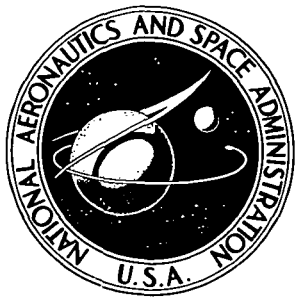
NASA TECHNICAL NOTE



NASA TN D-7074

NASA TN D-7074

SUMMARY OF DESIGN AND BLADE-ELEMENT PERFORMANCE DATA FOR 12 AXIAL-FLOW PUMP ROTOR CONFIGURATIONS

by Max J. Miller, Theodore H. Okiishi, George K. Serovy, Donald M. Sandercock, and Werner R. Britsch

Lewis Research Center
Cleveland, Ohio 44135

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • JANUARY 1973

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TN D-7074		

4. Title and Subtitle	5. Report Date
SUMMARY OF DESIGN AND BLADE-ELEMENT PERFORMANCE DATA FOR 12 AXIAL-FLOW PUMP ROTOR CONFIGURATIONS	January 1973
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Max J. Miller, Theodore H. Okiishi, and George K. Serovy, all of Iowa State University, Ames, Iowa; and Donald M. Sandercock and Werner R. Britsch, both of Lewis Research Center	E-6624
	10. Work Unit No. 502-24

9. Performing Organization Name and Address	11. Contract or Grant No.
Lewis Research Center National Aeronautics and Space Administration Cleveland, Ohio 44135	
	13. Type of Report and Period Covered Technical Note

12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code
National Aeronautics and Space Administration Washington, D. C. 20546	

15. Supplementary Notes

16. Abstract

A carefully selected and evaluated collection of noncavitating blade-element performance data for 12 axial-flow pump rotor configurations is presented in tabular form. Rotor design philosophy, test apparatus and procedure, and data reduction and evaluation are discussed. A data storage and recall computer program is described. All but one of the rotor configurations considered were composed of double-circular-arc blade sections and were designed for high inlet relative flow angles. Hub-tip radius ratios ranged from 0.40 to 0.90.

17. Key Words (Suggested by Author(s))		18. Distribution Statement
Turbomachinery	Tabulated data	Unclassified - unlimited
Axial-flow pump	Tip clearance	
Experimental data		
Computer program		

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	216	$3.00

* For sale by the National Technical Information Service, Springfield, Virginia 22151

Page Intentionally Left Blank

CONTENTS

SUMMARY OF DESIGN AND BLADE-ELEMENT PERFORMANCE DATA FOR 12 AXIAL-FLOW PUMP ROTOR CONFIGURATIONS

by Max J. Miller,* Theodore H. Okiishi,† George K. Serovy,‡
Donald M. Sandercock, and Werner R. Britsch

Lewis Research Center

SUMMARY

During the period 1958-70 a comprehensive program of research on pumps for liquid-propellant rocket systems was carried on and supported by the National Aeronautics and Space Administration through the Lewis Research Center. One important phase of the research on axial-flow pumps was an extensive investigation of rotor blade row configurations operating in water. A carefully selected and evaluated collection of noncavitating blade-element performance data for 12 of these axial-flow pump rotor configurations is presented. Rotor design philosophy, test apparatus and procedure, and data reduction and evaluation are discussed.

All but one of the rotor configurations considered were composed of double-circular-arc blade sections and were designed for high inlet relative flow angles. Hub-tip radius ratios ranged from 0.40 to 0.90.

This information should be useful for analysis and design purposes - not only for pumps, but also for axial-flow compressors and blowers. Except for the generally higher level of pump rotor blade chord Reynolds numbers involved, the flow conditions associated with the present pump rotor data are quite similar to those existing in the rear stages of industrial multistage axial-flow compressors and in fan and blower configurations with high hub-tip ratios.

To facilitate handling the large volume of experimental data presented, a data storage and recall computer program was developed. A listing and description of the program and detailed information concerning its use are presented. Other possible uses for the program are also suggested.

---

*Research Associate, Iowa State University, Ames, Iowa.

†Associate Professor of Mechanical Engineering, Iowa State University, Ames, Iowa.

‡Professor of Mechanical Engineering, Iowa State University, Ames, Iowa.

INTRODUCTION

During the period 1958-70 a comprehensive program of research on pumps for liquid-propellant rocket systems was carried on and supported by the National Aeronautics and Space Administration through the Lewis Research Center. The program included numerous projects involving the fluid mechanics of inducers and centrifugal and axial-flow pump configurations.

One important phase of the research on axial-flow pumps was extensive experimental investigation of rotor blade rows operating in water. Several features of these studies justify careful consideration of the results. First, a wide range of rotor geometries was utilized and consistent design techniques were used. Second, experimental facilities were planned, constructed, and operated so that the effects of extraneous and random variables could be eliminated or minimized. Both overall performance and radial distributions of fluid properties and velocities at inlet and exit measuring stations were measured. The results are believed to be the most complete, if not the only available, collection of detailed experimental performance data of axial-flow pump blade rows.

From 1960 to the present the NASA Lewis Research Center has supported at Iowa State University a research program concerned with prediction of the performance of axial-flow pumps by blade-element methods. Development of these methods has depended on correlation of experimental data from the various NASA studies.

To support this work, a computer-based storage and recall system for experimental axial-flow pump data has been developed. The system is structured so that rotor and stage geometric parameters and basic fluid property measurements can be retrieved rapidly and used in the computation of currently recognized, as well as newly proposed, hydrodynamic and geometric parameters.

The major objective of this report is to present a carefully selected and evaluated collection of data for 12 axial-flow pump rotor configurations. In addition, the report includes a discussion of the test facilities in which the data were obtained, information about rotor design procedures, and an evaluation of the results. Noncavitating data only are presented, but it is noted that some cavitation data for included rotors are given in references 1 to 6. All but one of the data sets included are for rotors having double-circular-arc blade-section geometries on cylindrical surfaces. The rotor geometries are characterized by high inlet relative flow angles.

A secondary objective of this report is to describe and demonstrate the utility of the data storage and recall system. The 12 rotor data sets have been placed in the proper format for entry into the system, and it has been used to prepare the detailed data tabulations presented herein. Data of questionable validity were eliminated wherever possible.

ROTOR DESIGN INFORMATION

The 12 rotor configurations were part of a systematic study to show the effects of design parameters such as blade loading, flow coefficient, radius ratio, tip clearance, and energy addition distribution on the performance of a class of rotor geometry. This class is composed of high-inlet-relative-flow-angle, high-head-rise blade rows operating in an annulus having constant-diameter hub and casing surfaces.

Design Procedure

A two-part design procedure based on the blade-element method given in reference 7 was used. A detailed description of this procedure as applied to pump rotor design is given in reference 3. In the first part of the procedure, velocity diagrams were calculated at the blade-row entrance and exit stations, assuming axisymmetric flow and cylindrical stream surfaces. A computer program which performs the velocity diagram calculations is presented in reference 8. The second part of the design procedure consisted of selecting blade sections on the assumed cylindrical stream surfaces to produce the desired exit velocity diagrams and stacking the sections to form a blade. The stacking procedure can be carried out by using the computer program of reference 9. A typical blade formed from stacked sections is shown in the blade fabrication drawing of figure 1.

The choice of design parameters for the different blade rows in a multistage pump usually depends on the changing values of flow conditions (particularly pressure) through the pump. The first rotor in a multistage pump is often an inducer which has a low design flow coefficient $\overline{\varphi}$, a low radius ratio r_h/r_t, and low blade loading to enhance cavitation performance. (All symbols are defined in appendix A.) Deeper in the pump, where the pressure is high enough to preclude cavitation, considerations of high head rise per stage dominate design decisions. Thus, it is desirable to raise $\overline{\varphi}$ as much as possible because, as shown by examples presented in references 3 and 10, for a given blade loading (as measured by D-factor), energy addition increases as $\overline{\varphi}$ is increased and this leads to higher head rise per stage. In a multistage pump having a constant tip diameter, the $\overline{\varphi}$ for downstream stages is increased by increasing r_h/r_t. This leads to short blades which impose a practical limit on the maximum value of $\overline{\varphi}$, depending on the scale of the pump. The blade loading of middle and rear stages is limited by hydrodynamic considerations other than cavitation; and accordingly, loading may be considerably higher for these stages than for inlet stages.

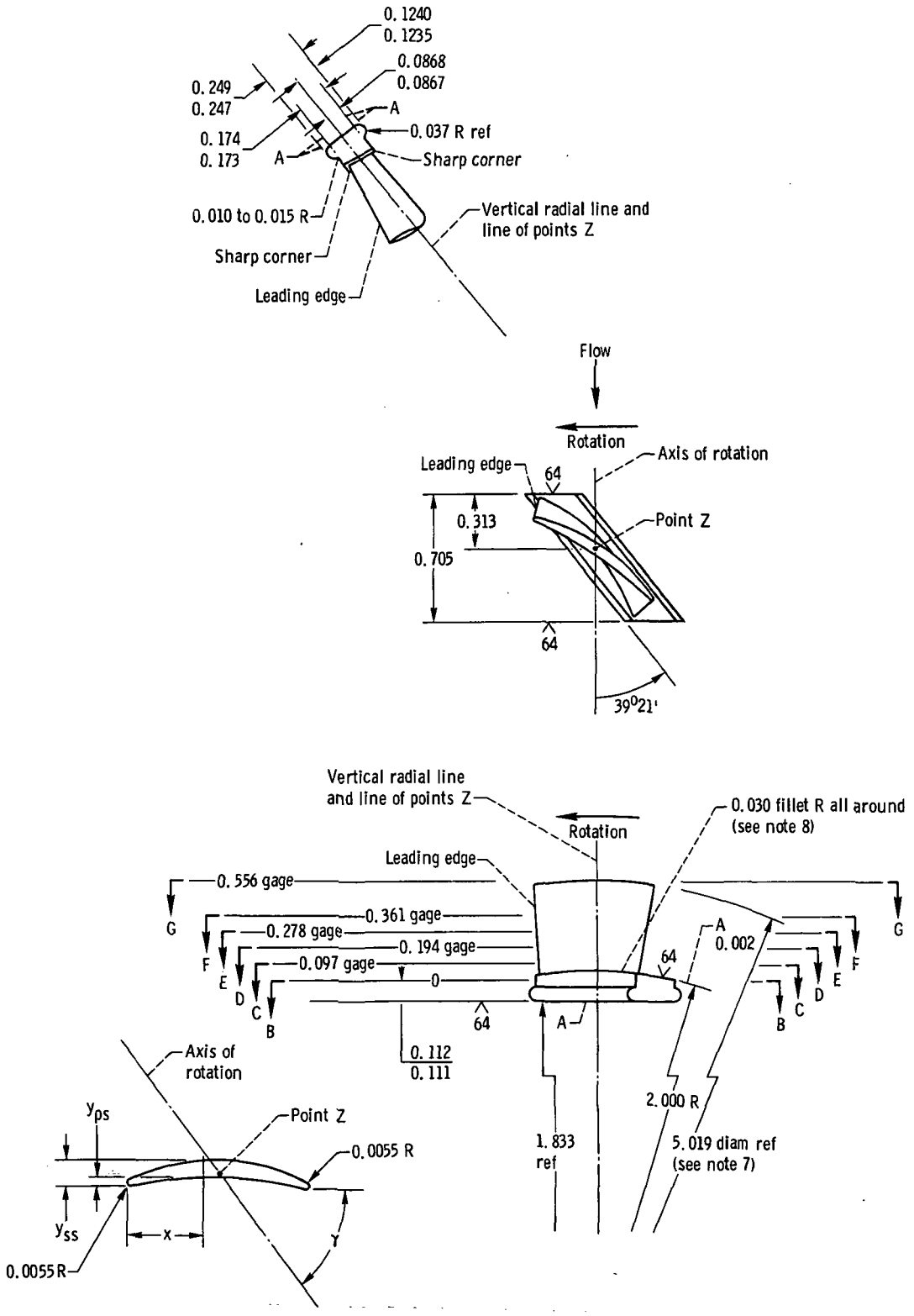


Figure 1. - Typical blade

1. Material must pass ultrasonic inspection as per NASA specification LRC-4-A.
2. Line of points Z is a radial line and perpendicular to airfoil sections.
3. Aerodynamic tolerance requirements will be satisfied if contour of blade is within +0.003 to -0.001 inch of true contour, provided contour is smooth and deviations from fairness do not exceed 0.002 inch per 0.250 inch of surface length.
4. To be dynamically balanced by NASA. See note 1 on CD843428.
5. "A" surfaces must be concentric, parallel, flat, square and true within 0.001 inch FIR.
6. $\sqrt{}^{32}$ all over unless otherwise specified.
7. Turn tip radius after assembly with rotor CD843430 to provide 0.015 to 0.020 clearance with 843433.
8. The 0.030-inch fillet radius must be polished smooth and be tangent to airfoil and base.
9. Finished part must pass Zyglo inspection.
10. Peen both ends of blade base at assembly.

Cross section		B-B		C-C		D-D	
Point Z	x	0.4170		0.4180		0.4174	
	y	0.0685		0.0665		0.0660	
γ		$38^{0}30'$		$41^{0}29'$		$44^{0}1'$	
Blade coordinates[a]							
x		y_{ps}	y_{ss}	y_{ps}	y_{ss}	y_{ps}	y_{ss}
0.0000		0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
.1000		.0210	.0620	.0210	.0590	.0210	.0580
.2000		.0360	.0960	.0360	.0935	.0360	.0915
.3000		.0455	.1170	.0447	.1135	.0450	.1105
.4000		.0480	.1240	.0480	.1215	.0490	.1180
.5000		.0455	.1190	.0460	.1170	.0470	.1140
.6000		.0970	.1035	.0375	.1005	.0385	.0985
.7000		.0235	.0790	.0250	.0710	.0255	.0700
.8000		.0060	.0280	.0065	.0280	.0065	.0280
.8360		.0055	.0055	.0055	.0055	.0055	.0055

Cross section		B-B		C-C		D-D	
Point Z	x	0.4175		0.4178		0.4177	
	y	0.0655		0.0598		0.0415	
γ		$46^{0}0'$		$48^{0}42'$		$55^{0}40'$	
Blade coordinates							
x		y_{ps}	y_{ss}	y_{ps}	y_{ss}	y_{ps}	y_{ss}
0.0000		0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
.1000		.0205	.0570	.0190	.0535	.0110	.0415
.2000		.0370	.0905	.0335	.0847	.0185	.0638
.3000		.0465	.1095	.0425	.1030	.0230	.0775
.4000		.0495	.1170	.0450	.1095	.0245	.0820
.5000		.0475	.1130	.0420	.1045	.0225	.0780
.6000		.0395	.0970	.0340	.0890	.0175	.0660
.7000		.0255	.0685	.0215	.0630	.0105	.0480
.8000		.0070	.0270	.0055	.0253	.0025	.0212
.8355		------	------	------	------	.0055	.0055
.8360		.0055	.0055	------	------	------	------
.8365		------	------	.0055	.0055	------	------

NO SCALE	REFERENCES	INITIAL	DATE	CHANGE NO.	REVISION	DATE	CK. APP.
UNLESS OTHERWISE SPECIFIED	19 REQ.	DR.					
.X DIM. MAY VARY ±		CK.					
.XX DIM. MAY VARY ±	MAT L-17-4PH	D.ENG					
.XXX DIM. MAY VARY ±.001	STAINLESS STL	P.ENG			8 WATER PUMP ASSEMBLY		
ANGULAR DIM. MAY VARY ±0°15'	CONDITION	P ENG			5" ROTOR $\varphi = 0.466$ $\phi = 0.420$		CD 843428
DIM. MAY VARY ±	H-1200	D S MD			NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	DWG NO.	
BREAK SHARP EDGES	SAFETY APPROVAL	R S MD			LEWIS RESEARCH CENTER		CD 843429
	BY DATE	D.D CH.			CLEVELAND, OHIO		
	AREA SAFETY COMM.	S D CH.					

fabrication drawing.

Overall Design Features

The overall design features of the 12 rotor configurations, which are summarized in the following table, were chosen to be representative of rotors in a multistage pump:

Configuration	Radius ratio,[a] r_h/r_t	Average ideal flow coefficient, $\overline{\varphi}_i$	Average ideal headrise coefficient, ψ_i	Energy addition distribution	Blade tip diffusion factor, D_t	Blade chord, in., c	Number of blades, NB	Radial tip clearance, in.	Reference
02	0.4	0.293	0.161	Approximately radially constant	0.24	1.50	16	0.013 to 0.020	None
07	.7	.294	.294	Radially constant	.43	1.52	19	0.005 to 0.012	1, 2
09	.7	.294	-----	Approximately radially constant	----	3.04	8	0.013 to 0.020	None
5	.8	.466	0.460	Increasing hub to tip	0.66	1.50	19	0.015 to 0.017	3, 4
6	↓	↓	↓	↓	↓	1.50	↓	0.025 to 0.027	None
8						.833		0.007 to 0.009	↓
9						.833		0.015 to 0.017	
10						.833		0.022 to 0.024	
13A	.85	.500	.7225	Radially constant	.72	1.17	33	0.009 to 0.011	
14A	.9	.700	.645	Radially constant	.63	1.50	19	0.009 to 0.011	5
15	.8	.466	.393	Increasing hub to tip	.56	1.50	19	0.009 to 0.010	6
16	.85	.500	.7225	Radially constant	.72	1.17	33	0.009 to 0.011	None

[a]Configurations 8, 9, and 10 have a 5-in. tip diameter. All other configurations have a 9-in. tip diameter.

Configuration 02 was intended to be typical of a transition rotor which would follow immediately downstream of an inducer stage. The other 11 configurations are typical middle- and rear-stage rotors. To avoid confusion, note that configurations 09 and 9 are different geometries.

Features common to all configurations include constant-diameter annulus surfaces, double-circular-arc blade sections (except configuration 16), and 9-inch outer-annulus

surface diameter (except configurations 8, 9, and 10, which had a 5-in. diameter). Tip clearance was obtained by grinding the required amount from the blade tips.

Certain subsets of the rotor configurations have identifiable common features:

(1) Configuration 09 was derived from the configuration 07 design by doubling the chord length and reducing the number of blades from 19 to 8.

(2) Configurations 5 and 6 are 9-inch-diameter rotors which differ only in the value of tip clearance.

(3) Likewise, configurations 8, 9, and 10 (which are 5/9 scale models of configuration 5) differ from one another only in the values of tip clearance.

(4) Configurations 13A and 16 have the same blade angles; but 13A has double-circular-arc blade sections, while configuration 16 has arbitrary blade profiles.

(5) Configurations 02, 07, 5, 14A, and 15 are similar designs which demonstrate the effects of increasing blade loading and flow coefficient.

Blade-Element Design Features

Blade-element procedures were used to obtain the local values of velocity diagram and rotor blade geometric parameters, as previously mentioned. Special features applying to specific configurations are given in this section. For additional information the references in table I should be consulted. Radial distributions of velocity diagram and blade geometry parameters are summarized in tables II and III. Blade parameters are illustrated in figure 2 and defined in appendix A.

