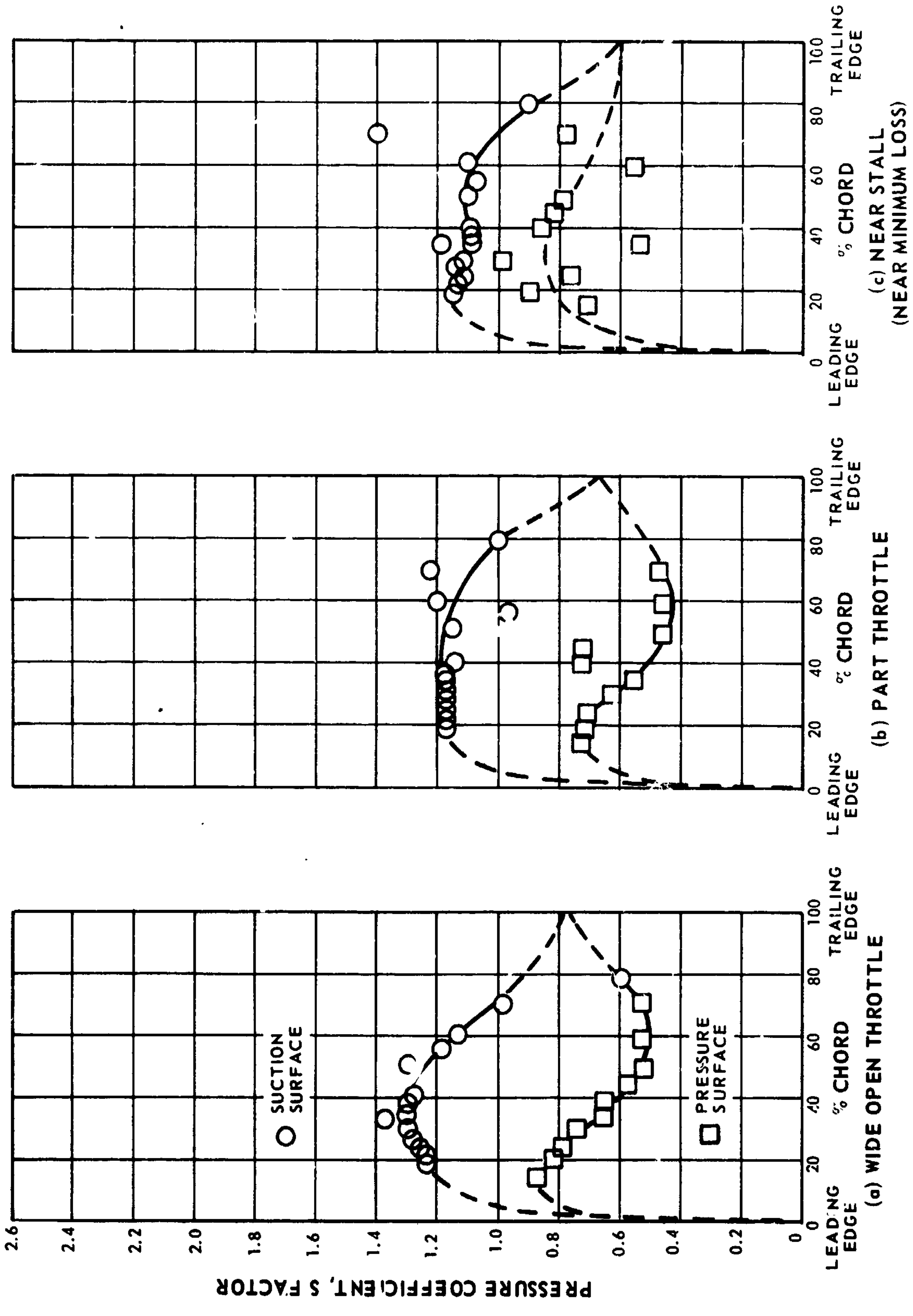


(a) WIDE OPEN THROTTLE (NEAR MINIMUM LOSS)

(b) PART THROTTLE (NEAR MINIMUM LOSS)

(c) NEAR STALL

Figure 41 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 50% Design Speed, 10% Span

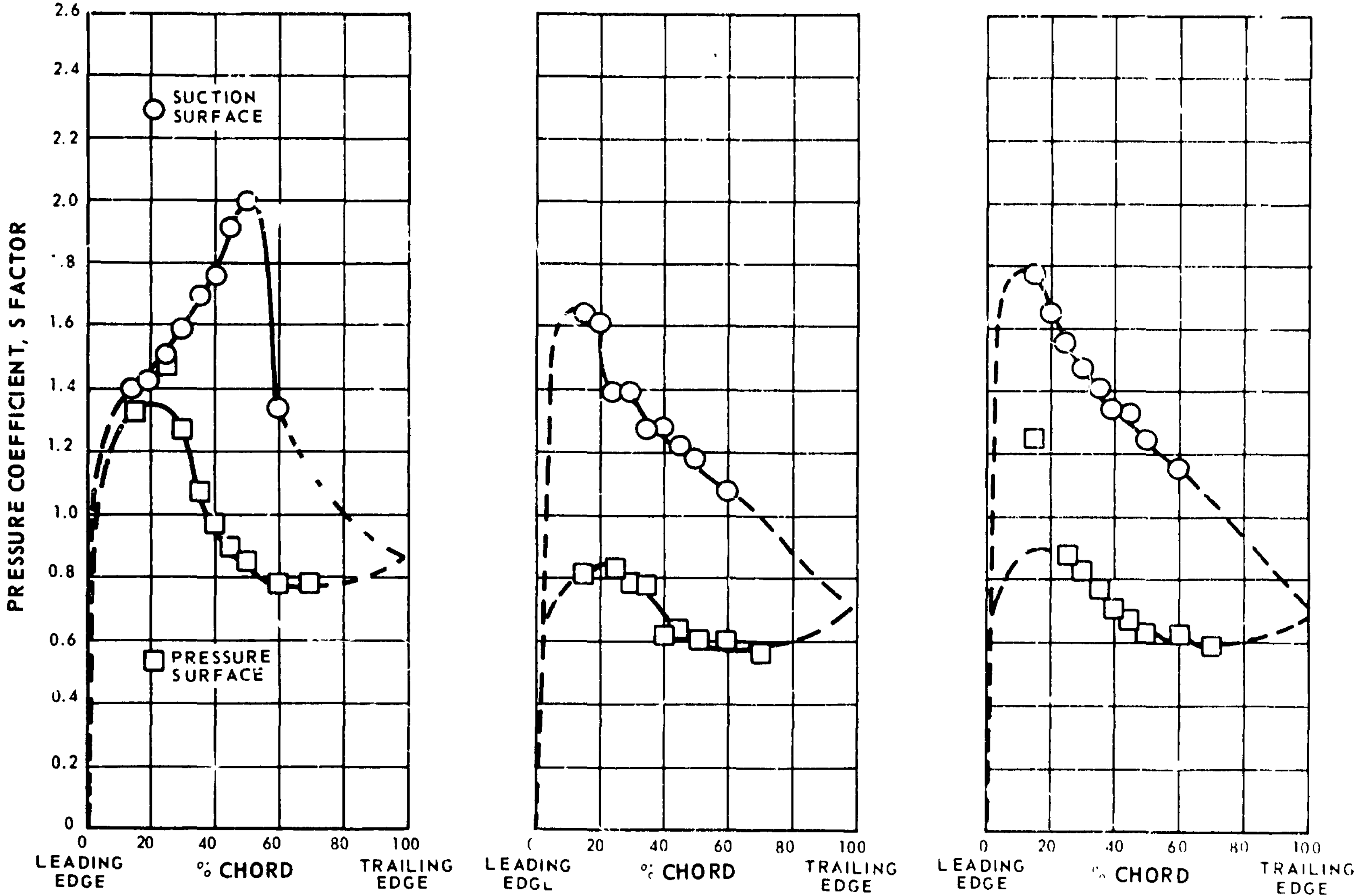


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL (NEAR MINIMUM LOSS)

Figure 42 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 50% Design Speed, 90% Span

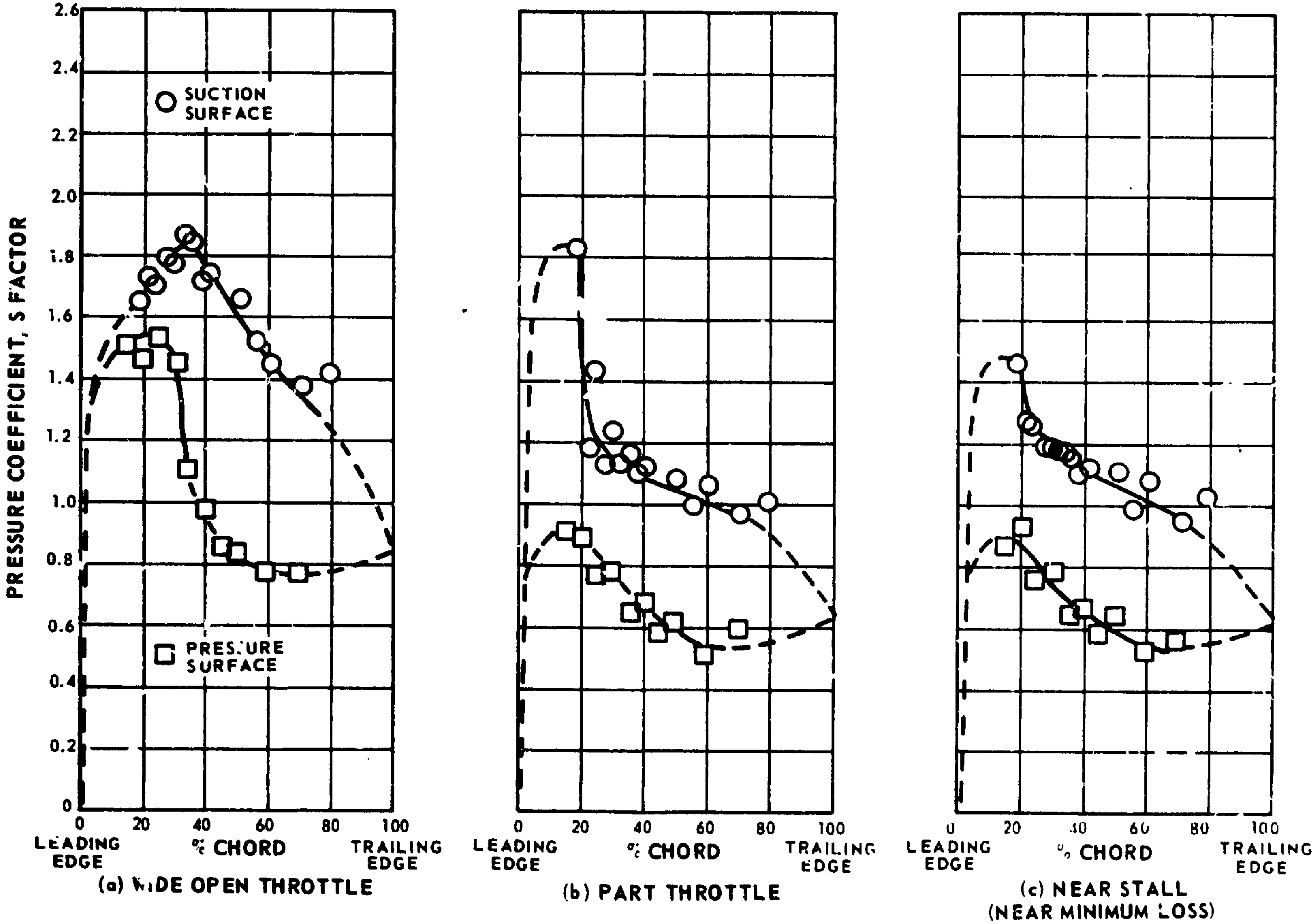


(a) WIDE OPEN THROTTLE (NEAR MINIMUM LOSS)

(b) PART THROTTLE

(c) NEAR STALL

Figure 43 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 100% Design Speed, 10% Span

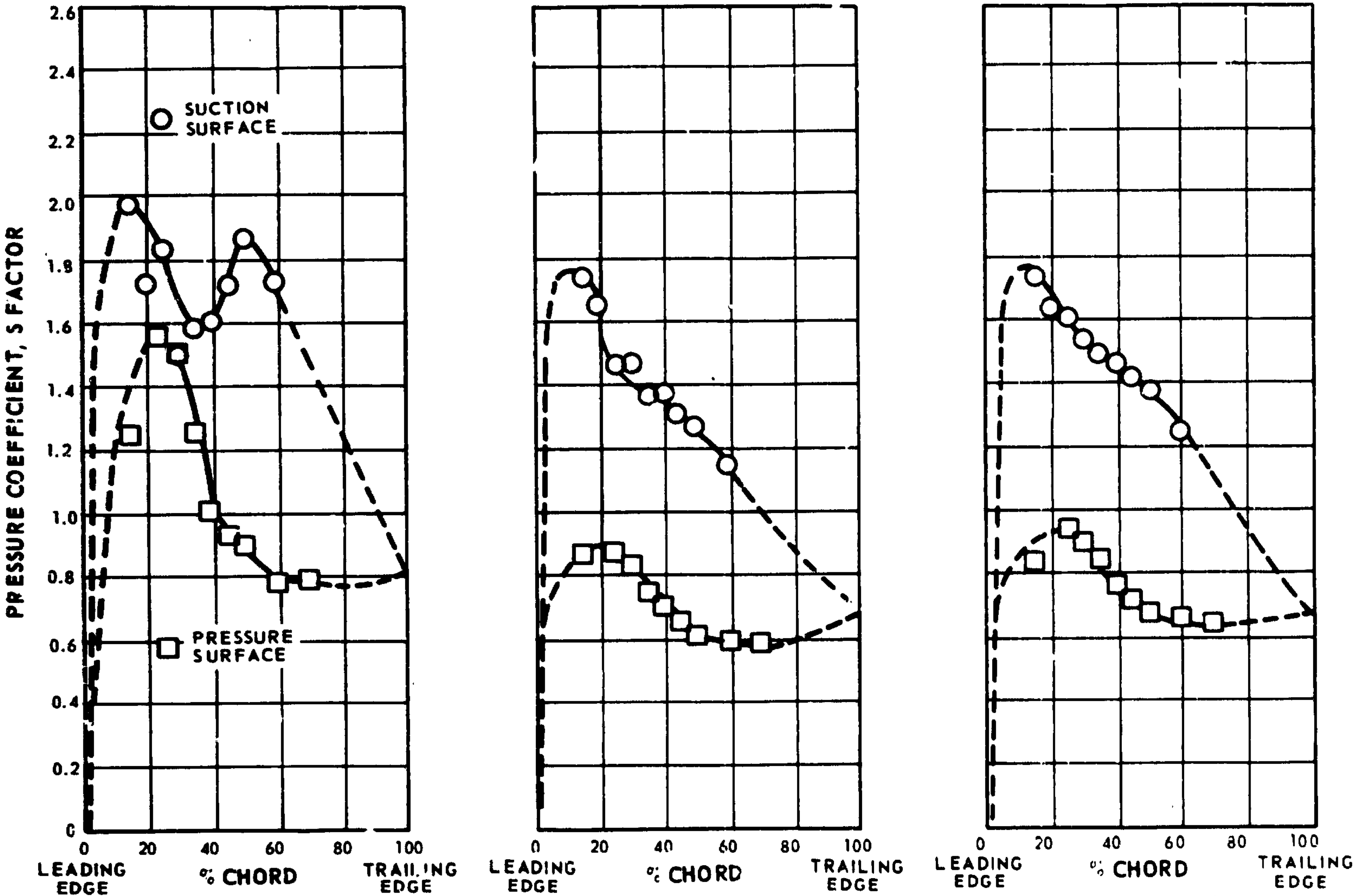


(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL (NEAR MINIMUM LOSS)

Figure 44 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 100% Design Speed, 90% Span

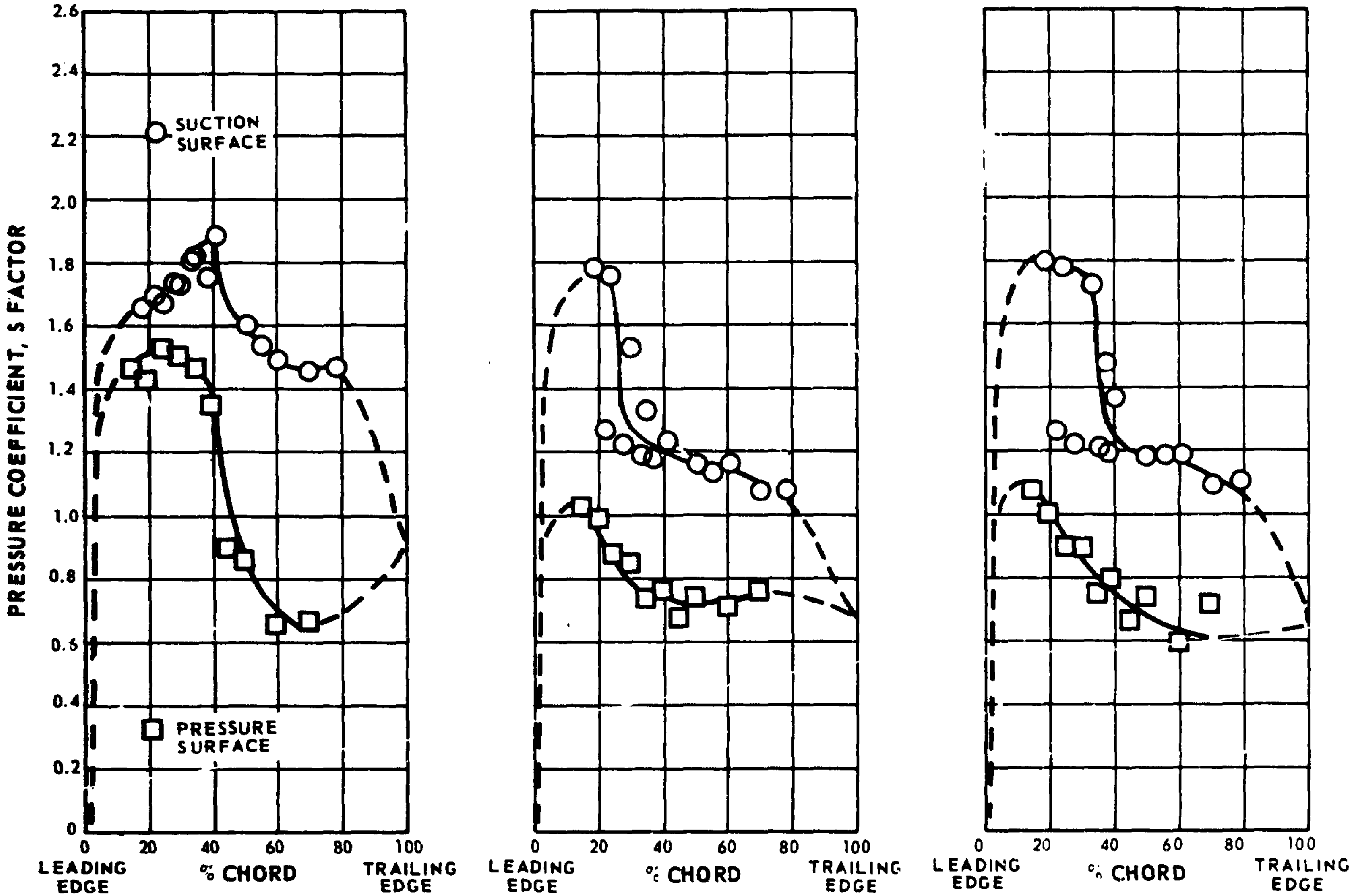


(a) WIDE OPEN THROTTLE (NEAR MINIMUM LOSS)

(b) PART THROTTLE

(c) NEAR STALL

Figure 45 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 110% Design Speed, 10% Span



(a) WIDE OPEN THROTTLE

(b) PART THROTTLE

(c) NEAR STALL
(NEAR MINIMUM LOSS)

Figure 46 MCA Stator A, Pressure Coefficient (S Factor) vs. Percent Chord, 110% Design Speed, 90% Span

APPENDIX A

Blade Element Data Tabulation

TABLE 1-1 BLADE ELEMENT PERFORMANCE AT 50% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.712	29.384	24.213	21.121	18.783
V_2	263.13	256.85	259.40	267.09	278.81
V_3	302.13	296.10	296.65	296.59	295.90
V_{z2}	263.10	256.82	259.38	267.07	278.79
V_{z3}	242.35	257.9[illegible]	269.87	273.48	272.89
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	176.36	145.28	121.67	106.87	95.28
M_2	.2370	.2313	.2336	.2406	.2513
M_3	.2726	.2671	.2676	.2676	.2669
$\Delta\beta$	-35.71	-29.38	-24.21	-21.12	-18.78
$\bar{\omega}$	.0316	.0133	.0084	.0166	.0221
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0075	.0040	.0030	.0069	.0103
D	.049	.045	.044	.069	.106
η_p	.9120	.9620	.9742	.9352	.8546
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_c	.000	.000	.000	.000	.000
$\delta°$	3.008	3.606	4.827	5.429	6.617

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.385	28.048	22.966	20.153	18.412
β_6	52.423	47.661	43.435	41.040	41.455
β'_5	37.967	45.932	51.200	55.385	58.686
β'_6	-3.528	12.075	24.718	33.058	39.609
V_5	295.66	302.54	308.93	309.83	307.04
V_6	555.84	519.78	491.33	471.74	450.68
V_{z5}	240.74	267.00	284.33	290.34	290.32
V_{z6}	338.96	350.08	356.76	355.77	337.76
$V_{\theta 5}$	171.20	142.26	120.54	106.74	96.98
$V_{\theta 6}$	440.52	384.21	337.81	309.74	298.37
V'_5	305.6	383.9	453.8	511.4	559.1
V'_6	339.6	358.0	392.8	424.5	438.4
$V'_{\theta 5}$	-187.9	-275.8	-353.6	-420.6	-477.2
$V'_{\theta 6}$	20.9	-74.9	-164.2	-231.6	-279.5
U_5	359.07	418.08	474.18	527.39	574.21
U_6	419.63	459.09	502.04	541.32	577.88
M_5	.2667	.2730	.2789	.2797	.2771
M_6	.5008	.4671	[illegible]	.4226	.4027
M'_5	.2757	.3464	[illegible]	.4617	.5047
M'_6	.3060	.3217	.3523	.3803	.3918
$\Delta\beta'$	41.461	33.856	26.472	22.279	18.989
$\bar{\omega}'$	.1338	.1040	.0812	.0738	.1274
$\bar{\omega}'\ \cos\beta'_6/2\sigma$	.0339	.0301	.0245	.0233	.0390
D	.1521	.2730	.3036	.3194	.3598
η_p	.9484	.9355	.9289	.9162	.8405
η_{ad}	.9475	.9344	.9278	.9148	.8380
i_m	4.98	5.70	5.89	5.37	5.10
i_c	-2.22	-.95	.08	.32	.60
$\delta°$	9.102	8.895	8.798	6.008	3.789

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	44.498	42.172	39.738	38.272	39.188
β_9	7.082	4.010	3.442	4.344	4.426
V_8	597.22	551.75	519.59	495.87	470.18
V_9	422.00	443.24	419.17	405.43	377.34
V_{z8}	425.30	408.52	399.37	389.24	364.42
V_{z9}	417.83	441.52	418.11	404.15	376.19
$V_{\theta 8}$	418.58	370.43	332.17	307.14	297.09
$V_{\theta 9}$	52.02	31.00	25.16	30.71	29.12
M_8	.5401	.4972	.4672	.4450	.4208
M_9	.3762	.3960	.3740	.3615	.3356
$\Delta\beta$	37.416	38.162	36.297	33.928	34.762
$\bar{\omega}$	.1545	.0298	.0419	.0481	.0905
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0406	.0087	.0133	.0157	.0314
D	.4518	.3745	.3793	.3639	.3956
η_p	.7211	.9240	.8902	.8611	.7622
i_m	3.75	5.88	6.56	7.02	8.86
i_c	-2.45	-1.91	-2.79	-3.41	-2.47
$\delta°$	16.55	12.79	11.94	12.94	13.67

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 49.9876$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 4433.900$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 73.270$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f} = 13.9802$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_{an}} = 19.4867$

TABLE 1-2 BLADE ELEMENT PERFORMANCE AT 50% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.713	29.396	24.216	21.113	18.760
V_2	251.56	245.34	247.72	255.08	266.36
V_3	288.28	282.37	282.74	282.48	281.90
V_{Z2}	251.57	245.32	247.70	255.06	266.34
V_{Z3}	231.19	245.91	257.24	260.52	260.06
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	168.27	138.60	115.97	101.75	90.66
M_2	.2265	.2208	.2230	.2297	.2400
M_3	.2600	.2546	.2549	.2547	.2541
$\Delta\beta$	-35.71	-29.40	-24.22	-21.11	-18.76
$\bar{\omega}$	.0319	.0128	.0075	.0168	.0218
$\bar{\omega}\ \mathrm{Cos}\ \beta_3/2\sigma$	.0076	.0039	.0027	.0070	.0101
D	.051	.046	.046	.071	.108
η_p	.9096	.9630	.9764	.9325	.8499
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_e	.000	.000	.000	.000	.000
$\delta°$	3.007	3.594	4.824	5.437	6.640