Configuration 02 was derived from the rotor described in reference 11 by reducing the number of blades from 19 to 16. The design parameters given for configuration 02 in tables II and III were reconstructed to reflect the reduced solidity. By using the procedure of reference 12, an ideal flow coefficient $\overline{\varphi}_i$ value was selected for optimum cavitation performance. Inlet relative flow angles and solidities outside the ranges given in the correlations of design incidence angle and deviation angles presented in reference 7 required extrapolation for this configuration. Designers should note that water-cascade data for double-circular-arc blade sections are now available for high blade setting angles (ref. 13).

The same $\overline{\varphi}_i$ used for configuration 02 was retained for configuration 07. Extrapolations of reference 7 correlations were required in computation of some incidence and deviation angles. No hydrodynamic design was carried out for configuration 09 since it was derived directly from configuration 07 by doubling the chord and reducing the number of blades from 19 to 8. For this reason, no design information is presented in tables II and III.

In the design of configurations 5, 6, 8, 9, and 10, a higher $\overline{\varphi}_i$ and an increasing

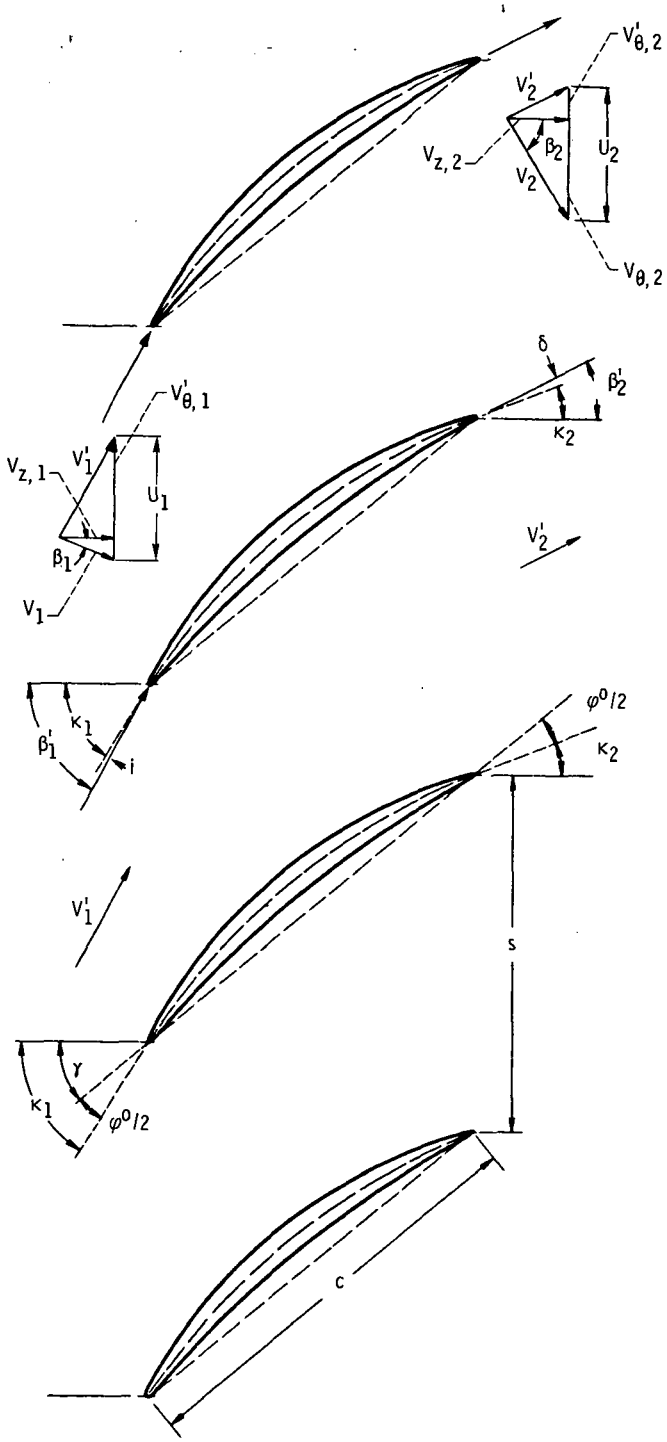
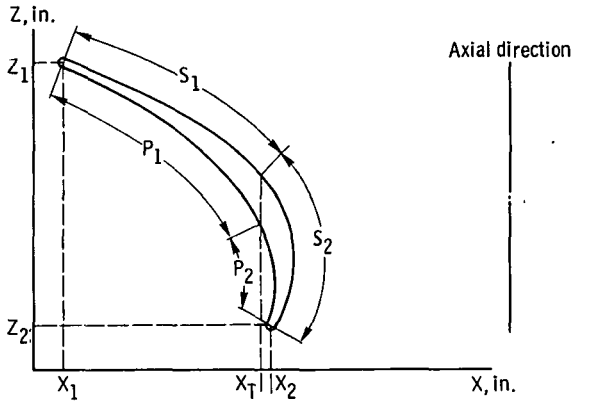


Figure 2. - Typical double-circular-arc blade elements and nomenclature.

energy addition from hub to tip were used to reduce gradients of exit flow coefficient φ_2 and head-rise coefficient ψ. Incidence and deviation angle data could be obtained directly from reference 7 without extrapolation.

The velocity diagrams for configuration 16 were computed by assuming zero inlet tangential velocity and radially constant values of inlet flow coefficient φ_1, ideal head-rise coefficient ψ_i, and efficiency η. These assumptions resulted in a radially constant exit flow coefficient φ_2. Specific values of efficiency or loss could not be assigned because an arbitrary blade profile having unknown loss characteristics was specified. The



$$Z = B1X^3 + B2X^2 + B3X + B4$$

Section	Arc	Cubic equation constant coefficients				Transition coordinate in tangential direction, X_T
		B1	B2	B3	B4	
Tip	Mean camber line	-1.394	0.486	-0.342	1.031	------
	S1	-2.349	2.049	-1.108	1.183	0.9079
	S2	-2.262	1.163	-.417	1.043	.9079
	P1	-1.009	.085	-.316	1.023	.8569
	P2	-1.116	.158	-.324	1.021	.8569
Hub	Mean camber line	-0.761	-0.649	0.592	0.648	------
	S1	-1.223	.017	.313	.724	0.7706
	S2	-2.026	.314	.477	.662	.7706
	P1	-.915	-.034	.033	.740	.6938
	P2	-.387	-1.128	.644	.636	.6938

Section	Axial coordinate at blade-row inlet, Z_1	Axial coordinate at blade-row outlet, Z_2	Tangential coordinate at blade-row inlet, X_1	Tangential coordinate at blade-row outlet, X_2
Tip	0.9	0.1	0.1	1.0
Hub	.9	.1	.1	.7

Figure 3. - Detailed description of hub and tip blade sections used for configuration 16.

blade mean camber line, the pressure surface, and the suction surface were described by third-order polynomials, as shown in figure 3. The particular polynomials selected were such that the flow area between adjacent blade sections in the cascade increased uniformly from the leading edge to the trailing edge. Blade profiles were developed in this way on the hub and tip stream surfaces and stacked on a radial line through their centers of area. The remainder of the blade was defined by passing straight lines through points on the hub and tip profiles at equal percentages of the distance along the profile from the leading edge to the trailing edge. Incidence angles were arbitrarily chosen so that at the off-design flow coefficient of 0.35 the incidence angles would be zero. Carter's rule was used to estimate deviation angles.

Configuration 13A was obtained by substituting double-circular-arc blade sections, having the same leading- and trailing-edge blade angles, for the arbitrary blade profiles of configuration 16. Identical chord lengths but different mean-camber-line shapes resulted in blade-setting-angle values which differ for the two configurations (table III).

Because of the relatively short span (0.45 in.) of configuration 14A, three-dimensional flows were expected to affect the losses over a significant fraction of the span. However, since no procedure was available to estimate such losses, a radially constant $\overline{\omega}$ of 0.125 was chosen.

APPARATUS AND PROCEDURE

Performance tests of all 12 rotor configurations were carried out in the Lewis water tunnel. A photograph and a schematic diagram of the water tunnel are shown in figures 4 and 5, and a description of the facility is given in reference 11. Schematics of typical pump-inlet flow paths and test sections are shown in figure 6. Before each test series, the water in the loop was conditioned by reducing the gas content to approximately 1 part per million by weight and by circulating the water through a filter capable of removing solid particles larger than 5 micrometers. During tests, the gas content was maintained below 3 parts per million by weight. For tests of a given configuration, water temperature was held within a few degrees of a constant value. The water temperature was slightly different for each configuration; but for all configurations, nominal water-temperature values were in the range 65° to 85° F.

Noncavitating performance characteristics were obtained by maintaining the inlet pressure and rotative speed constant while varying flow rate. Maximum-flow operating points were established by the water-tunnel pressure losses with the throttling valve wide open. Each minimum-flow operating point (except for configuration 02) was set, at the discretion of the operator, close to a stalled condition made apparent through vibrations and noise in the test apparatus. At each selected flow rate the radial distributions

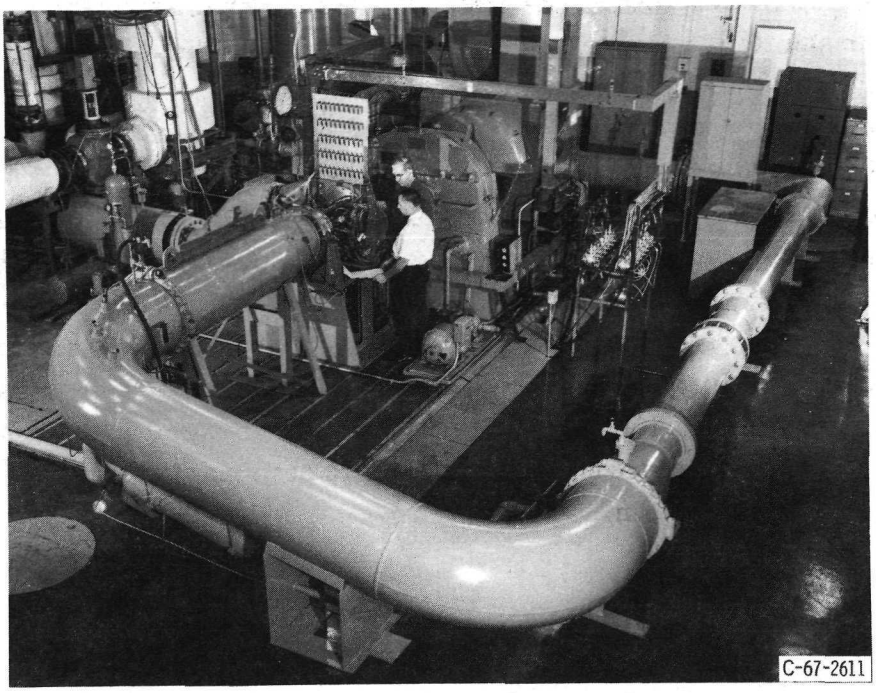


Figure 4. - Lewis water tunnel.

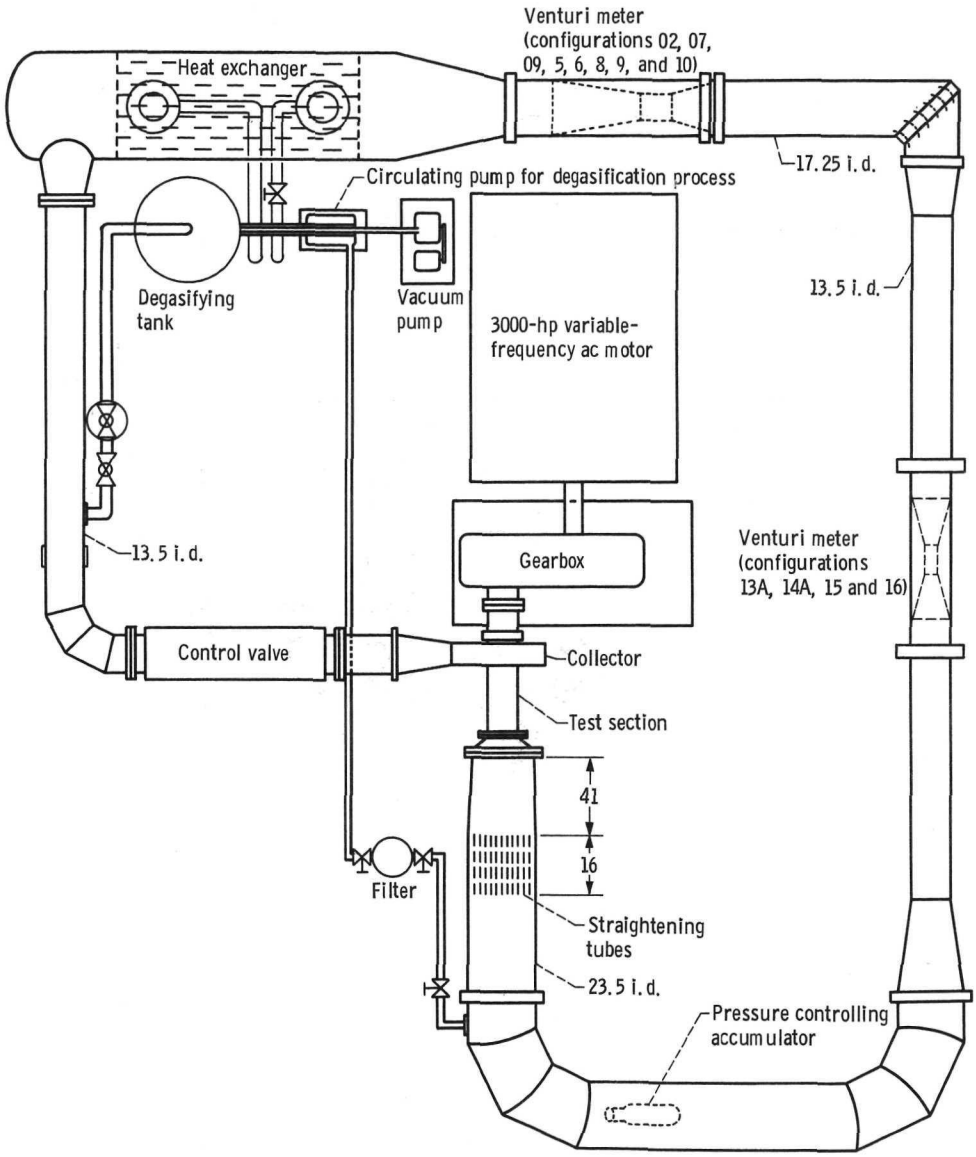
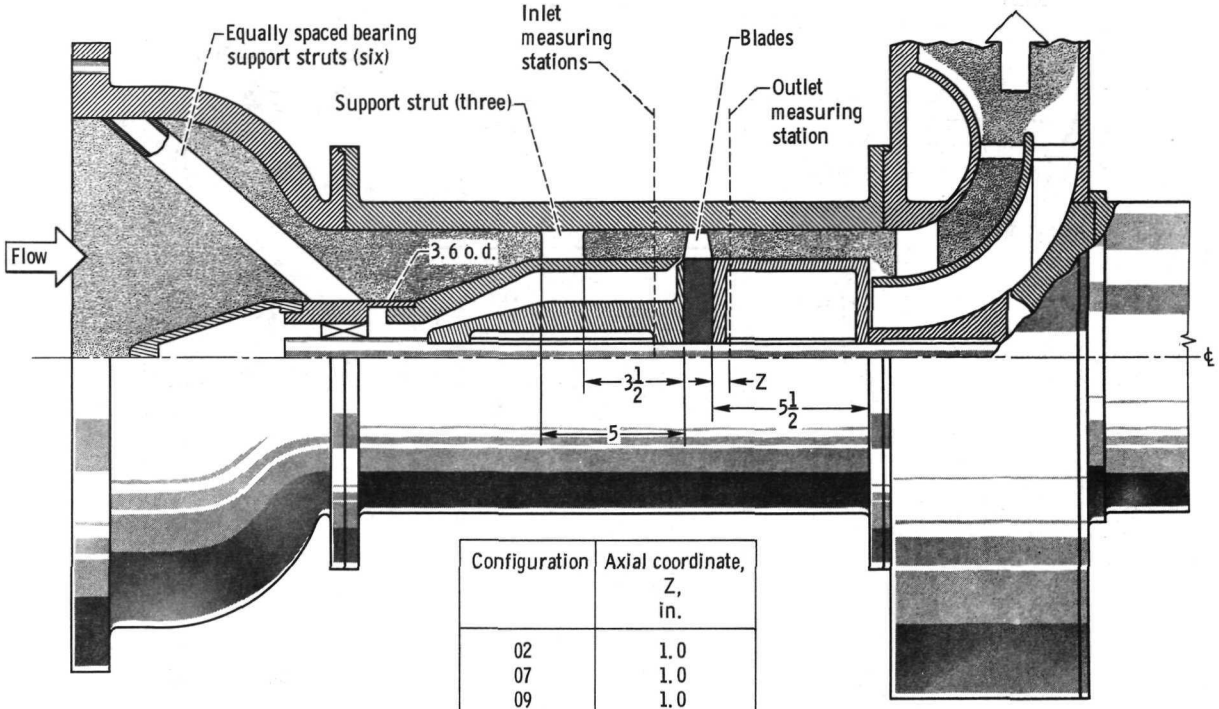


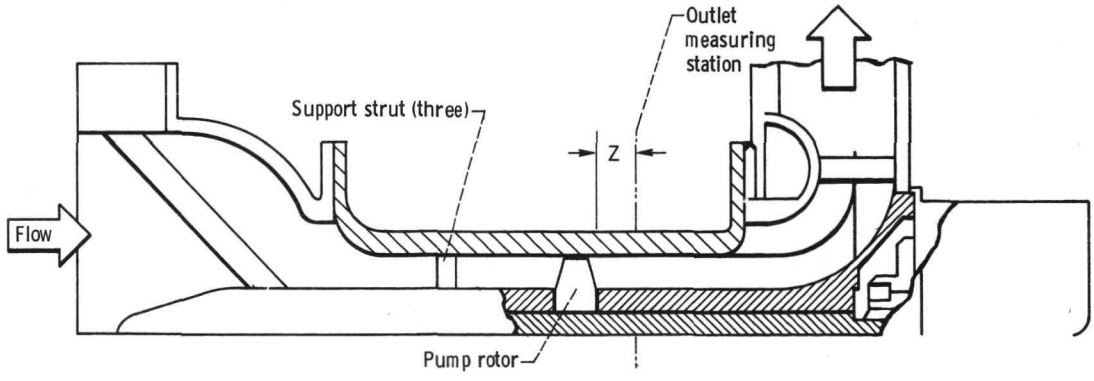
Figure 5. - Schematic diagram of Lewis water tunnel. (Dimensions are in inches.)

of flow conditions were surveyed at measuring stations no more than 1 chord length from the blade leading and trailing edges. Measurements of total pressure, static pressure, and flow angle were recorded at five or seven radial locations, which always included positions approximately 10, 30, 50, 70, and 90 percent of the passage height from the annulus outer surface. Blade elements were assumed to lie on cylindrical surfaces at these radial positions. Sketches showing details of typical survey probes are given in figure 7. All probes were automatically alined with the flow direction by means of a null pressure balance system. Static-pressure probes were calibrated in a low-speed air



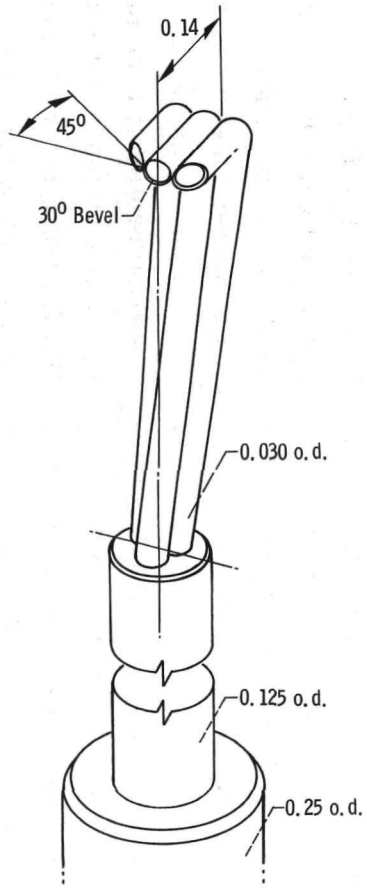
Configuration	Axial coordinate, Z, in.
02	1.0
07	1.0
09	1.0
5	.6
6	.6
13A	.7
14A	.7
15	1.4
16	.8

(a) Configurations 02, 07, 09, 5, 6, 13A, 14A, 15, 16. (Configuration 02 had a rotating hub upstream.)

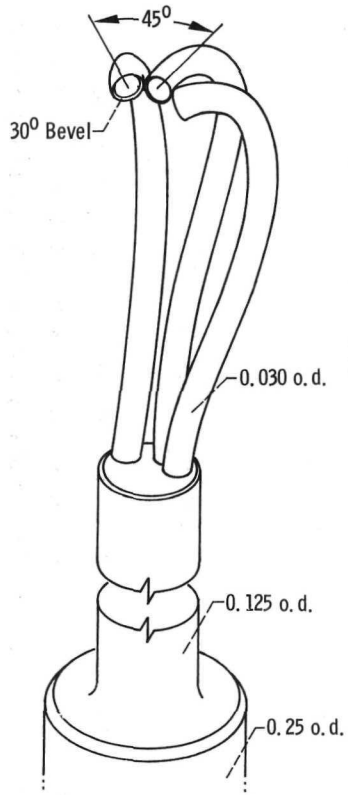


(b) Configurations 8, 9, and 10. Axial coordinate Z, 0.35 inch.

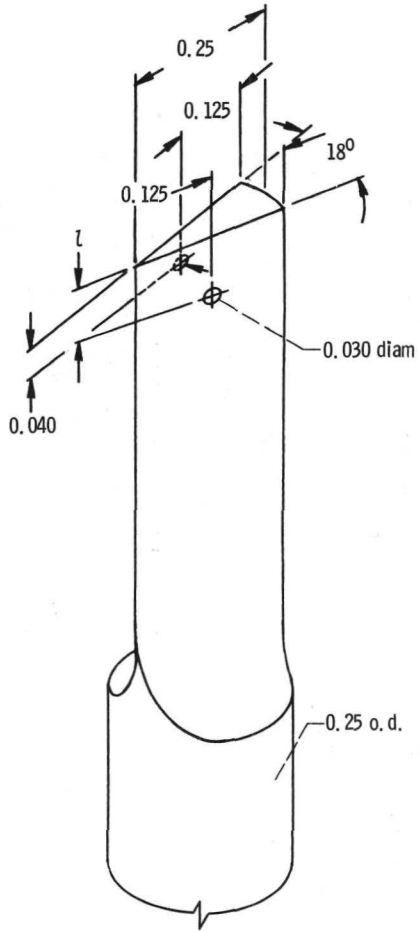
Figure 6. - Schematic diagrams of typical inlet flow paths and test sections. (Dimensions are in inches.)



(a) Total-pressure and flow-angle cobra.



(b) Total-pressure and flow-angle claw.



(c) Static-pressure wedge. (l = 0.125 if holes have separate passages; l = 0.040 if holes are manifolded.)

Figure 7. - Pressure and flow-angle probes. (Dimensions are in inches.)

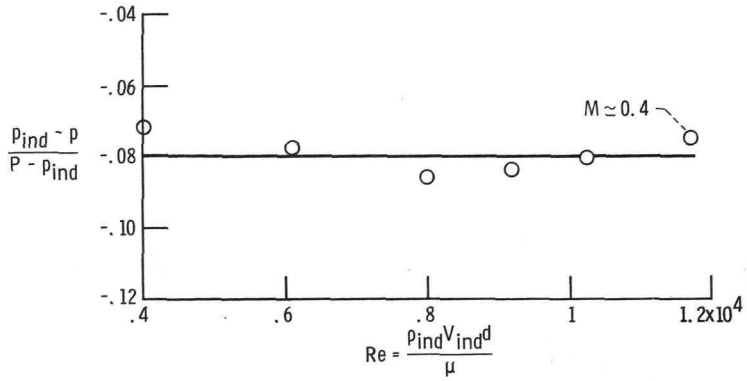


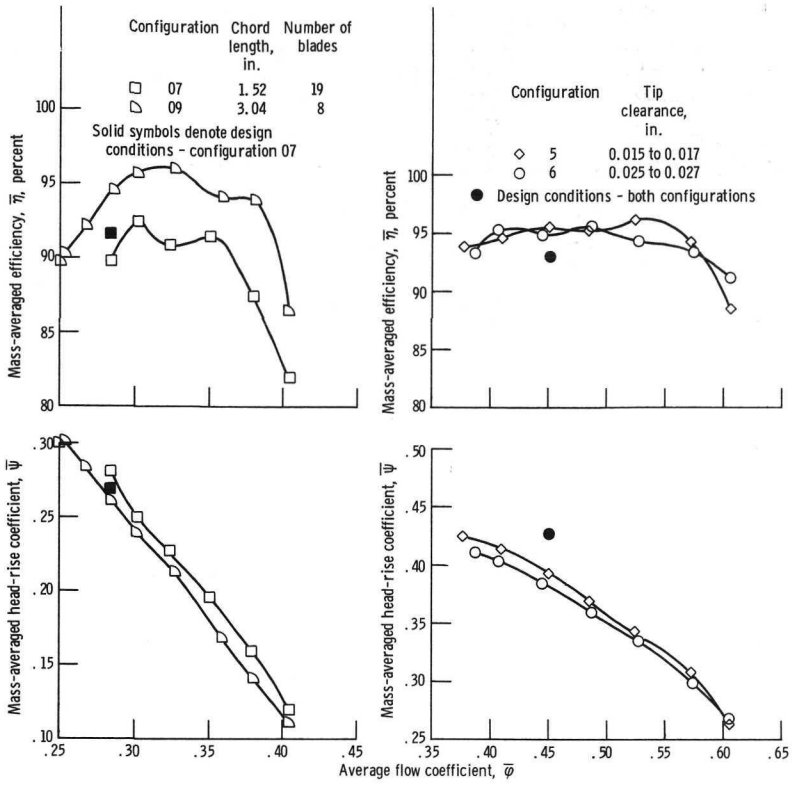
Figure 8. - Typical static-pressure-probe calibration curve.

p_{ind}	indicated static pressure	V_{ind}	$\sqrt{2g_c(P - p_{ind})144.0/\rho_{ind}}$
p	true static pressure	μ	viscosity
P	true total pressure	d	probe static-pressure-tap diameter
ρ_{ind}	$p_{ind}144.0/RT$	Re	probe Reynolds number

tunnel. A typical calibration curve is shown in figure 8. The inlet plenum pressure was measured by using a wall static tap. Additional test instrumentation included a venturi meter, a water-temperature recording system, and a rotor-shaft-speed pickup used in conjunction with an electronic counter.

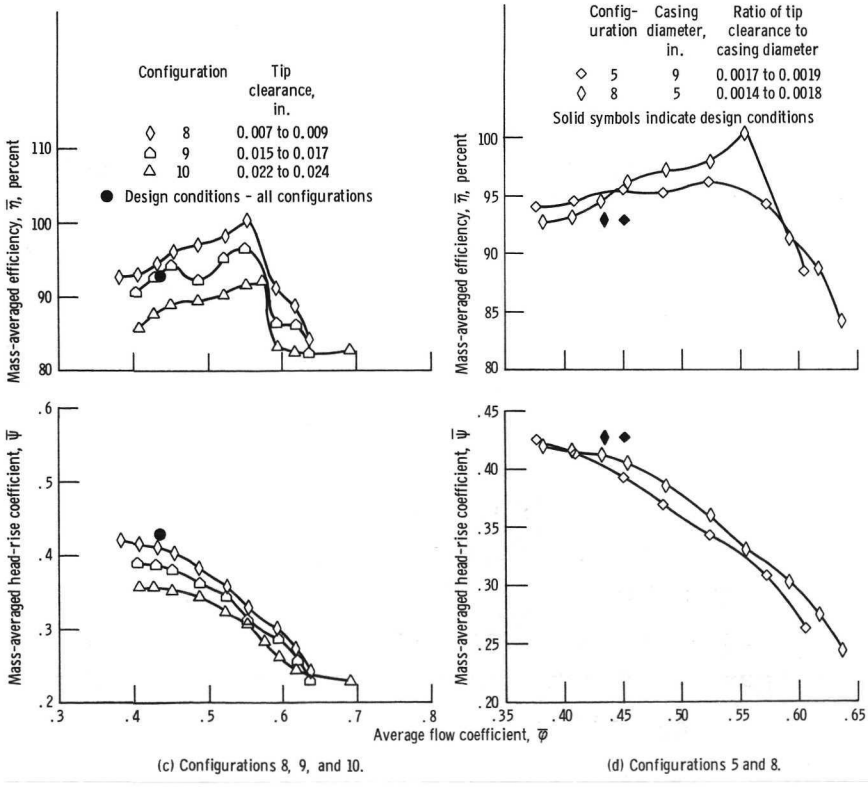
DATA PRESENTATION

The overall performance characteristics of the 12 pump rotors are summarized in figure 9 and table IV. (The headings of table IV are explained in appendix B.) For comparison, design operating-point values adjusted for boundary-layer blockage are indicated as solid symbols in figure 9. The data are presented in figure 9 in terms of the rotor subsets mentioned earlier. Starting with the configuration 07 design, doubling the chord length, and reducing the number of blades from 19 to 8 resulted in the 09 configuration. Data for these 9-inch-tip-diameter rotors are compared in figure 9(a). Rotor configurations 5 and 6, identical 9-inch-diameter rotors except for tip clearance, are compared in figure 9(b). Configurations 8, 9, and 10, identical 5-inch-diameter rotors except for tip clearance, form the comparison of figure 9(c). The basic rotor of configurations 8, 9, and 10 is a geometrically scaled 5/9 version of the basic rotor of configurations 5 and 6. The geometrically similar tip clearances of configurations 5 and 8 were scaled in the same ratio (5/9) as the rotor diameters. Data for these rotors are shown in figure 9(d). The tip clearances of configurations 5 and 9 are identical, and data for these rotors are compared in figure 9(e). Rotor configurations 13A and 16 have identical blade



(a) Configurations 07 and 09.

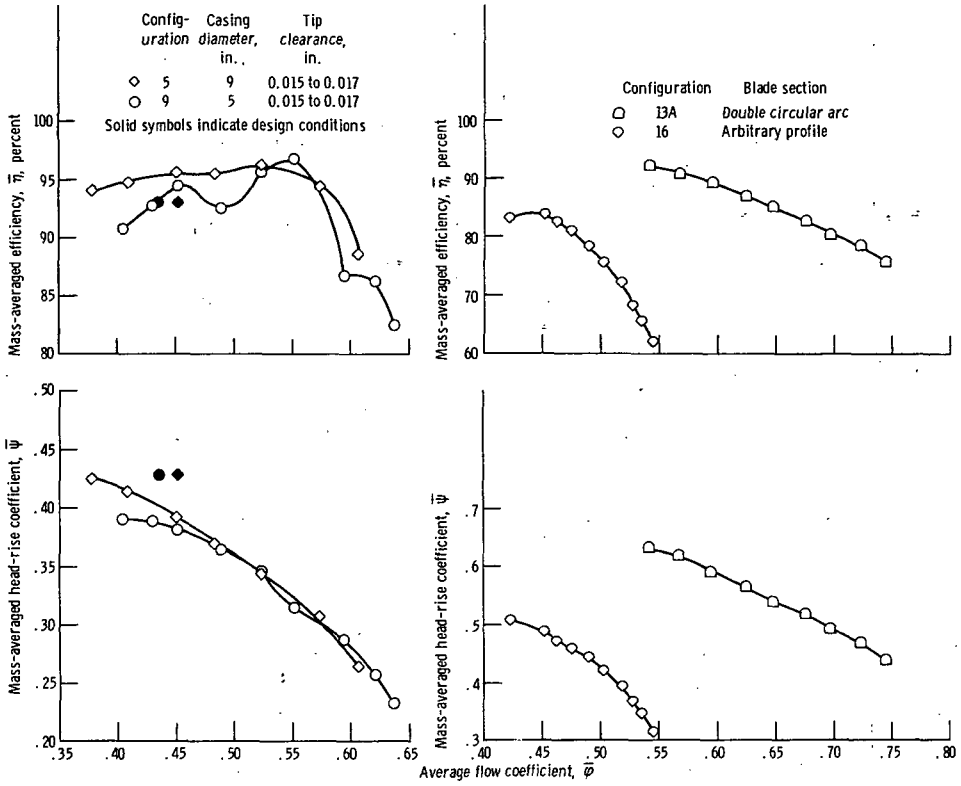
(b) Configurations 5 and 6.



(c) Configurations 8, 9, and 10.

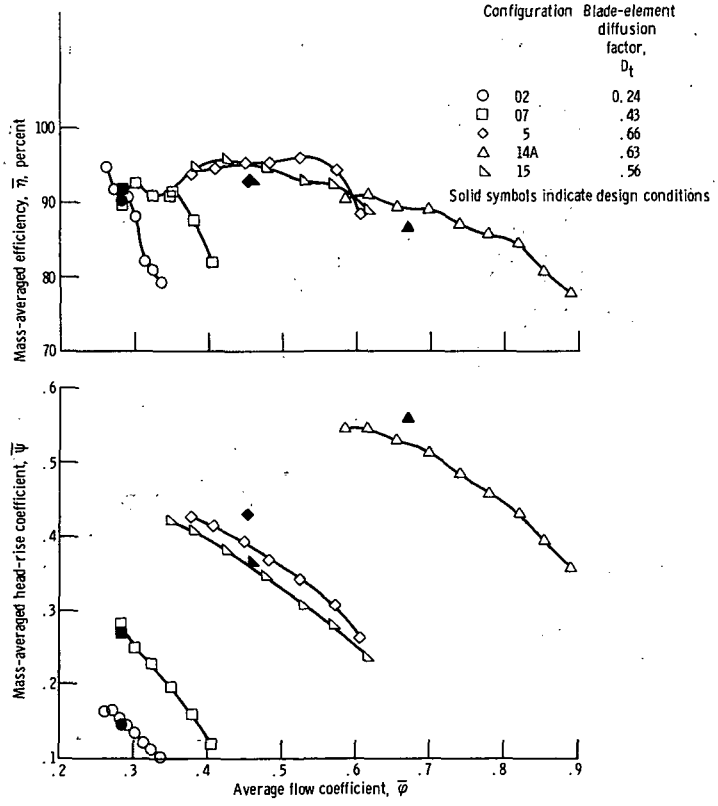
(d) Configurations 5 and 8.

Figure 9. - Overall performance of axial-flow pump rotor.



(e) Configurations 6 and 9.

(f) Configurations 13A and 16.



(g) Configurations 02, 07, 5, 14A, and 15.

Figure 9. - Concluded.

angles; however, configuration 13A was composed of double-circular-arc blade sections, while configuration 16 involved arbitrary (see fig. 3) blade sections. Data for these rotors are shown in figure 9(f). The configurations of figure 9(g), namely, 02, 07, 5, 14A, and 15, demonstrate the effects of increasing blade loading and design flow coefficient.

The blade-element data for the 12 rotors are presented in tables V to XVI. The table headings are explained in appendix B. The data-reduction computer program is discussed in the section DATA STORAGE AND RECALL PROGRAM, and a listing of the program is presented in appendix C.

The input data (see appendixes D and E) were available directly from NASA data-reduction computer output and were used as received, except as noted here. Since straightening tubes (fig. 5) and a converging passage (fig. 6) were used upstream of the test section, the entering absolute fluid flow angle was interpreted as being zero degrees even though very small angles were indicated in the NASA computer output. It was felt that this interpretation was well within the experimental precision involved. As explained in detail in the section DATA QUALITY EVALUATION, the as-measured data associated with rotor configurations 13 and 14 required significant adjustment. In order to permit calculation of approximate blade-chord Reynolds numbers, an average value of 9.28×10^{-6} ft^2/sec (water at 80° F) was used for kinematic viscosity for all runs.

Two unusual features of the data deserve mention. First, at the lowest flow rate associated with the configuration 02 data, a nearly zero outlet axial velocity is indicated near the annulus inner surface (hub). This suggests a reversed-flow region, as noted in reference 11 for the 19-bladed version of this rotor. Secondly, the tests of configurations 8, 9, and 10 involved a significantly nonuniform inlet total-head profile that probably resulted from the abruptly converging passage upstream of the test section (fig. 6(b)). This nonuniform profile must be considered thoroughly before any conclusions about the effects of scale are drawn on the basis of comparing the data of configurations 5 and 6 with those of configurations 8, 9, and 10.

DATA QUALITY EVALUATION

Data for four of the configurations have been published previously (refs. 1 to 6). Comments regarding the validity and consistency of those data are included in the cited references. A limited evaluation of the data of all 12 configurations is given here for completeness. This evaluation should be supplemented by a thorough scrutiny and critical study of the data by the user in every application. A detailed description of adjustments to original measurements for configurations 13A and 14A are included.

The general procedure for evaluating the data was

(1) To examine the comparisons of integrated flow rate and venturi flow rate

(2) To note occurrence of negative loss coefficients

(3) To scan the data for abnormal flow conditions

Integrated-flow-rate comparisons are included in the summary listing for each configuration in table IV. Flow-rate comparisons within the limits of ±2 percent at the entrance station and ±4 percent at the exit station are generally considered acceptable. As the flow-rate comparisons depart from the acceptable range the chances of significant discrepancies in the data increase. Hence, data corresponding to unacceptable integrated-flow-rate comparisons should be examined carefully before use, and caution should be exercised in the interpretation of subsequent results obtained.