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	46.121	44.101	41.204	40.756	42.707
β_9	8.211	3.515	3.706	4.626	4.947
V_8	593.48	549.05	506.59	491.72	461.92
V_9	401.69	422.00	393.04	382.72	358.63
V_{Z8}	410.73	393.92	380.98	372.43	339.43
V_{Z9}	396.72	420.64	391.95	381.38	357.28
$V_{\theta 8}$	427.78	382.10	333.71	321.01	313.30
$V_{\theta 9}$	57.37	25.87	25.41	30.87	30.92
M_8	.5360	.4940	.4547	.4404	.4123
M_9	.3572	.3760	.3499	.3402	.3180
$\Delta\beta$	37.910	40.587	37.498	36.130	37.760
$\bar{\omega}$	.1574	.0421	.0318	.0609	.0705
$\bar{\omega}\ \mathrm{Cos}\ \beta_9/2\sigma$	.0412	.0123	.0101	.0199	.0244
D	.4841	.4190	.4158	.4138	.4361
η_p	.7364	.9067	.9262	.8524	.8344
i_m	5.37	7.81	8.02	9.51	12.38
i_e	-.83	.02	-1.33	-.92	1.05
$\delta°$	17.68	12.29	12 21	13.23	14.19

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	2'.610	24.510	27.260	29.680
β_5	35.329	[illegible]8.036	22.975	20.165	18.433
β_6	54.134	49.602	44.839	43.493	45.111
β'_5	40.367	47.941	52.985	57.024	60.206
β'_6	-5.249	10.608	25.468	32.480	40.008
V_5	282.44	288.58	294.25	294.72	291.77
V_6	554.46	519.78	481.25	470.52	444.09
V_{Z5}	230.13	254.71	270.80	276.15	275.83
V_{Z6}	324.84	336.86	341.22	341.30	313.40
$V_{\theta 5}$	163.33	135.64	114.85	101.60	92.26
$V_{\theta 6}$	449.33	395.85	339.34	323.84	314.63
V'_5	302.3	380.2	449.9	507.6	555.6
V'_6	326.2	342.7	378.0	404.6	409.2
$V'_{\theta 5}$	-195.6	-282.3	-359.2	-425.6	-481.8
$V'_{\theta 6}$	29.8	-63.1	-162.5	-217.3	-263.1
U_5	358.95	417.94	474.02	527.21	574.01
U_6	419.48	458.94	501.87	541.13	577.69
M_5	.2546	.2602	.2654	.2658	.2632
M_6	4989	.4665	.4311	.4207	.3959
M'_5	.3725	.3429	.4058	.4579	.5011
M'_6	[illegible]	.3076	.3386	.3618	.3648
$\Delta\beta'$	45.580	37.332	27.506	24.496	20.112
$\bar{\omega}$	.1373	.1105	.0893	.1008	.1757
$\bar{\omega}\ \mathrm{Cos}\ \beta'_6/2\sigma$	.0347	.0321	.0269	.0312	.0534
D	.2011	.3206	.3356	.3676	.4234
η_p	.9510	.9572	.9254	.8992	.8020
η_{ad}	.9500	.9361	.9241	.8974	.7988
i_m	7.38	7.71	7.67	7.01	6.62
i_e	.18	1.06	1.77	1.96	2.12
$\delta°$	7.381	7.425	9.548	5.430	4.188

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100$ = 49 9707

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 4432 400

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 70 040

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 13 3639

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 18 6277

TABLE 1-3 BLADE ELEMENT PERFORMANCE AT 50% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.725	29.421	24.227	21.106	18.744
V_2	234.22	229.11	231.60	238.57	249.13
V_3	269.95	264.26	264.61	264.44	264.02
V_{z2}	234.20	229.09	231.58	238.55	249.11
V_{z3}	216.48	230.07	240.74	243.94	243.63
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	157.62	129.81	108.58	95.22	84.84
M_2	.2107	.2061	.2084	.2147	.2243
M_3	.2432	.2380	.2384	.2382	.2378
$\Delta\beta$	-35.73	-29.42	-24.23	-21.11	-18.74
$\bar{\omega}$	.0340	.0124	.0074	.0170	.0218
$\bar{\omega}$ Cos $\beta_3/2\sigma$	.0081	.0038	.0027	.0071	.0101
D	.046	.045	.045	.070	.107
η_p	.9080	.9644	.9768	.9320	.8525
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	2.995	3.569	4.813	5.444	6.656

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	46.929	47.586	43.897	43.646	47.150
β_9	8.625	5.709	4.173	4.687	5.385
V_8	574.06	562.97	492.85	473.16	441.83
V_9	376.95	406.88	360.94	356.22	326.59
V_{z8}	391.49	379.42	355.03	342.36	300.48
V_{z9}	371.97	404.38	352.78	354.95	325.14
$V_{\theta 8}$	419.36	415.63	341.72	326.57	323.92
$V_{\theta 9}$	56.53	40.48	26.26	29.11	30.65
M_8	.5175	.5056	.4414	.4228	.3932
M_9	.3347	.3610	.3204	.3158	.2886
$\Delta\beta$	38.305	41.877	39.724	38.959	41.765
$\bar{\omega}$	.1536	.1222	.0759	.0672	.0808
$\bar{\omega}$ Cos $\beta_9/2\sigma$	.0402	.0356	.0240	.0220	.0280
D	.5064	.4698	.4692	.4518	.4915
η_p	.7486	.7657	.8461	.8537	.8325
i_m	6.18	11.30	10.72	12.40	16.82
i_s	-.02	3.51	1.37	1.97	5.49
$\delta°$	18.09	14.49	12.67	13.29	14.63

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.318	27.979	22.952	20.182	18.475
β_6	54.934	52.932	47.387	46.391	49.741
β'_5	43.653	50.569	55.295	59.137	62.157
β'_6	-4.337	4.980	25.924	33.952	42.456
V_5	264.60	270.67	275.58	275.47	272.36
V_6	540.97	539.28	470.90	455.02	426.24
V_{z5}	215.65	239.03	253.65	258.06	257.40
V_{z6}	310.79	325.06	318.80	313.80	275.44
$V_{\theta 5}$	152.97	126.99	107.46	95.04	86.31
$V_{\theta 6}$	442.77	430.31	346.56	329.46	325.28
V'_5	298.2	376.3	445.6	503.3	551.5
V'_6	311.7	326.3	354.5	378.3	373.3
$V'_{\theta 5}$	-205.7	-290.7	-366.2	-431.8	-487.3
$V'_{\theta 6}$	23.6	-28.3	-155.0	-211.3	-252.0
U_5	358.71	417.65	473.70	526.85	573.62
U_6	419.20	458.63	501.53	540.77	577.29
M_5	.2384	.2439	.2484	.2483	.2454
M_6	.4861	.4833	.4210	.4060	.3789
M'_5	.2687	.3391	.4016	.4536	.4970
M'_6	.2801	.2924	.3170	.3376	.3319
$\Delta\beta'$	47.957	45.588	29.359	25.136	19.617
$\bar{\omega}$	.1357	.1054	.1080	.1252	.2315
$\bar{\omega}$ Cos $\beta'_6/2\sigma$	.0344	.0311	.0323	.0381	.0678
D	.2412	.3920	.3928	.4232	.4960
η_p	.9533	.9493	.9165	.8828	.7594
η_{ad}	.9524	.9482	.9151	.8807	.7554
i_m	10.67	10.34	9.98	9.12	8.57
i_s	3.47	3.69	4.08	4.07	4.07
$\delta°$	8.293	1.800	10.004	6.902	6.636

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 49 9369

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 4429 400

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 65.780

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f}$ = 12 5510

CO CTED FLOW PER UNIT ANNULUS AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_{an}}$ = 17 4947

TABLE 1-4 BLADE ELEMENT PERFORMANCE AT 50% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.804	29.498	24.289	21.132	18.704
V_2	218.11	212.84	214.60	220.19	228.43
V_3	251.92	246.68	246.89	247.05	248.07
V_{Z2}	218.09	212.82	214.58	220.18	228.42
V_{Z3}	201.72	214.58	224.58	228.02	229.23
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	147.37	121.46	101.55	89.06	79.55
M_2	.1961	.1913	.1929	.1980	.2055
M_3	.2268	.2220	.2222	.2224	.2233
$\Delta\beta$	-35.80	-29.50	-24.29	-21.13	-18.70
$\bar{\omega}$	.0362	.0120	.0074	.0176	.0224
$\bar{\omega}\cos\beta_3/2\sigma$	.0086	.0036	.0027	.0073	.0104
D	.044	.040	.039	.059	.085
η_p	.9039	.9667	.9781	.9374	.8909
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.090
$\delta°$	2.916	3.492	4.751	5.418	6.696

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.229	47.814	45.693	46.720	52.266
β_9	7.639	5.897	4.096	5.233	6.677
V_8	571.16	542.86	491.07	465.37	426.50
V_9	368.04	387.85	343.65	321.96	290.14
V_{Z8}	380.10	36[illegible].39	342.98	319.04	261.00
V_{Z9}	364.25	385.51	342.67	320.60	288.17
$V_{\theta 8}$	425.96	402.24	351.42	338.79	337.30
$V_{\theta 9}$	48.92	39.85	24.55	29.37	33.73
M_8	.5141	.4868	.4391	.4149	.3785
M_9	.3263	.3439	.3043	.2845	.2556
$\Delta\beta$	40.590	41.917	41.597	41.487	45.590
$\bar{\omega}$	.1462	.0856	.1036	.1297	.1201
$\bar{\omega}\cos\beta_9/2\sigma$	.0383	.0249	.0328	.0423	.0415
D	.5261	.4784	.5099	.5246	.5671
η_p	.7694	.8387	.8092	.7668	.7949
i_m	7.48	11.52	12.51	15.47	21.94
i_s	1.28	3.73	3.16	5.04	10.61
$\delta°$	17.11	14.68	12.60	13.83	15.92

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.160	27.850	22.862	20.195	18.637
β_6	56.267	53.091	48.908	49.196	54.773
β'_5	46.828	53.115	57.525	61.216	64.157
β'_6	-5.369	7.832	25.118	34.087	35.004
V_5	248.29	254.10	258.34	257.24	253.01
V_6	538.39	520.42	472.66	451.43	414.64
V_{Z5}	202.74	224.67	237.94	240.97	238.97
V_{Z6}	298.98	312.53	310.13	294.94	239.15
$V_{\theta 5}$	142.98	118.70	100.37	88.80	80.85
$V_{\theta 6}$	447.75	416.13	356.65	341.71	338.70
V'_5	296.5	374.3	443.2	500.7	548.5
V'_6	300.3	315.5	342.6	356.2	338.3
$V'_{\theta 5}$	-216.1	-299.4	-373.8	-438.5	-493.4
$V'_{\theta 6}$	28.1	-43.0	-145.4	-199.6	-239.2
U_5	359.09	418.10	474.21	527.41	574.23
U_6	419.65	459.11	502.07	54[illegible].34	577.91
M_5	.2235	.2288	.2327	.2317	.2278
M_6	.4832	.4658	.4221	.4021	.3677
M'_5	.2669	.3370	.3991	.4509	.4939
M'_6	.2695	.2824	.3059	.3172	.3000
$\Delta\beta'$	52.162	45.283	32.394	27.084	19.080
$\bar{\omega}$	.1403	.1186	.1232	.1758	.3013
$\bar{\omega}\cos\beta'_6/2\sigma$	.0355	.0348	.0372	.0534	.0846
D	.2875	.4122	.4294	.4760	.5709
η_p	.9545	.9425	.9119	.8684	.7111
η_{ad}	.9536	.9413	.9103	.8456	.7063
i_m	13.84	12.88	12.21	11.20	10.58
i_s	5.64	6.23	6.31	6.15	6.08
$\delta°$	7.261	4.652	9.198	7.037	9.184

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 49.9899$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 4434.100$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 61.760$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f} = 11.7840$

CORRECTED FLOW PER UNIT ANNULUS AREA $\dfrac{W\sqrt{\theta}/\delta}{A_{an}} = 16.4255$

TABLE 1-5 BLADE ELEMENT PERFORMANCE AT 50% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.819	29.525	24.320	21.127	18.642
V_2	203.46	198.75	200.71	206.51	215.17
V_3	233.54	228.80	228.86	228.89	230.02
V_{Z2}	203.44	198.73	200.70	206.50	215.16
V_{Z3}	186.96	198.97	208.14	211.30	212.63
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	136.67	112.75	94.25	82.50	73.53
M_2	.1829	.1786	.1804	.1856	.1935
M_3	.2101	.2058	.2059	.2059	.2069
$\Delta\beta$	-35.82	-29.52	-24.32	-21.13	-18.64
$\bar{\omega}$	.0375	.0117	.0065	.0183	.0219
$\bar{\omega}$ Cos $\beta_3/2\sigma$	.0089	.0035	.0024	.0076	.0101
D	.050	.047	.048	.070	.098
η_p	.8959	9656	.9792	.9268	.8692
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	2.901	3.465	4.720	5.423	6.758

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	49.471	49.242	47.916	49.853	62.254
β_9	7.765	7.295	5.935	8.679	-1.153
V_8	566.73	542.88	490.43	455.95	456.68
V_9	363.96	365.32	320.23	275.99	265.48
V_{Z8}	367.97	354.32	328.68	293.97	212.60
V_{Z9}	360.19	362.16	318.46	272.82	265.43
$V_{\theta 8}$	430.76	411.22	363.98	348.52	404.17
$V_{\theta 9}$	49.18	46.39	33.11	41.64	-5.34
M_8	.5094	.4862	.4378	.4057	.4034
M_9	.3223	.3230	.2828	.2431	.2323
$\Delta\beta$	41.706	41.947	41.981	41.175	63.407
$\bar{\omega}$	.1124	.1202	.1495	.2166	.2490
$\bar{\omega}$ Cos $\beta_9/2\sigma$	.0295	.0349	.0472	.0701	.0866
D	.5316	.5212	.5594	.6137	.7304
η_p	.8214	.7981	.7552	.7031	.7045
i_m	8.72	12.95	14.74	18.60	31.92
i_s	2.52	5.16	5.39	8.17	20.59
$\delta°$	17.24	16.08	14.44	17.28	8.09

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	[illegible].136	27.795	22.810	20.205	18.667
β_6	[illegible]7.642	54.246	50.803	52.173	64.937
β'_5	50.343	55.893	59.924	63.452	66.245
β'_6	-6.435	6.421	23.851	34.484	42.113
V_5	230.42	236.26	240.08	238.02	2[illegible]3.38
V_6	535.90	524.19	476.95	447.71	449.15
V_{Z5}	188.22	209.00	221.17	222.87	220.27
V_{Z6}	286.81	306.28	301.39	274.53	190.26
$V_{\theta 5}$	132.61	110.17	93.08	82.21	74.70
$V_{\theta 6}$	452.68	425.40	369.63	353.63	406.86
V'_5	295.1	372.7	441.4	498.9	547.1
V'_6	288.6	308.2	329.6	333.1	256.5
$V'_{\theta 5}$	-227.1	-308.6	-381.9	-446.1	-500.5
$V'_{\theta 6}$	32.3	-34.5	-133.3	-188.6	-172.0
U_5	359.68	418.79	474.99	528.28	575.18
U_6	420.34	459.87	502.89	542.23	578.86
M_5	.2073	.2126	.2161	.2142	.2100
M_6	.4804	.4687	.4253	.3980	.3965
M'_5	.2654	.3354	.3972	.4489	.4923
M'_6	.2587	.2756	.2939	.2961	.2264
$\Delta\beta'$	56.746	49.472	36.058	28.917	24.052
$\bar{\omega}$	.1838	.1271	.1512	.2232	.4610
$\bar{\omega}$ Cos $\beta'_6/2\sigma$	.0464	.0374	.0461	.0675	.1358
D	.3365	.4433	.4719	.5361	.7734
η_p	.9436	.9423	.9003	.8213	.6531
η_{ad}	.9424	.9410	.8983	.8179	.6462
i_m	17.36	15.66	14.61	13.43	12.67
i_s	10.1	9.01	8.71	8.38	8.17
$\delta°$	6.195	3.241	7.931	7.434	6.293

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 50.0722$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 4441.400$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 57.340$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 10.9407$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 15.2500$

TABLE 2-1 BLADE ELEMENT PERFORMANCE AT 70% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.654	29.353	24.219	21.151	18.828
V_2	367.42	359.90	364.28	375.77	392.97
V_3	429.12	419.30	419.35	419.38	416.86
V_{Z2}	367.38	359.86	364.24	375.74	392.94
V_{Z3}	344.56	365.34	381.48	386.64	384.42
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	250.13	205.54	172.03	151.33	134.53
M_2	.3327	.3258	.3298	.3405	.3564
M_3	.3902	.3810	.3810	.3811	.3787
$\Delta\beta$	-35.65	-29.35	-24.22	-21.15	-18.83
$\bar{\omega}$	.0315	.0178	.0132	.0152	.0239
$\bar{\omega}\ \mathrm{Cos}\ \beta_3\ 2\sigma$	.0075	.0054	.0048	.0063	.0111
D	.033	.035	.038	.064	.107
η_p	.9242	.9548	.9630	.9446	.8471
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.066	3.637	4.821	5.399	6.572

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	44.029	41.631	39.151	37.361	36.653
β_9	8.597	6.637	5.524	5.550	5.712
V_8	823.22	764.39	727.40	690.40	656.98
V_9	569.86	601.91	576.91	556.58	525.80
V_{Z8}	590.78	570.65	563.75	548.63	527.06
V_{Z9}	562.04	596.88	573.73	553.79	523.15
$V_{\theta 8}$	572.15	507.81	459.25	418.96	392.20
$V_{\theta 9}$	85.18	69.56	55.54	53.83	52.33
M_8	.7517	.6933	.6571	.6216	.5893
M_9	.5057	.5362	.5130	.4945	.4659
$\Delta\beta$	35.432	34.995	33.627	31.812	30.942
$\bar{\omega}$	.1761	.0379	.0535	.0522	.0874
$\bar{\omega}\ \mathrm{Cos}\ \beta_9\ 2\sigma$	.0460	.0110	.0169	.0170	.0303
D	.4602	.3780	.3815	.3659	.3795
η_p	.7179	.9170	.8784	.8713	.7860
i_m	3.28	5.34	5.97	6.11	6.32
i_s	-2.92	-2.45	-3.38	-4.32	-5.01
$\delta°$	18.07	15.42	14.02	14.15	14.95

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.525	28.065	22.909	20.052	18.266
β_6	52.311	47.619	43.265	40.468	39.036
β'_5	37.000	45.142	50.449	54.598	57.976
β'_6	-2.361	13.019	24.923	33.679	40.106
V_5	418.06	428.09	438.08	440.88	436.85
V_6	761.20	713.24	681.53	650.78	625.46
V_{Z5}	339.86	377.74	403.39	413.47	413.47
V_{Z6}	465.36	480.76	496.27	495.06	485.83
$V_{\theta 5}$	242.92	201.41	170.53	151.17	136.92
$V_{\theta 6}$	602.37	526.86	467.10	422.37	393.92
V'_5	425.9	535.5	633.6	714.1	780.5
V'_6	465.8	493.4	547.3	595.0	635.2
$V'_{\theta 5}$	-255.1	-379.6	-488.5	-581.8	-661.1
$V'_{\theta 6}$	19.2	-111.2	-230.6	-329.9	-409.2
U_5	499.02	581.02	659.00	732.93	798.00
U_6	583.17	638.02	697.71	752.29	803.11
M_5	.3798	.3892	.3986	.4012	.3974
M_6	.6894	.6429	.6124	.5834	.5593
M'_5	[illegible]	.4869	.5765	.6499	.7100
M'_6	[illegible]	.4448	.4918	.5334	.5680
$\Delta\beta'$	[illegible]	32.121	25.516	20.874	17.786
$\bar{\omega}$	[illegible]	.0852	.0533	.0510	.0636
$\bar{\omega}\ \mathrm{Cos}\ \beta'_6\ 2\sigma$	.0264	.0246	.0161	.0156	.0193
D	.1599	.2773	.3017	.3101	.3177
η_p	.9590	.9470	.9544	.9443	.9188
η_{ad}	.9576	.9453	.9529	.9426	.9164
i_m	4.02	4.91	5.14	4.58	4.39
i_s	-3.18	-1.74	-0.76	-0.47	-0.11
$\delta°$	10.269	9.839	9.003	6.629	4.286

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}}\ 100 = 69.4701$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 6162.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 100.750$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 19.2234$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 26.7952$

TABLE 2-2 BLADE ELEMENT PERFORMANCE AT 70% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.651	29.352	24.200	21.120	18.787
V_2	354.19	346.43	350.30	361.03	377.04
V_3	412.93	403.48	403.79	404.14	402.72
V_{Z2}	354.15	346.40	350.27	360.99	377.01
V_{Z3}	331.54	351.56	367.35	372.58	371.32
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	240.68	197.77	165.52	145.62	129.70
M_2	.3205	.3133	.3169	.3268	.3417
M_3	.3750	.3662	.3665	.3668	.3655
$\Delta\beta$	-35.65	-29.35	-24.20	-21.12	-18.79
$\bar{\omega}$	.0310	.0171	.0124	.0152	.0235
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0074	.0052	.0045	.0064	.0109
D	.034	.035	.037	.061	.100
η_p	.9241	.9562	.9652	.9458	.8634
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.659	3.638	4.840	5.430	6.613

STATOR

% SPAN	90	70	50	30	10
Dia	22.680	24.480	26.350	28.190	30.000
β_8	45.397	43.062	40.852	40.015	39.255
β_9	8.776	5.433	5.523	6.106	5.994
V_8	803.42	747.88	701.66	681.73	637.66
V_9	534.58	567.87	537.90	524.18	496.07
V_{Z8}	563.14	545.80	530.44	522.03	493.75
V_{Z9}	527.02	564.41	534.95	521.03	493.32
$V_{\theta 8}$	572.02	510.65	458.96	438.35	403.49
$V_{\theta 9}$	81.56	53.77	51.77	55.75	51.80
M_8	.7311	.6763	.6315	.6124	.5697
M_9	.4726	.5038	.4764	.4631	.4376
$\Delta\beta$	36.620	37.629	35.329	33.909	33.261
$\bar{\omega}$	.1609	.0366	.037[illegible]	.0735	.0703
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0421	.0107	.0119	.0239	.0243
D	.4920	.4172	.4160	.4137	.4137
η_p	.7570	.9275	.9201	.8448	.8419
i_m	4.65	6.77	7.67	8.77	8.92
i_s	-1.55	-1.02	-1.68	-1.66	-2.41
$\delta°$	18.25	14.21	14.02	14.71	15.23

ROTOR

SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.442	28.045	22.925	20.079	18.322
β_6	53.552	48.869	44.914	43.029	41.781
β'_5	38.970	46.796	51.916	55.920	59.167
β'_6	-2.367	13.207	26.187	33.256	41.246
V_5	402.98	412.05	421.19	423.79	420.07
V_6	747.70	702.88	661.67	647.45	608.25
V_{Z5}	327.92	363.65	387.78	397.35	397.43
V_{Z6}	444.19	462.34	468.5[illegible]	473.24	453.55
$V_{\theta 5}$	233.68	193.73	164.06	145.50	132.05
$V_{\theta 6}$	601.44	529.42	467.17	441.80	405.27
V'_5	422.1	531.2	628.8	709.5	776.1
V'_6	444.6	474.9	522.2	566.0	603.2
$V'_{\theta 5}$	-265.3	-387.2	-494.8	-587.3	-665.8
$V'_{\theta 6}$	18.4	-108.5	-230.4	-310.4	-397.7
U_5	498.94	580.93	658.89	732.82	797.87
U_6	583.08	637.92	697.60	752.17	802.98
M_5	.3658	.3742	.3828	.3852	.3817
M_6	.6756	.6322	.5929	.5785	.5418
M'_5	.3831	.4824	.5714	.6449	.7053
M'_6	.4017	.4271	.4679	.5057	.5374
$\Delta\beta$	41.304	33.588	25.719	22.618	17.836
$\bar{\omega}$	.0953	.0694	.0688	.0718	.0899
$\bar{\omega}\ \cos\beta'_6\ 2\sigma$	.0242	.0201	.0205	.0220	.0268
D	.2071	.3119	.3396	.3595	.3634
η_p	.9639	.9585	.9431	.9287	.8926
η_{ad}	.9627	.9571	.9413	.9264	.8893
i_m	5.99	6.5[illegible]	6.61	5.90	5.58
i_s	1.21	-0.08	0.71	0.95	1.08
$\delta°$	10.263	10.027	10.267	6.206	5.426

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 69.4588$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 6161.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 96.850$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 18.4793$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 25.7580$

TABLE 2-3 BLADE ELEMENT PERFORMANCE AT 70% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.687	29.387	24.216	21.123	18.789
V_2	337.40	329.83	333.37	343.48	358.69
V_3	392.14	383.09	383.31	383.42	382.04
V_{z2}	337.36	329.79	333.34	343.45	358.66
V_{z3}	314.70	333.67	348.68	353.48	352.26
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	228.76	187.96	157.23	138.17	123.05
M_2	.3050	.2981	.3013	.3106	.3247
M_3	.3557	.3473	.3475	.3476	.3463
$\Delta\beta$	-35.69	-29.39	-24.22	-21.12	-18.79
$\bar{\omega}$	.0307	.0164	.0116	.0156	.0230
$\bar{\omega}$ Cos β_3 2σ	.0073	.0049	.0042	.0065	.0107
D	.038	.038	.039	.064	.103
η_p	.9227	.9570	.9666	.9427	.8597
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.033	3.603	4.824	5.427	6.611

STATOR

% SPAN	90	70	50	30	10
Dia	22.680	24.480	26.350	28.190	30.000
β_8	46.952	45.105	43.251	42.495	43.230
β_9	8.618	5.869	4.511	5.109	5.141
V_8	794.15	747.95	686.35	660.15	625.66
V_9	511.20	542.50	498.29	491.50	458.84
V_{z8}	541.18	527.35	499.66	486.67	455.85
V_{z9}	504.25	538.85	496.35	489.40	456.96
$V_{\theta 8}$	580.35	529.86	470.28	445.94	428.54
$V_{\theta 9}$	76.60	55.48	39.19	43.77	41.12
M_8	.7205	.6743	.6154	.5896	.5560
M_9	.4503	.4789	.4390	.4323	.4021
$\Delta\beta$	38.333	39.230	38.740	37.386	38.089
$\bar{\omega}$	.1531	.0585	.0500	.0559	.0948
$\bar{\omega}$ Cos β_9 /2σ	.0400	.0171	.0158	.0182	.0329
D	.5199	.4579	.4718	.4538	.4819
η_p	.7779	.8953	.9077	.8852	.8162
i_m	6.20	8.82	10.07	11.24	12.90
i_s	.00	1.03	.72	.81	1.57
$\delta°$	18.09	14.65	13.01	13.71	14.38

ROTOR

% SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.395	28.011	22.935	20.114	18.365
β_6	55.173	50.862	47.265	45.533	45.748
β'_5	41.553	48.913	53.810	57.676	60.764
β'_6	-3.632	11.262	26.381	34.410	41.610
V_5	383.43	391.90	399.75	401.39	397.60
V_6	743.01	707.65	651.20	630.14	600.91
V_{z5}	312.19	345.98	368.01	376.25	376.08
V_{z6}	424.32	446.66	441.89	441.36	419.31
$V_{\theta 5}$	222.09	184.05	155.78	138.03	125.27
$V_{\theta 6}$	609.92	548.57	478.30	449.70	430.42
V'_5	417.5	525.4	623.3	704.0	771.1
V'_6	425.2	455.4	493.3	535.0	560.8
$V'_{\theta 5}$	-276.8	-396.8	-503.0	-594.7	-672.5
$V'_{\theta 6}$	26.9	-88.9	-219.2	-302.3	-372.4
U_5	498.86	580.84	658.78	732.70	797.74
U_6	582.99	637.82	697.49	752.05	802.85
M_5	.3476	.3554	.3628	.3643	.3608
M_6	.6697	.6350	.5816	.5610	.5328
M'_5	.3785	.4775	.5656	.6390	.6996
M'_6	.3833	.4087	.4406	.4764	.4972
$\Delta\beta'$	45.156	37.650	27.419	23.223	19.091
$\bar{\omega}'$	.1086	.0665	.0979	.1020	.1432
$\bar{\omega}'$ Cos β'_6 /2σ	.0275	.0193	.0292	.0309	.0425
D	.2569	.3593	.3906	.4065	.4307
η_p	.9617	.9640	.9247	.9046	.8470
η_{ad}	.9603	.9627	.9222	.9014	.8420
i_m	8.57	8.68	8.50	7.66	7.20
i_s	1.37	2.03	2.60	2.61	2.70
$\delta°$	8.998	8.082	10.461	7.360	5.790

PERCENT DESIGN SPEED $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 69.4476$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 6160.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 92.560$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 17.6608$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 24.6170$

TABLE 2-4 BLADE ELEMENT PERFORMANCE AT 70% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.744	29.445	24.262	21.133	18.758
V_2	313.20	306.71	310.20	319.61	333.70
V_3	365.29	356.33	356.09	356.00	355.13
V_{Z2}	313.17	306.69	310.18	319.59	333.68
V_{Z3}	292.94	310.18	323.86	328.33	327.69
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	213.39	175.16	146.32	128.35	114.20
M_2	.2828	.2768	.2800	.2887	.3016
M_3	.3308	.3225	.3223	.3222	.3214
$\Delta\beta$	-35.74	-29.44	-24.26	-21.13	-18.76
$\bar{\omega}$	.0309	.0155	.0107	.0161	.0227
$\bar{\omega}$ Cos $\beta_3/2\sigma$	.0074	.0047	.0039	.0067	.0105
D	.035	.038	.041	.066	.103
η_p	.9237	.9590	.9685	.9397	.8591
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_c	.000	.000	.000	.000	.000
$\delta°$	2.97[illegible]	3.545	4.778	5.417	6.642

STATOR

% SPAN	90	70	50	30	10
Dia	22.680	24.480	26.350	28.190	30.000
β_8	48.386	47.176	45.427	46.744	49.355
β_9	9.083	8.372	5.250	7.722	7.480
V_8	785.31	747.61	681.81	649.95	593.48
V_9	496.73	523.26	468.34	441.32	401.11
V_{Z8}	520.77	507.77	478.35	445.35	386.58
V_{Z9}	489.53	517.07	466.11	437.23	397.68
$V_{\theta 8}$	587.13	548.33	485.69	473.36	450.31
$V_{\theta 9}$	78.42	76.18	42.86	59.30	52.21
M_8	.7102	.6718	.6091	.5772	.5237
M_9	.4362	.4597	.4105	.3851	.3488
$\Delta\beta$	39.303	38.804	40.176	39.023	41.875
$\bar{\omega}$	.1390	.0846	.1006	.1419	.1269
$\bar{\omega}$ Cos $\beta_9/2\sigma$	.0363	.0245	.0318	.0461	.0438
D	.5345	.4824	.5176	.5283	.5573
η_p	.8015	.8562	.8332	.7605	.7876
i_m	7.64	10.89	12.25	15.49	19.02
i_c	1.44	3.10	2.90	5.06	7.69
$\delta°$	18.55	17.15	13.75	16.32	16.72

ROTOR

SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.344	27.941	22.893	20.154	18.476
β_6	56.824	52.867	49.134	49.476	51.765
β'_5	45.113	51.801	56.366	60.108	63.104
β'_6	-4.646	9.444	25.673	34.092	44.663
V_5	357.92	365.73	372.24	371.78	366.60
V_6	737.03	711.92	652.67	627.97	575.76
V_{Z5}	291.63	323.09	342.78	348.37	346.50
V_{Z6}	403.30	429.76	427.00	407.98	356.32
$V_{\theta 5}$	207.05	171.37	144.80	128.09	116.18
$V_{\theta 6}$	616.89	567.57	493.57	477.34	452.25
V'_5	413.5	522.5	618.9	699.3	766.5
V'_6	404.6	435.7	473.8	492.7	501.0
$V'_{\theta 5}$	-292.8	-410.6	-515.3	-606.0	-683.1
$V'_{\theta 6}$	32.8	-71.5	-205.3	-276.2	-352.2
U_5	499.83	581.97	660.07	734.12	799.30
U_6	584.12	639.06	698.84	753.51	804.41
M_5	.3240	.3312	.3372	.3368	.3320
M_6	.6625	.6370	.5813	.5565	.5073
M'_5	.3742	.4731	.5607	.6335	.6941
M'_6	.3637	.3898	.4220	.4366	.4414
$\Delta\beta'$	49.726	42.356	30.682	25.970	18.361
$\bar{\omega}$	.1184	.0676	.0955	.1590	.2329
$\bar{\omega}$ Cos $\beta'_6/2\sigma$	.0300	.0197	.0287	.0483	.0658
D	.3125	.4102	.4319	.4829	.5214
η_p	.9611	.9668	.9330	.8678	.7737
η_{ad}	.9596	.9655	.9306	.8630	.7663
i_m	12.13	11.57	11.06	10.09	9.52
i_c	4.93	4.92	5.16	5.04	5.02
$\delta°$	7.984	6.264	9.753	7.042	8.843

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 69.5829$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 6172.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 86.850$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} =$ [illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} =$ [illegible]

TABLE 2-5 BLADE ELEMENT PERFORMANCE AT 70% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
D_{in}	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.755	29.477	24.290	21.127	18.718
V_2	294.09	287.93	291.20	300.06	313.34
V_3	342.49	333.78	333.24	333.16	332.62
V_{z2}	294.07	287.91	291.18	300.05	313.35
V_{z3}	274.57	290.44	303.06	307.38	307.13
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	200.12	164.25	137.08	120.09	106.71
M_2	.2653	.2596	.2626	.2707	.2829
M_3	.3097	.3017	.3012	.3011	.3002
$\Delta\beta$	-35.76	-29.48	-24.29	-21.13	-18.72
$\bar{\omega}$	.0309	.0146	.0100	.0161	.0224
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0074	.0044	.0036	.0067	.0104
D	.036	.040	.044	.069	.105
η_p	.9226	.9605	.9696	.9374	.8544
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_c	.000	.000	.000	.000	.000
$\delta°$	2.965	3.513	4.750	5.523	6.682

STATOR

% SPAN	90	70	50	30	10
D_{in}	22.680	24.480	26.350	28.190	30.000
β_8	49.912	49.112	47.294	50.034	55.553
β_9	9.392	9.263	7.676	9.820	1.325
V_8	785.41	751.28	677.60	628.18	597.36
V_9	498.97	497.56	441.43	389.89	364.46
V_{z8}	505.14	491.47	459.48	403.49	337.89
V_{z9}	491.46	490.61	437.29	384.13	364.35
$V_{\theta 8}$	600.89	567.96	497.93	481.45	492.62
$V_{\theta 9}$	81.42	80.09	58.96	66.50	8.43
M_8	.7086	.6733	.6037	.5557	.5241
M_9	.4372	.4350	.3853	.3385	.3144
$\Delta\beta$	40.521	39.849	39.618	40.214	54.228
$\bar{\omega}$	.1014	.1231	.1482	.1910	.2062
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0265	.0356	.0466	.0616	.0717
D	.5353	.5251	.5524	.5942	.6717
η_p	.8522	.8137	.7695	.7172	.7021
i_m	9.16	12.82	14.11	18.78	25.22
i_c	2.96	5.03	4.76	8.35	13.89
$\delta°$	18.86	18.04	16.18	18.42	10.56

ROTOR

SPAN	90	70	50	30	10
D_{in}	18.560	21.610	24.510	27.260	29.680
β_5	35.274	27.890	22.851	20.180	18.535
β_6	58.528	54.595	50.676	52.553	57.981
β'_5	48.041	54.181	58.446	62.062	64.929
β'_6	-7.093	6.913	24.771	35.608	44.941
V_5	336.16	343.32	349.00	347.13	341.40
V_6	740.14	720.67	654.51	611.95	583.24
V_{z5}	274.13	303.44	321.46	325.19	322.54
V_{z6}	386.41	417.52	414.74	372.04	309.22
$V_{\theta 5}$	194.13	160.60	135.53	119.75	108.52
$V_{\theta 6}$	631.26	587.40	506.31	485.83	494.51
V'_5	410.2	518.5	614.4	694.4	761.7
V'_6	389.4	420.6	456.8	457.7	436.9
$V'_{\theta 5}$	-304.9	-420.4	-523.5	-613.2	-689.5
$V'_{\theta 6}$	48.1	-50.6	-191.4	-266.5	-308.6
U_5	499.02	581.02	659.00	732.93	798.00
U_6	583.17	638.02	697.71	752.29	803.11
M_5	.3039	.3105	.3157	.3140	.3087
M_6	.6639	.6435	.5817	.5494	.5111
M'_5	.3708	.4689	.5558	.6281	.6887
M'_6	.3493	.3756	.4060	.4041	.3828
$\Delta\beta'$	55.102	47.267	33.662	26.408	19.910
$\bar{\omega}$	.1602	.0873	.1029	.2063	.3216
$\bar{\omega}\ \cos\beta'_6/2\sigma$	.0404	.0256	.0311	.0616	.0904
D	.3612	.4525	.4674	.5386	.6256
η_p	.9510	.9605	.9327	.8371	.7259
η_{ad}	.9491	.9589	.9301	.8313	.7164
i_m	15.06	13.95	13.13	12.05	11.35
i_c	7.86	7.30	7.23	7.00	6.85
$\delta°$	5.537	3.733	8.851	8.558	9.121

PERCENT DESIGN SPEED $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 69.4701$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 6162.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 81.900$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 15.6268$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 2$ [illegible]

TABLE 3-1 BLADE ELEMENT PERFORMANCE AT 90% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

SPAN	90	70	50	30	10
Dia.	17.590	20.720	27.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.521	29.260	24.177	21.157	18.896
V_2	479.47	469.69	475.11	489.66	511.20
V_3	570.90	562.99	559.94	557.80	552.27
V_{Z2}	479.40	469.63	475.05	489.61	511.15
V_{Z3}	465.87	491.05	509.20	513.51	508.26
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	336.34	275.17	229.33	201.33	178.76
M_2	.4376	.4284	.4335	.4473	.4678
M_3	.5331	.5176	.5147	.5126	.5073
$\Delta\beta$	-35.52	-29.26	-24.18	-21.16	-18.89
$\bar{\omega}$	.0318	.0216	.0170	.0149	.0273
$\bar{\omega} \cos\beta_3/2\sigma$	.0076	.0065	.0062	.0062	.0126
D	-.001	.006	.015	.045	.091
η_p	.9403	.9567	.9616	.9563	.8711
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_c	.000	.000	.000	.000	.000
$\delta°$	3.199	3.730	4.863	5.393	6.514

STATOR

SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	44.165	41.751	39.330	37.537	36.121
β_9	8.838	6.681	6.276	7.018	4.103
V_8	1038.88	982.98	939.31	902.14	851.73
V_9	721.81	787.35	754.26	759.02	680.82
V_{Z8}	743.36	732.06	725.83	714.88	687.96
V_{Z9}	711.10	780.39	748.87	752.97	678.99
$V_{\theta 8}$	723.82	654.56	595.32	549.90	502.09
$V_{\theta 9}$	110.89	91.60	82.46	52.74	48.71
M_8	.9602	.8997	.8538	.8158	.7563
M_9	.6374	.7006	.6685	.6737	.5999
$\Delta\beta$	35.328	35.070	33.054	30.538	32.018
$\bar{\omega}$	.2276	.0609	.0892	.0786	.1389
$\bar{\omega} \cos\beta_9/2\sigma$	.0595	.0177	.0282	.0256	.0482
D	.4572	.3643	.3688	.3234	.3857
η_p	.6636	.8722	.8065	.8007	.6651
i_m	3.42	5.46	6.15	6.31	5.79
i_c	-2.78	-2.33	-3.20	-4.12	-5.54
$\delta°$	18.31	15.46	14.78	15.52	13.34

ROTOR

SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.445	27.952	22.790	19.959	18.271
β_6	53.449	49.089	44.715	41.399	38.131
β'_5	34.852	43.477	49.089	53.431	57.077
β'_6	-.675	14.067	25.923	33.673	39.717
V_5	563.08	575.46	587.57	590.20	581.44
V_6	947.47	897.38	860.50	878.26	817.53
V_{Z5}	458.18	508.28	541.58	553.97	550.46
V_{Z6}	564.23	587.68	611.47	628.75	643.06
$V_{\theta 5}$	326.54	269.73	227.60	201.46	182.28
$V_{\theta 6}$	761.12	678.18	605.44	554.34	504.79
V'_5	558.8	700.5	827.1	930.3	1013.7
V'_6	564.3	605.8	679.9	755.6	836.0
$V'_{\theta 5}$	-319.1	-482.0	-625.0	-746.8	-850.1
$V'_{\theta 6}$	6.7	-147.3	-297.2	-418.9	-534.2
U_5	545.60	751.69	852.57	948.22	1032.40
U_6	754.47	825.43	902.66	973.27	1039.01
M_5	.5177	.5297	.5415	.5441	.5356
M_6	.8624	.8105	.7732	.7513	.7321
M'_5	.5138	.6448	.7623	.8576	.9337
M'_6	.5136	.5472	.6109	.6771	.7487
$\Delta\beta'$	35.495	29.408	23.160	19.719	17.280
$\bar{\omega}$	.0618	.0633	.0570	.0459	.0294
$\bar{\omega} \cos\beta'_6/2\sigma$	.0157	.0182	.0171	.0140	.0090
D	.2261	.3264	.3396	.3309	.3024
η_p	.9744	.9607	9530	.9535	.9647
η_{ad}	.9731	.9587	.9506	.9511	.9629
i_m	1.87	3.24	3.78	3.42	[illegible]
i_c	-5.33	-3.41	-2.21	-1.63	-1.20
$\delta°$	11.955	10.887	10.003	6.623	3.897

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}_{DESIGN}} \times 100$ = 89 8760

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 7972 000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 126 000

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 24 [illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 33 5106

TABLE 3-2 BLADE ELEMENT PERFORMANCE AT 90% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.615	29.338	24.222	21.166	18.842
V_2	464.34	454.67	460.07	474.33	495.22
V_3	553.57	539.70	539.40	540.25	537.98
V_{Z2}	464.30	454.63	460.03	474.30	495.18
V_{Z3}	444.72	470.33	490.56	497.72	495.65
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	322.37	264.43	221.30	195.07	173.75
M_2	.4233	.4142	.4193	.4328	.4526
M_3	.5085	.4951	.4949	.4957	.4935
$\Delta\beta$	-35.62	-29.34	-24.22	-21.17	-18.84
$\bar{\omega}$	.0314	.0211	.0164	.0148	.0266
$\bar{\omega}$ Cos $\beta_3/2\sigma$	.0075	.0064	.0060	.0062	.0123
D	.013	.016	.020	.045	.086
η_p	.9360	.9546	.9614	.9563	.8813
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.105	3.652	4.818	5.384	6.558

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	45.661	43.695	41.612	39.961	39.258
β_9	9.394	5.490	5.635	7.483	5.864
V_8	1023.74	962.16	911.50	880.07	836.91
V_9	628.86	683.29	654.01	644.55	622.02
V_{Z8}	714.06	694.75	681.03	674.39	648.01
V_{Z9}	618.76	678.92	650.21	638.80	618.71
$V_{\theta 8}$	732.20	664.67	605.31	565.25	529.61
$V_{\theta 9}$	102.64	65.38	64.21	83.94	63.55
M_8	.9412	.8753	.8229	.7906	.7473
M_9	.5487	.5993	.5719	.5629	.5420
$\Delta\beta$	36.267	38.204	35.977	32.479	33.394
$\bar{\omega}$	.1784	.0544	.0592	.0770	.0836
$\bar{\omega}$ Cos $\beta_9/2\sigma$	.0445	.0159	.0187	.0250	.0289
D	.5443	.4698	.4693	.4455	.4503
η_p	.7896	.9157	.9034	.8659	.8464
i_m	4.91	7.40	8.43	8.71	8.93
i_s	-1.29	-.39	-.92	-1.72	-2.40
$\delta°$	18.86	14.27	14.13	16.08	15.10

ROTOR

% SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.514	28.053	22.872	19.983	18.222
β_6	54.288	50.238	46.383	43.588	42.308
β'_5	37.283	45.429	50.646	54.644	57.950
β'_6	-1.448	13.545	26.162	34.073	41.035
V_5	538.92	551.15	564.85	570.72	566.09
V_6	947.94	895.96	850.67	826.59	790.34
V_{Z5}	438.17	486.38	520.26	535.49	535.97
V_{Z6}	553.30	573.05	586.80	598.67	584.46
$V_{\theta 5}$	313.06	259.20	219.54	195.04	177.02
$V_{\theta 6}$	769.69	688.73	615.86	569.91	531.99
V'_5	551.1	693.1	820.6	925.9	1011.8
V'_6	553.5	589.4	653.8	722.8	774.9
$V'_{\theta 5}$	-333.6	-493.7	-634.4	-754.7	-857.1
$V'_{\theta 6}$	14.0	-138.1	-288.3	-404.9	-508.7
U_5	646.65	752.92	853.96	949.77	1034.09
U_6	755.70	826.78	904.13	974.86	1040.71
M_5	.4944	.5062	.5194	.5251	.5206
M_6	.8607	.8069	.7613	.7371	.7015
M'_5	.5056	.6365	.7546	.8519	.9305
M'_6	.5025	.5309	.5852	.6446	.6877
$\Delta\beta$	38.700	31.883	24.475	20.527	16.862
$\bar{\omega}$	.0438	.0496	.0548	.0382	.0573
$\bar{\omega}$ Cos $\beta'_6/2\sigma$	.0111	.0143	.0164	.0116	.0171
D	.2449	.3519	.3737	.3719	.3743
η_p	.9831	.9712	.9573	.9638	.9372
η_{ad}	.9822	.9696	.9550	.9618	.9338
i_m	4.30	5.20	5.34	4.63	4.40
i_s	-2.90	-1.49	-0.56	-0.42	-0.10
$\delta°$	11.182	10.365	10.242	7.023	5.215

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 90\ 0225$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 7985\ 000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 122\ 600$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 23\ 3925$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 32\ 6064$

TABLE 3-3 BLADE ELEMENT PERFORMANCE AT 90% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.590	29.323	24.205	21.146	18.824
V_2	441.71	432.94	438.19	451.77	471.63
V_3	525.40	512.20	511.95	512.57	510.25
V_{Z2}	441.67	432.90	438.16	451.74	471.60
V_{Z3}	422.28	446.43	465.68	472.36	470.28
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	305.77	250.84	209.90	184.91	164.64
M_2	.4020	.3938	.3987	.4115	.4302
M_3	.4814	.4688	.4685	.4691	.4669
$\Delta\beta$	-35.59	-29.32	-24.20	-21.15	-18.82
$\bar{\omega}$	.0313	.0205	.0157	.0149	.0261
$\bar{\omega}\cos\beta_3/2\sigma$	.0075	.0062	.0057	.0062	.0121
D	.015	.019	.024	.048	.089
η_p	.9346	.9545	.9617	.9542	.8756
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.130	3.667	4.835	5.404	6.576

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.100
β_8	47.673	46.327	43.840	42.717	43.405
β_9	8.862	5.422	5.061	6.156	5.960
V_8	1001.41	954.92	882.51	852.30	820.69
V_9	600.80	647.42	609.81	599.72	582.40
V_{Z8}	672.98	658.56	636.12	626.05	596.23
V_{Z9}	592.06	643.39	606.85	596.03	579.20
$V_{\theta 8}$	740.35	690.69	611.27	578.17	563.93
$V_{\theta 9}$	92.56	61.18	53.80	64.31	60.47
M_8	.9147	.8632	.7915	.7601	.7261
M_9	.5215	.5630	.5298	.5198	.5023
$\Delta\beta$	38.811	40.905	38.779	36.561	37.445
$\bar{\omega}$	.1693	.0929	.0674	.0928	.1134
$\bar{\omega}\cos\beta_9/2\sigma$	.0442	.0271	.0213	.0302	.0393
D	.5670	.5126	.5079	.4926	.5036
η_p	.7929	.8657	.8948	.8427	.8088
i_m	6.92	10.04	10.[illegible]6	11.47	13.07
i_s	.72	2.25	1.31	1.04	1.74
$\delta°$	18.33	14.20	13.56	14.76	15.20

ROTOR

% SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.505	28.022	22.863	19.989	18.226
β_6	56.036	52.601	48.406	46.178	46.304
β'_5	39.918	47.551	52.511	56.357	59.553
β'_6	-2.754	11.307	26.859	34.803	41.071
V_5	511.35	523.28	535.79	540.71	536.13
V_6	939.08	900.25	831.72	808.26	763.25
V_{Z5}	415.81	461.91	493.53	507.31	507.60
V_{Z6}	524.62	546.78	552.11	559.61	541.07
$V_{\theta 5}$	296.98	245.85	208.17	184.84	167.69
$V_{\theta 6}$	778.86	715.17	622.02	583.15	566.30
V'_5	542.5	684.4	811.0	916.1	1002.5
V'_6	525.2	557.6	618.9	681.6	717.7
$V'_{\theta 5}$	-347.9	-505.0	-643.4	-762.3	-863.5
$V'_{\theta 6}$	25.2	-109.3	-279.6	-389.0	-471.5
U_5	644.87	750.84	851.60	947.15	1031.24
U_6	753.62	824.50	901.64	972.17	1037.84
M_5	.4680	.4794	.4914	.4961	.4917
M_6	.8490	.8072	.7408	.7166	.6898
M'_5	.4965	.6270	.7438	.8406	.9195
M'_6	.4749	.4999	.5512	.6043	.6321
$\Delta\beta$	42.641	36.243	25.647	21.511	18.401
$\bar{\omega}$	.0521	.0484	.057[illegible]	.0555	.1087
$\bar{\omega}\cos\beta'_6/2\sigma$	.0132	.0140	.0170	.0167	.0275
D	.2966	.4077	.4165	.4196	.4429
η_p	.9814	.9747	.958[illegible]	.9510	.8934
η_{ad}	.9803	.9732	.9557	.9482	.8874
i_m	6.94	7.32	7.20	6.34	5.97
i_s	-0.26	0.67	1.30	1.29	1.47
$\delta°$	9.876	8.127	10.939	7.753	5.251

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 89.7745$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 7963.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 118.050$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 22.5243$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 31.3963$

TABLE 3-4 BLADE ELEMENT PERFORMANCE AT 90% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.609	29.355	24.230	21.152	18.811
V_2	429.43	420.49	425.40	438.61	457.85
V_3	509.00	495.75	495.04	495.47	493.37
V_{Z2}	429.39	420.46	425.37	438.49	457.82
V_{Z3}	408.99	431.95	450.22	456.60	454.79
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	296.36	243.03	203.17	178.78	159.08
M_2	.3005	.3821	.3867	.3990	.4172
M_3	.4657	.4531	.4524	.4528	.4508
$\Delta\beta$	-35.61	-29.35	-24.23	-21.16	-18.81
$\bar{\omega}$	.0313	.0200	.0152	.0149	.0256
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0075	.0060	.0055	.0062	.0119
D	.018	.023	.028	.053	.093
η_p	.9330	.9544	.9615	.9523	.8717
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.111	3.635	4.810	5.398	6.589