For rotor configurations having essentially constant inlet total-head H_1 profiles and zero prewhirl, negative values of loss coefficient are considered to indicate some inconsistency in the measurements. (Of course, positive loss coefficients alone are not necessarily a sign of consistent data.) Negative loss coefficients in varying numbers appear in the data for every configuration except 07, 13A, and 16. In most instances the negative values are very close to zero, indicating that very low positive loss coefficients probably existed. In the cases of configurations 8, 9, 10, and 14A, some caution must be used in the interpretation of negative loss coefficients since a significantly nonuniform inlet total-head profile existed. When H_1 is nonuniform, discrepancies between the real stream surfaces and those assumed for testing and data-reduction purposes may lead to computation of negative loss coefficients. If radial flow shifts occur such that the real stream surface at a given exit radius originates in a region of higher H_1 than was assumed, the measured actual head rise will be too high. The resulting loss coefficients will be too low, possibly even negative. This problem does not arise when H_1 is uniform and prewhirl is zero.

The data presented in tables XIII and XIV for configurations 13A and 14A contain values of inlet total head H_1 which have been adjusted from the as-measured values. Full details on the analysis leading to these adjustments are presented in reference 14 and are summarized here for completeness. The as-measured values of H_1 for configuration 13A were quite irregular in profile and unrealistically lower than the total head in the upstream plenum. Large discrepancies between the venturi-measured flow rate and the flow rate obtained by integrating the inlet axial velocities further indicated inconsistencies, as did a number of negative loss coefficients. All these indicated inconsistencies were significantly reduced by the use of a constant profile of H_1 equal to the upstream plenum value.

A similar situation existed for configuration 14A data. Because of the proximity of the annulus surfaces to the hub and tip measuring stations for this configuration, replacement of all survey inlet total-head values by the upstream plenum total head was not considered appropriate. A preliminary adjustment was made by assuming the maximum value of inlet total head at each radial position to apply for that radial position at all flow rates. Again, all indicated inconsistencies were reduced by this adjustment.

DATA STORAGE AND RECALL PROGRAM

A computer program was written to read, reduce, and systematically store and print data as indicated by the general flow diagram of figure 10. The instructions are listed in FORTRAN IV on pages 34-40 of appendix C. In its present form, the program will handle isolated rotor or stage data measured up- and downstream of blade rows.

This program may be used for purposes other than producing the output data

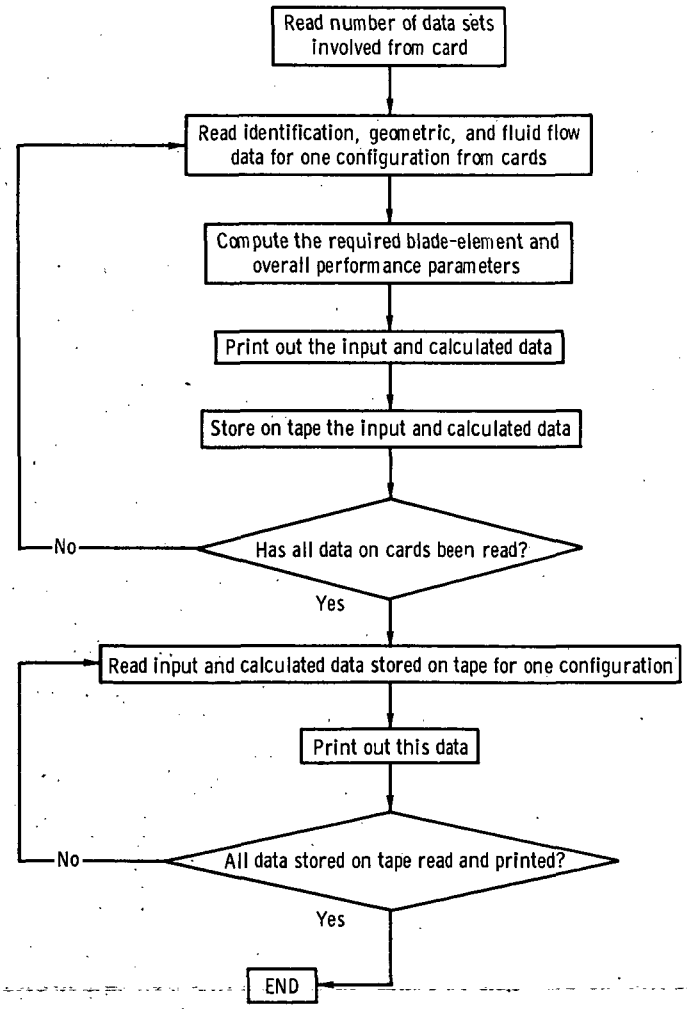


Figure 10. - General logic block diagram of data-reduction and tape storage program.

associated with the 12 axial-flow pump rotor configurations described in table I. For instance, it could be used as a data-reduction program to process flow and performance measurements from other axial-flow pump configurations. Analyses and correlations of the data presented in this report or other data can be accomplished conveniently by using this program to store the data on magnetic tape. Then a second program can be written which reads the reduced data from the tape and performs other calculations desired by the user. The basis for this second program can be derived from the coding of appendix C by deleting all coding between the first READ statement and statement 3000 except the second statement after the first READ statement and statement 4700. The user must add coding after statement 4700 to effect further analysis of the data.

CONCLUDING REMARKS

Comments should be made in conclusion concerning two questions raised by publication of the data contained in this report. The first relates to the direct and immediate aspects of application of the data to design of axial-flow fans, compressors, and pumps. The second concerns longer-term utilization of the data in development of more satisfactory design and analysis methods for axial-flow turbomachinery.

The experimental information contained in the report should not be viewed as useful only to designers and manufacturers of multistage axial-flow pumps for liquid-propellant rocket propulsion systems. Although the primary goal in the organization of the test program was to evaluate configurations for such systems and to study the hydrodynamic problems encountered, the resulting data obviously have a much more general range of usability. It is notable that, with one exception, the rotors described are of relatively high hub-tip radius ratio (0.7 or higher) and have design relative-fluid-inlet angles greater than 50° at all spanwise stations. These values are typical of the geometric and aerodynamic conditions found in the final stage of multistage axial-flow compressors for industrial application. Very little experimental information is readily available on the performance of rotor configurations of this kind in air or other gases. A cursory inspection of some of the blade-element performance for rotors such as configurations 5 and 13A, where deviation angle distributions and loss gradients are vastly different from those considered normal for design practice in entrance stages of axial-flow compressors, should convince users that reevaluation of patterns assumed for design is in order. Single-stage blower and fan rotor configurations similar to those discussed in this report are also encountered in gas circulation systems for a number of industrial requirements. When due consideration is given to nonsimilar flow conditions, which may call for caution in cases where direct geometrical scaling may appear to be an easy solution, both overall performance and blade-element results presented herein may be of value.

In fields other than propulsion, designers of fluid components are likely to find multistage axial-flow pumps attractive for large-scaled projects such as pumped-storage hydroelectric systems and large industrial process systems. In all these cases some guidelines on the effects of scale, rotor tip clearance, and blade-element loading levels can be developed by consideration of data from selected subsets of the configurations in this report.

Collections of radial and circumferential probe traverse or survey data are recognized as the essential foundation of all current design and analysis procedures. Similar experimental data are likely to fill a substantial role in developing more satisfactory design and analysis procedures. The radial survey data of this report have several features which should enhance their usefulness in long-range improvement of these procedures. Data from a large number of configurations are presented in a single source. The data were all obtained by using the same basic facility, procedures, and instrumentation. The measurements were processed by the same data-reduction program and are presented in a common format. This report does not attempt to correlate data or to develop new design recommendations. However, the authors have attempted to provide an additional base for correlation and design by uniformly and consistently organizing a large body of valid data. A computerized storage and recall system has also been provided to expedite future analysis and correlation of the data.

Lewis Research Center,
National Aeronautics and Space Administration,
Cleveland, Ohio, August 2, 1972,
502-24.

APPENDIX A

SYMBOLS

ΔA	stream-tube cross-sectional area, $in.^2$
B1, B2, B3, B4	cubic equation constant coefficients (fig. 3)
CM	position of blade-element maximum camber as percent of total chord length
c	blade-element chord length, in.
D	blade-element diffusion factor (eqs. (F25) and (F26))
d	probe static-tap diameter (fig. 8), ft
FFT	spanwise location as fraction of total passage height from annulus outer surface (eqs. (F1) and (F2))
FRC	comparison of integrated and venturi-metered volume flow rates (eqs. (F48) and (F49))
g_c	dimensional constant, 32.174 lbm-ft/lbf-sec^2
H	total head, ft-lbf/lbm
$\overline{H}_{sv}$	mass-averaged net positive suction head (eq. (F47)), ft-lbf/lbm
h	static head, ft-lbf/lbm
h_v	vapor pressure head, ft-lbf/lbm
I	number of axial stations being considered
i	incidence angle, angle between inlet flow direction and tangent to blade mean camber line at leading edge (fig. 2 and eq. (F22)), deg
J	number of blade elements being considered
K	blade-row configuration number
L	number of flow rates per configuration being considered
l	static-pressure-wedge dimension (fig. 7(c))
M	Mach number
N	rotor rotational speed, rpm
NB	number of blades
P	total pressure, psi

p	static pressure, psi
Q	flow rate, gal/min
Q_v	venturi-metered flow rate, gal/min
R	gas constant for air, 53.36 ft-lbf/(lbm)(^oR)
Re	probe Reynolds number (fig. 8)
Re_c	blade-chord Reynolds number (eq. (F19)
RLE	blade-element leading-edge radius, in.
RTE	blade-element trailing-edge radius, in.
RR	radius ratio (eqs. (F3) and (F4))
r	radius from pump axis, in.
s	space between blades (fig. 2), in.
T	absolute temperature, ^oR
t_{max}	maximum blade-element thickness, in.
U	blade velocity (fig. 2 and eqs. (F13) and (F14)), ft/sec
V	fluid velocity (fig. 2), ft/sec
X	coordinate in tangential direction (fig. 3), in.
x	length coordinate for rotated blade section (fig. 1), in.
y	height coordinate for rotated blade section (fig. 1), in.
Z	axial coordinate, in.
β	axisymmetric flow angle with respect to axial direction (fig. 2), deg
γ	blade setting angle, angle between blade chord and axial direction (fig. 2), deg
δ	deviation angle, angle between outlet flow direction and tangent to blade camber line at trailing edge (fig. 2), deg
$\left(\frac{\theta}{c}\right)_A$	wake momentum thickness parameter (eqs. (F39) and (F40))
κ	blade angle, angle between tangent to blade camber line and axial direction (fig. 2), deg
η	hydraulic efficiency (eqs. (F31) and (F32))
$\bar{\eta}$	mass-averaged hydraulic efficiency (eqs. (F45) and (F46))
μ	absolute viscosity, lbf-sec/ft^2
ν	kinematic viscosity, ft^2/sec

ρ	fluid density, lbm/ft^3
σ	solidity, c/s
φ	flow coefficient (eqs. (F33) and (F34))
$\overline{\varphi}$	average flow coefficient (eq. (F54))
φ^o	blade camber angle, $\kappa_1 - \kappa_2$, deg
ψ	head-rise coefficient (eqs. (F27) to (F30))
$\overline{\psi}$	mass-averaged head-rise coefficient (eqs. (F41) to (F44))
$\overline{\omega}$	total-head loss coefficient (eqs. (F37) and (F38))

Subscripts:

A	simplified form of two-dimensional version of wake momentum thickness parameter
a	average value
h	pump-annulus inner surface (hub)
i	ideal
ind	indicated
J1	radial location index
ps	pressure surface
R	rotor
r1, r2, r3 r4, r5, r6, r7	radial positions between tip and hub
S	stator
ss	suction surface
stage	stage
T	transition (fig. 3)
t	pump-annulus outer surface (tip)
z	axial component
θ	tangential component
1	blade-row-inlet calculation station
2	blade-row-outlet calculation station

Superscript:

	relative to rotor

APPENDIX B

GLOSSARY OF COMPUTER PROGRAM OUTPUT VARIABLES

Each data column heading associated with the listing of overall performance parameters (table IV) and blade-element data (tables V to XVI) is explained in the accompanying glossary. For convenience, examples of the headings are included as figures 11 and 12.

NASA CONFIGURATION 13 ADJUSTED-SEE ERI-77900
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS

NASA CONFIGURATION 14 ADJUSTED-SEE ERI-77900
0.9 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.63 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.7 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS

Figure 11. - Example of overall performance data table.

NASA CONFIGURATION 07
0.7 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.005-0.012-INCH RADIAL TIP CLEARANCE,
0.43 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-2295 AND TN D-2481.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES

FLOW RATE # 1 5784. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	SIGTUB1 SQ IN
1												
2												
3												
4												
5												

PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	SIGTUB2 SQ IN
1												
2												
3												
4												
5												

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1								
2								
3								
4								
5								

PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1											
2											
3											
4											
5											

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS

Figure 12. - Example of blade-element data table.

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
BETA1	β_1	BETA(L1, I1, J1)	Absolute axisymmetric flow angle with respect to axial direction at blade-row-inlet calculation station (fig. 2)	deg
BETA2	β_2	BETA(L1, I1+1, J1)	Absolute axisymmetric flow angle with respect to axial direction at blade-row-outlet calculation station (fig. 2)	deg
BETAP1	β'_1	BETAP1(L1, I1, J1)	Relative axisymmetric flow angle with respect to axial direction at blade-row-inlet calculation station (fig. 2 and eq. (F20))	deg
BETAP2	β'_2	BETAP2(L1, I1, J1)	Relative axisymmetric flow angle with respect to axial direction at blade-row-outlet calculation station (fig. 2 and eq. (F21))	deg
CAMBER	φ^o	THTA(I1, J1)	Blade-element mean line camber angle: $\kappa_1 - \kappa_2$ for rotors, $\kappa_2 - \kappa_1$ for stators	deg
CHORD	c	CHORD(I1, J1)	Blade-element chord length	in.
D	D_R	XD(L1, I1, J1)	Blade-element diffusion factor (eq. (F25))	--------
DELTA H	ΔH	DELTAH(L1, I1, J1)	Blade-element total-head rise (eq. (F11))	ft-lbf/lbm
DELTA P	Δh	DELTAP(L1, I1, J1)	Blade-element static-head rise (eq. (F12))	ft-lbf/lbm
DENSITY	ρ	RHO(L1)	Fluid density	lbm/ft^3
DEV	δ_R	DEL2(L1, I1, J1)	Deviation angle, angle between outlet flow direction and tangent to mean camber line at trailing edge (fig. 2 and eq. (F23))	deg
EFF	η_R	XEFF(L1, I1, J1)	Blade-element hydraulic efficiency (eq. (F31))	--------

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
FRC1	FRC_1	QERR1(L1, I1)	Comparison of integrated and venturi-metered volume flow rates at blade-row-inlet calculation station (eq. (F48))	--------
FRC2	FRC_2	QERR2(L1, I1)	Comparison of integrated and venturi-metered volume flow rates at blade-row-outlet calculation station (eq. (F49))	--------
H1	H_1	H(L1, I1, J1)	Total head at blade-row-inlet calculation station	ft-lbf/lbm
H2	H_2	H(L1, I1+1, J1)	Total head at blade-row-outlet calculation station	ft-lbf/lbm
HSVB	$\overline{H}_{sv}$	HSVB(L1, I1)	Mass-averaged net positive suction head (eq. (F47))	ft-lbf/lbm
INC	i	FNC1(L1, I1)	Incidence angle, angle between inlet flow direction and tangent to blade mean camber line at leading edge (fig. 2 and eq. (F22))	deg
KAPPA1	κ_1	ALF1(I1, J1)	Blade inlet angle, angle between tangent to blade mean camber line and axial direction at leading-edge center (fig. 2)	deg
KAPPA2	κ_2	ALF2(I1, J1)	Blade outlet angle, angle between tangent to blade mean camber line and axial direction at trailing-edge center (fig. 2)	deg
NBLADES	NB	NBLADE(I1)	Number of blades	--------
OMEGAB	$\overline{\omega}_R$	OMEGB(L1, I1, J1)	Blade-element total-head loss coefficient (eq. (F37))	--------
P1	h_1	P(L1, I1, J1)	Blade-element static head at blade-row-inlet calculation station	ft-lbf/lbm

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
P2	h_2	P(L1, I1+1, J1)	Blade-element static head at blade-row-outlet calculation station	ft-lbf/lbm
PASS. HT. 1 or 2 FROM TIP or PASS. HT.	FFT	FLOHIT(I1, J1)	Blade-element stream-surface span location as fraction of total passage height from annulus outer surface at blade-row-inlet (1) or -outlet (2) calculation station (eq. (F1) or (F2))	---
PHI1	$\varphi_{1,R}$	XPHI1(L1, I1, J1)	Blade-element flow coefficient at blade-row-inlet calculation station (eq. (F33))	---
PHI2	$\varphi_{2,R}$	XPHI2(L1, I1, J1)	Blade-element flow coefficient at blade-row-outlet (eq. (F34))	---
PHIB1	$\overline{\varphi}$	PHIB(L1)	Average flow coefficient (eq. (F54))	---
PSI	ψ_R	XPSI(L1, I1, J1)	Blade-element head-rise coefficient (eq. (F27))	---
PSII	$\psi_{i,R}$	XPSII(L1, I1, J1)	Blade-element ideal head-rise coefficient (eq. (F29))	---
QV	Q_v	GPM(L1)	Instantaneous volume flow rate as measured with a venturi meter	gal/min
R1	r_1	R(I1, J1)	Radius of blade-element stream surface from rotor axis at blade-row-inlet calculation station	in.
R2	r_2	R(I1+1, J1)	Radius of blade-element stream surface from rotor axis at blade-row-outlet calculation station	in.

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
R1/RT	$r_1/r_{1,t}$	RRT(I1, J1)	Ratio of a blade-element stream-surface radius to annulus outer-surface radius at blade-row-inlet calculation station (eq. (F3))	---
R2/RT	$r_2/r_{2,t}$	RRT(I1+1, J1)	Ratio of a blade-element stream-surface radius to pump annulus outer-surface radius at blade-row-outlet calculation station (eq. (F4))	---
REC	Re_c	REC(L1, I1, J1)	Blade-chord Reynolds number (eq. (F19))	---
RHUB 1	$r_{1,h}$	RHUB(I1)	Annulus inner-surface radius from rotor axis at blade-row-inlet calculation station	in.
RHUB 2	$r_{2,h}$	RHUB(I1+1)	Annulus inner-surface radius from rotor axis at blade-row-outlet calculation station	in.
ROTOR EFFB	$\bar{\eta}_R$	RMAE(L1, I1)	Mass-averaged hydraulic efficiency (eq. (F45))	---
ROTOR PSIB	$\bar{\psi}_R$	RHRCO(L1, I1)	Mass-averaged head-rise coefficient (eq. (F41))	---
ROTOR PSIIB	$\bar{\psi}_{i,R}$	RHRCOI(L1, I1)	Mass-averaged ideal head-rise coefficient (eq. (F43))	---
RPM	N	RN(L1, I1, J1)	Rotor rotational speed	rpm
RPMA	N_a	RNA(L1, I1)	Average rotor rotational speed (eq. (F51))	rpm
RTIP 1	$r_{1,t}$	RTIP(I1)	Annulus outer-surface radius from rotor axis at blade-row-inlet calculation station	in.
RTIP 2	$r_{2,t}$	RTIP(I1+1)	Annulus outer-surface radius from rotor axis at blade-row-outlet calculation station	in.

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
SETANG	γ	ANGLST(I1, J1)	Blade-element setting angle, angle between blade-element chord and axial direction (fig. 2)	deg
SOLIDITY	σ	SGMA(I1, J1)	Blade-row solidity based on stream-surface radius from rotor axis at blade-row-outlet calculation station	---
STRTUB1	ΔA_1	STRTUB(L1, I1, J1)	Stream-tube cross-sectional area at blade-row-inlet calculation station	$in.^2$
STRTUB2	ΔA_2	STRTUB(L1, I1+1, J1)	Stream-tube cross-sectional area at blade-row-outlet calculation station	$in.^2$
(T/C)A	$(\theta/c)_A$	TCA(L1, I1, J1)	Wake momentum thickness parameter (eqs. (F39) and (F40))	---
TMAX/C	t_{max}/c	TMAXC(I1, J1)	Ratio of blade-element maximum thickness to chord length	---
U1	U_1	U1(L1, I1, J1)	Blade velocity at blade-row-inlet calculation station (fig. 2 and eq. (F13))	ft/sec
U2	U_2	U2(L1, I1, J1)	Blade velocity at blade-row-outlet calculation station (fig. 2 and eq. (F14))	ft/sec
UT1A	$U_{1,t,a}$	UTIP1A(L1, I1)	Average blade-tip velocity at blade-row-inlet calculation station (eq. (F52))	ft/sec
UT2A	$U_{2,t,a}$	UTIP2A(L1, I1)	Average blade-tip velocity at blade-row-outlet calculation station (eq. (F53))	ft/sec
V1	V_1	V(L1, I1, J1)	Absolute axisymmetric fluid velocity at blade-row-inlet calculation station (fig. 2 and eq. (F5))	ft/sec

Computer output variable	Mathematical symbol	Program FORTRAN IV variable	Description	Unit
V2	V_2	XV(L1, I1+1, J1)	Absolute axisymmetric fluid velocity at blade-row-outlet calculation station (fig. 2 and eq. (F6))	ft/sec
VISK	ν	VISK(L1)	Fluid kinematic viscosity	ft^2/sec
VTH1	$V_{\theta,1}$	VU(L1, I1, J1)	Tangential component of V1 (fig. 2 and eq. (F7))	ft/sec
VTH2	$V_{\theta,2}$	VU(L1, I1+1, J1)	Tangential component of V2 (fig. 2 and eq. (F8))	ft/sec
VZ1	$V_{z,1}$	VZ(L1, I1, J1)	Axial component of V1 (fig. 2 and eq. (F9))	ft/sec
VZ2	$V_{z,2}$	VZ(L1, I1+1, J1)	Axial component of V2 (fig. 2 and eq. (F10))	ft/sec
W1	V'_1	XVP1(L1, I1, J1)	Relative axisymmetric fluid velocity at blade-row-inlet calculation station (fig. 2 and eq. (F17))	ft/sec
W2	V'_2	XVP2(L1, I1, J1)	Relative axisymmetric fluid velocity at blade-row-outlet calculation station (fig. 2 and eq. (F18))	ft/sec
WTH1	$V'_{\theta,1}$	VUP1(L1, I1, J1)	Tangential component of W1 (fig. 2 and eq. (F15))	ft/sec
WTH2	$V'_{\theta,2}$	VUP2(L1, I1, J1)	Tangential component of W2 (fig. 2 and eq. (F16))	ft/sec

APPENDIX C

COMPUTER PROGRAM LISTING AND GLOSSARY OF FORTRAN VARIABLES

The FORTRAN IV program listed in this appendix was written for use on an IBM 360 model 65 operating on Release 20.1. Using a FORTRAN G compiler, 128 000 bytes of storage were required, and execution CPU time was approximately 6 seconds per configuration. The program was also compiled with a Version 1, Level 2 WATFIV Compiler. The input format is described in detail in appendix D, while a listing of all input data cards is given in appendix E. The variable arrays are presently dimensioned for a maximum of 16 flow rates, two blade rows, and seven blade elements per configuration. The mathematical relationships used in reducing data are presented in appendix F. All FORTRAN IV variables used in the program are defined in the Glossary of FORTRAN Variables in this appendix.

Computer Program Listing

```
C     THIS PROGRAM WILL INSTRUCT THE COMPUTER TO READ AXIAL-FLOW PUMP
C     GEOMETRICAL AND FLOW DATA, CALCULATE A NUMBER OF BLADE-ELEMENT
C     AND OVERALL PERFORMANCE PARAMETERS AND THEN SYSTEMATICALLY PRINT
C     ON PAPER AS WELL AS STORE ON TAPE THE READ DATA AND CALCULATED
C     RESULTS
C     THE ENGLISH SYSTEM OF UNITS SHOULD BE USED WITH THIS PROGRAM
C
      DIMENSION RHUB(3),RTIP(3),ZCOORD(3),NBLADE(2),CMBRMX(2,7),
     1ALF1(2,7),ALF2(2,7),TMAXC(2,7),CHORD(2,7),ANGLST(2,7),
     2THTA(2,7 ),RADLE(2,7 ),RADTE(2,7 ),SGMA(2,7 ),R(3,7 ),GPMA(16),
     3PHIB(16),RHO(16),PV(16),BETA(16,3,7),H(16,3,7),P(16,3,7),
     4STRTUB(16,3,7),RN(16,3,7),GPM(16,3,7),VISK(16),TCA(16,2,7)
      DIMENSION FLOHIT(3,7),RRT(3,7),XV(16,3,7),VU(16,3,7),
     1VZ(16,3,7),U1(16,2,7),U2(16,2,7),VUP1(16,2,7),VUP2(16,2,7),
     2XVP1(16,2,7),XVP2(16,2,7),BETAP1(16,2,7),BETAP2(16,2,7),
     3FNC1(16,2,7),DEL2(16,2,7),XD(16,2,7),UTIP1(16,2,7),
     4UTIP2(16,2,7),XPSI(16,2,7),XPSII(16,2,7),XEFF(16,2,7),
     5XPHI1(16,2,7),XPHI2(16,2,7),OMEGB(16,2,7),RHRCO(16,2)
      DIMENSION RHRCOI(16,2),RMAE(16,2),REC(16,2,7)
      DIMENSION INFO(7,20),DELTAH(16,2,7 ),DELTAP(16,2,7 ),QERR1(16,2),
     1QERR2(16,2),RNA(16,2),HSVB(16,2),UTIP1A(16,2),UTIP2A(16,2)
      KI=5
      KO=6
      NDS=9
C
C     READ NUMBER OF DATA SETS INVOLVED
C
      READ (KI,1111) NDTSET
      DO 3000 IKT=1,2
C
```

```
C      IKT=1   READ INPUT DATA, CALCULATE BLADE ELEMENT AND OVERALL
C      PERFORMANCE PARAMETERS, PRINT OUT AND STORE ON TAPE THE INPUT
C      AND CALCULATED DATA
C      IKT=2   READ INPUT AND CALCULATED DATA STORED ON TAPE AND
C      PRINT OUT THIS DATA
C
C
C      CATA SET LOOP BEGINS HERE, ONE PER DATA SET
C
       DO 3000 KOUNT=1,NDTSET
       IF (IKT-1) 4,4,4700
C
C      READ ICENTIFICATION, GEOMETRIC AND FLUID FLOW DATA FOR ONE CONFIGURA
C      TION
C
    4  DO 5 M1=1,7
    5  READ (KI,6) (INFO(M1,N1),N1=1,20)
       READ (KI,10) K,L,I,J
       II=I-1
       DO 100 I1=1,II
       READ (KI,11) RHUB(I1),RTIP(I1),ZCOORD(I1),NBLADE(I1)
       DO 100 J1=1,J
  100  READ (KI,12) R(I1,J1),ALF1(I1,J1),ALF2(I1,J1),TMAXC(I1,J1),
      1CHORD(I1,J1),ANGLST(I1,J1),THTA(I1,J1),CMBRMX(I1,J1),RADLE(I1,J1),
      2RADTE(I1,J1),SGMA(I1,J1)
       READ (KI,11) RHUB(I),RTIP(I),ZCOORD(I)
       READ (KI,15) (R(I,J1),J1=1,J)
       DO 200 L1=1,L
       READ (KI,13)GPMA(L1),PHIB(L1),RHO(L1),PV(L1),VISK(L1)
       DO 200 I1=1,I
       DO 200 J1=1,J
  200  READ (KI,12) BETA(L1,I1,J1),H(L1,I1,J1),P(L1,I1,J1),
      1STRTUB(L1,I1,J1),RN(L1,I1,J1),GPM(L1,I1,J1)
C
C      RN(L1,I1,J1)=RCTOR RPM AT EACH ROTOR INLET CALCULATION STATION
C      (STATOR OUTLET CALCULATION STATION),RN(L1,I1,J1)=0.0 AT EACH
C      STATOR INLET CALCULATION STATION(ROTOR OUTLET CALCULATION STATION)
C
       DO 2100 I1=1,I
       D1=RTIP(I1)-RHUB(I1)
       DO 2100 J1=1,J
       FLOHIT(I1,J1)=(RTIP(I1)-R(I1,J1))/D1
 2100  RRT(I1,J1)=R(I1,J1)/RTIP(I1)
C
C      COMPUTE BLADE ELEMENT AND OVERALL PERFORMANCE PARAMETERS
C
       DO 2200 L1=1,L
       DO 2200 I1=1,I
       DO 2200 J1=1,J
       D2=64.348*(H(L1,I1,J1)-P(L1,I1,J1))
       B1=BETA(L1,I1,J1)*3.1415927/180.0
       XV(L1,I1,J1)=SQRT(D2)
       VU(L1,I1,J1)=XV(L1,I1,J1)*SIN(B1)
 2200  VZ(L1,I1,J1)=XV(L1,I1,J1)*COS(B1)
       DO 2300 L1=1,L
       DO 2300 I1=1,II
       Q1=0.0
       PSIN=0.0
       PSINI=0.0
```

```
      PSIDI=0.0
      HSVBN=0.0
      RNN=0.0
      UTIP1N=0.0
      UTIP2N=0.0
      DO 2260 J1=1,J
      DELTAH(L1,I1,J1)=H(L1,I1+1,J1)-H(L1,I1,J1)
      DELTAP(L1,I1,J1)=P(L1,I1+1,J1)-P(L1,I1,J1)
      U1(L1,I1,J1)=RN(L1,I1,J1)*R(I1,J1)*3.1415927/360.0
      U2(L1,I1,J1)=RN(L1,I1,J1)*R(I1+1,J1)*3.1415927/360.0
      VUP1(L1,I1,J1)=U1(L1,I1,J1)-VU(L1,I1,J1)
      VUP2(L1,I1,J1)=U2(L1,I1,J1)-VU(L1,I1+1,J1)
      D3=VUP1(L1,I1,J1)*VUP1(L1,I1,J1)+VZ(L1,I1,J1)*VZ(L1,I1,J1)
      XVP1(L1,I1,J1)=SQRT(D3)
      REC(L1,I1,J1)=CHORD(I1,J1)*XVP1(L1,I1,J1)/(VISK(L1)*12.0)
      D4=VUP2(L1,I1,J1)*VUP2(L1,I1,J1)+VZ(L1,I1+1,J1)*VZ(L1,I1+1,J1)
      XVP2(L1,I1,J1)=SQRT(D4)
      D5=VUP1(L1,I1,J1)/XVP1(L1,I1,J1)
      BETAP1(L1,I1,J1)=(180.0/3.1415927)*ARSIN(D5)
      D6=VUP2(L1,I1,J1)/XVP2(L1,I1,J1)
      BETAP2(L1,I1,J1)=(180.0/3.1415927)*ARSIN(D6)
      BP2=BETAP2(L1,I1,J1)*3.141593/180.
      DB=ABS(BETAP1(L1,I1,J1))
      DALF=ABS(ALF1(I1,J1))
      FNC1(L1,I1,J1)=DB-DALF
      IF (RN(L1,I1,J1)-0.01) 2205,2206,2206
2205  DEL2(L1,I1,J1)=ALF2(I1,J1)-BETAP2(L1,I1,J1)
      GO TO 2207
2206  DEL2(L1,I1,J1)=BETAP2(L1,I1,J1)-ALF2(I1,J1)
2207  IF (RN(L1,I1,J1)-0.01) 2210,2250,2250
2210  D2A=R(I1+1,J1)*VU(L1,I1+1,J1)-R(I1,J1)*VU(L1,I1,J1)
      D2B=SGMA(I1,J1)*XV(L1,I1,J1)*(R(I1+1,J1)+R(I1,J1))
      D7=XV(L1,I1+1,J1)/XV(L1,I1,J1)
      XD(L1,I1,J1)=1.0-D7-(D2A/D2B)
      XPSI(L1,I1,J1)=32.174*(H(L1,I1+1,J1)-H(L1,I1-1,J1))/
     1(UTIP2(L1,I1-1,J1)*UTIP2(L1,I1-1,J1))
      XPSII(L1,I1,J1)=(U2(L1,I1-1,J1)*VU(L1,I1,J1)-U1(L1,I1-1,J1)*
     1VU(L1,I1-1,J1))/(UTIP2(L1,I1-1,J1)*UTIP2(L1,I1-1,J1))
      XEFF(L1,I1,J1)=XPSI(L1,I1,J1)/XPSII(L1,I1,J1)
      XPHI1(L1,I1,J1)=VZ(L1,I1,J1)/UTIP1(L1,I1-1,J1)
      XPHI2(L1,I1,J1)=VZ(L1,I1+1,J1)/UTIP1(L1,I1-1,J1)
      OMEGB(L1,I1,J1)=-DELTAH(L1,I1,J1)*2.0*32.174/ (XV(L1,I1,J1)**2)
      TCA(L1,I1,J1)=OMEGB(L1,I1,J1)*COS(BP2)/(2.0*SGMA(I1,J1))
      PSINI=PSINI+XPSII(L1,I1,J1)*VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      PSIDI=PSIDI+VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      PSIN=PSIN+XPSI(L1,I1,J1)*VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      Q1=Q1+VZ(L1,I1,J1)*STRTUB(L1,I1,J1)
      GO TO 2260
2250  D2A=R(I1,J1)*VU(L1,I1,J1)-R(I1+1,J1)*VU(L1,I1+1,J1)
      D2B=SGMA(I1,J1)*XVP1(L1,I1,J1)*(R(I1+1,J1)+R(I1,J1))
      D7=XVP2(L1,I1,J1)/XVP1(L1,I1,J1)
      XD(L1,I1,J1)=1.0-D7-(D2A/D2B)
      UTIP1(L1,I1,J1)=RN(L1,I1,J1)*RTIP(I1)*3.1415927/360.0
      UTIP2(L1,I1,J1)=RN(L1,I1,J1)*RTIP(I1+1)*3.1415927/360.0
      XPSI(L1,I1,J1)=32.174*(H(L1,I1+1,J1)-H(L1,I1,J1))/(UTIP2(L1,I1,J1)
     1*UTIP2(L1,I1,J1))
      XPSII(L1,I1,J1)=(U2(L1,I1,J1)*VU(L1,I1+1,J1)-U1(L1,I1,J1)*
     1VU(L1,I1,J1))/(UTIP2(L1,I1,J1)*UTIP2(L1,I1,J1))
      XEFF(L1,I1,J1)=XPSI(L1,I1,J1)/XPSII(L1,I1,J1)
```

```
      XPHI1(L1,I1,J1)=VZ(L1,I1,J1)/UTIP1(L1,I1,J1)
      XPHI2(L1,I1,J1)=VZ(L1,I1+1,J1)/UTIP2(L1,I1,J1)
      OMEGB(L1,I1,J1)=(XPSII(L1,I1,J1)-XPSI(L1,I1,J1))*2.0*UTIP2(L1,I1,
     1J1)*UTIP2(L1,I1,J1)/(XVP1(L1,I1,J1)*XVP1(L1,I1,J1))
      TCA(L1,I1,J1)=CMEGB(L1,I1,J1)*COS(BP2)/(2.0*SGMA(I1,J1))
      PSINI=PSINI+XPSII(L1,I1,J1)*VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      PSIDI=PSIDI+VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      PSIN=PSIN+XPSI(L1,I1,J1)*VZ(L1,I1+1,J1)*STRTUB(L1,I1+1,J1)
      Q1=Q1+VZ(L1,I1,J1)*STRTUB(L1,I1,J1)
      HSVBN=HSVBN+(H(L1,I1,J1)-PV(L1))*VZ(L1,I1,J1)*STRTUB(L1,I1,J1)
      RNN=RNN+RN(L1,I1,J1)
      UTIP1N=UTIP1N+UTIP1(L1,I1,J1)
      UTIP2N=UTIP2N+UTIP2(L1,I1,J1)
 2260 CONTINUE
      RHRCO(L1,I1)=PSIN/PSIDI
      RHRCOI(L1,I1)=PSINI/PSIDI
      RMAE(L1,I1)=RHRCO(L1,I1)/RHRCOI(L1,I1)
      HSVB(L1,I1)=HSVBN/Q1
      QERR2(L1,I1)=(PSIDI*720.0/231.0-GPMA(L1))/(GPMA(L1))
      IF (RN(L1,I1,1)-0.01) 2270,2280,2280
 2270 QERR1(L1,I1)=QERR2(L1,I1-1)
      GO TO 2300
 2280 QERR1(L1,I1)=(Q1*720.0/231.0-GPMA(L1))/(GPMA(L1))
      RNA(L1,I1)=RNN/J
      UTIP1A(L1,I1)=UTIP1N/J
      UTIP2A(L1,I1)=UTIP2N/J
 2300 CONTINUE
      WRITE (KO,90)
      GO TO 4900
C
C     READ INPUT AND CALCULATED DATA STORED ON TAPE FOR A CONFIGURATION
C     IF IKT=2
C
 4700 READ (NDS) K,L,I,J,RHUB(I),RTIP(I),ZCOORD(I),(R(I,J1),J1=1,J),II,
     1(RHUB(I1),RTIP(I1),ZCOORD(I1),NBLADE(I1),I1=1,II),
     2((R(I1,J1),ALF1(I1,J1),ALF2(I1,J1),TMAXC(I1,J1),CHORD(I1,J1),
     3ANGLST(I1,J1),THTA(I1,J1),CMBRMX(I1,J1),RADLE(I1,J1),RADTE(I1,J1),
     4SGMA(I1,J1),I1=1,II),J1=1,J),((INFO(M1,N1),M1=1,7),N1=1,20)
      READ(NDS)
     1(((BETA(L1,I1,J1),H(L1,I1,J1),P(L1,I1,J1),STRTUB(L1,I1,J1),
     2RN(L1,I1,J1),GPM(L1,I1,J1),L1=1,L),I1=1,I),J1=1,J),
     3(GPMA(L1),PHIB(L1),RHO(L1),PV(L1),VISK(L1),L1=1,L),
     4((FLOHIT(I1,J1),RRT(I1,J1),I1=1,I),J1=1,J),
     5(((XV(L1,I1,J1),VU(L1,I1,J1),VZ(L1,I1,J1),L1=1,L),I1=1,I),J1=1,J)
      READ(NDS)
     1(((U1(L1,I1,J1),U2(L1,I1,J1),VUP1(L1,I1,J1),VUP2(L1,I1,J1),
     2XVP1(L1,I1,J1),XVP2(L1,I1,J1),BETAP1(L1,I1,J1),BETAP2(L1,I1,J1),
     3FNC1(L1,I1,J1),DEL2(L1,I1,J1),XD(L1,I1,J1),UTIP1(L1,I1,J1),
     4UTIP2(L1,I1,J1),XPSI(L1,I1,J1),XPSII(L1,I1,J1),XEFF(L1,I1,J1),
     5XPHI1(L1,I1,J1),XPHI2(L1,I1,J1),OMEGB(L1,I1,J1),
     6REC(L1,I1,J1),TCA(L1,I1,J1),L1=1,L),I1=1,II),J1=1,J)
      READ(NDS)
     1          ((RHRCO(L1,I1),RHRCOI(L1,I1),RMAE(L1,I1),L1=1,L),I1=1,II),
     2((HSVB(L1,I1),QERR1(L1,I1),QERR2(L1,I1),RNA(L1,I1),
     3UTIP1A(L1,I1),UTIP2A(L1,I1),I1=1,II),L1=1,L),
     4(((DELTAH(L1,I1,J1),DELTAP(L1,I1,J1),L1=1,L),I1=1,II),J1=1,J)
 4900 WRITE (KO,23)
C
C     PRINT OUT INPUT AND CALCULATED DATA FOR A CONFIGURATION
```

```
C
      DO 4901 M1=1,7
 4901 WRITE (KO,4902) (INFO(M1,N1),N1=1,20)
      DO 4940 I1=1,II
      IF (RN(1,I1,1)-0.01) 4910,4910,4915
 4910 WRITE(KO,4903) I1
      GO TO 4917
 4915 WRITE(KO,4904) I1
 4917 WRITE (KO,4920)
      DO 4930 J1=1,J
 4930 WRITE (KO,4931) J1,R(I1,J1),ALF1(I1,J1),R(I1+1,J1),ALF2(I1,J1),
     1SGMA(I1,J1),TMAXC(I1,J1),CHORD(I1,J1),THTA(I1,J1),ANGLST(I1,J1)
      WRITE (KO,4935)
      WRITE (KO,4936) RHUB(I1),RTIP(I1),RHUB(I1+1),RTIP(I1+1),NBLADE(I1)
 4940 CONTINUE
      DO 6000 L1=1,L
      WRITE (KO,4999) L1,GPMA(L1)
      DO 5110 I1=1,II
      IF(RN(L1,I1,1)-.01)50,51,51
   50 WRITE(KO,53)
      GO TO 52
   51 WRITE(KO,57)
   52 WRITE (KO,5001)
      DO 5100 J1=1,J
 5100 WRITE (KO,5002) J1,FLOHIT(I1,J1),RRT(I1,J1),U1(L1,I1,J1),
     1XV(L1,I1,J1),VZ(L1,I1,J1),VU(L1,I1,J1),BETA(L1,I1,J1),
     2XVP1(L1,I1,J1),VUP1(L1,I1,J1),BETAP1(L1,I1,J1),H(L1,I1,J1),
     3P(L1,I1,J1),STRTUB(L1,I1,J1)
      WRITE (KO,5003)
      I2=I1+1
      DO 5110 J1=1,J
 5110 WRITE (KO,5002) J1,FLOHIT(I2,J1),RRT(I2,J1),U2(L1,I1,J1),
     1XV(L1,I2,J1),VZ(L1,I2,J1),VU(L1,I2,J1),BETA(L1,I2,J1),
     2XVP2(L1,I1,J1),VUP2(L1,I1,J1),BETAP2(L1,I1,J1),H(L1,I2,J1),
     3P(L1,I2,J1),STRTUB(L1,I2,J1)
      DO 5210 I1=1,II
      IF(RN(L1,I1,1)-.01)54,55,55
   54 WRITE(KO,53)
      GO TO 56
   55 WRITE(KO,57)
   56 WRITE (KO,5201)
      DO 5200 J1=1,J
 5200 WRITE (KO,5202) J1,FLOHIT(I1,J1),RRT(I1,J1),FNC1(L1,I1,J1),
     1XPHI1(L1,I1,J1),RN(L1,I1,J1),GPM(L1,I1,J1),RHO(L1),
     2VISK(L1),REC(L1,I1,J1)
      WRITE (KO,5203)
      DO 5210 J1=1,J
 5210 WRITE (KO,5204) J1,FLOHIT(I1+1,J1),RRT(I1+1,J1),DEL2(L1,I1,J1),
     1XPHI2(L1,I1,J1),XPSI(L1,I1,J1),XPSII(L1,I1,J1),XEFF(L1,I1,J1),
     2OMEGB(L1,I1,J1),XD(L1,I1,J1),DELTAH(L1,I1,J1),DELTAP(L1,I1,J1)
     3,TCA(L1,I1,J1)
      WRITE (KO,5301)
      DO 5350 I1=1,II
      IF (0.01-RN(1,I1,1)) 5310,5310,5320
 5310 WRITE (KO,5311)
      WRITE (KO,5312) PHIB(L1),RHRCO(L1,I1),RHRCOI(L1,I1),
     1RMAE(L1,I1),HSVB(L1,I1),QERR1(L1,I1),QERR2(L1,I1),RNA(L1,I1),
     2UTIP1A(L1,I1),UTIP2A(L1,I1)
      GO TO 5350
```

```
 5320 WRITE (KO,5321)
      WRITE (KO,5312) PHIB(L1),RHRCO(L1,I1),RHRCOI(L1,I1),
     1RMAE(L1,I1),              QERR1(L1,I1),QERR2(L1,I1)
 5350 CONTINUE
 6000 CONTINUE
      IF (IKT-1) 5400,5400,3000
C
C     STORE ON TAPE THE INPUT AND CALCULATED DATA FOR A CONFIGURATION
C     IF IKT=1
C
 5400 WRITE(NDS) K,L,I,J,RHUB(I),RTIP(I),ZCOORD(I),(R(I,J1),J1=1,J),II,
     1(RHUB(I1),RTIP(I1),ZCOORD(I1),NBLADE(I1),I1=1,II),
     2((R(I1,J1),ALF1(I1,J1),ALF2(I1,J1),TMAXC(I1,J1),CHORD(I1,J1),
     3ANGLST(I1,J1),THTA(I1,J1),CMBRMX(I1,J1),RADLE(I1,J1),RADTE(I1,J1),
     4SGMA(I1,J1),I1=1,II),J1=1,J),((INFO(M1,N1),M1=1,7),N1=1,20)
      WRITE(NDS)
     1(((BETA(L1,I1,J1),H(L1,I1,J1),P(L1,I1,J1),STRTUB(L1,I1,J1),
     2RN(L1,I1,J1),GPM(L1,I1,J1),L1=1,L),I1=1,I),J1=1,J),
     3(GPMA(L1),PHIB(L1),RHO(L1),PV(L1),VISK(L1),L1=1,L),
     4((FLOHIT(I1,J1),RRT(I1,J1),I1=1,I),J1=1,J),
     5(((XV(L1,I1,J1),VU(L1,I1,J1),VZ(L1,I1,J1),L1=1,L),I1=1,I),J1=1,J)
      WRITE(NDS)
     1(((U1(L1,I1,J1),U2(L1,I1,J1),VUP1(L1,I1,J1),VUP2(L1,I1,J1),
     2XVP1(L1,I1,J1),XVP2(L1,I1,J1),BETAP1(L1,I1,J1),BETAP2(L1,I1,J1),
     3FNC1(L1,I1,J1),DEL2(L1,I1,J1),XD(L1,I1,J1),UTIP1(L1,I1,J1),
     4UTIP2(L1,I1,J1),XPSI(L1,I1,J1),XPSII(L1,I1,J1),XEFF(L1,I1,J1),
     5XPHI1(L1,I1,J1),XPHI2(L1,I1,J1),OMEGB(L1,I1,J1),
     6REC(L1,I1,J1),TCA(L1,I1,J1),L1=1,L),I1=1,II),J1=1,J)
      WRITE(NDS)
     1         ((RHRCO(L1,I1),RHRCOI(L1,I1),RMAE(L1,I1),L1=1,L),I1=1,II),
     2((HSVB(L1,I1),QERR1(L1,I1),QERR2(L1,I1),RNA(L1,I1),
     3UTIP1A(L1,I1),UTIP2A(L1,I1),I1=1,II),L1=1,L),
     4(((DELTAF(L1,I1,J1),DELTAP(L1,I1,J1),L1=1,L),I1=1,II),J1=1,J)
      IF (KCUNT-NDTSET) 3000,5410,5410
 5410 END FILE NDS
      REWIND NDS
 3000 CONTINUE
    6 FORMAT (20A4)
   10 FORMAT (4I2)
   11 FORMAT (3F10.5,I10)
   12 FORMAT (6F10.5)
   13 FORMAT(4F10.5,E7.1)
   15 FORMAT (7F10.5)
   23 FORMAT (1H1,6F10.5)
   53 FORMAT(/,' STATOR BLADE ELEMENT PARAMETERS',/,' 1 INDICATES LEADIN
     1G EDGE, 2 INDICATES TRAILING EDGE')
   57 FORMAT(/,' ROTOR BLADE ELEMENT PARAMETERS',/,' 1 INDICATES LEADING
     1 EDGE, 2 INDICATES TRAILING EDGE')
   90 FORMAT (1HO,//)
 1111 FORMAT (I2)
 4902 FORMAT (1X,20A4)
 4903 FORMAT(1HO,//' BLADE GEOMETRIC PARAMETERS- BLADE ROW#',I2,2X,'(STA
     1TOR)',/,' 1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE')
 4904 FORMAT(1HO,//' BLADE GEOMETRIC PARAMETERS- BLADE ROW#',I2,2X,'(ROT
     1OR)',/,' 1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE')
 4920 FORMAT(1HO//,11X,'R1',6X,'KAPPA1',10X,'R2',6X,'KAPPA2',4X,
     1'SOLIDITY',6X,'TMAX/C',7X,'CHORD',6X,'CAMBER',6X,'SETANG',/,7X,
     2'INCHES',5X,'DEGREES',6X,'INCHES',5X,'DEGREES',30X,'INCHES',5X,
     3'DEGREES',5X,'DEGREES',/)
```

```
4931 FORMAT (1H ,I1,2X,F9.6,3X,F9.3,3X,F9.6,3X,F9.3,3X,3(F9.6,3X),
    12(F9.3,3X))
4935 FORMAT (1HO,//,8X,'RHUB1',7X,'RTIP1',7X,'RHUB2',7X,'RTIP2',5X,
    1'NBLADES',/,7X,'INCHES',6X,'INCHES',6X,'INCHES',6X,'INCHES',/)
4936 FORMAT (4X,4(F9.6,3X),I9)
4999 FORMAT (1H1///,' FLOW RATE #',I2,10X,F9.0,' GALLONS PER MINUTE')
5001 FORMAT ( /3X,' PASS.HT.1      R1/RT',8X,'U1',8X,'V1',7X,'VZ1',6X,
    1'VTH1',5X,'BETA1',8X,'W1',6X,'WTH1',4X,'BETAP1',8X,'H1',8X,'P1',
    23X,'STRTUB1',/,5X,'FROM TIP',17X,'FPS',7X,'FPS',7X,'FPS',7X,'FPS',
    37X,'DEG',7X,'FPS',7X,'FPS',7X,'DEG',8X,'FT',8X,'FT',5X,'SQ IN')
5002 FORMAT (1H ,I1,1X,2F10.6,1X,10(F9.3,1X),F9.5)
5003 FORMAT ( /3X,' PASS.HT.2      R2/RT',8X,'U2',8X,'V2',7X,'VZ2',6X,
    1'VTH2',5X,'BETA2',8X,'W2',6X,'WTH2',4X,'BETAP2',8X,'H2',8X,'P2',
    23X,'STRTUB2',/,5X,'FROM TIP',17X,'FPS',7X,'FPS',7X,'FPS',7X,'FPS',
    37X,'DEG',7X,'FPS',7X,'FPS',7X,'DEG',8X,'FT',8X,'FT',5X,'SQ IN')
5201 FORMAT ( /,3X,' PASS.HT.1      R1/RT',7X,'INC',6X,'PHI1',7X,'RPM',
    18X,'QV',3X,'DENSITY',10X,'VISK',10X,'REC',
    2/,5X,'FROM TIP',17X,'DEG',27X,'GPM  LB/CU FT',5X,'SQ FT/SEC')
5202 FORMAT (1H ,I1,2X,2(F9.6,1X),F9.3,1X,F9.6,1X,3(F9.3,1X)
    1,1X,E12.4,1X,E12.4)
5203 FORMAT ( /,3X,' PASS.HT.2      R2/RT',7X,'DEV',6X,'PHI2',7X,'PSI',
    16X,'PSII',7X,'EFF',4X,'OMEGAB',9X,'D   DELTA H   DELTA P',
    24X,'(TH/C)A',/,5X,'FROM TIP',17X,'DEG',68X,'FT',8X,'FT')
5204 FORMAT (1H ,I1,2X,2(F9.6,1X),F9.3,1X,6(F9.6,1X),2(F9.3,1X),
    1F10.5)
5301 FORMAT (1HO,'AVERAGED PARAMETERS',/,' 1 INDICATES LEADING EDGE, 2
    1INDICATES TRAILING EDGE',/)
5311 FORMAT (19X,'ROTOR',8X,'ROTOR',8X,'ROTOR',9X,'HSVB',9X,'FRC1',
    19X,'FRC2',9X,'RPMA',9X,'UT1A',9X,'UT2A',/,6X,'PHIB1',9X,'PSIB',
    28X,'PSIIB',9X,'EFFB',11X,'FT',49X,'FPS',10X,'FPS')
5312 FORMAT (2X,4(F9.6,4X),6(F9.3,4X))
5321 FORMAT (19X,'STAGE',8X,'STAGE',8X,'STAGE',9X,'FRC1',
    19X,'FRC2',/,6X,'PHIB1',9X,'PSIB',8X,'PSIIB',9X,'EFFB')
     STOP
     END
```