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.514	46.934	44.885	44.229	46.329
β_9	8.117	4.985	4.457	5.749	6.006
V_8	1000.53	952.07	880.48	838.57	807.07
V_9	593.13	621.98	578.45	555.51	537.48
V_{Z8}	661.53	649.31	623.47	600.77	557.28
V_{Z9}	585.72	618.61	570.22	552.53	534.49
$V_{\theta 8}$	749.51	695.57	621.35	584.92	583.77
$V_{\theta 9}$	83.75	54.05	44.49	55.64	56.24
M_8	.9116	.8587	.7875	.7450	.7099
M_9	.5134	.5387	.4946	.4786	.4600
$\Delta\beta$	40.397	41.951	40.428	38.480	40.323
$\bar{\omega}$	.1831	.0695	.0804	.0941	.1155
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0322	.0203	.0254	.0307	.0400
D	.5790	.5415	.5562	.5430	.5612
η_p	.8513	.9049	.8865	.8513	.8247
i_m	7.76	10.65	11.71	12.98	16.00
i_s	1.56	2.86	2.36	2.55	4.67
$\delta°$	17.59	13.76	12.96	14.35	15.25

ROTOR

% SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.450	27.986	22.857	20.021	18.287
β_6	57.046	53.171	49.138	47.393	49.021
β'_5	41.523	48.884	53.727	57.532	60.682
β'_6	-3.776	10.982	26.303	35.180	41.612
V_5	496.26	507.40	518.51	521.79	516.27
V_6	938.98	900.06	835.73	801.93	776.59
V_{Z5}	403.80	448.05	477.62	489.44	488.59
V_{Z6}	510.76	539.52	546.74	542.83	509.26
$V_{\theta 5}$	287.82	238.10	201.41	178.65	162.00
$V_{\theta 6}$	787.90	720.43	632.06	590.23	586.29
V'_5	539.7	681.4	807.4	912.2	998.6
V'_6	511.9	549.6	609.9	664.2	681.1
$V'_{\theta 5}$	-357.5	-513.3	-650.8	-769.2	-870.0
$V'_{\theta 6}$	33.7	-104.7	-270.3	-382.7	-458.3
U_5	645.36	751.41	852.25	947.87	1032.01
U_6	754.19	825.12	902.32	972.90	1038.62
M_5	.4536	.4642	.4748	.4780	.4727
M_6	.8470	.8055	.7429	.7090	.6805
M'_5	.4933	.6233	.7393	.8355	.9143
M'_6	.4617	.4919	.5422	.5872	.5969
$\Delta\beta'$	45.266	37.901	27.414	22.309	18.990
$\bar{\omega}$	.0881	.0593	.0667	.0844	.1646
$\bar{\omega}\ \mathrm{Cos}\,\beta_6/2\sigma$	.0223	.0172	.0199	.0253	.0489
D	.3262	.4224	.4320	.4415	.4875
η_p	.9699	.9700	.9533	.9280	.8473
η_{ad}	.9681	.9681	.9505	.9239	.8386
i_m	8.54	8.65	8.42	7.52	7.10
i_s	1.34	2.00	2.52	2.47	2.60
$\delta°$	8.854	7.802	10.383	8.130	5.798

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 89.6[illegible]

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 7969.000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 115.000

CORRECTED FLOW PER UNIT FRONTAL AREA $\dfrac{W\sqrt{\theta}/\delta}{A_f}$ = [illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA $\dfrac{W\sqrt{\theta}/\delta}{A_{an}}$ [illegible]

TABLE 3-5 BLADE ELEMENT PERFORMANCE AT 90% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.649	29.381	24.253	21.197	18.815
V_2	424.76	416.34	421.34	434.28	453.25
V_3	504.04	491.02	490.20	490.54	488.48
V_{Z2}	424.72	416.31	421.31	434.26	453.22
V_{Z3}	404.82	427.72	445.77	452.11	450.42
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	293.76	240.90	201.36	177.12	157.54
M_2	.3861	.3712	.3829	.3950	.4129
M_3	.4610	.4486	.4478	.4481	.4462
$\Delta\beta$	-35.65	-29.38	-24.25	-21.17	-18.82
$\bar{\omega}$	.0316	.0201	.0153	.0151	.0258
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0075	.0061	.0056	.0063	.0120
D	.017	.023	.028	.053	.093
η_p	.9327	.9542	.9612	.9516	.8711
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_c	.000	.000	.000	.000	.000
$\delta°$	3.071	3.609	4.787	5.383	6.585

STATOR 1

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.874	47.531	45.254	44.953	48.160
β_9	8.206	6.063	5.535	7.106	6.614
V_8	1016.27	963.53	889.10	841.96	803.61
V_9	593.54	627.19	585.20	551.93	524.95
V_{Z8}	667.20	649.84	625.57	595.74	536.04
V_{Z9}	586.06	622.72	582.01	547.53	521.42
$V_{\theta 8}$	765.52	710.74	631.47	594.86	598.69
$V_{\theta 9}$	84.74	66.24	56.45	68.27	60.46
M_8	.9261	.8685	.7947	.7469	.7046
M_9	.5126	.5423	.5053	.4746	.4477
$\Delta\beta$	40.656	41.468	39.719	37.847	41.546
$\bar{\omega}$	.1560	.1023	.0973	.1296	.1441
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0408	.0298	.0307	.0421	.0498
D	.5889	.5424	.5454	.5480	.5795
η_p	.8151	.8607	.8612	.8006	.7862
i_m	8.12	11.24	12.07	13.70	17.83
i_c	1.02	3.45	2.72	3.27	6.50
$\delta°$	17.68	14.84	14.04	15.71	15.85

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.472	27.971	22.634	20.026	18.315
β_6	57.511	53.751	49.506	48.059	50.902
β'_5	42.354	49.276	54.064	57.879	61.039
β'_6	-5.523	9.477	25.461	34.714	41.904
V_5	491.56	503.15	514.20	516.65	510.36
V_6	953.75	912.49	844.39	806.94	774.72
V_{Z5}	399.89	444.36	473.73	484.60	482.95
V_{Z6}	512.28	539.55	548.27	539.29	488.56
$V_{\theta 5}$	285.26	235.99	199.54	176.92	160.37
$V_{\theta 6}$	804.48	735.89	642.15	600.23	601.23
V'_5	538.9	681.1	807.3	911.8	998.2
V'_6	514.7	547.0	607.3	656.1	656.5
$V'_{\theta 5}$	-360.7	-516.2	-653.6	-771.9	-872.7
$V'_{\theta 6}$	49.5	-90.1	-261.1	-373.6	-438.4
U_5	646.00	752.16	853.10	948.82	1033.05
U_6	754.95	625.95	903.22	973.88	1039.66
M_5	.4491	.4601	.4707	.4730	.4670
M_6	.8603	.8162	.7502	.7126	.6769
M'_5	.4924	.6229	.7390	.8348	.9134
M'_6	[illegible]	.4893	.5395	.5794	.5736
$\Delta\beta$	[illegible]	39.798	28.593	23.122	19.057
$\bar{\omega}$	[illegible]	.0553	.0633	.0931	.2023
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0214	.0162	.0190	.0281	.0598
D	.3296	.4339	.4402	.4549	.5186
η_p	.9722	.9730	.9569	.9227	.8179
η_{ad}	.9704	.9713	.9543	.9181	.8075
i_m	9.07	9.04	8.75	7.87	7.46
i_c	1.07	2.39	2.05	2.82	2.96
$\delta°$	7.107	6.297	9.541	7.664	6.084

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100 = 89.9324$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 7977.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 114.450$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 21.8374$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 30.4388$

TABLE 4-1 BLADE ELEMENT PERFORMANCE AT 95% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.591	29.316	24.207	21.162	18.858
V_2	504.03	493.85	500.01	515.77	538.67
V_3	607.01	592.17	592.09	593.18	590.08
V_{Z2}	503.97	493.80	499.97	515.72	538.62
V_{Z3}	487.73	516.15	538.57	546.51	543.57
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	353.27	289.94	242.78	214.14	190.73
M_2	.4610	.4513	.4572	.4722	.4942
M_3	.5606	.5460	.5459	.5470	.5440
$\Delta\beta$	-35.59	-29.32	-24.21	-21.16	-18.86
$\bar{\omega}$	.0322	.0222	.0178	.0151	.0278
$\bar{\omega}\ Cos\ \beta_3/2\sigma$	.0077	.0067	.0065	.0063	.0129
D	.002	.006	.010	.036	.078
η_p	.9393	.9559	.9615	.9596	.8891
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.129	3.574	4.833	5.388	6.542

STATOR 1

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	44.649	41.965	39.587	38.026	36.560
β_9	7.394	6.790	6.849	6.894	5.919
V_8	1085.71	1030.11	982.99	950.62	918.29
V_9	703.74	785.05	745.00	736.95	736.72
V_{Z8}	770.83	764.90	756.99	748.63	737.57
V_{Z9}	695.97	778.08	738.91	731.30	732.71
$V_{\theta 8}$	763.00	688.80	626.41	585.60	546.99
$V_{\theta 9}$	90.57	92.82	88.84	88.46	75.97
M_8	1.0053	.9445	.8943	.8599	.8267
M_9	.6165	.6943	.6558	.6478	.6477
$\Delta\beta$	37.255	35.175	32.738	31.132	30.641
$\bar{\omega}$	.2308	.0976	.1149	.1163	.0998
$\bar{\omega}\ Cos\ \beta_9/2\sigma$	.0605	.0284	.0362	.0378	.0345
D	.5117	.4049	.4141	.3949	.3760
η_p	.7007	.8272	.7932	.7722	.7795
i_m	3.90	5.67	6.41	6.78	6.23
i_s	-2.90	-2.12	-2.94	-3.65	-5.10
$\delta°$	16.86	15.57	15.35	15.49	15.16

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.538	28.022	22.798	19.895	18.126
β_6	52.995	48.730	44.753	42.110	39.793
β'_5	35.245	43.677	49.046	53.137	56.578
β'_6	-.429	14.231	26.259	33.854	39.756
V_5	590.42	605.17	621.67	629.31	624.67
V_6	1004.12	949.33	904.74	880.48	858.40
V_{Z5}	479.92	534.21	572.91	590.81	591.78
V_{Z6}	604.34	626.19	642.47	653.14	659.55
$V_{\theta 5}$	343.18	284.31	240.88	214.15	194.34
$V_{\theta 6}$	801.88	713.52	636.99	590.41	549.39
V'_5	588.1	738.6	874.2	985.4	1075.4
V'_6	604.4	646.0	716.4	786.5	857.9
$V'_{\theta 5}$	-339.1	-510.1	-660.1	-788.0	-896.7
$V'_{\theta 6}$	4.5	-158.8	-317.0	-438.2	-548.7
U_5	682.28	794.41	901.01	1002.11	1091.07
U_6	797.35	872.34	953.95	1028.57	1098.05
M_5	.5443	.5587	.5750	.5825	.5779
M_6	.9165	.8589	.8132	.7882	.7662
M'_5	.5421	.6820	.8085	.9121	.9950
M'_6	.5516	.5845	.6440	.7041	.7658
$\Delta\beta'$	35.645	29.445	22.778	19.239	16.738
$\bar{\omega}$	.0950	.0672	.0570	.0509	.0443
$\bar{\omega}\ Cos\ \beta'_6/2\sigma$	.0241	.0193	.0170	.0155	.0135
D	.2088	.3161	.3409	.3459	.3342
η_p	.9610	.9586	.9533	.9497	.9496
η_{ad}	.9587	.9562	.9506	.9468	.9468
i_m	2.27	3.45	3.74	3.12	2.99
i_s	-4.93	-3.20	-2.16	-1.93	-1.51
$\delta°$	12.201	11.051	10.339	6.804	3.936

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ DESIGN} \times 100 = 94\ 9831$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8425\ 000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 131\ 100$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 25\ 0143$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 34\ 8670$

TABLE 4-2 BLADE ELEMENT PERFORMANCE AT 95% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.584	29.317	24.210	21.163	18.650
V_2	492.12	482.20	488.12	503.36	525.53
V_3	591.76	576.81	576.38	577.32	574.60
V_{Z2}	492.08	482.16	488.08	503.33	525.50
V_{Z3}	475.60	502.77	524.23	531.85	529.31
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	344.35	282.43	236.37	208.42	185.65
M_2	.4496	.4402	.4458	.4603	.4815
M_3	.5456	.5310	.5306	.5315	.5289
$\Delta\beta$	-35.58	-29.32	-24.21	-21.16	-18.85
$\bar{\omega}$	.0320	.0219	.0174	.0160	.0275
$\bar{\omega} \cos\beta_3/2\sigma$	.0077	.0066	.0063	.0063	.0128
D	.004	.008	.013	.038	.080
η_p	.9388	.9558	.9614	.9587	.8874
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.136	3.673	4.930	5.387	6.550

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.120	30.000
β_8	45.646	43.596	41.461	39.940	39.171
β_9	8.381	4.553	4.814	5.987	5.871
	1078.29	1018.63	968.29	934.08	900.31
V_9	642.29	705.15	679.09	675.76	649.16
V_{Z8}	752.26	736.69	725.11	715.98	697.96
V_{Z9}	633.67	701.56	675.99	671.78	645.68
$V_{\theta 8}$	771.02	702.41	641.12	599.67	568.67
$V_{\theta 9}$	93.62	56.53	56.99	70.49	66.40
M_8	.9948	.9293	.8760	.8401	.8047
M_9	.5580	.6162	.5917	.5883	.5629
$\Delta\beta$	37.265	38.998	36.647	33.953	33.300
$\bar{\omega}$	.1693	.0536	.0565	.0572	.1067
$\bar{\omega} \cos\beta_9/2\sigma$	.0443	.0157	.0179	.0186	.0369
D	.5665	.4911	.4806	.4609	.4729
η_p	.8035	.9232	.9144	.9040	.8210
i_m	4.90	7.31	8.28	8.69	8.84
i_s	-1.30	-.48	-1.07	-1.74	-2.49
$\delta°$	17.85	13.38	13.31	14.59	15.11

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.553	28.049	22.835	19.935	18.166
β_6	54.329	50.287	46.489	43.880	42.362
β'_5	36.524	44.771	50.033	54.053	57.420
β'_6	-1.549	13.245	25.808	33.8[illegible]8	39.931
V_5	575.21	588.93	604.34	611.34	606.77
V_6	938.55	946.30	899.35	872.42	847.66
V_{Z5}	467.45	519.74	556.80	573.79	574.69
V_{Z6}	582.27	604.63	619.17	628.78	626.33
$V_{\theta 5}$	334.46	276.93	234.53	208.44	189.17
$V_{\theta 6}$	811.20	727.95	652.25	604.72	571.16
V'_5	582.1	732.1	866.9	978.0	1068.2
V'_6	582.5	621.2	687.8	757.0	816.8
$V'_{\theta 5}$	-346.2	-515.6	-664.3	-791.3	-899.3
$V'_{\theta 6}$	15.7	-142.3	-299.4	-421.4	-524.3
U_5	680.66	792.52	898.87	999.73	1088.48
U_6	795.45	870.27	951.68	1026.13	1095.44
M_5	.5295	.5429	.5579	.5648	.5603
M_6	.9085	.8533	.8052	.7777	.7521
M'_5	.5358	.6748	.8004	.9035	.9865
M'_6	.5300	.5601	.6158	.6748	.7247
$\Delta\beta'$	38.043	31.524	24.216	20.181	17.406
$\bar{\omega}$	.0793	.0628	.0613	.0513	.0600
$\bar{\omega} \cos\beta'_6/2\sigma$	.0201	.0181	.0184	.0156	.0183
D	.2462	.3529	.3768	.3787	.3782
η_p	.9692	.9636	.9528	.9522	.9366
η_{ad}	.9674	.9614	.9500	.9493	.9328
i_m	3.5[illegible]	4.54	4.72	4.04	3.84
i_s	-3.46	-2.11	-1.19	-1.01	-0.68
$\delta°$	[illegible].081	10.065	9.884	6.778	4.111

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 94\ 7576$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8405\ 000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 128\ 700$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f} = 25\ 5564$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_{an}} = 34\ 2287$

TABLE 4-3 BLADE ELEMENT PERFORMANCE AT 95% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.607	29.353	24.235	21.171	18.850
V_2	473.60	464.26	470.15	485.12	507.09
V_3	566.73	551.78	551.22	551.98	548.90
V_{Z2}	473.56	464.23	470.12	485.09	507.06
V_{Z3}	455.34	480.78	501.30	508.59	505.79
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	329.96	270.47	226.27	199.35	177.35
M_2	.4321	.4232	.4288	.4430	.4639
M_3	.5213	.5068	.5063	.5070	.5040
$\Delta\beta$	-35.61	-29.35	-24.24	-21.17	-18.85
$\bar{\omega}$	.0318	.0215	.0168	.0150	.0269
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0076	.0065	.0061	.0063	.0125
D	.009	.015	.020	.046	.089
η_p	.9368	.9544	.9604	.9556	.8753
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
$\delta°$	3.113	3.637	4.805	5.379	6.550

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	47.521	45.825	43.647	42.815	43.355
β_9	8.190	3.943	3.823	4.954	6.133
V_8	1065.30	1010.27	949.96	918.14	883.56
V_9	595.09	657.11	627.46	625.41	606.66
V_{Z8}	717.96	703.08	686.93	673.34	642.43
V_{Z9}	587.44	654.37	625.45	622.83	603.13
$V_{\theta 8}$	785.68	724.57	655.67	624.00	606.58
$V_{\theta 9}$	84.78	45.19	41.84	54.01	64.81
M_8	.9766	.9156	.8535	.8191	.7813
M_9	.5129	.5687	.5419	.5388	.5199
$\Delta\beta$	39.330	41.881	39.824	37.861	37.222
$\bar{\omega}$	.1840	.0750	.0742	.0775	.1020
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0482	0219	.0235	.0253	.0353
D	.6113	.5441	.5430	.5209	.5265
η_p	.7957	.9012	.8960	.8801	.8425
i_m	6.77	9.53	10.47	11.56	13.02
i_o	.57	1.74	1.12	1.13	1.69
$\delta°$	17.66	12.72	12.32	13.55	15.37

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.518	28.044	22.845	19.960	18.182
β_6	56.111	52.234	48.334	46.516	46.551
β'_5	38.980	46.826	51.853	55.745	58.992
β'_6	-2.831	11.967	25.889	33.868	40.390
V_5	551.58	563.95	578.03	583.74	578.91
V_6	995.05	949.32	893.18	867.56	838.82
V_{Z5}	448.44	497.71	532.51	547.78	548.22
V_{Z6}	554.81	581.40	593.75	596.97	576.85
$V_{\theta 5}$	320.45	265.14	224.41	199.27	180.64
$V_{\theta 6}$	826.01	750.45	667.24	629.48	608.97
V'_5	577.3	727.4	862.2	973.7	1065.1
V'_6	555.5	594.3	660.0	719.0	757.4
$V'_{\theta 5}$	-362.9	-530.5	-678.0	-804.4	-912.1
$V'_{\theta 6}$	27.4	-123.2	-288.2	-400.7	-490.8
U_5	683.34	795.63	902.40	1003.65	1092.75
U_6	798.58	873.68	955.42	1030.16	1099.75
M_5	.5066	.5186	.5322	.5378	.5331
M_6	.9012	.8521	.7958	.7684	.7373
M'_5	.5302	.6689	.7939	.8971	.9808
M'_6	.5031	.5334	.5880	.6368	.6657
$\Delta\beta'$	41.779	34.858	25.954	21.834	18.520
$\bar{\omega}$	.0876	.0639	.0639	.0744	.1234
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0222	.0185	.0192	.0227	.0373
D	.2994	.3998	.4154	.4278	.4495
η_p	.9684	.9660	.9540	.9363	.8824
η_{ad}	.9664	.9638	.9511	.9322	.8750
i_m	6.00	6.59	6.54	5.73	5.41
i_s	-1.20	-0.06	0.64	0.68	0.91
$\delta°$	9.799	8.787	9.969	6.818	4.570

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100$ = 95 1297

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 8438 000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 124 900

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 23 8313

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 33 2181

TABLE 4-4 BLADE ELEMENT PERFORMANCE AT 95% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
D_{io}	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.604	29.358	24.240	21.166	18.834
V_2	454.59	445.35	450.75	464.81	485.44
V_3	541.98	527.57	526.97	527.76	525.42
V_{z2}	454.55	445.32	450.72	464.78	485.42
V_{z3}	435.51	459.67	479.21	486.26	494.17
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	315.53	258.65	216.35	190.56	169.62
M_2	.4141	.4054	.4105	.4238	.4433
M_3	.4973	.4835	.4829	.4837	.4814
$\Delta\beta$	-35.60	-29.36	-24.24	-21.17	-18.03
$\bar{\omega}$	.0312	.0208	.0160	.0148	.0262
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0074	.0063	.0058	.0062	.0122
D	.012	.018	.023	.048	.089
η_p	.9362	.95 5	.9614	.9551	.8772
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	[illegible]
$\delta°$	5.116	3.632	4.800	5.384	6.566

ROTOR

SPAN	90	70	50	30	10
D_{io}	18.560	21.610	24.510	27.260	29.680
β_5	35.512	28.031	22.848	19.993	18.247
β_6	58.312	53.834	49.551	47.751	49.593
β'_5	41.070	48.513	53.333	57.125	60.282
β'_6	-6.356	10.281	25.817	34.854	40.791
V_5	527.59	539.52	552.59	557.08	551.78
V_6	1003.25	951.22	884.88	848.61	828.88
V_{z5}	428.95	476.21	509.06	522.64	522.33
V_{z6}	526.98	561.34	574.07	570.52	537.28
$V_{\theta 5}$	306.46	253.55	214.57	190.47	172.77
$V_{\theta 6}$	853.68	767.93	673.38	628.16	631.16
V'_5	569.3	718.9	852.6	963.3	1054.5
V'_6	530.3	570.5	637.7	695.3	709.7
$V'_{\theta 5}$	-373.8	-538.5	-683.8	-808.7	-915.1
$V'_{\theta 6}$	58.7	-101.8	-277.7	-397.4	-463.6
U_5	680.26	792.05	898.34	999.13	1087.83
U_6	791.98	869.75	951.12	1025.52	1094.79
M_5	.4835	.4950	.5076	.5119	.5068
M_6	.9952	.8509	.7858	.7491	.7242
M'_5	.5218	.6595	.7831	.8852	.9685
M'_6	.4785	.5103	.5064	.5137	.6201
$\Delta\beta'$	47.393	38.231	27.506	22.228	19.410
$\bar{\omega}$	.1708	.0805	.0677	.0838	.1691
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0431	.0235	.0203	.0252	.0508
D	.3530	.3379	.4411	.4490	.5005
η_p	.9436	.9600	.9536	.9302	.8491
η_{ad}	.9399	.9573	.9506	.9257	.8394
i_m	8.09	8.28	8.02	7.11	6.70
i_s	0.89	1.63	2.12	2.06	2.20
$\delta°$	6.274	7.101	9.897	7.804	4.971

STATOR

% SPAN	90	70	50	30	10
D_i	22.680	24.480	26.350	28.190	30.000
β_8	50.055	47.707	45.142	44.320	46.607
β_9	7.931	4.700	4.802	7.465	7.627
V_8	1060.95	1002.79	933.89	890.[illegible]2	865.06
V_9	583.78	634.59	605.37	587.31	570.28
V_{z8}	679.80	673.92	658.30	636.91	594.28
V_{z9}	576.65	631.34	602.67	582.11	565.18
$V_{\theta 8}$	813.39	741.78	661.99	622.10	628.61
$V_{\theta 9}$	80.55	51.99	50.68	76.31	75.69
M_8	.9668	.9043	.8353	.7906	.7594
M_9	.5003	.5461	.5208	.5037	.4850
$\Delta\beta$	42.124	43.008	40.340	36.854	38.980
$\bar{\omega}$	.1598	.0932	.0772	.0882	.1291
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0419	.0272	.0244	.0286	.0445
D	.6282	.5661	.5579	.5399	.5629
η_p	.8252	.8811	.8940	.8618	.8107
i_m	9.30	11.42	11.96	13.07	16.28
i_s	3.10	3.63	2.61	2.64	4.95
$\delta°$	17.40	13.48	13.30	16.07	16.87

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100 = 94.7012$

CORRECTED ROTOR SPEED $N/\sqrt{\theta} = 8400.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 120.600$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f} = 23.0109$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_{an}} = 32.07$

TABLE 4-5 BLADE ELEMENT PERFORMANCE AT 95% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.580	29.349	24.240	21.159	18.816
V_2	442.78	433.81	438.98	452.52	472.39
V_3	528.41	513.79	512.56	513.04	510.94
V_{z2}	442.74	433.78	438.95	452.49	472.37
V_{z3}	424.81	447.72	466.05	472.65	470.83
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	307.45	251.83	210.44	185.19	164.79
M_2	.4030	.3946	.3994	.4122	.4309
M_3	.4843	.4703	.4691	.4696	.4676
$\Delta\beta$	-35.58	-29.35	-24.24	-21.16	-18.82
$\bar{\omega}$	.0312	.0204	.0156	.0148	.0260
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0074	.0062	.0057	.0062	.0120
D	.011	.018	.025	.049	.089
η_p	.9363	.9551	.9617	.9544	.8767
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.140	3.641	4.800	5.391	6.584