Glossary of FORTRAN Variables

FORTRAN IV variable	Mathematical symbol	Definition	Unit
ALF1(I1, J1)	κ_1	Inlet blade angle, angle between tangent to blade mean camber line and axial direction at leading edge (fig. 2)	deg
ALF2(I1, J1)	κ_2	Outlet blade angle, angle between tangent to blade mean camber line and axial direction at trailing edge (fig. 2)	deg
ANGLST(I1, J1)	γ	Blade setting angle, angle between blade-element chord and axial direction (fig. 2)	deg
B1		β_1 expressed in radians	radians
BETA(L1, I1, J1)	β	Absolute axisymmetric flow angle with respect to axial direction	deg
BETAP1(L1, I1, J1)	β'_1	Relative axisymmetric flow angle with respect to axial direction at blade-row-inlet calculation station (fig. 2 and eq. (F20))	deg
BETAP2(L1, I1, J1)	β'_2	Relative axisymmetric flow angle with respect to axial direction at blade-row-outlet calculation station (fig. 2 and eq. (F21))	deg
BP2		β'_2 expressed in radians	radians
CHORD(I1, J1)	c	Blade-element chord length	in.
CMBRMX(I1, J1)	CM	Position of blade-element maximum camber as percent of total chord length	percent
D1		Intermediate result, $r_t - r_h$	in.
D2		Intermediate result, H - h	ft-lbf/lbm
D3		Intermediate result, $(V'_{\theta, 1})^2 + (V_{z, 1})^2$	ft^2/sec^2
D4		Intermediate result, $(V'_{\theta, 2})^2 + (V_{z, 2})^2$	ft^2/sec^2

FORTRAN IV variable	Mathematical symbol	Definition	Unit
D5		Intermediate result, $V'_{\theta,1}/V'_1$	----------
D6		Intermediate result, $V'_{\theta,2}/V'_2$	----------
D7		Intermediate result: V'_2/V'_1 for rotors, V_2/V_1 for stators	----------
D2A		Intermediate result: $r_2V_{\theta,2} - r_1V_{\theta,1}$ for stators, $r_1V_{\theta,1} - r_2V_{\theta,2}$ for rotors	in.-ft/sec
D2B		Intermediate result: $V'_1(r_2 + r_1)$ for rotors, $V_1(r_2 + r_1)$ for stators	in.-ft/sec
DALF	$\lvert\kappa_1\rvert$	Absolute value of ALF1(L1,I1,J1)	deg
DB	$\lvert\beta_1\rvert$	Absolute value of BETAP1(L1,I1,J1)	deg
DEL2(L1,I1,J1)	δ	Deviation angle, angle between outlet flow direction and tangent to mean camber line at trailing edge (fig. 2 and eqs. (F23) and (F24))	deg
DELTAH(L1,I1,J1)	ΔH	Blade-element total-head rise (eq. (F11))	ft-lbf/lbm
DELTAP(L1,I1,J1)	Δh	Blade-element static-head rise (eq. (F12))	ft-lbf/lbm
FLOHIT(I1,J1)	FFT	Blade-element stream-surface span location as fraction of total passage height from pump annulus outer surface at a blade-row calculation station (eqs. (F1) and (F2))	----------
FNC1(L1,I1,J1)	i	Incidence angle, angle between inlet flow direction and tangent to mean camber line at leading edge (fig. 2 and eq. (F22))	deg
GPM(L1,I1,J1)	Q_v	Instantaneous volume flow rate as measured with a venturi meter	gal/min

FORTRAN IV variable	Mathematical symbol	Definition	Unit
GPMA(L1)	$Q_{v,a}$	Average volume flow rate as measured with a venturi meter (eq. (F50))	gal/min
H(L1, I1, J1)	H	Blade-element total head	ft-lbf/lbm
HSVB(L1, I1)	$\overline{H}_{sv}$	Mass-averaged net positive suction head (eq. (F47))	ft-lbf/lbm
HSVBN		Cumulative value of integrated-volume-flow-rate-weighted net positive suction head	$(ft^2)(in.^2)(lbf)/(lbm)(sec)$
I	I	Number of axial stations being considered	----------
I1		Axial station loop index	----------
I2		I1 + 1	----------
II		Number of blade rows being considered	----------
IKT		Overall program loop index	----------
INFO(M1, N1)		Rotor configuration identification information	----------
J	J	Number of blade elements being considered	----------
J1		Blade-element radial position loop index	----------
K	K	Blade-row configuration number	----------
KI		Card reader unit reference number	----------
KO		Line printer unit reference number	----------
KOUNT		Configuration loop index	----------
L	L	Number of flow rates per configuration being considered	----------
L1		Flow-rate loop index	----------
M1		Identification information "READ" and "WRITE" loops index	----------

FORTRAN IV variable	Mathematical symbol	Definition	Unit
N1		Identification information "READ" and "WRITE" loops index	----------
NBLADE(I1)	NB	Number of blades in blade row being considered	----------
NDS		Tape unit reference number	----------
NDTSET		Number of blade-row configurations being considered	----------
OMEGB(L1, I1, J1)	$\overline{\omega}$	Blade-element loss coefficient (eqs. (F37) and (F38))	----------
P(L1, I1, J1)	h	Blade-element static head at an axial calculation station	ft-lbf/lbm
PHIB(L1)	$\overline{\varphi}$	Average flow coefficient (eq. (F54))	----------
PSIDI		Cumulative value of integrated volume flow rate at blade-row-outlet calculation station	$(ft)(in.^2)/sec$
PSIN		Cumulative value of integrated-volume-flow-rate-weighted rotor or stage head-rise coefficient	$(ft)(in.^2)/sec$
PSINI		Cumulative value of integrated-volume-flow-rate-weighted ideal head-rise coefficient	$(ft)(in.^2)/sec$
PV(L1)	h_v	Flowing fluid vapor pressure	ft-lbf/lbm
Q1		Cumulative value of integrated volume flow rate at blade-row-inlet calculation station	$(ft)(in.^2)/sec$
QERR1(L1, I1)	FRC_1	Comparison of integrated and venturi-metered volume flow rates at blade-row-inlet calculation station (eq. (F48))	----------
QERR2(L1, I1)	FRC_2	Comparison of integrated and venturi-metered volume flow rates at blade-row-outlet calculation station (eq. (F49))	----------

FORTRAN IV variable	Mathematical symbol	Definition	Unit
R(I1, J1)	r	Radius of blade-element stream surface from pump axis at an axial calculation station	in.
RADLE(I1, J1)	RLE	Blade-element leading-edge radius	in.
RADTE(I1, J1)	RTE	Blade-element trailing-edge radius	in.
REC(L1, I1, J1)	Re_c	Blade-chord Reynolds number (eq. (F19))	----------
RHO(L1)	ρ	Fluid density	lbm/ft^3
RHRCO(L1, I1)	$\overline{\psi}$	Mass-averaged rotor or stage head-rise coefficient (eqs. (F41) and (F42))	----------
RHRCOI(L1, I1)	$\overline{\psi}_i$	Mass-averaged rotor or stage ideal head-rise coefficient (eqs. (F43) and (F44))	----------
RHUB(I1)	r_h	Pump annulus inner-surface radius from pump axis at an axial calculation station	in.
RMAE(L1, I1)	$\overline{\eta}$	Mass-averaged rotor or stage hydraulic efficiency (eqs. (F45) and (F46))	----------
RN(L1, I1, J1)	N	Instantaneous value of pump rotor speed: equal to rotor rpm at each rotor-inlet calculation station (stator-outlet calculation station), equal to zero at each stator-inlet calculation station (rotor-outlet calculation station)	rpm
RNA(L1, I1)	N_a	Average pump rotor speed (eq. (F51))	rpm
RNN		Cumulative value of summation of rotor speeds	rpm

FORTRAN IV variable	Mathematical symbol	Definition	Unit
RRT(I1, J1)	r/r_t	Ratio of a blade-element stream-surface radius to pump-annulus outer-surface radius at an axial calculation station (eqs. (F3) and (F4))	----------
RTIP(I1)	r_t	Pump annulus outer-surface radius at an axial calculation station	in.
SGMA(I1, J1)	σ	Blade-row solidity based on stream-surface radius at blade-row-outlet calculation station	----------
STRTUB(L1, I1, J1)	ΔA	Stream-tube cross-sectional area at an axial calculation station including boundary-layer correction	$in.^2$
TCA(L1, I1, J1)	$(\theta/c)_A$	Wake momentum thickness parameter (eqs. (F39) and (F40))	----------
THTA(I1, J1)	φ^o	Blade camber angle; $\kappa_1 - \kappa_2$ for rotors, $\kappa_2 - \kappa_1$ for stators	deg
TMAXC(I1, J1)	t_{max}/c	Ratio of blade-element maximum thickness to chord length	----------
U1(L1, I1, J1)	U_1	Blade velocity at blade-row-inlet calculation station (fig. 2 and eq. (F13))	ft/sec
U2(L1, I1, J1)	U_2	Blade velocity at blade-row-outlet calculation station (fig. 2 and eq. (F14))	ft/sec
UTIP1(L1, I1, J1)	$U_{1,t}$	Instantaneous value of blade-tip velocity at blade-row-inlet calculation station	ft/sec
UTIP2(L1, I1, J1)	$U_{2,t}$	Instantaneous value of blade-tip velocity at blade-row-outlet calculation station	ft/sec

FORTRAN IV variable	Mathematical symbol	Definition	Unit
UTIP1N		Cumulative value of summation of instantaneous blade-tip velocities at blade-row-inlet calculation station	ft/sec
UTIP1A(L1, I1)	$U_{1,t,a}$	Average blade-tip velocity at blade-row-inlet calculation station (eq. (F52))	ft/sec
UTIP2N		Cumulative value of summation of instantaneous blade-tip velocities at blade-row-outlet calculation station	ft/sec
UTIP2A(L1, I1)	$U_{2,t,a}$	Average blade-tip velocity at blade-row-outlet calculation station (eq. (F53))	ft/sec
VISK(L1)	ν	Fluid kinematic viscosity	ft^2/sec
VU(L1, I1, J1)	V_θ	Tangential component of absolute fluid velocity at an axial calculation station (fig. 2 and eqs. (F7) and (F8))	ft/sec
VUP1(L1, I1, J1)	$V'_{\theta,1}$	Tangential component of relative fluid velocity at blade-row-inlet calculation station (fig. 2 and eq. (F15))	ft/sec
VUP2(L1, I1, J1)	$V'_{\theta,2}$	Tangential component of relative fluid velocity at blade-row-outlet calculation station (fig. 2 and eq. (F16))	ft/sec
VZ(L1, I1, J1)	V_z	Axial component of fluid velocity at an axial calculation station (fig. 2 and eqs. (F9) and (F10))	ft/sec
XD(L1, I1, J1)	D	Blade-element diffusion factor (eqs. (F25) and (F26))	----------
XEFF(L1, I1, J1)	η	Blade-element hydraulic efficiency (eqs. (F31) and (F32))	----------

FORTRAN IV variable	Mathematical symbol	Definition	Unit
XPHI1(L1, I1, J1)	φ_1	Blade-element flow coefficient at blade-row-inlet calculation station (eqs. (F33) and (F35))	----------
XPHI2(L1, I1, J1)	φ_2	Blade-element flow coefficient at blade-row-outlet calculation station (eqs. (F34) and (F36))	----------
XPSI(L1, I1, J1)	ψ	Blade-element head-rise coefficient (eqs. (F27) and (F28))	----------
XPSII(L1, I1, J1)	ψ_i	Blade-element ideal head-rise coefficient (eqs. (F29) and (F30))	----------
XV(L1, I1, J1)	V	Absolute axisymmetric fluid velocity at an axial calculation station (fig. 2 and eqs. (F5) and (F6))	ft/sec
XVP1(L1, I1, J1)	V_1'	Relative axisymmetric fluid velocity at blade-row-inlet calculation station (fig. 2 and eq. (F17))	ft/sec
XVP2(L1, I1, J1)	V_2'	Relative axisymmetric fluid velocity at blade-row-outlet calculation station (fig. 2 and eq. (F18))	ft/sec
ZCOORD(I1)	Z	Distance between reference and other axial calculation stations	in.

APPENDIX D

COMPUTER INPUT FORMAT

The computer data input format is as follows: All the FORTRAN IV variables involved are explained in appendix C. Columns 72 to 80 were used for identification. The "A" and "B" notation appearing in the J1 columns (79 and 80) indicate blade-row-inlet and -outlet calculation stations, respectively. Sample numbers have been inserted appropriately for clarification in the coding sheet example shown in figure 13. Rotor speed is read in at the rotor-inlet calculation station as RN(L1, I1, J1). At the rotor-outlet calculation station, RN(L1, I1, J1) must be equal to zero if a stator is downstream of the rotor.

NDTSET

12

INFORMATION CARD 1

NASA CONFIGURATION 02

INFORMATION CARD 2

0.4 HUB-TIP RATIO, 16 BLADES, 9-INCH TIP DIAMETER.

INFORMATION CARD 3

1.5-INCH CHORD. 0.013-0.020-INCH RADIAL TIP CLEARANCE.

INFORMATION CARD 4

0.23 DESIGN TIP D-FACTOR,

INFORMATION CARD 5

DOUBLE CIRCULAR ARC BLADE PROFILE

INFORMATION CARD 6

0.293 DESIGN FLOW COEFFICIENT

INFORMATION CARD 7

NOT REPORTED.

K	L	I	J
02	8	2	7

K
02

RHUB(1)	RTIP(1)	ZCOORD(1)	NBLADE(1)
1.800	4.50	0.0	16

K	I1
02	1

R(1,1)	ALF1(1,1)	ALF2(1,1)	TMAXC(1,1)	CHORD(1,1)	ANGLST(1,1)
4.35	72.4	66.3	0.072	1.50	69.35

K	I1	J1
02	1	A1

THTA(1,1)	CMBRMX(1,1)	RADLE(1,1)	RADTE(1,1)	SGMA(1,1)
6.10	50.0	0.010	0.010	0.8781

K	I1	J1
02	1	B1

R(1,2)	ALF1(1,2)	ALF2(1,2)	TMAXC(1,2)	CHORD(1,2)	ANGLST(1,2)
4.25	72.0	65.6	0.073	1.50	68.8

K	I1	J1
02	1	A2

THTA(1,2)	CMBRMX(1,2)	RADLE(1,2)	RADTE(1,2)	SGMA(1,2)
6.40	50.0	0.010	0.010	0.8988

K	I1	J1
02	1	B2

R(1J)	ALF1(1,J)	ALF2(1,J)	TMAXC(1,J)	CHORD(1,J)	ANGLST(1,J)
1.95	51.2	3.8	0.098	1.50	27.5

K	I1	J1
02	1	A7

THTA(1,J)	CMBRMX(1,J)	RADLE(1,J)	RADTE(1,J)	SGMA(1,J)
47.40	50.0	0.010	0.010	1.9588

K	I1	J1
02	1	B7

RHUB(2)	RTIP(2)	ZCOORD(2)	NBLADE(2)

K	I1

R(2,1)	ALF1(2,1)	ALF2(2,1)	TMAXC(2,1)	CHORD(2,1)	ANGLST(2,1)

K	I1	J1

Figure 13. - Example of input data coding sheet.

THTA(2,1)	CMBRMX(2,1)	RADLE(2,1)	RADTE(2,1)	SGMA(2,1)			K	I1 J1
R(2,J)	ALF1(2,J)	ALF2(2,J)	TMAXC(2,J)	CHORD(2,J)	ANGLST(2,J)		K	I1 J1
THTA(2,J)	CMBRMX(2,J)	RADLE(2,J)	RADTE(2,J)	SGMA(2,J)			K	I1 J1
RHUB(I-1)	RTIP(I-1)	ZCOORD(I-1)	NBLADE(I-1)				K	I1
R(I-1,1)	ALF1(I-1,1)	ALF2(I-1,1)	TMAXC(I-1,1)	CHORD(I-1,1)	ANGLST(I-1,1)		K	I1 J1
THTA(I-1,1)	CMBRMX(I-1,1)	RADLE(I-1,1)	RADTE(I-1,1)	SGMA(I-1,1)			K	I1 J1
R(I-1,J)	ALF1(I-1,J)	ALF2(I-1,J)	TMAXC(I-1,J)	CHORD(I-1,J)	ANGLST(I-1,J)		K	I1 J1
THTA(I-1,J)	CMBRMX(I-1,J)	RADLE(I-1,J)	RADTE(I-1,J)	SGMA(I-1,J)			K	I1 J1

RHUB(I)	RTIP(I)	ZCOORD(I)					K	I1
1.800	4.50	0.0					02	2
R(I,1)	R(I,2)	R(I,3)				R(I,7)	K	I1
4.35	4.25	3.70	3.15	2.60	2.05	1.95	02	2
R(I,8)	R(I,J)							
GPMA(1)	PHIB(1)	RHO(1)	PV(1)	VISK(1)			K	L1
8602.6	0.337	62.15	1.330	9.28E-6			02	1
BETA(1,1,1)	H(1,1,1)	P(1,1,1)	STRTUB(1,1,1)	RN(1,1,1)	GPM(1,1,1)		K	L1 I1 J1
0.0	112.90	77.969	4.7276	3898.8	8602.6		02	1 1 1
BETA(1,1,2)	H(1,1,2)	P(1,1,2)	STRTUB(1,1,2)	RN(1,1,2)	GPM(1,1,2)		K	L1 I1 J1
0.0	112.90	74.0798	8.4489	3898.8	8602.6		02	1 1 2

BETA(1,1,J)	H(1,1,J)	P(1,1,J)	STRUB(1,1,J)	RN)1,1,J)	GPM(1,1,J)	K	L1	I1	J1
0.0	112.90	68.817	1.5860	3898.8	8602.6	02	1	1	7
BETA(1,2,1)	H(1,2,1)	P(1,2,1)	STRUB(1,2,1)	RN(1,2,1)	GPM(1,2,1)	K	L1	I1	J1
27.774	172.50	131.005	4.7276	0.0	8602.6	02	1	2	1
BETA(1,2,2,)	H(1,2,2)	P(1,2,2,)	STRTUB(1,2,2)	RN(1,2,2)	GPM(1,2,2)	K	L1	I1	J1
21.833	179.58	129.401	8.4489	0.0	8602.6	02	1	2	2

BETA(1,2,J)	H(1,2,J)	P(1,2,J)	STRTUB(1,2,J)	RN(1,2,J)	GPM(1,2,J)	K	L1	I1	J1
41.842	203.80	115.269	1.5860	0.0	8602.6	02	1	2	1

Figure 13. - Continued.

BETA(1,I,1)	H(1,I,1)	P(1,I,1)	STRTUB(1,I,1)	RN(1,I,1)	GPM(1,I,1)	K L1 I1 J1
BETA(1,I,2)	H(1,I,2)	P(1,I,2)	STRTUB(1,I,2)	RN(1,I,2)	GPM(1,I,2)	K L1 I1 J1
.						
.						
.						
BETA(1,I,J)	H(1,I,J)	P(1,I,J)	STRTUB(1,I,J)	RN(1,I,J)	GPM(1,I,J)	K L1 I1 J1
GPMA(2)	PHIB(2)	RHO(2)	PV(2)	VISK(2)		K L1
8313.7	0.325	62.15	1.330	9.28E-06		0 2 2
BETA(2,1,1)	H(2,1,1)	P(2,1,1)	STRTUB(2,1,1)	RN(2,1,1)	GPM(2,1,1)	K L1 I1 J1
0.0	113.17	81.181	4.7276	3909.1	8313.7	0 2 2 1 1
BETA(2,1,2)	H(2,1,2)	P(2,1,2)	STRTUB(2,1,2)	RN(2,1,2)	GPM(2,1,2)	K L1 I1 J1
0.0	113.17	76.630	8.4489	3909.1	8313.7	0 2 2 1 2
.						
.						
.						
BETA(2,1,J)	H(2,1,J)	P(2,1,J)	STRTUB(2,1,J)	RN(2,1,J)	GPM(2,1,J)	K L1 I1 J1
0.0	113.17	72.384	1.5860	3909.1	8313.7	0 2 2 1 7
BETA(2,2,1)	H(2,2,1)	P(2,2,1)	STRTUB(2,2,1)	RN(2,2,1)	GPM(2,2,1)	K L1 I1 J1
30.378	191.00	147.449	4.7276	0.0	8313.7	0 2 2 2 1
BETA(2,2,2)	H(2,2,2)	P(2,2,2)	STRTUB(2,2,2)	RN(2,2,2)	GPM(2,2,2)	K L1 I1 J1
26.444	193.37	143.738	8.4489	0.0	8313.7	0 2 2 2 2
.						
.						
.						
BETA(2,2,J)	H(2,2,J)	P(2,2,J)	STRTUB(2,2,J)	RN(2,2,J)	GPM(2,2,J)	K L1 I1 J1
43.658	209.39	125.769	1.5860	0.0	8313.7	0 2 2 2 7
.						
.						
.						
BETA(2,I,1)	H(2,I,1)	P(2,I,1)	STRTUB(2,I,1)	RN(2,I,1)	GPM(2,I,1)	K L1 I1 J1
BETA(2,I,2)	H(2,I,2)	P(2,I,2)	STRTUB(2,I,2)	RN(2,I,2)	GPM(2,I,2)	K L1 I1 J1
.						
.						
.						
BETA(2,I,J)	H(2,I,J)	P(2,I,J)	STRTUB(2,I,J)	RN(2,I,J)	GPM(2,I,J)	K L1 I1 J1
.						
.						
.						
GPMA(L)	PHIB(L)	RHO(L)	PV(L)	VISK(L)		K L1

Figure 13. - Continued.

6712.7	0.262	62.15	1.330	9.28E-6		02 8
BETA(L,1,1)	H(L,1,1)	P(L,1,1)	STRTUB(L,1,1)	RN(L,1,1)	GPM(L,1,1)	K L1 I1 J1
0.0	113.36	90.967	4.7276	3913.6	6712.7	02 8 1 1
BETA(L,1,2)	H(L,1,2)	P(L,1,2)	STRTUB(L,1,2)	RN(L,1,2)	GPM(L,1,2)	K L1 I1 J1
0.0	113.36	88.545	8.4489	3913.6	6712.7	02 8 1 2

BETA(L,1,J)	H(L,1,J)	P(L,1,J)	STRTUB(L,1,J)	RN(L,1,J)	GPM(L,1,J)	K L1 I1 J1
0.0	113.36	90.564	1.5860	3913.6	6712.7	02 8 1 7
BETA(L,2,1)	H(L,2,1)	P(L,2,1)	STRTUB(L,2,1)	RN(L,2,1)	GPM(L,2,1)	K L1 I1 J1
37.750	248.98	202.271	4.7276	0.0	6712.7	02 8 2 1
BETA(L,2,2)	H(L,2,2)	P(L,2,2)	STRTUB(L,2,2)	RN(L,2,2)	GPM(L,2,2)	K L1 I1 J1
36.042	246.88	196.716	8.4489	0.0	6712.7	02 8 2 2

BETA(L,2,J)	H(L,2,J)	P(L,2,J)	STRTUB(L,2,J)	RN(L,2,J)	GPM(L,2,J)	K L1 I1 J1
-65.283	162.72	160.897	1.5860	0.0	6712.7	02 8 2 7

BETA(L,I,1)	H(L,I,1)	P(L,I,1)	STRTUB(L,I,1)	RN(L,I,1)	GPM(L,I,1)	K L1 I1 J1
BETA(L,I,2)	H(L,I,2)	P(L,I,2)	STRTUB(L,I,2)	RN(L,I,2)	GPM(L,I,2)	K L1 I1 J1

BETA(L,I,J)	H(L,I,J)	P(L,I,J)	STRTUB(L,I,J)	RN(L,I,J)	GPM(L,I,J)	K L1 I1 J1

Figure 13. - Concluded.