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	51.102	48.957	45.925	45.772	48.875
β_9	7.345	5.029	4.947	6.943	5.735
V_8	1067.25	1011.55	929.66	878.72	847.66
V_9	602.21	635.20	589.81	554.66	538.47
V_{z8}	668.74	663.33	646.25	612.80	557.50
V_{z9}	595.67	631.64	587.06	550.38	535.73
$V_{\theta 8}$	830.60	762.93	667.90	629.66	638.52
$V_{\theta 9}$	76.98	55.68	50.86	67.05	53.81
M_8	.9703	.9098	.8294	.7773	.7405
M_9	.5154	.5447	.5058	.4734	.4557
$\Delta\beta$	43.757	43.928	40.978	38.829	43.139
$\bar{\omega}$	.1520	.1179	.1225	.1582	.1812
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0399	.0344	.0388	.0514	.0627
D	.6182	.5742	.5746	.5772	.6045
η_p	.8297	.8530	.8349	.7684	.7435
i_m	10.35	12.67	12.75	14.52	18.54
i_s	4.15	4.88	3.40	4.09	7.21
$\delta°$	16.81	13.81	13.45	15.54	14.98

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.485	28.008	22.837	20.013	18.286
β_6	59.577	55.181	50.109	48.823	51.661
β'_5	42.396	49.609	54.323	58.076	61.182
β'_6	-8.513	8.260	25.593	35.097	41.427
V_5	514.35	525.67	537.69	540.87	539.01
V_6	1011.13	962.61	885.54	844.11	817.61
V_{z5}	418.32	464.08	495.38	507.38	506.34
V_{z6}	511.99	549.64	567.89	555.71	507.11
$V_{\theta 5}$	298.58	246.86	208.69	185.10	167.87
$V_{\theta 6}$	871.91	790.27	679.45	635.34	641.32
V'_5	566.8	716.2	849.5	959.9	1051.2
V'_6	517.7	555.4	629.7	679.3	680.6
$V'_{\theta 5}$	-381.9	-545.5	-690.0	-814.4	-920.4
$V'_{\theta 6}$	76.6	-79.8	-272.0	-390.5	-953.9
U_5	680.50	792.33	898.66	999.49	1088.22
U_6	795.26	870.06	951.46	1025.89	1095.18
M_5	.4708	.4817	.4932	.4963	.4906
M_6	.9104	.8590	.7850	.7431	.7116
M'_5	.5189	.6562	.7792	.8808	.9640
M'_6	.4661	.4956	.5582	.5980	.5923
$\Delta\beta'$	50.876	41.340	28.721	22.938	19.277
$\bar{\omega}$	.2272	.1112	.0716	.1030	.2107
$\bar{\omega}\ \cos\beta'_6/2\sigma$	.0571	.0326	.0215	.0309	.0623
D	.3843	.4691	.4532	.4686	.5329
η_p	.9286	.9477	.9525	.9168	.8170
η_{ad}	.9237	.9441	.9493	.9114	.8051
i_m	9.41	9.38	9.01	8.06	7.60
i_s	2.21	2.73	3.11	3.01	3.10
$\delta°$	4.117	5.080	9.673	8.047	6.007

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 94.7751$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8403.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 118.000$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 77.5148$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 31.3830$

TABLE 5-1 BLADE ELEMENT PERFORMANCE AT 100% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.563	29.318	24.233	21.183	18.860
V_2	519.36	509.62	516.38	532.76	556.34
V_3	631.28	614.92	614.21	615.53	612.84
V_{z2}	519.30	509.57	516.31	532.72	556.30
V_{z3}	507.49	535.98	550.57	567.04	564.61
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	367.15	301.10	252.10	222.42	198.11
M_2	.4756	.4663	.4727	.4885	.5112
M_3	.5845	.5683	.5676	.5689	.5663
$\Delta\beta$	-35.56	-29.32	-24.23	-21.18	-18.86
$\bar{\omega}$	.0328	.0232	.0186	.0154	.0287
$\bar{\omega}\cos\beta_3/2\sigma$	.0078	.0070	.0068	.0064	.0133
D	-.007	-.000	.006	.031	.073
η_p	.9419	.9562	.9613	.9605	.8931
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
δ°	3.157	3.672	4.807	5.367	6.540

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.[illegible]90	30.000
β_8	44.800	42.138	39.885	38.716	38.666
β_9	7.439	4.554	4.942	5.044	6.815
V_8	1120.06	1066.22	1022.60	982.43	952.51
V_9	721.33	785.88	748.17	723.76	737.15
V_{z8}	793.13	789.57	784.12	766.35	743.70
V_{z9}	713.31	781.95	745.55	720.65	731.86
$V_{\theta 8}$	789.23	715.35	655.74	614.47	595.10
$V_{\theta 9}$	93.40	62.39	52.73	63.63	87.47
M_8	1.0382	.9780	.9303	.8871	.8529
M_9	.6300	.6913	.6548	.6312	.6416
$\Delta\beta$	37.360	37.584	35.843	33.672	31.851
$\bar{\omega}$	.2506	.0924	.1193	.1547	.1214
$\bar{\omega}\cos\beta_9/2\sigma$	.0657	.0270	.0378	.0505	.0419
D	.5163	.4399	.4541	.4458	.4113
η_p	.6816	.8525	.8060	.7347	.7634
i_m	4.05	5.85	6.71	7.47	8.34
i_o	-2.15	-1.94	-2.64	-2.96	-2.99
δ°	16.91	13.33	12.94	13.64	16.05

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.880
β_5	35.560	27.963	22.747	19.857	18.184
β_6	53.520	49.215	45.116	42.801	[illegible]
β'_5	35.690	44.015	49.316	53.385	56.082
β'_6	.509	15.081	26.550	34.377	39.882
V_5	613.37	628.23	646.92	654.78	[illegible]
V_6	1032.06	97[illegible].29	941.78	912.07	891.44
V_{z5}	498.46	555.60	596.30	614.82	618.37
V_{z6}	613.58	639.69	664.59	669.15	661.96
$V_{\theta 5}$	356.71	295.34	250.14	222.30	201.82
$V_{\theta 6}$	829.85	741.49	667.27	619.71	597.52
V'_5	614.2	772.6	916.0	1031.4	1128.6
V'_6	613.6	662.5	743.0	810.8	862.1
$V'_{\theta 5}$	-358.0	-536.9	-693.8	-827.4	-941.2
$V'_{\theta 6}$	-5.4	-172.4	-332.1	-457.8	-552.7
U_5	714.76	832.22	943.90	1049.80	1143.60
U_6	835.30	913.86	999.35	1077.53	1156.71
M_5	.5668	.5824	.6000	.6078	[illegible]
M_6	.9414	.8851	.8457	.8148	.7711
M'_5	.5675	.7152	.8486	.9574	1.0442
M'_6	.5597	.5980	.6672	.7243	.7650
$\Delta\beta'$	35.153	28.937	22.786	18.964	16.857
$\bar{\omega}'$	.0906	.0625	.0508	.0522	[illegible]
$\bar{\omega}'\cos\beta'_6/2\sigma$	.0230	.0179	.0181	.0156	.0256
D	.2347	.3320	.3494	.3592	.3797
η_p	.9629	.9619	.9594	.9498	.9111
η_{ad}	.9606	.9595	.9569	.9467	.9055
i_m	2.71	3.79	4.01	3.37	3.24
i_o	-4.49	-2.86	-1.89	-1.66	-1.26
δ°	13.1[illegible]3	11.901	10.630	7.327	4.842

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 99 5039

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 8826 000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 134 700

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 3[illegible] 3012

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 35 8245

TABLE 5-2 BLADE ELEMENT PERFORMANCE AT 100% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.568	29.331	24.234	21.176	18.849
V_2	506.65	496.76	503.11	519.04	542.10
V_3	612.20	596.16	595.57	596.01	594.15
V_{Z2}	506.60	496.72	503.07	519.00	542.07
V_{Z3}	492.12	519.57	541.61	549.62	547.42
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	356.10	292.03	244.46	215.59	191.96
M_2	.4635	.4541	.4601	.4753	.4975
M_3	.5657	.5499	.5493	.5506	.5480
$\Delta\beta$	-35.57	-29.33	-24.23	-21.18	-18.85
$\bar{\omega}$	.0324	.0225	.0180	.0152	.0281
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0077	.0068	.0066	.0063	.0130
D	-.001	.005	.011	.036	.077
η_p	.9402	.9557	.9609	.9593	.8889
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
$\delta°$	3.152	3.659	4.806	5.374	6.551

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.573	28.0[illegible]	22.786	19.896	18.147
β_6	55.347	51.215	47.214	45.242	45.174
β'_5	37.591	45.612	50.719	54.671	58.019
β'_6	-1.303	13.538	26.137	33.940	40.088
V_5	594.68	609.38	626.17	633.37	627.87
V_6	1036.21	986.63	940.56	914.15	887.54
V_{Z5}	483.17	537.86	577.11	594.60	594.74
V_{Z6}	589.17	618.02	638.86	643.62	625.6[illegible]
$V_{\theta 5}$	345.95	286.42	242.51	215.55	195.55
$V_{\theta 6}$	852.40	769.09	690.27	649.12	629.49
V'_5	610.2	768.9	911.6	1028.8	1123.9
V'_6	589.3	635.7	711.7	775.8	817.3
$V'_{\theta 5}$	-372.0	-549.5	-705.6	-838.9	-952.5
$V'_{\theta 6}$	13.4	-148.8	-313.5	-433.2	-525.9
U_5	717.92	835.89	948.07	1054.44	1148.05
U_6	838.99	917.90	1003.77	1082.29	1155.40
M_5	.5485	.5629	.5794	.5865	.5811
M_6	.7412	.8877	.8481	.8116	.7818
M'_5	[illegible]	.7102	.843[illegible]	.95[illegible]7	1.0402
M'_6	[illegible]	.5720	.6357	.6864	.7197
Vi	[illegible]	32.073	24.572	20.688	17.888
$\bar{\omega}$	.1364	.0750	.0589	.0658	.1888
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0270	.0216	.0176	.0200	.0331
D	.2838	.3781	.3926	.4046	.4270
η_p	.9598	.9580	.9564	.9422	.8947
η_{ad}	.9571	.9552	.9539	.9382	.8875
i_m	4.61	5.38	5.41	4.61	4.46
i_o	-2.89	-1.27	-0.49	-0.39	-0.07
$\delta°$	11.327	10.358	10.217	6.890	4.228

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	46.761	44.563	42.220	41.229	41.779
β_9	8.143	3.860	3.511	4.555	5.912
V_8	1112.88	1057.99	1009.77	976.36	940.69
V_9	615.12	689.07	672.49	673.28	647.21
V_{Z8}	760.81	753.80	747.30	734.13	701.47
V_{Z9}	607.27	686.25	670.56	670.88	643.70
$V_{\theta 8}$	810.74	742.39	678.54	643.49	626.74
$V_{\theta 9}$	87.13	46.39	41.18	53.47	66.66
M_8	1.0250	.9634	.9118	.8750	.8347
M_9	.5292	.5944	.5810	.5804	.5543
$\Delta\beta$	38.618	40.703	38.709	36.674	35.868
$\bar{\omega}$	.1973	.0651	.0569	.0527	.0977
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0517	.0190	.0180	.0172	.0338
D	.6152	.5390	.5328	.5072	.5189
η_p	.7880	.9166	.9225	.9184	.8528
i_m	6.01	8.27	9.04	9.98	11.45
i_o	-.19	.48	-.31	-.45	.12
$\delta°$	17.61	12.64	12.01	13.16	15.15

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100 = 99.9436$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8865.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 131.900$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 35.1670$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 39.0798$

TABLE 5-3 BLADE ELEMENT PERFORMANCE AT 100% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.588	29.345	24.241	21.179	18.852
V_2	490.01	480.33	486.40	501.76	524.12
V_3	588.82	573.41	572.89	574.14	571.60
V_{z2}	489.97	480.31	486.37	501.73	524.09
V_{z3}	473.22	499.66	520.95	528.9	526.65
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	342.66	281.01	235.22	207.42	184.70
M_2	.4476	.4385	.4442	.4588	.4802
M_3	.5427	.5277	.5272	.5284	.5260
$\Delta\beta$	-35.59	-29.35	-24.24	-21.18	-18.85
$\bar{\omega}$	.0321	.0219	.0174	.0150	.0274
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0077	.0066	.0063	.0063	.0127
D	.005	.011	.016	.041	.082
η_p	.9393	.9551	.9607	.9578	.984[illegible]
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
$\delta°$	3.132	3.645	4.799	5.371	6.548

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.556	46.878	44.553	43.854	45.472
β_9	6.974	3.765	3.406	5.305	6.534
V_8	1059.34	1049.55	988.16	957.17	941.52
V_9	588.69	649.77	631.49	631.95	619.92
V_{z8}	7[illegible]6.15	716.46	703.69	690.06	660.23
V_{z9}	582.74	647.16	629.75	628.99	615.83
$V_{\theta 8}$	824.07	766.07	693.27	663.15	671.21
$V_{\theta 9}$	71.48	42.89	37.51	58.43	70.55
M_8	1.0064	.9494	.8859	.8513	.8278
M_9	.5037	.5576	.5416	.5402	.5251
$\Delta\beta$	41.582	43.094	41.147	38.549	38.938
$\bar{\omega}$	.1849	.0941	.0715	.0807	.1423
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0485	.0275	.0227	.0263	.0492
D	.6415	.5802	.5700	.5455	.5633
η_p	.8042	.8854	.9071	.8812	.7988
i_m	7.81	10.59	11.37	12.60	15.14
i_o	1.61	2.80	2.02	2.17	3.81
$\delta°$	16.44	12.56	11.91	13.91	15.77

ROTOR

% SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.559	28.049	22.823	19.930	18.167
β_6	56.984	53.216	49.183	47.625	48.752
β'_5	39.546	47.235	52.154	55.972	59.188
β'_6	-2.926	11.745	26.022	33.988	39.113
V_5	572.41	586.03	601.60	608.36	603.48
V_6	1033.54	990.56	931.68	905.86	895.89
V_{z5}	465.15	517.18	554.31	570.99	571.55
V_{z6}	563.13	593.15	608.96	610.48	590.66
$V_{\theta 5}$	332.88	275.57	233.35	207.37	188.15
$V_{\theta 6}$	866.64	793.33	705.10	669.21	673.59
V'_5	603.6	761.7	903.6	1020.9	1116.8
V'_6	563.9	605.8	677.7	736.3	761.3
$V'_{\theta 5}$	-384.1	-559.2	-713.4	-845.6	-958.3
$V'_{\theta 6}$	28.8	-123.3	-297.3	-411.6	-480.2
U_5	716.95	834.76	946.78	1053.01	1146.49
U_6	837.85	916.65	1002.41	1080.83	1153.83
M_5	.5268	.5400	.5552	.5619	.5571
M_6	.9350	.8874	.8280	.7995	.7827
M'_5	.5555	.7019	.8340	.9429	1.0309
M'_6	.5111	.5427	.6023	.6499	.6651
$\Delta\beta'$	42.441	35.489	26.123	21.941	19.994
$\bar{\omega}$	.1328	.0833	.0708	.0836	.1530
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0337	.0241	.0212	.0254	.0471
D	.3297	.4253	.4337	.4489	.4919
η_p	.9530	.9569	.9507	.9312	.8663
η_{ad}	.9498	.9538	.9473	.9263	.8566
i_m	6.56	7.00	6.84	5.96	5.61
i_o	-0.64	0.35	0.94	0.91	1.11
$\delta°$	9.704	8.565	10.102	6.958	3.243

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 99.8083

CORRECTED ROTOR SPEED $N/\sqrt{\theta}$ = 8851.000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 128.100

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 24.499[illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 34.1489

TABLE 5-4 BLADE ELEMENT PERFORMANCE AT 100% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.562	29.330	24.229	21.163	18.844
V_2	475.03	465.47	471.16	485.91	507.55
V_3	569.61	554.15	553.05	553.79	550.89
V_{z2}	474.99	465.44	471.14	485.88	507.53
V_{z3}	458.02	482.98	502.31	510.15	507.50
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	331.27	271.44	226.96	199.93	177.93
M_2	.4534	.4244	.4298	.4437	.4643
M_3	.5240	.5091	.5080	.5087	.5059
$\Delta\beta$	-35.56	-29.33	-24.23	-21.16	-18.84
$\bar{\omega}$	.0317	.0215	.0169	.0149	.0270
$\bar{\omega} \cos\beta_3/2\sigma$	.0076	.0065	.0081	.0062	.0125
D	.007	.013	.019	.044	.066
η_p	.9378	.9548	.9607	.9564	.8789
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
$\delta°$	3.158	3.660	4.811	5.387	6.556

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	49.972	48.549	46.252	46.015	49.006
β_9	6.638	4.073	3.436	6.163	4.429
V_8	1100.62	1050.63	978.34	924.69	947.47
V_9	604.97	640.42	596.83	581.34	586.72
V_{z8}	706.35	694.53	676.02	642.01	613.98
V_{z9}	599.25	637.61	595.14	577.74	584.91
$V_{\theta 8}$	842.78	787.47	706.74	665.33	721.60
$V_{\theta 9}$	69.93	45.48	35.77	62.41	45.31
M_8	1.0035	.9460	.8726	.8171	.8253
M_9	.5163	.5467	.5085	.4935	.4909
$\Delta\beta$	43.334	44.476	42.815	39.852	45.176
$\bar{\omega}$	.1456	.0980	.1238	.1154	.2266
$\bar{\omega} \cos\beta_9/2\sigma$	.0383	.0286	.0392	.0376	.0786
D	.6319	.5947	.6060	.5836	.6289
η_p	.8420	.8825	.8441	.8193	.6987
i_m	9.22	12.26	13.07	14.76	19.28
i_o	3.02	4.47	3.72	4.33	7.95
$\delta°$	16.11	12.85	11.94	14.76	13.67

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.514	28.031	22.839	19.975	18.197
β_6	58.569	54.898	50.599	49.376	52.416
β'_5	41.281	48.690	53.486	57.240	69.342
β'_6	-5.077	10.009	25.645	35.464	37.781
V_5	553.89	566.34	580.07	585.19	580.55
V_6	1038.55	997.01	930.56	884.09	912.16
V_{z5}	450.33	499.88	534.42	549.10	549.74
V_{z6}	541.56	573.32	590.65	575.59	556.34
$V_{\theta 5}$	321.76	266.15	225.15	199.91	181.30
$V_{\theta 6}$	886.16	815.68	719.06	671.02	722.84
V'_5	599.6	757.3	898.3	1015.2	1111.9
V'_6	543.7	582.2	655.2	706.7	703.9
$V'_{\theta 5}$	-395.3	-568.8	-721.8	-853.3	-965.5
$V'_{\theta 6}$	48.1	-101.2	-283.6	-410.1	-431.2
U_5	717.11	834.95	947.00	1053.25	1146.75
U_6	838.04	916.86	1002.64	1081.07	1154.09
M_5	.5088	.5209	.5342	.5392	.5347
M_6	.9363	.8899	.8240	.7767	.7909
M'_5	.5509	.6965	.8272	.9354	1.0240
M'_6	.4902	.5196	.5802	.6209	.6103
$\Delta\beta$	46.325	38.680	27.831	21.734	22.482
$\bar{\omega}$	.1690	.1022	.0755	.1098	.2128
$\bar{\omega} \cos\beta_6/2\sigma$	.0428	.0298	.0227	.0328	.0668
D	.3721	.4658	.4637	.4783	.5613
η_p	.9438	.9505	.9502	.9118	.8308
η_{ad}	.9398	.9468	.9465	.9056	.8176
i_m	8.30	8.46	8.18	7.23	6.76
i_o	1.10	1.81	2.28	2.18	2.26
$\delta°$	7.553	6.829	9.725	8.414	1.961

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.8109$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8855.000$

CORRECTED WEIGHT FLOW, $w\sqrt{\theta}/\delta = 125.100$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{w\sqrt{\theta}/\delta}{A_f} = 23.8695$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{w\sqrt{\theta}/\delta}{A_{an}} = 33.2713$

TABLE 5-5 BLADE ELEMENT PERFORMANCE AT 100% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.551	29.309	24.211	21.158	18.859
V_2	466.30	456.78	462.20	476.45	497.46
V_3	558.98	543.68	542.22	542.38	539.02
V_{Z2}	466.27	456.75	462.17	476.43	497.44
V_{Z3}	449.58	473.96	493.08	499.56	496.41
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	325.00	266.14	222.36	195.77	174.23
M_2	.4252	.4162	.4213	.4348	.4547
M_3	.5137	.4990	.4976	.4977	.4945
$\Delta\beta$	-35.55	-29.31	-24.21	-21.16	-18.86
$\bar{\omega}$	.0315	.0212	.0165	.0149	.0268
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0075	.0064	.0060	.0062	.0124
D	.007	.013	.020	.045	.088
η_p	.9379	.9552	.9612	.9559	.8769
i_m	-4.9600	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
δ°	3.169	3.681	4.829	5.392	6.541

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	51.092	50.004	47.262	47.194	46.653
β_9	7.371	4.238	3.302	5.401	3.089
V_8	1098.04	1047.90	966.57	904.79	880.05
V_9	604.57	641.69	596.58	560.72	556.33
V_{Z8}	688.05	672.48	655.42	614.63	604.05
V_{Z9}	597.83	638.66	594.93	557.97	555.45
$V_{\theta 8}$	854.45	802.78	709.91	663.81	639.98
$V_{\theta 9}$	77.56	47.42	34.36	52.77	29.98
M_8	.9980	.9401	.8593	.7968	.7698
M_9	.5148	.5463	.5077	.4753	.4702
$\Delta\beta$	43.722	45.766	43.960	41.794	43.564
$\bar{\omega}$	.1522	.1145	.1347	.1520	.1958
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0399	.0334	.0427	.0496	.0680
D	.6323	.5962	.6030	.6002	.6088
η_p	.8332	.8627	.8271	.7897	.7263
i_m	10.34	13.71	14.08	15.94	16.32
i_o	4.14	5.92	4.73	5.51	4.99
δ°	16.84	13.02	11.80	14.00	12.33

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.511	28.048	22.861	20.003	18.207
β_6	59.624	56.354	51.613	50.487	49.167
β'_5	42.340	49.583	54.284	57.979	60.995
β'_6	-6.432	8.699	26.219	36.820	42.749
V_5	543.31	554.97	567.93	572.48	568.35
V_6	1041.53	998.77	921.39	867.55	849.11
V_{Z5}	441.72	489.76	523.17	537.12	538.20
V_{Z6}	526.66	553.38	572.13	551.94	555.18
$V_{\theta 5}$	315.58	260.95	220.64	195.83	177.58
$V_{\theta 6}$	898.56	831.45	722.22	669.29	642.46
V'_5	598.0	755.4	896.3	1013.4	1110.8
V'_6	530.0	560.1	637.8	689.5	756.1
$V'_{\theta 5}$	-402.5	-575.1	-727.6	-858.9	-970.7
$V'_{\theta 6}$	59.4	-86.6	-281.8	-413.2	-513.2
U_5	718.08	836.08	948.28	1054.68	1148.31
U_6	829.18	918.10	1004.00	1082.58	1155.66
M_5	.4986	.5099	.5224	.5268	.5228
M_6	.9370	.8888	.8137	.7601	.7398
M'_5	.5488	.6940	.8245	.9326	1.0218
M'_6	.4768	.4985	.5632	.6041	.6587
$\Delta\beta'$	48.738	40.682	28.057	21.118	18.169
$\bar{\omega}$	.2031	.1317	.0855	.1210	.1238
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0513	.0385	.0255	.0355	.0361
D	.4014	.5021	.4848	.4951	.4864
η_p	.9347	.9386	.9447	.9037	.8897
η_{ad}	.9300	.9339	.9406	.8968	.8817
i_m	9.36	9.35	8.98	7.97	7.42
i_o	[illegible]	2.70	3.08	2.92	2.92
δ°	6.198	5.719	10.299	9.770	6.929

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100 = 99.9662$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8867.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 123.200$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_f} = 23.5070$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\dfrac{W\sqrt{\theta}/\delta}{A_{an}} = 32.7660$

TABLE 6-1 BLADE ELEMENT PERFORMANCE AT 110% DESIGN SPEED, POINT 1, MCA STATOR A

INLET GUIDE VANE

SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.664	29.421	24.313	21.224	18.816
V_2	562.50	552.41	560.41	578.81	604.49
V_3	685.86	670.50	673.54	679.21	680.91
V_{Z2}	562.46	552.37	560.36	578.77	604.45
V_{Z3}	550.18	583.70	612.47	626.17	628.17
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	399.88	329.37	277.31	245.88	219.62
M_2	.5172	.5074	.5151	.5330	.5581
M_3	.6389	.6235	.6266	.6323	.6340
$\Delta\beta$	-35.66	-29.42	-24.31	-21.22	-18.82
$\bar{\omega}$	.0334	.0246	.0200	.0158	.0298
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0080	.0074	.0073	.0066	.0138
D	-.010	-.005	-.004	.017	.052
η_p	.9429	.9561	.9618	.9645	.9121
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.056	3.569	4.727	5.326	6.584

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.681	28.035	22.692	19.709	17.918
β_6	52.645	48.659	45.245	43.384	46.111
β'_5	36.597	44.555	49.485	53.239	56.512
β'_6	1.051	16.025	27.583	34.447	42.580
V_5	666.83	687.63	712.90	728.15	726.33
V_6	1146.59	1075.04	1025.74	1005.74	937.39
V_{Z5}	541.17	606.94	657.39	684.23	688.80
V_{Z6}	695.68	710.11	722.17	730.89	649.85
$V_{\theta 5}$	388.94	323.19	275.03	245.57	223.46
$V_{\theta 6}$	911.41	807.14	728.40	690.82	675.56
V'_5	674.4	851.7	1012.1	1144.0	1249.6
V'_6	695.8	738.8	814.8	886.4	882.6
$V'_{\theta 5}$	-401.9	-597.6	-769.3	-915.9	-1041.2
$V'_{\theta 6}$	-12.8	-204.3	-377.3	-501.4	-597.1
U_5	790.81	920.77	1044.33	1161.50	1264.61
U_6	924.17	1011.10	1105.69	1192.18	1272.71
M_5	.6198	.6407	.6663	.6819	.6800
M_6	1.1519	.9742	.9208	.8967	.8220
M'_5	.6269	.7937	.9460	1.0714	1.1700
M'_6	.6383	.6695	.7315	.7903	.7739
$\Delta\beta'$	35.522	28.529	21.888	18.742	13.845
$\bar{\omega}$	.0964	.0733	.0602	.0499	.1611
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0245	.0209	.0178	.0148	.0471
D	.2032	.3191	.3535	.3720	.4383
η_p	.9615	.9558	.9529	.9554	.8383
η_{ad}	.9587	.9526	.9494	.9519	.8266
i_m	3.62	4.32	4.17	3.22	2.92
i_s	-3.58	-2.33	-1.73	-1.83	-1.58
$\delta°$	13.681	12.845	1..663	7.397	6.760

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	43.931	41.597	39.558	38.898	41.298
β_9	7.285	.267	1.921	5.000	6.507
V_8	1245.96	1171.24	1120.48	1086.56	1018.40
V_9	751.82	801.69	781.88	770.06	750.42
V_{Z8}	896.02	875.14	863.56	845.55	765.11
V_{Z9}	744.18	800.49	781.14	766.89	745.52
$V_{\theta 8}$	864.43	777.58	713.58	682.30	672.12
$V_{\theta 9}$	94.29	3.74	13.93	67.11	85.04
M_8	1.1665	1.0808	1.0230	.9825	.9042
M_9	.6499	.6977	.6784	.6650	.6427
$\Delta\beta$	36.726	41.330	38.537	33.898	34.791
$\bar{\omega}$	.2711	.1560	.1456	.1669	.1117
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0711	.0457	.0462	.0545	.0386
D	.5562	.5069	.4990	.4756	.4635
η_p	.6998	.7934	.7946	.7497	.8157
i_m	3.18	5.31	6.38	7.65	10.97
i_s	-3.02	-2.48	-2.97	-2.78	-.36
$\delta°$	16.67	9.05	9.52	13.60	15.75

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100 = 110.0913$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 9765.100$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 143.090$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 27.3020$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 38.0558$

TABLE 6-2 BLADE ELEMENT PERFORMANCE AT 110% DESIGN SPEED, POINT 2, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.5[illegible]	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.544	29.326	24.249	21.200	18.356
V_2	548.52	538.18	545.40	562.95	588.01
V_3	671.76	654.14	653.52	655.09	652.74
V_{Z2}	548.49	538.15	545.36	562.92	587.97
V_{Z3}	540.08	570.10	594.29	603.49	601.46
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	390.51	320.39	268.40	236.89	210.95
M_2	.5036	.4937	.5006	.5176	.5420
M_3	.6248	.6072	.6065	.6081	.6058
$\Delta\beta$	-35.54	-29.33	-24.25	-21.20	-18.86
$\bar{\omega}$	.0330	.0241	.0195	.0156	.0295
$\bar{\omega}\cos\beta_3/2\sigma$	.0079	.0073	.0071	.0065	.0137
D	-.015	-.007	-.001	.025	.066
η_p	.9447	.9570	.9618	.9625	.8998
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.176	3.664	4.791	5.350	6.544

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	46.423	44.931	42.430	41.481	43.990
β_9	7.894	5.037	3.276	3.909	4.327
V_8	1181.36	1141.84	1097.95	1072.80	1024.26
V_9	600.26	718.00	709.85	711.18	674.54
V_{Z8}	812.76	807.35	809.89	803.55	736.89
V_{Z9}	593.02	713.97	708.02	709.24	672.55
$V_{\theta 8}$	855.84	806.44	740.77	710.58	711.38
$V_{\theta 9}$	82.44	63.04	40.57	48.48	50.89
M_8	1.0913	1.0409	.9919	.9608	.9015
M_9	.5111	.6155	.6075	.6062	.5681
$\Delta\beta$	38.529	39.894	39.153	37.572	39.663
$\bar{\omega}$	.2375	.1003	.0793	.0878	.1126
$\bar{\omega}\cos\beta_9/2\sigma$	.0622	.0293	.0251	.0287	.0391
D	.6611	.5594	.5544	.5381	.5656
η_p	.7649	.8828	.9008	.8790	.8469
i_m	5.67	8.64	9.25	10.23	13.66
i_s	-.53	.85	-.10	-.20	2.33
$\delta°$	17.36	13.82	11.78	12.51	13.57

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.579	27.965	22.667	19.762	18.047
β_6	55.122	51.800	47.852	45.858	48.023
β'_5	37.744	45.638	50.629	54.520	57.906
β'_6	1.887	14.892	27.229	34.199	40.885
V_5	652.31	670.24	690.96	700.37	693.57
V_6	1099.84	1062.61	1016.16	999.81	961.16
V_{Z5}	529.98	591.96	637.36	658.05	657.36
V_{Z6}	628.89	657.13	681.87	696.27	542.84
$V_{\theta 5}$	379.53	314.30	266.28	236.81	214.87
$V_{\theta 6}$	902.28	835.06	753.40	717.48	714.54
V'_5	670.7	846.7	1004.9	1134.4	1238.3
V'_6	629.3	680.0	766.9	841.9	850.3
$V'_{\theta 5}$	-410.3	-605.3	-776.7	-923.2	-1048.1
$V'_{\theta 6}$	-20.7	-174.8	-350.9	-473.2	-556.6
U_5	789.81	919.60	1043.00	1160.03	1263.01
U_6	923.00	1009.81	1104.28	1130.67	1271.09
M_5	.6053	.6233	.6441	.6536	.6467
M_6	.9998	.9549	.9053	.8846	.8379
M'_5	.6224	.7873	.9367	1.0586	1.1547
M'_6	.5720	.6110	.6832	.7448	.7412
$\Delta\beta'$	35.828	30.745	23.389	20.277	16.939
$\bar{\omega}$	.1187	.0862	.0642	.0766	.1889
$\bar{\omega}\cos\beta'_6/2\sigma$	.0301	.0247	.0190	.0233	.0567
D	.2975	.3977	.4079	.4174	.4745
η_p	.9535	.9521	.9536	.9357	.8287
η_{ad}	.9501	.9483	.9500	.9305	.8152
i_m	4.77	5.41	5.32	4.51	4.32
i_s	-2.43	-1.24	-0.58	-0.54	-0.18
$\delta°$	14.517	11.712	11.309	7.149	5.065

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100 = 109.9515$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 9752.700$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 140.400$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 26.7888$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 37.3404$

TABLE 6-3 BLADE ELEMENT PERFORMANCE AT 110% DESIGN SPEED, POINT 3, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.539	29.334	24.254	24.200	18.856
V_2	535.22	524.96	531.77	548.64	572.86
V_3	654.13	635.99	634.69	635.83	633.39
V_{Z2}	535.19	524.92	531.73	548.61	572.83
V_{Z3}	526.02	554.26	577.08	585.67	583.54
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	380.22	311.57	260.72	229.93	204.71
M_2	.4908	.4810	.4875	.5038	.5272
M_3	.6071	.5891	.5878	.5890	.5866
$\Delta\beta$	-35.54	-29.33	-24.25	-21.20	-18.86
$\bar{\omega}$	.0328	.0236	.0190	.0155	.0291
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0078	.0071	.0069	.0065	.0135
D	-.013	-.004	.003	.029	.069
η_p	.9441	.9567	.9615	.9614	.8963
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.181	3.656	4.786	5.350	6.544

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.279	46.019	43.371	43.459	46.271
β_9	5.885	4.451	2.740	5.378	3.958
V_8	1193.56	1139.98	1086.61	1056.75	1013.16
V_9	606.61	703.12	689.84	669.79	637.84
V_{Z8}	792.67	790.56	789.35	766.88	700.33
V_{Z9}	601.79	699.74	688.38	666.57	636.25
$V_{\theta 8}$	890.87	820.30	746.20	726.87	732.12
$V_{\theta 9}$	62.19	54.57	32.98	62.77	44.03
M_8	1.0973	1.0349	.9774	.9397	.8855
M_9	.5136	.5998	.5878	.5660	.5328
$\Delta\beta$	42.395	41.568	40.631	38.082	42.312
$\bar{\omega}$	.2133	.0826	.0826	.1327	.1565
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0561	.0241	.0262	.0433	.0543
D	.6714	.5775	.5720	.5708	.6065
η_p	.7905	.9046	.8973	.8197	.7963
i_m	7.53	9.73	10.19	12.21	15.94
i_s	1.33	1.94	.84	1.78	4.01
$\delta°$	15.35	13.23	11.24	13.96	13.20

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.549	27.967	22.693	19.821	18.108
β_6	57.114	52.785	48.482	47.444	49.765
β'_5	39.108	46.819	51.724	55.583	58.895
β'_6	-1.341	13.929	27.126	34.068	40.689
V_5	635.45	651.71	670.46	677.92	670.94
V_6	1115.26	1066.31	1013.96	996.56	963.14
V_{Z5}	516.44	575.58	618.35	636.74	635.70
V_{Z6}	605.53	644.91	672.08	673.94	622.14
$V_{\theta 5}$	369.45	305.63	258.66	229.87	208.53
$V_{\theta 6}$	936.55	849.17	759.20	734.08	735.30
V'_5	666.0	841.1	998.3	1127.1	1231.6
V'_6	605.7	664.4	755.2	813.6	820.5
$V'_{\theta 5}$	-419.8	-613.3	-783.6	-929.4	-1053.6
$V'_{\theta 6}$	14.2	-159.9	-344.3	-455.8	-534.9
U_5	789.26	918.96	1042.29	1159.23	1262.14
U_6	922.37	1009.12	1193.52	1189.85	1270.22
M_5	.5886	.6047	.6235	.6310	.6240
M_6	1.0098	.9553	.9009	.8774	.8356
M'_5	.6169	.7805	.9284	1.0491	1.1453
M'_6	.5484	.5953	.6710	.7164	.7118
$\Delta\beta'$	40.418	32.889	24.588	21.473	18.126
$\bar{\omega}$	.2004	.1044	.0697	.1085	.2181
$\bar{\omega}\ \cos\beta'_6/2\sigma$	.0509	.0300	.0207	.0330	.0657
D	.3455	.4203	.4202	.4464	.5046
η_p	.9275	.9448	.9515	.9131	.8116
η_{ad}	.9219	.9403	.9475	.9059	.7964
i_m	6.13	6.59	6.41	5.57	5.31
i_s	-1.07	-0.06	0.51	0.52	0.81
$\delta°$	11.289	10.749	11.206	7.018	4.869

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 109 8760

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9746 000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 137 690

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 26 2717

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 36 6197

TABLE 6-4 BLADE ELEMENT PERFORMANCE AT 110% DESIGN SPEED, POINT 4, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.568	29.349	24.254	21.186	18.837
V_2	521.01	511.01	517.62	534.05	557.71
V_3	633.97	616.40	615.07	616.18	613.85
V_{z2}	520.98	510.98	517.60	534.02	557.68
V_{z3}	509.59	537.11	559.27	567.66	565.64
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	368.76	302.11	252.66	222.68	198.19
M_2	.4772	.4676	.4740	.4897	.5125
M_3	.5871	.5698	.5685	.5696	.5673
$\Delta\beta$	-35.57	-29.35	-24.25	-21.19	-18.84
$\bar{\omega}$	.0326	.0231	.0186	.0153	.0286
$\bar{\omega}\ \cos\beta_3/2\sigma$	.0078	.0070	.0068	.0064	.0133
D	-.008	.000	.007	.033	.073
η_p	.9426	.9562	.9610	.9603	.8925
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_s	.000	.000	.000	.000	.000
$\delta°$	3.152	3.641	4.786	5.364	6.563

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	48.748	47.405	45.073	45.853	48.873
β_9	5.227	3.992	3.067	7.482	1.374
V_8	1187.20	1133.52	1066.62	1036.90	995.47
V_9	627.60	680.44	665.67	633.37	616.21
V_{z8}	781.27	766.22	752.80	722.05	654.73
V_{z9}	623.39	677.64	664.10	627.75	615.98
$V_{\theta 8}$	892.55	834.45	755.17	744.04	749.84
$V_{\theta 9}$	57.18	47.37	35.62	82.48	14.77
M_8	1.0880	1.0237	.9531	.9149	.8636
M_9	.5315	.5771	.5642	.5313	.5116
$\Delta\beta$	43.521	43.413	42.005	38.371	47.500
$\bar{\omega}$	.1743	.1233	.1127	.1875	.1918
$\bar{\omega}\ \cos\beta_9/2\sigma$	.0459	.0360	.0357	.0609	.0667
D	.6535	.6006	.5885	.5968	.6377
η_p	.8237	.8594	.8560	.7566	.7510
i_m	8.00	11.12	11.89	14.60	18.54
i_s	1.30	3.33	2.54	4.17	7.21
$\delta°$	14.70	12.77	11.57	16.08	10.51

ROTOR

SPAN	90	70	50	30	10
Dia	18.560	21.610	24.510	27.260	29.680
β_5	35.506	27.975	22.747	19.893	18.176
β_6	57.630	53.994	49.898	49.504	52.190
β'_5	40.700	48.176	52.975	56.762	59.979
β'_6	-1.559	13.061	27.297	34.335	41.529
V_5	616.70	631.36	648.00	654.11	647.17
V_6	1111.58	1067.80	1005.95	988.53	953.22
V_{z5}	501.48	557.57	597.39	614.07	612.90
V_{z6}	595.10	627.73	647.96	641.90	584.36
$V_{\theta 5}$	358.17	296.17	250.56	222.57	201.87
$V_{\theta 6}$	938.85	863.80	769.45	751.73	753.08
V'_5	661.9	836.1	992.2	1120.9	1226.0
V'_6	595.3	644.4	729.2	779.4	780.6
$V'_{\theta 5}$	-431.3	-623.1	-792.0	-937.0	-1060.7
$V'_{\theta 6}$	16.2	-145.6	-334.4	-438.5	-517.5
U_5	789.51	919.25	1042.61	1159.59	1262.53
U_6	922.65	1009.43	1163.86	1190.21	1270.61
M_5	.5701	.5845	.6011	.6071	.6002
M_6	1.0038	.9532	.8898	.8653	.8219
M'_5	.6118	.7741	.9203	1.0404	1.1371
M'_6	.5376	.5752	.6450	.6805	.6730
$\Delta\beta'$	42.228	35.114	25.668	22.383	18.370
$\bar{\omega}$	.1674	.1103	.0900	.1436	.2468
$\bar{\omega}\ \cos\beta'_6\ 2\sigma$	.0425	.0318	.0266	.0435	.0734
D	.3621	.4495	.4490	.4838	.5428
η_p	.9417	.9445	.9398	.8901	.7955
η_{ad}	.9370	.9399	.9349	.8808	.7737
i_m	7.72	7.94	7.67	6.75	6.40
i_s	0.52	1.29	1.77	1.70	1.90
$\delta°$	11.071	9.881	11.377	7.285	5.709

PERCENT DESIGN SPEED, $\dfrac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 109.9098

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9749.000

CORRECTED WEIGHT FLOW, $w\sqrt{\theta}/\delta$ = 134.800

CORRECTED FLOW PER UNIT FRONTAL AREA, $\dfrac{w\sqrt{\theta}/\delta}{A_f}$ = 25.7203

CORRECTED FLOW PER UNIT ANNULUS AREA, $\dfrac{w\sqrt{\theta}/\delta}{A_{an}}$ = 35.851

TABLE 6-5 BLADE ELEMENT PERFORMANCE AT 110% DESIGN SPEED, POINT 5, MCA STATOR A

INLET GUIDE VANE

% SPAN	90	70	50	30	10
Dia.	17.590	20.720	23.940	26.940	29.620
β_2	.000	.000	.000	.000	.000
β_3	35.579	29.368	24.272	21.194	18.037
V_2	510.46	500.55	506.91	522.91	546.06
V_3	620.08	602.13	600.03	600.64	598.19
V_{z2}	510.43	500.52	506.88	522.88	546.04
V_{z3}	498.41	524.58	545.50	553.28	551.19
$V_{\theta 2}$	-.00	-.00	-.00	-.00	-.00
$V_{\theta 3}$	360.77	295.29	246.65	217.15	193.14
M_2	.4671	.4577	.4637	.4790	.5013
M_3	.5734	.5558	.5537	.5543	.5519
$\Delta\beta$	-35.58	-29.37	-24.27	-21.19	-18.84
$\bar{\omega}$	.0324	.0226	.0181	.0152	.0282
$\bar{\omega}\ \mathrm{Cos}\,\beta_3/2\sigma$	.0078	.0068	.0066	.0063	.0131
D	-.006	.003	.011	.037	.078
η_p	.9421	.9562	.9607	.9590	.8881
i_m	-4.9000	-5.3200	-5.7500	-6.1500	-6.5100
i_o	.000	.000	.000	.000	.000
$\delta°$	3.141	3.622	4.768	5.356	6.563

STATOR

% SPAN	90	70	50	30	10
Dia.	22.680	24.480	26.350	28.190	30.000
β_8	49.837	47.740	45.677	46.981	50.359
β_9	5.535	4.835	4.152	7.213	-.447
V_8	1192.82	1136.84	1055.79	1014.23	982.37
V_9	632.93	693.14	634.71	577.13	583.48
V_{z8}	767.76	763.55	737.24	691.81	626.71
V_{z9}	628.38	689.52	632.48	572.36	583.41
$V_{\theta 8}$	911.57	841.37	755.33	741.54	756.49
$V_{\theta 9}$	61.05	58.43	45.95	72.47	-4.55
M_8	1.0897	1.0247	.9405	.8909	.8485
M_9	.5344	.5873	.5357	.4813	.4821
$\Delta\beta$	44.302	42.905	41.525	39.768	50.806
$\bar{\omega}$	.1737	.0861	.1170	.2080	.2076
$\bar{\omega}\ \mathrm{Cos}\,\beta_9/2\sigma$	.0457	.0257	.0371	.0676	.0723
D	.6539	.5895	.6105	.6457	.6754
η_p	.8251	.8993	.8534	.7408	.7443
i_m	9.09	11.45	12.50	15.73	20.03
i_o	2.89	3.66	3.15	5.30	8.70
$\delta°$	15.01	13.62	12.65	15.81	8.79

ROTOR

% SPAN	90	70	50	30	10
Dia.	18.560	21.610	24.510	27.260	29.680
β_5	35.448	27.936	22.755	19.942	18.224
β_6	58.741	54.510	50.313	50.252	53.368
β'_5	41.894	49.184	53.939	57.716	60.868
β'_6	-3.134	12.768	27.864	35.483	42.291
V_5	604.07	617.76	632.23	636.28	629.06
V_6	1118.95	1069.70	999.28	974.06	946.65
V_{z5}	491.54	545.74	502.83	597.15	595.58
V_{z6}	580.61	621.02	638.12	622.78	564.83
$V_{\theta 5}$	350.34	289.41	244.54	217.01	196.73
$V_{\theta 6}$	956.51	870.97	768.99	748.92	759.62
V'_5	660.8	835.0	990.2	1118.5	1274.3
V'_6	581.5	636.8	721.8	764.9	703.6
$V'_{\theta 5}$	-440.9	-631.9	-800.4	-945.2	-1068.6
$V'_{\theta 6}$	31.8	-140.7	-337.4	-444.0	-513.8
U_5	791.28	921.31	1044.95	1162.19	1265.37
U_6	924.72	1011.70	1106.34	1192.89	1273.47
M_5	.5577	.5711	.5854	.5894	.5823
M_6	1.0077	.9528	.8819	.8502	.8135
M'_5	.6100	.7719	.9169	1.0361	1.1333
M'_6	.5237	.5672	.6371	.6676	.6562
$\Delta\beta'$	44.995	36.415	26.067	22.191	18.499
$\bar{\omega}$	.1982	.1145	.1029	.1663	.2688
$\bar{\omega}\ \mathrm{Cos}\,\beta'_6/2\sigma$	.0503	.0331	.0303	.0497	.0790
D	.3920	.4628	.4571	.4948	.5599
η_p	.9339	.9441	.9323	.8736	.7813
η_{ad}	.9284	.9393	.9266	.8631	.7633
i_m	8.91	8.95	8.63	7.70	7.29
i_o	1.71	2.30	2.73	2.65	2.79
$\delta°$	9.496	9.538	11.944	8.433	6.471

PERCENT DESIGN SPEED $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \mathrm{DESIGN}} \times 100 = 110\ 1567$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 9770\ 900$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 132\ 600$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 25\ 1005$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 15\ 2660$

APPENDIX B

Over-All Performance Data Tabulation

TABLE 1-1 OVERALL PERFORMANCE AT 50% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 49.9[illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 44[illegible]

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = [illegible]

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 13.9802

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = [illegible]9.4867

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9993	.9339	---
ROTOR	1.1468	.8844	.8825
STATOR	.9919	.9058	–––
IGV - ROTOR	1.1250	.8731	.8709
ROTOR - STATOR	1.147[illegible]	.8239	.8211
IGV - ROTOR - STATOR	1.1159	.8125	.8096

POINT 2

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 49.9[illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 4432.400

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 73.040

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 13.3[illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 18.6[illegible]

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9992	.8626	------
ROTOR	1.1196	.8957	.8940
STATOR	.9914	.8703	–––
IGV - ROTOR	1.1177	.8823	.8803
ROTOR - STATOR	1.1099	.8269	.8243
IGV - ROTOR - STATOR	1.1080	.8135	.8108

POINT 3

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 49.9[illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 4429.4[illegible]

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 65.280

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 12.5[illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 17.4947

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9994	.8574	---
ROTOR	1.1351	.8771	.8749
STATOR	.9888	.8676	–––
IGV - ROTOR	1.1336	.8677	.8653
ROTOR - STATOR	1.1225	.7995	.7961
IGV - ROTOR - STATOR	1.1209	.7900	.7866

POINT 4

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 49.9299

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 4434.100

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 61.760

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 11.7840

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 16.4255

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9993	.9731	------
ROTOR	1.1391	.8574	.8548
STATOR	.9974	.8692	–––
IGV - ROTOR	1.1378	.8495	.8467
ROTOR - STATOR	1.1248	.7740	.7702
IGV - ROTOR - STATOR	1.1234	.7661	.7622

POINT 5

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100$ = 50.0722

CORRECTED ROTOR SPEED, $N\sqrt{\theta}$ = 4441.400

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 57.340

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 10.9407

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 15.2500

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9995	.9169	------
ROTOR	1.1500	.8315	.8281
STATOR	.9[illegible]08	.7828	–––
IGV - ROTOR	1.1498	.8253	.8218
ROTOR - STATOR	1.1479	.7161	.7111
IGV - ROTOR - STATOR	1.1467	.7098	.7048

TABLE 1-2 OVERALL PERFORMANCE AT 70% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ DESIGN} \times 100$ = [illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 6142

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = [illegible]

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 19.2234

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 26.7852

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9964	.8938	
ROTOR	1.2371	.9346	.9282
STATOR	.9838	.8678	——
IGV - ROTOR	1.2338	.9188	.9051
ROTOR - STATOR	1.2171	.8537	.8496
IGV - ROTOR - STATOR	1.2133	.8408	.8358

POINT 2

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ DESIGN} \times 100$ = 69.4476

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 6162.30

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 92.36

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 17.6600

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 24.6370

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9988	.8615	——
ROTOR	1.2976	.9203	.9178
STATOR	.9856	.9117	
IGV - ROTOR	1.2937	.9078	.9043
ROTOR - STATOR	1.2296	.8599	.8558
IGV - ROTOR - STATOR	1.2258	.8468	.8423

POINT 3

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ DESIGN} \times 100$ = 69.4588

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 6161.070

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 96.850

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 18.4793

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 25.7560

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9986	.8612	
ROTOR	1.2617	.9038	.9005
STATOR	.9855	.9161	
IGV - ROTOR	1.2581	.8928	.8892
ROTOR - STATOR	1.2434	.8470	.8422
IGV - ROTOR - STATOR	1.2399	.8360	.8309

POINT 4

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ DESIGN} \times 100$ = 69.5029

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 6172.000

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 86.850

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 16.5733

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 23.0984

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9988	.8599	
ROTOR	1.2811	.8865	.8824
STATOR	.9785	.8605	
IGV - ROTOR	1.2781	.8778	.8735
ROTOR - STATOR	1.2537	.8089	.8026
IGV - ROTOR - STATOR	1.2506	.8002	.7938

POINT 5

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ DESIGN} \times 100$ = 69.4701

CORRECTED ROTOR SPEED $N\sqrt{\theta}$ = 6142.000

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 81.900

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 15.6268

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 21.7819

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9990	.8408	- -
ROTOR	1.2981	.8696	.8647
STATOR	.9691	.7713	——
IGV - ROTOR	1.2259	.8626	.8575
ROTOR - STATOR	1.2580	.7652	.7572
IGV - ROTOR - STATOR	1.2553	.7579	.7500

TABLE 1-3 OVERALL PERFORMANCE AT 90% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 89$ [illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 7972\ 000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}\,\delta =$ [illegible]

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}\,\delta}{A_f} = 24$ [illegible]

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}\,\delta}{A_{an}} = 33\ 5106$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9966	.8847	
ROTOR	1.4186	.9456	.9428
STATOR	.9654	.7850	
IGV - ROTOR	1.4100	.9291	.9255
ROTOR - STATOR	1.3694	.8503	.8434
IGV - ROTOR - STATOR	1.3611	.8337	.8263

POINT 2

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 90.0225$

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 7985\ 000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}\,\delta = 122\ 600$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}\,\delta}{A_f} = 23\ 3925$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}\,\delta}{A} = 32\ 6064$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9969	.8920	
ROTOR	1.4488	.9482	.9454
STATOR	.9729	.9089	
IGV - ROTOR	1.4405	.9335	.9300
ROTOR - STATOR	1.4095	.8778	.8718
IGV - ROTOR STATOR	1.4014	.8632	.8565

POINT 3

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 89.7745$

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 7963\ 000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}\,\delta = 118\ 050$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}\,\delta}{A_f} = 22\ 5243$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}\,\delta}{A_{an}} = 31\ 3963$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9972	.8843	
ROTOR	1.4796	.9388	.9353
STATOR	.9677	.8596	
IGV - ROTOR	1.4721	.9267	.9225
ROTOR - STATOR	1.4318	.8601	.8528
IGV - ROTOR - STATOR	1.4246	.8480	.8402

POINT 4

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 89.8422$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 7967\ 000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}\,\delta = 115\ 000$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}\,\delta}{A_f} = 21\ 9424$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}\,\delta}{A_{an}} = 30\ 3851$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9975	.8762	
ROTOR	1.4899	.9206	.9160
STATOR	.9735	.9141	
IGV - ROTOR	1.4829	.9097	.9045
ROTOR - STATOR	1.4504	.8586	.8509
IGV - ROTOR - STATOR	1.4435	.8476	.8395

POINT 5

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 89.9374$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 7977\ 000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}\,\delta = 114\ 450$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}\,\delta}{A_f} = 21\ 8374$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}\,\delta}{A_{an}} = 30\ 4288$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9975	.8735	—
ROTOR	1.5048	.9150	.9100
STATOR	.9623	.8618	
IGV - ROTOR	1.4980	.9049	.8994
ROTOR - STATOR	1.4481	.8291	.8199
IGV - ROTOR - STATOR	1.4416	.8190	.8094

TABLE 1-4 OVERALL PERFORMANCE AT 95% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 94.9[illegible]$

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 842[illegible].000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta =$ [illegible]

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 25.0143$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 34.8670$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9961	.8929	
ROTOR	1.4710	.9360	.9324
STATOR	.9553	.7307	
IGV - ROTOR	1.4608	.9191	.9187
ROTOR - STATOR	1.4053	.8281	.8165
IGV - ROTOR - STATOR	1.3958	.8083	.7990

POINT 2

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 =$ [illegible]

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 8445.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 128.700$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 25.5564$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 34.2287$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9963	.8962	
ROTOR	1.5915	.9394	.9358
STATOR	.92[illegible]	.8121	
IGV - ROTOR	1.[illegible]	.9293	.9199
ROTOR - STATOR	1.[illegible]	.8719	.8659
IGV - ROTOR - STATOR	1.[illegible]	.8560	.8491

POINT 3

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 95.1497$

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 8438.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 124.900$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 23.8313$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 33.2181$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9968	.8517	
ROTOR	1.5412	.9263	.9217
STATOR	.9691	.9204	
IGV - ROTOR	1.5321	.9136	.9083
ROTOR - STATOR	1.4936	.8591	.8509
IGV - ROTOR - STATOR	1.4887	.8464	.8376

POINT 4

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 94.[illegible]012$

CORRECTED ROTOR SPEED $N\sqrt{\theta} =$ [illegible]

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 120.6[illegible]$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 23.0109$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 32.0745$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9970	.8789	
ROTOR	1.5592	.9140	.9084
STATOR	.9651	.9012	
IGV - ROTOR	1.5508	.9028	.8966
ROTOR - STATOR	1.5049	.8410	.8315
IGV - ROTOR - STATOR	1.4967	.8298	.8198

POINT 5

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 94.7351$

CORRECTED ROTOR SPEED $N\sqrt{\theta} = 8403.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 118.000$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 22.5148$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 31.3830$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9972	.8875	
ROTOR	1.5792	.9025	.8961
STATOR	.9516	[illegible]	
IGV - ROTOR	1.5660	.8922	.8852
ROTOR - STATOR	1.4979	.8037	.7922
IGV - ROTOR - STATOR	1.4[illegible]	.7936	.7815

TABLE 1-5 OVERALL PERFORMANCE AT 100% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.5039$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 8826.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 134.700$

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f} = 25.7012$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 35.8245$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.5957	.6943	
ROTOR	1.5323	.9365	.9325
STATOR	.9462	.6447	
IGV - ROTOR	1.5210	.9202	.9153
ROTOR - STATOR	1.4499	.6151	.8052
IGV - ROTOR - STATOR	1.4391	.7983	.7882

POINT 2

PERCENT DESIGN SPEED, $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.9456$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 8865.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 131.900$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 25.1670$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 35.0798$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9960	.8879	
ROTOR	1.5756	.9279	.9231
STATOR	.9730	.9413	
IGV - ROTOR	1.5646	.9136	.9080
ROTOR - STATOR	1.5330	.8720	.8641
IGV - ROTOR - STATOR	1.5224	.8578	.8491

POINT 3

PERCENT DESIGN SPEED, $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.8083$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 8853.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 128.400$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 24.4991$

CORRECTED FLOW PER UNIT ANNULUS AREA $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 34.1489$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9964	.8817	
ROTOR	1.619[illegible]	.9170	.9112
STATOR	.9616	.8965	
IGV - ROTOR	1.6[illegible]	.9048	.8982
ROTOR - STATOR	1.5569	.8425	.8324
IGV - ROTOR - STATOR	1.5469	.8303	.8196

POINT 4

PERCENT DESIGN SPEED, $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.8309$

CORRECTED ROTOR SPEED, $N\sqrt{\theta} = 8855.000$

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta = 125.100$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 23.8695$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 33.2713$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9967	.8779	
ROTOR	1.6514	.9044	.8974
STATOR	.9492	.8383	
IGV - ROTOR	1.6415	.8936	.8859
ROTOR - STATOR	1.5675	.8104	.7980
IGV - ROTOR - STATOR	1.5562	.7996	.7867

POINT 5

PERCENT DESIGN SPEED, $\frac{N\sqrt{\theta}}{N\sqrt{\theta}\ \text{DESIGN}} \times 100 = 99.9662$

CORRECTED ROTOR SPEED, $N/\sqrt{\theta} = 8867.000$

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta = 123.200$

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f} = 23.5070$

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}} = 32.7660$

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9968	.8853	
ROTOR	1.6451	.9129	.9066
STATOR	.9486	.8339	
IGV - ROTOR	1.6357	.9024	.8954
ROTOR - STATOR	1.5606	.8162	.8043
IGV - ROTOR - STATOR	1.5517	.8057	.7933

TABLE 1-6 OVERALL PERFORMANCE AT 110% DESIGN SPEED

POINT 1

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 110.0911

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9765.100

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 143.090

CORRECTED FLOW PER UNIT FRONTAL AREA $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 27.3020

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 38.9558

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9947	.8999	
ROTOR	1.6608	.9234	.9178
STATOR	.9217	.5286	
IGV - ROTOR	1.6461	.9072	.9004
ROTOR - STATOR	1.5308	.7780	.7611
IGV - ROTOR - STATOR	1.5171	.7587	.7492

POINT 2

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 109.9515

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9752.700

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 140.400

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 26.7888

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 37.3404

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9951	.8929	
ROTOR	1.7101	.9141	.9074
STATOR	.9522	.8810	
IGV - ROTOR	1.6959	.8999	.8922
ROTOR - STATOR	1.6284	.8308	.8188
IGV - ROTOR - STATOR	1.6149	.8166	.8038

POINT 3

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 109.8760

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9746.000

CORRECTED WEIGHT FLOW $W\sqrt{\theta}/\delta$ = 137.690

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 26.2717

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 36.6197

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9954	.8957	
ROTOR	1.7326	.8963	.8902
STATOR	.9481	.8543	
IGV - ROTOR	1.7189	.8853	.8763
ROTOR - STATOR	1.6375	.8060	.7921
IGV - ROTOR - STATOR	1.6245	.7930	.7784

POINT 4

PERCENT DESIGN SPEED $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 109.9098

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9749.000

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 134.800

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 25.7203

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 35.3511

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9957	.8917	
ROTOR	1.7601	.8914	.8824
STATOR	.9322	.8046	
IGV - ROTOR	1.7469	.8796	.8697
ROTOR - STATOR	1.6407	.7806	.7649
IGV - ROTOR - STATOR	1.6284	.7688	.7525

POINT 5

PERCENT DESIGN SPEED, $\frac{N/\sqrt{\theta}}{N/\sqrt{\theta}\ \text{DESIGN}} \cdot 100$ = 110.1567

CORRECTED ROTOR SPEED, $N/\sqrt{\theta}$ = 9770.900

CORRECTED WEIGHT FLOW, $W\sqrt{\theta}/\delta$ = 132.600

CORRECTED FLOW PER UNIT FRONTAL AREA, $\frac{W\sqrt{\theta}/\delta}{A_f}$ = 25.3005

CORRECTED FLOW PER UNIT ANNULUS AREA, $\frac{W\sqrt{\theta}/\delta}{A_{an}}$ = 35.2660

	PRESSURE RATIO	POLYTROPIC EFFICIENCY	ADIABATIC EFFICIENCY
IGV	.9959	.8875	
ROTOR	1.7683	.8821	.8723
STATOR	.9393	.8268	
IGV - ROTOR	1.7556	.8711	.8608
ROTOR - STATOR	1.6609	.7652	.7694
IGV - ROTOR - STATOR	1.6491	.7761	.7577

APPENDIX C

Pressure Coefficient Data Tabulation

TABLE 1-1

PRESSURE COEFFICIENT DATA, MCA STATOR A
50% DESIGN SPEED, POINT 1

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.214	0.185	1.259	0.859	0.202	0.872	19.1	-0.165	1.240	8.5	0.816
20	-0.242	-	1.288	-	0.258	0.817	22.4	-0.165	1.240	13.5	0.816
25	-0.271	0.185	1.316	0.859	0.276	0.798	24.7	-0.183	1.258	18.8	0.813
30	-0.357	0.214	1.402	0.831	0.331	0.743	28.0	-0.201	1.277	23.7	0.816
35	-0.328	0.357	1.373	0.688	0.423	0.651	30.2	-0.220	1.295	34.1	0.826
40	-0.442	0.357	1.488	0.688	0.423	0.651	33.5	-0.294	1.369	45.8	0.844
45	-0.385	0.442	1.421	0.602	0.497	0.577	35.7	-0.220	1.295	58.0	0.853
50	-0.442	0.442	1.488	0.602	0.552	0.522	38.8	-0.220	1.295	71.3	0.860
60	-0.157	0.528	1.202	0.516	0.552	0.522	40.9	-0.201	1.277		
70	-	0.499	-	0.545	0.552	0.522	51.3	-0.220	1.295		
							56.1	-0.109	1.185		
							61.0	-0.054	1.129		
							70.4	0.092	0.982		
							79.4	0.479	0.596		

TABLE 1-2

PRESSURE COEFFICIENT DATA, MCA STATOR A
50% DESIGN SPEED, POINT 2

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.227	0.270	1.271	0.773	0.277	0.796	19.1	-0.127	1.201	8.5	0.826
20	-0.227	-	1.271	-	0.204	0.870	22.4	-0.127	1.201	13.5	0.826
25	-0.227	0.241	1.271	0.802	0.351	0.722	24.7	-0.145	1.219	18.8	0.826
30	-0.344	0.299	1.388	0.744	0.351	0.722	28.0	-0.164	1.238	23.7	0.831
35	-0.256	0.358	1.300	0.685	0.480	0.593	30.2	-0.145	1.219	34.1	0.837
40	-0.344	0.387	1.388	0.656	0.461	0.612	33.5	-0.219	1.293	45.8	0.859
45	-0.286	0.475	1.329	0.568	0.517	0.557	35.7	-0.145	1.219	58.0	0.868
50	-0.344	0.475	1.388	0.568	0.498	0.575	38.8	-0.182	1.256	71.3	0.868
60	-0.110	0.533	1.154	0.509	0.572	0.501	40.9	-0.127	1.201		
70		0.533	-	0.509	0.498	0.575	51.3	-0.127	1.201		
							56.1	-0.017	0.091		
							61.0	-0.127	1.201		
							70.4	0.019	1.054		
							79.4	0.038	1.036		

TABLE 1-3

PRESSURE COEFFICIENT DATA, MCA STATOR A
50% DESIGN SPEED, POINT 3

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_5
15	-0.317	0.369	1.356	0.669	0.342	0.726	19.1	-0.097	1.165	8.5	0.844
20	-0.285	-	1.325	-	0.361	0.706	22.4	-0.097	1.165	13.5	0.844
25	-0.192	0.369	1.231	0.669	0.361	0.706	24.7	-0.097	1.165	18.8	0.850
30	-0.223	0.369	1.262	0.669	0.438	0.630	28.0	-0.097	1.165	23.7	0.853
35	-0.223	0.463	1.262	0.576	0.514	0.553	30.2	-0.097	1.165	34.1	0.862
40	-0.160	0.463	1.200	0.576	0.342	0.726	33.5	-0.097	1.165	45.8	0.877
45	-0.160	0.525	1.200	0.513	0.342	0.726	35.7	-0.097	1.165	58.0	0.883
50	-0.223	0.525	1.262	0.513	0.610	0.458	38.8	-0.097	1.165	71.3	0.889
60	-0.004	0.556	1.044	0.482	0.610	0.458	40.9	-0.097	1.165		
70	-	0.588	-	0.451	0.531	0.477	51.3	-0.078	1.146		
							56.1	0.094	0.974		
							61.0	-0.135	1.204		
							70.4	-0.154	1.223		
							79.4	0.074	0.994		

TABLE 1-4

PRESSURE COEFFICIENT DATA, MCA STATOR A
50% DESIGN SPEED, POINT 4

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_5
15	-0.503	-	1.540	-	0.342	0.725	19.1	-0.173	1.241	8.5	0.846
20	-0.403	-	1.440	-	0.342	0.725	22.4	-0.173	1.241	13.5	0.843
25	-0.237	0.393	1.274	0.642	0.361	0.706	24.7	-0.173	1.241	18.8	0.852
30	-0.204	0.393	1.240	0.642	0.151	0.916	28.0	-0.173	1.241	23.7	0.858
35	-0.137	0.526	1.174	0.509	0.514	0.553	30.2	-0.173	1.241	34.1	0.870
40	-0.171	0.526	1.207	0.509	0.552	0.515	33.5	-0.173	1.241	45.8	0.882
45	-0.038	0.526	1.074	0.509	0.342	0.725	35.7	-0.173	1.241	58.0	0.887
50	-0.071	0.560	1.107	0.476	0.533	0.534	38.8	-0.230	1.298	71.3	0.890
60	0.061	0.593	0.975	0.443	0.495	0.572	40.9	-0.230	1.298		
70	-	0.593	-	0.443	0.533	0.534	51.3	-0.249	1.317		
							56.1	-0.020	1.088		
							61.0	-0.211	1.279		
							70.4	-0.001	1.069		
							79.4	-0.230	1.298		

TABLE 1-5

PRESSURE COEFFICIENT DATA, MCA STATOR A
50% DESIGN SPEED, POINT 5

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_s
15	-0.432	0.404	1.473	0.636	0.360	0.705	19.1	-0.079	1.146	8.5	0.848
20	-0.374	-	1.415	-	0.169	0.897	22.4	-0.060	1.127	13.5	0.848
25	-0.259	0.318	1.300	0.723	0.303	0.763	24.7	-0.041	1.108	18.8	0.854
30	-0.230	0.318	1.271	0.723	0.073	0.993	28.0	-0.060	1.127	23.7	0.857
35	-0.114	0.375	1.156	0.665	0.514	0.552	30.2	-0.041	1.108	34.1	0.843
40	-0.143	0.346	1.185	0.624	0.207	0.859	33.5	-0.118	1.185	45.8	0.954
45	-0.057	0.462	1.098	0.578	0.245	0.820	35.7	-0.022	1.089	58.0	0.889
50	-0.085	0.462	1.127	0.578	0.284	0.782	38.8	-0.022	1.089	71.3	0.892
60	0.058	0.462	0.983	0.578	0.514	0.552	40.9	-0.022	1.089		
70	-	0.491	-	0.550	0.302	0.763	51.3	-0.041	1.108		
							56.1	-0.003	1.070		
							61.0	-0.022	1.089		
							70.4	-0.328	1.395		
							79.4	0.169	0.897		

TABLE 2-1

PRESSURE COEFFICIENT DATA, MCA STATOR A
70% DESIGN SPEED, POINT 1

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.223	0.116	1.313	0.973	0.089	1.059	19.1	-0.219	1.368	8.5	0.668
20	-0.285	-	1.375	-	0.089	1.059	22.4	-0.165	1.315	13.5	0.662
25	-0.316	0.131	1.406	0.958	0.270	0.378	24.7	-0.229	1.379	18.8	0.659
30	-0.424	0.270	1.514	0.819	0.302	0.846	28.0	-0.229	1.379	23.7	0.662
35	-0.408	0.301	1.498	0.789	0.409	0.740	30.2	-0.282	1.432	34.1	0.682
40	-0.532	0.425	1.622	0.664	0.409	0.740	33.5	-0.314	1.464	45.8	0.723
45	-0.455	0.425	1.545	0.664	0.494	0.655	35.7	-0.282	1.432	58.0	0.740
50	-0.501	0.425	1.580	0.664	0.462	0.686	38.8	-0.250	1.400	71.3	0.746
60	-0.177	0.471	1.267	0.619	0.558	0.591	40.9	-0.272	1.421		
70	-	0.486	-	0.603	0.526	0.623	51.3	-0.187	1.336		
							56.1	-0.080	1.230		
							61.0	-0.069	1.219		
							70.4	-0.016	1.166		
							79.4	-0.016	1.166		

TABLE 2-2

PRESSURE COEFFICIENT DATA, MCA STATOR A
70% DESIGN SPEED, POINT 2

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 50% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.239	0.212	1.323	0.871	0.219	0.921	19.1	-0.174	1.315	8.5	0.695
20	-0.287	- -	1.371	-	0.263	0.877	22.4	-0.152	1.293	13.5	0.695
25	-0.271	0.228	1.355	0.855	0.340	0.800	24.7	-0.174	1.315	18.8	0.695
30	-0.352	0.260	1.436	0.823	0.362	0.778	28.0	-0.196	1.337	23.7	0.703
35	-0.319	0.470	1.403	0.613	0.482	0.658	30.2	-0.196	1.337	34.1	0.724
40	-0.400	0.405	1.484	0.678	0.460	0.680	33.5	-0.272	1.413	45.8	0.755
45	-0.352	0.486	1.436	0.597	0.559	0.581	35.7	-0.185	1.326	58.0	0.770
50	-0.400	0.502	1.484	0.581	0.548	0.592	38.8	-0.185	1.326	71.3	0.772
60	-0.126	0.534	1.210	0.549	0.614	0.526	40.8	-0.174	1.315		
70	-	0.550	-	0.533	0.581	0.559	51.3	-0.130	1.271		
							56.1	0.001	1.139		
							61.0	0.044	1.096		
							70.4	0.033	1.107		
							79.4	0.165	0.975		

TABLE 2-3

PRESSURE COEFFICIENT DATA, MCA STATOR A
70% DESIGN SPEED, POINT 3

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_8
15	-0.302	0.321	1.382	0.758	0.317	0.819	19.1	-0.121	1.257	8.5	0.713
20	-0.286	-	1.366	-	0.273	0.862	22.4	-0.110	1.246	13.5	0.718
25	-0.220	0.305	1.300	0.774	0.416	0.720	24.7	-0.110	1.246	18.8	0.724
30	-0.270	0.321	1.349	0.758	0.427	0.709	28.0	-0.132	1.268	23.7	0.732
35	-0.220	0.255	1.300	0.823	0.526	0.610	30.2	-0.110	1.246	34.1	0.752
40	-0.286	0.255	1.366	0.823	0.515	0.621	33.5	-0.165	1.301	45.8	0.778
45	-0.220	0.173	1.300	0.906	0.515	0.621	35.7	-0.088	1.224	58.0	0.789
50	-0.253	0.518	1.333	0.561	0.558	0.577	38.8	-0.066	1.202	71.3	0.795
60	-0.039	0.551	1.119	0.528	0.471	0.665	40.9	-0.066	1.202		
70	-	0.551	-	0.528	0.504	0.632	51.3	-0.033	1.170		
							56.1	0.098	1.038		
							61.0	-0.011	1.148		
							70.4	-0.044	1.181.		
							79.4	0.153	0.983		

TABLE 2-4

PRESSURE COEFFICIENT DATA, MCA STATOR A
70% DESIGN SPEED, POINT 4

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_8
15	-0.643	0.404	1.714	0.666	0.375	0.756	19.1	-0.090	1.222	8.5	0.727
20	-0.501	-	1.572	-	0.397	0.735	22.4	-0.079	1.212	13.5	0.737
25	-0.306	0.369	1.376	0.701	0.451	0.680	24.7	-0.057	1.190	18.8	0.743
30	-0.270	0.369	1.341	0.701	0.473	0.659	28.0	-0.079	1.212	23.7	0.749
35	-0.164	0.457	1.234	0.612	0.560	0.572	30.2	-0.046	1.179	34.1	0.768
40	-0.181	0.475	1.252	0.595	0.549	0.583	33.5	-0.046	1.179	45.8	0.790
45	-0.075	0.546	1.145	0.523	0.516	0.615	35.7	-0.025	1.157	58.0	0.803
50	-0.092	0.546	1.163	0.523	0.614	0.518	38.8	0.007	1.125	71.3	0.811
60	0.061	0.564	0.985	0.506	0.679	0.453	40.9	0.007	1.125		
70	-	0.600	-	0.470	0.625	0.507	51.3	0.061	1.071		
							56.1	0.169	0.962		
							61.0	0.169	0.962		
							70.4	0.289	0.843		
							79.4	0.191	0.941		

TABLE 2-5

PRESSURE COEFFICIENT DATA, MCA STATOR A 70 % DESIGN SPEED, POINT 5

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_s
15	-0.576	0.411	1.646	0.659	0.349	0.782	19.1	-0.097	1.229	8.5	0.725
20	-0.489	-	1.560	-	0.328	0.803	22.4	-0.087	1.219	13.5	0.733
25	-0.403	0.289	1.473	0.780	0.445	0.686	24.7	-0.055	1.187	18.8	0.741
30	-0.351	0.289	1.421	0.780	0.424	0.707	28.0	-0.087	1.219	23.7	0.749
35	-0.264	0.393	1.335	0.676	0.552	0.579	30.2	-0.044	1.176	34.1	0.765
40	-0.264	0.393	1.335	0.676	0.541	0.590	33.5	-0.097	1.229	45.8	0.787
45	-0.160	0.463	1.231	0.607	0.616	0.515	35.7	-0.012	1.144	58.0	0.800
50	-0.125	0.480	1.196	0.590	0.573	0.558	38.8	-0.001	1.133	71.3	0.809
60	-0.004	0.497	1.075	0.572	0.658	0.473	40.9	0.008	1.123		
70	-	0.497	-	0.572	0.605	0.526	51.3	0.040	1.091		
							56.1	0.126	1.005		
							61.0	0.083	1.048		
							70.4	0.232	0.899		
							79.4	0.126	1.005		

TABLE 3-1

PRESSURE COEFFICIENT DATA, MCA STATOR A
90% DESIGN SPEED, POINT 1

Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P
15	-0.271	-0.072	1.427	1.228	-0.145	1.397	19.1	-0.237	1.489	8.5	0.520
20	-0.301	-	1.457	-	-0.001	1.252	22.4	-0.069	1.321	13.5	0.514
25	-0.401	-0.013	1.556	1.168	0.167	1.085	24.7	-0.198	1.451	18.8	0.498
30	-0.510	0.056	1.666	1.098	0.273	0.978	28.0	-0.207	1.458	23.7	0.471
35	-0.570	0.235	1.726	0.919	0.373	0.879	30.2	-0.260	1.512	34.1	0.487
40	-0.719	0.275	1.875	0.679	0.419	0.833	33.5	-0.351	1.603	45.8	0.577
45	-0.650	0.285	1.805	0.869	0.472	0.779	35.7	-0.382	1.634	58.0	0.599
50	-0.769	0.295	1.925	0.859	0.487	0.764	38.8	-0.412	1.664	71.3	0.599
60	-0.192	0.454	1.347	0.700	0.548	0.703	40.9	-0.496	1.748		
70	-	0.464	-	0.691	0.556	0.696	51.3	-0.115	1.367		
							56.1	-0.046	1.298		
							61.0	-0.061	1.313		
							70.4	0.014	1.237		
							79.4	0.007	1.245		

TABLE 3-2

PRESSURE COEFFICIENT DATA, MCA STATOR A
90 % DESIGN SPEED, POINT 2

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_s
15	-0.243	0.211	1.391	0.935	0.183	1.057	19.1	-0.365	1.607	8.5	0.529
20	-0.312	-	1.460	-	0.198	1.042	22.4	-0.071	1.313	13.5	0.545
25	-0.253	0.231	1.401	0.915	0.356	0.884	24.7	-0.139	1.381	18.8	0.550
30	-0.362	0.241	1.510	0.905	0.402	0.839	28.0	-0.154	1.396	23.7	0.558
35	-0.293	0.390	1.440	0.757	0.507	0.734	30.2	-0.169	1.411	34.1	0.595
40	-0.421	0.409	1.569	0.737	0.522	0.718	33.5	-0.245	1.486	45.8	0.951
45	-0.293	0.449	1.440	0.648	0.590	0.651	35.7	-0.192	1.433	58.0	0.927
50	-0.372	0.508	1.519	0.638	0.590	0.651	38.8	-0.102	1.343	71.3	0.919
60	-0.055	0.568	1.203	0.579	0.657	0.583	40.9	-0.169	1.411		
70	-	0.568	-	0.579	0.642	0.598	51.3	-0.011	1.253		
							56.1	0.101	1.140		
							61.0	0.086	1.155		
							70.4	0.213	1.027		
							79.4	0.198	1.042		

TABLE 3-3

PRESSURE COEFFICIENT DATA, MCA STATOR A
90% DESIGN SPEED, POINT 3

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.351	0.342	1.490	0.796	0.305	0.921	19.1	-0.243	1.470	8.5	0.573
20	-0.410	-	1.549	-	0.410	0.816	22.4	-0.047	1.274	13.5	0.593
25	-0.202	0.322	1.341	0.816	0.455	0.771	24.7	-0.032	1.259	18.8	0.586
30	-0.242	0.342	1.381	0.796	0.493	0.733	28.0	-0.032	1.259	23.7	0.616
35	-0.172	0.441	1.311	0.697	0.568	0.658	30.2	-0.047	1.274	34.1	0.601
40	-0.212	0.461	1.351	0.677	0.583	0.643	33.5	-0.077	1.304	45.8	0.716
45	-0.143	0.540	1.282	0.598	0.643	0.583	35.7	-0.032	1.259	58.0	0.698
50	-0.153	0.550	1.291	0.588	0.643	0.583	38.8	0.079	1.147	71.3	0.685
60	0.025	0.580	1.113	0.558	0.710	0.516	40.9	-0.062	1.289		
70	-	0.590	-	0.548	0.681	0.546	51.3	0.094	1.132		
							56.1	0.042	1.194		
							61.0	0.034	1.192		
							70.4	-0.177	1.244		
							79.4	0.252	0.974		

TABLE 3-4

PRESSURE COEFFICIENT DATA, MCA STATOR A
90% DESIGN SPEED, POINT 4

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_s
15	-0.503	0.076	1.636	1.055	0.371	0.854	19.1	-0.031	1.257	8.5	0.593
20	-0.523	-	1.656	-	0.378	0.846	22.4	-0.009	1.234	13.5	0.616
25	-0.239	0.361	1.371	0.770	0.497	0.727	24.7	0.021	1.205	18.8	0.628
30	-0.249	0.392	1.382	0.740	0.505	0.720	28.0	-0.017	1.242	23.7	0.641
35	-0.137	0.473	1.269	0.659	0.617	0.608	30.2	0.021	1.205	34.1	0.668
40	-0.147	0.514	1.279	0.618	0.617	0.608	33.5	-0.024	1.249	45.8	0.702
45	-0.096	0.565	1.229	0.567	0.684	0.540	35.7	0.035	1.190	58.0	0.719
50	-0.076	0.575	1.208	0.557	0.647	0.578	38.8	0.117	1.108	71.3	0.720
60	0.096	0.605	1.035	0.526	0.737	0.488	40.9	0.065	1.160		
70	-	0.605	-	0.526	0.692	0.533	51.3	0.169	1.055		
							56.1	0.244	0.981		
							61.0	0.191	1.033		
							70.4	0.303	0.921		
							79.4	0.251	0.973		

TABLE 3-5

PRESSURE COEFFICIENT DATA, MCA STATOR A
90 % DESIGN SPEED, POINT 5

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub Mid Channel Ratio P/P_∞
15	-0.538	0.435	1.668	0.695	0.420	0.812	19.1	0.021	1.211	8.5	0.609
20	-0.436	-	1.567	-	0.413	0.819	22.4	0.064	1.169	13.5	0.628
25	-0.264	0.394	1.394	0.735	0.520	0.712	24.7	0.057	1.176	18.8	0.643
30	-0.213	0.435	1.344	0.695	0.548	0.684	28.0	0.078	1.154	23.7	0.653
35	0.496	0.486	0.634	0.644	0.634	0.598	30.2	0.064	1.169	34.1	0.672
40	0.486	0.536	0.644	0.593	0.634	0.598	33.5	0.085	1.147	45.8	0.702
45	0.415	0.567	0.715	0.563	0.705	0.527	35.7	0.092	1.140	58.0	0.722
50	0.394	0.607	0.736	0.522	0.677	0.555	38.8	0.221	1.012	71.3	0.685
60	-	0.597	-	0.532	0.762	0.470	40.9	0.121	1.112		
70	-	0.638	-	0.492	0.705	0.527	51.3	0.242	0.990		
							56.1	0.256	0.976		
							61.0	0.228	1.005		
							70.4	0.320	0.912		
							79.4	0.313	0.919		

TABLE 4-1

PRESSURE COEFFICIENT DATA, MCA STATOR A 95% DESIGN SPEED, POINT 1

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P
15	-0.218	-0.149	1.401	1.331	-0.228	1.507	19.1	-0.350	1.629	8.5	0.469
20	-0.236	-	1.419	-	-0.128	1.407	22.4	-0.429	1.708	13.5	0.469
25	-0.349	-0.140	1.532	1.323	-0.135	1.414	24.7	-0.501	1.780	18.8	0.455
30	-0.419	0.016	1.602	1.165	0.150	1.128	28.0	-0.451	1.729	23.7	0.426
35	-0.533	0.191	1.715	0.991	0.336	0.941	30.2	-0.451	1.729	34.1	0.392
40	-0.620	0.261	1.803	0.920	0.401	0.877	33.5	-0.436	1.715	45.8	0.519
45	-0.742	0.357	1.925	0.825	0.451	0.827	35.7	-0.386	1.665	58.0	0.549
50	-0.899	0.392	2.082	0.790	0.494	0.784	38.8	-0.372	1.651	71.3	0.554
60	-0.236	0.444	1.419	0.735	0.501	0.777	40.9	-0.379	1.658		
70	-	0.435	-	0.729	0.554	0.754	51.3	-0.228	1.507		
							56.1	-0.193	1.472		
							61.0	-0.085	1.364		
							70.4	-0.057	1.335		
							79.4	-0.042	1.321		

TABLE 4-2

PRESSURE COEFFICIENT DATA, MCA STATOR A 95% DESIGN SPEED, POINT 2

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P
15	-0.216	0.231	1.389	0.941	0.181	1.091	19.1	-0.448	1.720	8.5	0.462
20	-0.295	-	1.468	-	0.273	0.999	22.4	-0.009	1.282	13.5	0.481
25	-0.207	0.257	1.380	0.915	0.386	0.886	24.7	-0.469	1.732	18.8	0.507
30	-0.321	0.266	1.494	0.906	0.450	0.822	28.0	-0.031	1.303	23.7	0.533
35	-0.251	0.415	1.424	0.757	0.520	0.751	30.2	-0.292	1.565	34.1	0.579
40	-0.374	0.441	1.547	0.730	0.563	0.709	33.5	-0.101	1.374	45.8	0.624
45	-0.251	0.520	1.424	0.651	0.605	0.666	35.7	-0.059	1.331	58.0	0.639
50	-0.321	0.529	1.494	0.642	0.627	0.645	38.8	-0.053	1.218	71.3	0.645
60	0.002	0.582	1.169	0.590	0.676	0.595	40.9	-0.038	1.310		
70	-	0.599	-	0.572	0.676	0.595	51.3	0.117	1.154		
							56.1	0.160	1.112		
							61.0	0.145	1.126		
							70.4	0.244	1.027		
							79.4	0.273	0.999		

TABLE 4-3

PRESSURE COEFFICIENT DATA, MCA STATOR A
95% DESIGN SPEED, POINT 3

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_δ
15	-0.431	0.280	1.593	0.881	0.301	0.960	19.1	-0.497	1.758	8.5	0.511
20	-0.458	-	1.620	-	0.357	0.904	22.4	0.016	1.244	13.5	0.551
25	-0.194	0.333	1.356	0.826	0.468	0.793	24.7	-0.080	1.342	18.8	0.574
30	-0.211	0.368	1.373	0.794	0.502	0.758	28.0	0.037	1.224	23.7	0.589
35	-0.132	0.456	1.294	0.705	0.579	0.682	30.2	0.016	1.244	34.1	0.621
40	-0.141	0.500	1.303	0.661	0.607	0.654	33.5	0.023	1.238	45.8	0.657
45	-0.106	0.553	1.268	0.608	0.662	0.599	35.7	0.030	1.231	58.0	0.677
50	-0.088	0.579	1.250	0.582	0.648	0.612	38.8	0.155	1.106	71.3	0.687
60	0.060	0.597	1.101	0.564	0.718	0.543	40.9	0.058	1.203		
70	-	0.632	-	0.529	0.697	0.564	51.3	0.190	1.071		
							56.1	0.232	1.029		
							61.0	0.197	1.064		
							70.4	0.238	1.022		
							79.4	0.259	1.001		

TABLE 4-4

PRESSURE COEFFICIENT DATA, MCA STATOR A
95 % DESIGN SPEED, POINT 4

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P_δ
15	-0.590	0.062	1.743	1.089	0.408	0.847	19.1	-0.056	1.311	8.5	0.575
20	-0.492	-	1.644	-	0.394	0.861	22.4	0.032	1.223	13.5	0.600
25	-0.277	0.349	1.430	0.803	0.517	0.738	24.7	0.073	1.182	18.8	0.614
30	-0.214	0.403	1.367	0.749	0.544	0.711	28.0	0.066	1.189	23.7	0.629
35	-0.116	0.456	1.268	0.695	0.626	0.629	30.2	0.094	1.161	34.1	0.651
40	-0.089	0.528	1.242	0.624	0.619	0.636	33.5	0.073	1.182	45.8	0.680
45	-0.044	0.555	1.197	0.597	0.694	0.561	35.7	0.114	1.141	58.0	0.700
50	-0.017	0.591	1.170	0.561	0.674	0.581	38.8	0.189	1.066	71.3	0.712
60	0.089	0.582	1.062	0.570	0.749	0.506	40.9	0.141	1.113		
70	-	0.644	-	0.507	0.701	0.554	51.3	0.223	1.032		
							56.1	0.298	0.956		
							61.0	0.217	1.038		
							70.4	0.326	0.929		
							79.4	0.292	0.963		

TABLE 4-5

PRESSURE COEFFICIENT DATA, MCA STATOR A 95% DESIGN SPEED, POINT 5

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P
15	-0.636	-0.046	1.781	1.191	0.409	0.847	19.1	0.002	1.255	8.5	0.583
20	-0.470	-	1.615	-	0.356	0.901	22.4	0.015	1.242	13.5	0.605
25	-0.341	0.350	1.486	0.794	0.516	0.741	24.7	0.076	1.181	18.8	0.619
30	-0.239	0.396	1.384	0.748	0.510	0.747	28.0	0.055	1.202	23.7	0.631
35	-0.166	0.442	1.310	0.702	0.630	0.627	30.2	0.102	1.155	34.1	0.652
40	-0.111	0.506	1.255	0.637	0.617	0.640	33.5	0.062	1.195	45.8	0.680
45	-0.064	0.534	1.209	0.610	0.690	0.567	35.7	0.055	1.202	56.0	0.699
50	-0.018	0.571	1.163	0.573	0.670	0.587	38.8	0.156	1.101	71.3	0.711
60	0.073	0.571	1.071	0.573	0.743	0.514	40.9	0.156	1.101		
70	-	0.626	-	0.518	0.703	0.554	51.3	0.169	1.088		
							56.1	0.303	0.954		
							61.0	0.189	1.068		
							70.4	0.336	0.921		
							79.4	0.276	0.981		

TABLE 5-1

PRESSURE COEFFICIENT DATA, MCA STATOR A
100% DESIGN SPEED, POINT 1

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub Mid Channel Ratio P/P
15	-0.204	-0.130	1.399	1.325	-0.213	1.513	19.1	-0.351	1.650	8.5	0.441
20	-0.228	-	1.424	-	-0.165	1.464	22.4	-0.427	1.726	13.5	0.444
[illegible]	-0.318	-0.286	1.514	1.481	-0.241	1.540	24.7	-0.399	1.698	18.8	0.434
30	-0.392	-0.072	1.588	1.268	-0.151	1.451	28.0	-0.495	1.795	23.7	0.405
35	-0.499	0.123	1.694	1.071	0.198	1.100	30.2	-0.475	1.774	34.1	0.347
40	-0.564	0.214	1.760	0.981	0.315	0.983	33.5	-0.564	1.863	45.8	0.478
45	-0.720	0.312	1.916	0.882	0.446	0.852	35.7	-0.550	1.850	58.0	0.515
50	-0.835	0.337	2.031	0.858	0.467	0.832	38.8	-0.413	1.712	71.3	0.520
60	-0.138	0.410	1.333	0.784	0.528	0.770	40.9	-0.440	1.740		
70	-	0.410	-	0.784	0.528	0.770	51.3	-0.358	1.657		
							56.1	-0.220	1.520		
							61.0	-0.145	1.444		
							70.4	-0.083	1.382		
							79.4	-0.117	1.416		

TABLE 5-2

PRESSURE COEFFICIENT DATA, MCA STATOR A
100% DESIGN SPEED, POINT 2

% Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P
15	-0.310	0.318	1.496	0.867	0.252	1.037	19.1	-0.503	1.794	8.5	0.413
20	-0.398	-	1.585	-	0.400	0.890	22.4	0.031	1.258	13.5	0.446
25	-0.189	0.326	1.375	0.859	0.427	0.863	24.7	-0.503	1.794	18.8	0.489
30	-0.213	0.375	1.400	0.811	0.507	0.783	28.0	0.105	1.185	23.7	0.527
35	-0.165	0.464	1.351	0.722	0.561	0.729	30.2	-0.389	1.680	34.1	0.573
40	-0.173	0.512	1.359	0.674	0.627	0.662	33.5	0.119	1.171	45.8	0.621
45	-0.140	0.568	1.327	0.617	0.641	0.649	35.7	-0.088	1.379	58.0	0.641
50	-0.116	0.593	1.303	0.593	0.627	0.662	38.8	0.226	1.064	71.3	0.648
60	0.133	0.617	1.053	0.569	0.594	0.696	40.9	0.045	1.245		
70		0.649		0.537	0.601	0.698	51.3	0.232	1.058		
							56.1	0.206	1.084		
							61.0	0.226	1.064		
							70.4	0.273	1.017		
							79.4	0.252	1.037		

TABLE 5-3

PRESSURE COEFFICIENT DATA, MCA STATOR A
100% DESIGN SPEED, POINT 3

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio P/P_s
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		
15	-0.461	0.362	1.644	0.820	0.368	0.910	19.1	-0.544	1.823	8.5	0.703
20	-0.430	-	1.613	-	0.395	0.884	22.4	0.103	1.175	13.5	0.540
25	-0.212	0.346	1.395	0.836		0.771	24.7	-0.154	1.433	18.8	0.567
30	-0.212	0.393	1.395	0.789	0.500	0.778	28.0	0.150	1.129	23.7	0.585
35	-0.096	0.409	1.279	0.774	-	-	30.2	0.050	1.228	34.1	0.622
40	-0.096	0.556	1.279	0.626	0.600	0.679	33.5	0.150	1.129	45.8	0.650
45	-0.041	0.541	1.224	0.641	0.699	0.580	35.7	0.117	1.162	58.0	0.678
50	-0.002	0.580	1.186	0.603	0.659	0.619	38.8	0.170	1.109	71.3	0.690
60	0.098	0.580	1.085	0.603	0.758	0.520	40.9	0.156	1.122		
70	-	0.626	-	0.556	0.686	0.593	51.3	0.196	1.083		
							56.1	0.289	0.990		
							61.0	0.216	1.063		
							70.4	0.309	0.970		
							79.4	0.269	1.010		

TABLE 5-4

PRESSURE COEFFICIENT DATA, MCA STATOR A
100% DESIGN SPEED, POINT 4

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio P/P_s
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		
15	-0.560	-0.001	1.742	1.182	0.402	0.874	19.1	-0.277	1.554	8.5	0.535
20	-0.433	-	1.615	-	0.364	0.913	22.4	0.095	1.182	13.5	0.570
25	-0.329	0.290	1.511	0.891	0.518	0.759	24.7	0.024	1.253	18.8	0.592
30	-0.239	0.357	1.421	0.824	0.492	0.784	28.0	0.139	1.137	23.7	0.606
35	-0.179	0.387	1.362	0.794	0.633	0.643	30.2	0.114	1.163	34.1	0.632
40	-0.120	0.461	1.302	0.720	0.582	0.695	33.5	0.139	1.137	45.8	0.661
45	-0.090	0.469	1.272	0.712	0.704	0.573	35.7	0.139	1.137	58.0	0.682
50	-0.030	0.521	1.212	0.660	0.614	0.662	38.8	0.184	1.092	71.3	0.701
60	0.051	0.506	1.130	0.675	0.762	0.515	40.9	0.165	1.110		
70		0.558	-	0.623	0.672	0.605	51.3	0.197	1.080		
							56.1	0.300	0.977		
							61.0	0.229	1.047		
							70.4	0.319	0.958		
							79.4	0.281	0.996		

TABLE 5-5

PRESSURE COEFFICIENT DATA, MCA STATOR A
100% DESIGN SPEED, POINT. 5

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		P/P_8
15	-0.596	-0.101	1.753	1.258	0.402	0.871	19.1	-0.187	1.461	8.5	547
20	-0.495	-	1.652	-	0.345	0.928	22.4	0.003	1.271	13.5	0.575
25	-0.403	0.275	1.560	0.881	0.504	0.770	24.7	0.009	1.265	18.8	0.59
30	-0.319	0.325	1.476	0.831	0.491	0.782	28.0	0.079	1.195	23.7	0.607
35	-0.260	0.376	1.417	0.780	0.624	0.649	30.2	0.085	1.188	34.1	0.631
40	-0.202	0.443	1.359	0.713	0.593	0.681	33.5	0.098	1.176	45.8	0.659
45	-0.177	0.476	1.334	0.680	0.688	0.586	35.7	0.117	1.157	58.0	0.680
50	-0.093	0.518	1.250	0.638	0.631	0.643	38.8	0.161	1.113	71.3	0.694
60	-0.009	0.518	1.166	0.638	0.745	0.528	40.9	0.155	1.119		
70	-	0.560	-	0.596	0.682	0.592	51.3	0.174	1.100		
							56.1	0.282	0.992		
							61.0	0.193	1.081		
							70.4	0.320	0.954		
							79.4	0.244	1.030		

TABLE 6-1

PRESSURE COEFFICIENT DATA, MCA STATOR A
110% DESIGN SPEED, POINT 1

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio p/p_s
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		
15	-0.764	-0.022	1.983	1.245	-0.086	1.474	19.1	-0.273	1.661	8.5	0.399
20	-0.498		1.720		-0.045	1.433	22.4	-0.308	1.696	13.5	0.392
25	-0.613	-0.332	1.836	1.555	-0.145	1.532	24.7	-0.291	1.679	18.8	0.387
30	-0.274	-0.282	1.497	1.504	-0.121	1.509	28.0	-0.355	1.743	23.7	0.363
35	0.361	-0.022	1.584	1.245	-0.080	1.469	30.2	-0.349	1.737	34.1	0.303
40	-0.382	0.215	1.605	1.007	0.030	1.357	33.5	-0.420	1.808	45.8	0.387
45	-0.498	0.294	1.721	0.962	0.487	0.900	35.7	-0.431	1.819	58.0	0.455
50	-0.642	0.330	1.865	0.892	0.528	0.859	38.8	-0.367	1.755	71.3	0.450
60	-0.505	0.445	1.728	0.776	0.727	0.660	40.9	-0.502	1.890		
70		0.431		0.791	0.721	0.666	51.3	-0.215	1.603		
							56.1	-0.156	1.545		
							61.0	-0.104	1.492		
							70.4	-0.074	1.462		
							79.4	-0.080	1.468		

TABLE 6-2

PRESSURE COEFFICIENT DATA, MCA STATOR A
110% DESIGN SPEED, POINT 2

% Chord	C_p 10% Span		S Factor 10% Span		C_p 90% Span	S Factor 90% Span	% Chord	C_p 90% Span	S Factor 90% Span	% Chord	Hub/Mid Channel Ratio p/p_s
	Suction Surface	Pressure Surface	Suction Surface	Pressure Surface	Pressure Surface	Pressure Surface		Suction Surface	Suction Surface		
15	-0.518	0.360	1.738	0.859	0.306	1.027	19.1	-0.449	1.783	8.5	0.399
20	-0.428		1.648		0.342	0.991	22.4	0.062	1.271	13.5	0.438
25	-0.248	0.347	1.468	0.873	0.452	0.881	24.7	-0.424	1.758	18.8	0.488
30	-0.255	0.388	1.475	0.831	0.482	0.851	28.0	0.117	1.216	23.7	0.519
35	-0.144	0.485	1.364	0.734	0.598	0.735	30.2	-0.199	1.533	34.1	0.551
40	-0.144	0.527	1.364	0.693	0.568	0.766	33.5	0.141	1.192	45.8	0.582
45	-0.038	0.582	1.309	0.638	0.653	0.680	35.7	0.001	1.332	58.0	0.596
50	-0.040	0.617	1.260	0.603	0.592	0.741	38.8	0.153	1.180	71.3	0.599
60	0.077	0.637	1.143	0.582	0.616	0.717	40.9	0.099	1.236		
70		0.637		0.582	0.568	0.766	51.3	0.172	1.161		
							56.1	0.190	1.143		
							61.0	0.178	1.155		
							70.4	0.251	1.082		
							79.4	0.251	1.082		

TABLE 6-3

PRESSURE COEFFICIENT DATA FOR POINT 3 AT 110% DESIGN SPEED WAS NOT RECORDED

TABLE 6-4

PRESSURE COEFFICIENT DATA, MCA STATOR A 110% DESIGN SPEED, POINT 4

Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	Chord	Hub Mid Channel Ratio P/P
15	-0.563	0.350	1.764	0.850	0.220	1.111	19.1	-0.473	1.805	8.5	0.384
20	-0.458		1.659		0.358	0.973	22.4	0.092	1.239	13.5	0.411
25	-0.403	0.287	1.603	0.912	0.433	0.897	24.7	-0.450	1.782	18.8	0.459
30	-0.340	0.301	1.541	0.898	0.474	0.857	28.0	0.133	1.198	23.7	0.498
35	-0.284	0.399	1.485	0.801	0.578	0.753	30.2	-0.294	1.626	34.1	0.539
40	-0.256	0.441	1.457	0.759	0.5[illegible]	0.770	33.5	0.133	1.198	45.8	0.577
45	-0.193	0.511	1.394	0.689	0.653	0.678	35.7	-0.069	1.401	58.0	0.596
50	-0.158	0.532	1.359	0.568	0.619	0.712	38.8	0.144	1.187	71.3	0.605
60	-0.019	0.560	1.219	0.540	0.728	0.603	40.9	0.022	1.308		
70		0.567		0.633	0.647	0.684	51.3	0.185	1.146		
							56.1	0.167	1.163		
							61.0	0.173	1.158		
							70.4	0.248	1.083		
							79.4	0.248	1.083		

TABLE 6-5

PRESSURE COEFFICIENT DATA, MCA STATOR A
110% DESIGN SPEED, POINT 5

Chord	C_p 10% Span Suction Surface	C_p 10% Span Pressure Surface	S Factor 10% Span Suction Surface	S Factor 10% Span Pressure Surface	C_p 90% Span Pressure Surface	S Factor 90% Span Pressure Surface	% Chord	C_p 90% Span Suction Surface	S Factor 90% Span Suction Surface	% Chord	Hub/Mid Channel Ratio P/P
15	-0.538	0.358	1.732	0.834	0.255	1.077	19.1	-0.469	1.799	8.5	0.384
20	-0.453		1.646		0.323	1.009	22.4	0.069	1.263	13.5	0.399
25	-0.411	0.252	1.604	0.940	0.424	0.908	24.7	-0.454	1.787	18.8	0.432
30	-0.340	0.295	1.533	0.898	0.436	0.896	28.0	0.114	1.218	23.7	0.475
35	-0.298	0.365	1.491	0.827	0.571	0.761	30.2	-0.398	1.731	34.1	0.528
40	-0.262	0.436	1.456	0.756	0.526	0.806	33.5	0.126	1.207	45.8	0.552
45	-0.220	0.485	1.413	0.707	0.656	0.676	35.7	-0.144	1.477	58.0	0.597
50	-0.171	0.528	1.364	0.664	0.577	0.755	38.8	0.137	1.195	71.3	0.610
60	-0.059	0.535	1.244	0.657	0.729	0.603	40.9	-0.037	1.370		
70		0.563		1.629	0.611	0.722	51.3	0.148	1.184		
							56.1	0.142	1.190		
							61.0	0.142	1.190		
							70.4	0.238	1.094		
							79.4	0.221	1.111		