APPENDIX E

LISTING OF INPUT DATA

All the input cards associated with the pump data presently considered are listed here, following a key which identifies the values listed. Instantaneous values of rotor speeds and volume flow rates were entered where available. In other instances, average values were used.

Number of data sets
Identification - line 1
Identification - line 2
Identification - line 3
Identification - line 4
Identification - line 5
Identification - line 6
Identification - line 7

K L I J

$r_{1,h}$	$r_{1,t}$	z_1	NB			
$r_{1,r1}$	$\kappa_{1,r1}$	$\kappa_{2,r1}$	$(t_{max}/c)_{r1}$	c_{r1}	γ_{r1}	
φ^o_{r1}	CM_{r1}	RLE_{r1}	RTE_{r1}	σ_{r1}		
$r_{1,r2}$	$\kappa_{1,r2}$	$\kappa_{2,r2}$	$(t_{max}/c)_{r2}$	c_{r2}	γ_{r2}	
φ^o_{r2}	CM_{r2}	RLE_{r2}	RTE_{r2}	σ_{r2}		
$r_{1,r3}$	$\kappa_{1,r3}$	$\kappa_{2,r3}$	$(t_{max}/c)_{r3}$	c_{r3}	γ_{r3}	
φ^o_{r3}	CM_{r3}	RLE_{r3}	RTE_{r3}	σ_{r3}		
$r_{1,r4}$	$\kappa_{1,r4}$	$\kappa_{2,r4}$	$(t_{max}/c)_{r4}$	c_{r4}	γ_{r4}	
φ^o_{r4}	CM_{r4}	RLE_{r4}	RTE_{r4}	σ_{r4}		
$r_{1,r5}$	$\kappa_{1,r5}$	$\kappa_{2,r5}$	$(t_{max}/c)_{r5}$	c_{r5}	γ_{r5}	
φ^o_{r5}	CM_{r5}	RLE_{r5}	RTE_{r5}	σ_{r5}		
$r_{1,r6}$	$\kappa_{1,r6}$	$\kappa_{2,r6}$	$(t_{max}/c)_{r6}$	c_{r6}	γ_{r6}	
φ^o_{r6}	CM_{r6}	RLE_{r6}	RTE_{r6}	σ_{r6}		
$r_{1,r7}$	$\kappa_{1,r7}$	$\kappa_{2,r7}$	$(t_{max}/c)_{r7}$	c_{r7}	γ_{r7}	
φ^o_{r7}	CM_{r7}	RLE_{r7}	RTE_{r7}	σ_{r7}		
$r_{2,h}$	$r_{2,t}$					
$r_{2,r1}$	$r_{2,r2}$	$r_{2,r3}$	$r_{2,r4}$	$r_{2,r5}$	$r_{2,r6}$	$r_{2,r7}$
$Q_{v,a}$	$\overline{\varphi}$	ρ	h_v	ν		
$\beta_{1,r1}$	$H_{1,r1}$	$h_{1,r1}$	$\Delta A_{1,r1}$	$N_{1,r1}$	$Q_{v,1,r1}$	
$\beta_{1,r2}$	$H_{1,r2}$	$h_{1,r2}$	$\Delta A_{1,r2}$	$N_{1,r2}$	$Q_{v,1,r2}$	
$\beta_{1,r3}$	$H_{1,r3}$	$h_{1,r3}$	$\Delta A_{1,r3}$	$N_{1,r3}$	$Q_{v,1,r3}$	
$\beta_{1,r4}$	$H_{1,r4}$	$h_{1,r4}$	$\Delta A_{1,r4}$	$N_{1,r4}$	$Q_{v,1,r4}$	
$\beta_{1,r5}$	$H_{1,r5}$	$h_{1,r5}$	$\Delta A_{1,r5}$	$N_{1,r5}$	$Q_{v,1,r5}$	
$\beta_{1,r6}$	$H_{1,r6}$	$h_{1,r6}$	$\Delta A_{1,r6}$	$N_{1,r6}$	$Q_{v,1,r6}$	
$\beta_{1,r7}$	$H_{1,r7}$	$h_{1,r7}$	$\Delta A_{1,r7}$	$N_{1,r7}$	$Q_{v,1,r7}$	
$\beta_{2,r1}$	$H_{2,r1}$	$h_{2,r1}$	$\Delta A_{2,r1}$	$N_{2,r1}$	$Q_{v,2,r1}$	
$\beta_{2,r2}$	$H_{2,r2}$	$h_{2,r2}$	$\Delta A_{2,r2}$	$N_{2,r2}$	$Q_{v,2,r2}$	
$\beta_{2,r3}$	$H_{2,r3}$	$h_{2,r3}$	$\Delta A_{2,r3}$	$N_{2,r3}$	$Q_{v,2,r3}$	
$\beta_{2,r4}$	$H_{2,r4}$	$h_{2,r4}$	$\Delta A_{2,r4}$	$N_{2,r4}$	$Q_{v,2,r4}$	
$\beta_{2,r5}$	$H_{2,r5}$	$h_{2,r5}$	$\Delta A_{2,r5}$	$N_{2,r5}$	$Q_{v,2,r5}$	
$\beta_{2,r6}$	$H_{2,r6}$	$h_{2,r6}$	$\Delta A_{2,r6}$	$N_{2,r6}$	$Q_{v,2,r6}$	
$\beta_{2,r7}$	$H_{2,r7}$	$h_{2,r7}$	$\Delta A_{2,r7}$	$N_{2,r7}$	$Q_{v,2,r7}$	

Input Data

```
12
NASA CONFIGURATION 02
0.4 HUB-TIP RATIO, 16 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD,   0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.24 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.293 DESIGN FLOW COEFFICIENT.
NOT REPORTED.
02 8 2 7                                                                     02
   1.800     4.50      0.0             16                                    02    1
   4.35     72.4      66.38      0.072       1.50      69.39                 02    1A1
   6.02     50.0       0.010     0.010       0.8781                          02    1B1
   4.25     72.0      65.6       0.073       1.50      68.8                  02    1A2
   6.40     50.0       0.010     0.010       0.8988                          02    1B2
   3.70     69.5      60.5       0.079       1.50      65.0                  02    1A3
   9.00     50.0       0.010     0.010       1.0324                          02    1B3
   3.15     66.4      52.4       0.085       1.50      59.4                  02    1A4
  14.00     50.0       0.010     0.010       1.2126                          02    1B4
   2.60     62.4      38.4       0.091       1.50      50.4                  02    1A5
  24.00     50.0       0.010     0.010       1.4691                          02    1B5
   2.05     55.4      10.0       0.097       1.50      32.7                  02    1A6
  45.40     50.0       0.010     0.010       1.8633                          02    1B6
   1.95     53.53      3.5       0.098       1.50      28.52                 02    1A7
  50.03     50.0       0.010     0.010       1.9588                          02    1B7
   1.800     4.50                                                            02    2
   4.35      4.25      3.70      3.15        2.60       2.05       1.95      02    2
8602.6       0.337    62.15      1.330      9.28E-6                          02 1
   0.0     112.90     77.969     4.7276   3898.8     8602.6                  02 1 1 1
   0.0     112.90     74.0798    8.4489   3898.8     8602.6                  02 1 1 2
   0.0     112.90     70.181    12.7863   3898.8     8602.6                  02 1 1 3
   0.0     112.90     68.119    10.8856   3898.8     8602.6                  02 1 1 4
   0.0     112.90     67.718     8.9849   3898.8     8602.6                  02 1 1 5
   0.0     112.90     67.365     4.4159   3898.8     8602.6                  02 1 1 6
   0.0     112.90     68.817     1.5860   3898.8     8602.6                  02 1 1 7
  27.774   172.50    131.005     4.7276      0.0     8602.6                  02 1 2 1
  21.833   179.58    129.401     8.4489      0.0     8602.6                  02 1 2 2
  20.767   180.14    124.853    12.7863      0.0     8602.6                  02 1 2 3
  25.536   186.54    124.481    10.8856      0.0     8602.6                  02 1 2 4
  30.250   194.41    124.167     8.9849      0.0     8602.6                  02 1 2 5
  38.533   205.39    115.840     4.4159      0.0     8602.6                  02 1 2 6
  41.842   203.80    115.269     1.5860      0.0     8602.6                  02 1 2 7
8313.7       0.325    62.15      1.330      9.28E-6                          02 2
   0.0     113.17     81.181     4.7276   3909.1     8313.7                  02 2 1 1
   0.0     113.17     76.630     8.4489   3909.1     8313.7                  02 2 1 2
   0.0     113.17     73.223    12.7863   3909.1     8313.7                  02 2 1 3
   0.0     113.17     71.503    10.8856   3909.1     8313.7                  02 2 1 4
   0.0     113.17     71.197     8.9849   3909.1     8313.7                  02 2 1 5
   0.0     113.17     70.695     4.4159   3909.1     8313.7                  02 2 1 6
   0.0     113.17     72.384     1.5860   3909.1     8313.7                  02 2 1 7
  30.378   191.00    147.449     4.7276      0.0     8313.7                  02 2 2 1
  26.444   193.37    143.738     8.4489      0.0     8313.7                  02 2 2 2
  24.007   189.58    136.278    12.7863      0.0     8313.7                  02 2 2 3
  28.307   193.89    134.104    10.8856      0.0     8313.7                  02 2 2 4
  32.000   199.66    133.150     8.9849      0.0     8313.7                  02 2 2 5
  40.567   210.01    125.683     4.4159      0.0     8313.7                  02 2 2 6
  43.658   209.39    125.769     1.5860      0.0     8313.7                  02 2 2 7
8065.8       0.315    62.15      1.330      9.28E-6                          02 3
   0.0     113.51     82.943     4.7276   3912.1     8065.8                  02 3 1 1
   0.0     113.51     79.239     8.4489   3912.1     8065.8                  02 3 1 2
```

0.0	113.51	75.708	12.7863	3912.1	8065.8	02 3 1 3
0.0	113.51	74.050	10.8856	3912.1	8065.8	02 3 1 4
0.0	113.51	73.736	8.9849	3912.1	8065.8	02 3 1 5
0.0	113.51	73.752	4.4159	3912.1	8065.8	02 3 1 6
0.0	113.51	75.785	1.5860	3912.1	8065.8	02 3 1 7
33.345	197.45	155.308	4.7276	0.0	8065.8	02 3 2 1
28.650	201.47	152.563	8.4489	0.0	8065.8	02 3 2 2
25.919	199.71	147.624	12.7863	0.0	8065.8	02 3 2 3
32.700	202.37	145.246	10.8856	0.0	8065.8	02 3 2 4
35.315	206.06	141.680	8.9849	0.0	8065.8	02 3 2 5
42.167	212.00	131.093	4.4159	0.0	8065.8	02 3 2 6
45.183	212.28	132.009	1.5860	0.0	8065.8	02 3 2 7
7734.3	0.302	62.15	1.330	9.28E-6		02 4
0.0	113.74	85.219	4.7276	3910.0	7734.3	02 4 1 1
0.0	113.74	82.201	8.4489	3910.0	7734.3	02 4 1 2
0.0	113.74	78.957	12.7863	3910.0	7734.3	02 4 1 3
0.0	113.74	77.606	10.8856	3910.0	7734.3	02 4 1 4
0.0	113.74	77.230	8.9849	3910.0	7734.3	02 4 1 5
0.0	113.74	77.800	4.4159	3910.0	7734.3	02 4 1 6
0.0	113.74	79.615	1.5860	3910.0	7734.3	02 4 1 7
34.408	211.72	168.436	4.7276	0.0	7734.3	02 4 2 1
30.620	215.62	166.970	8.4489	0.0	7734.3	02 4 2 2
28.444	210.47	160.599	12.7863	0.0	7734.3	02 4 2 3
32.744	210.30	156.930	10.8856	0.0	7734.3	02 4 2 4
36.923	213.82	153.322	8.9849	0.0	7734.3	02 4 2 5
45.000	213.81	139.431	4.4159	0.0	7734.3	02 4 2 6
48.617	215.96	140.493	1.5860	0.0	7734.3	02 4 2 7
7481.0	0.292	62.15	1.330	9.28E-6		02 5
0.0	113.82	86.459	4.7276	3918.6	7481.0	02 5 1 1
0.0	113.82	83.952	8.4489	3918.6	7481.0	02 5 1 2
0.0	113.82	81.093	12.7863	3918.6	7481.0	02 5 1 3
0.0	113.82	79.812	10.8856	3918.6	7481.0	02 5 1 4
0.0	113.82	80.015	8.9849	3918.6	7481.0	02 5 1 5
0.0	113.82	80.721	4.4159	3918.6	7481.0	02 5 1 6
0.0	113.82	82.070	1.5860	3918.6	7481.0	02 5 1 7
35.848	223.46	178.860	4.7276	0.0	7481.0	02 5 2 1
32.503	225.55	176.894	8.4489	0.0	7481.0	02 5 2 2
30.362	219.55	171.789	12.7863	0.0	7481.0	02 5 2 3
33.900	218.87	165.568	10.8856	0.0	7481.0	02 5 2 4
40.217	217.57	158.973	8.9849	0.0	7481.0	02 5 2 5
49.075	215.31	145.604	4.4159	0.0	7481.0	02 5 2 6
52.542	218.59	145.068	1.5860	0.0	7481.0	02 5 2 7
7216.0	0.282	62.15	1.330	9.28E-6		02 6
0.0	114.10	88.635	4.7276	3917.7	7216.0	02 6 1 1
0.0	114.10	85.792	8.4489	3917.7	7216.0	02 6 1 2
0.0	114.10	83.478	12.7863	3917.7	7216.0	02 6 1 3
0.0	114.10	82.406	10.8856	3917.7	7216.0	02 6 1 4
0.0	114.10	82.672	8.9849	3917.7	7216.0	02 6 1 5
0.0	114.10	83.326	4.4159	3917.7	7216.0	02 6 1 6
0.0	114.10	85.712	1.5860	3917.7	7216.0	02 6 1 7
38.175	235.34	189.469	4.7276	0.0	7216.0	02 6 2 1
34.693	236.53	187.591	8.4489	0.0	7216.0	02 6 2 2
34.894	227.08	179.843	12.7863	0.0	7216.0	02 6 2 3
37.176	227.42	173.668	10.8856	0.0	7216.0	02 6 2 4
43.267	222.95	166.702	8.9849	0.0	7216.0	02 6 2 5
51.958	217.63	151.337	4.4159	0.0	7216.0	02 6 2 6
55.800	223.46	154.410	1.5860	0.0	7216.0	02 6 2 7
6983.6	0.273	62.15	1.330	9.28E-6		02 7
0.0	113.09	89.307	4.7276	3915.9	6983.6	02 7 1 1
0.0	113.09	86.531	8.4489	3915.9	6983.6	02 7 1 2
0.0	113.09	84.275	12.7863	3915.9	6983.6	02 7 1 3
0.0	113.09	83.535	10.8856	3915.9	6983.6	02 7 1 4
0.0	113.09	83.521	8.9849	3915.9	6983.6	02 7 1 5
0.0	113.09	85.126	4.4159	3915.9	6983.6	02 7 1 6
0.0	113.09	86.979	1.5860	3915.9	6983.6	02 7 1 7

```
   39.928    244.58    198.352    4.7276     0.0     6983.6        02 7 2 1
   37.179    244.41    194.992    8.4489     0.0     6983.6        02 7 2 2
   36.485    234.16    187.258   12.7863     0.0     6983.6        02 7 2 3
   40.263    233.09    180.644   10.8856     0.0     6983.6        02 7 2 4
   44.854    225.70    170.839    8.9849     0.0     6983.6        02 7 2 5
   54.269    218.48    157.305    4.4159     0.0     6983.6        02 7 2 6
   57.688    225.10    157.057    1.5860     0.0     6983.6        02 7 2 7
 6712.7        0.262    62.15     1.330   9.28E-6                  02 8
    0.0      113.36     90.967    4.7276  3913.6    6712.7        02 8 1 1
    0.0      113.36     88.545    8.4489  3913.6    6712.7        02 8 1 2
    0.0      113.36     86.479   12.7863  3913.6    6712.7        02 8 1 3
    0.0      113.36     86.051   10.8856  3913.6    6712.7        02 8 1 4
    0.0      113.36     86.698    8.9849  3913.6    6712.7        02 8 1 5
    0.0      113.36     88.520    4.4159  3913.6    6712.7        02 8 1 6
    0.0      113.36     90.564    1.5860  3913.6    6712.7        02 8 1 7
   37.750    248.98    202.271    4.7276     0.0     6712.7        02 8 2 1
   36.042    246.88    196.716    8.4489     0.0     6712.7        02 8 2 2
   34.846    233.64    185.358   12.7863     0.0     6712.7        02 8 2 3
   38.070    235.62    181.360   10.8856     0.0     6712.7        02 8 2 4
   43.661    226.73    170.774    8.9849     0.0     6712.7        02 8 2 5
   63.333    173.58    151.619    4.4159     0.0     6712.7        02 8 2 6
  -65.283    162.72    160.897    1.5860     0.0     6712.7        02 8 2 7
```

```
NASA CONFIGURATION 07
0.7 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD,   0.005-0.012-INCH RADIAL TIP CLEARANCE,
0.43 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-2295 AND TN D-2481.
07 6 2 5                                                       07
    3.15       4.5       0.0            19                     07   1
    4.375     70.0      61.70      0.07138    1.52     65.85   07   1A1
    8.30      50.0       0.010     0.010      1.0506           07   1B1
    4.075     71.03     55.00      0.07472    1.52     63.015  07   1A2
   16.03      50.0       0.010     0.010      1.1279           07   1B2
    3.825     70.42     50.64      0.0775     1.52     60.53   07   1A3
   19.78      50.0       0.010     0.010      1.2017           07   1B3
    3.575     69.08     46.73      0.08027    1.52     57.905  07   1A4
   22.35      50.0       0.010     0.010      1.2857           07   1B4
    3.275     66.92     41.00      0.08361    1.52     53.96   07   1A5
   25.92      50.0       0.010     0.010      1.4035           07   1B5
    3.15       4.5                                             07   2
    4.375      4.075     3.825     3.575      3.275            07   2
 5784.4        0.40511  62.15      1.3354 9.28E-6              07 1
    0.0      185.66    137.05      6.7004 3596.3     5784.5    07 1 1 1
    0.0      188.52    134.54      7.0411 3592.5     5781.6    07 1 1 2
    0.0      188.46    133.65      6.0083 3600.0     5788.2    07 1 1 3
    0.0      188.36    134.34      6.1772 3587.5     5777.9    07 1 1 4
    0.0      188.36    132.76      5.0158 3602.5     5789.6    07 1 1 5
   23.040    241.74    197.61      6.7004    0.0     5784.5    07 1 2 1
   19.485    260.40    194.36      7.0411    0.0     5781.6    07 1 2 2
   22.050    267.26    193.56      6.0083    0.0     5788.2    07 1 2 3
   21.735    271.48    193.49      6.1772    0.0     5777.9    07 1 2 4
   24.525    271.72    191.94      5.0158    0.0     5789.6    07 1 2 5
 5438.7        0.38079  62.15      1.3318 9.28E-6              07 2
    0.0      184.69    142.48      6.7004 3588.8     5419.2    07 2 1 1
    0.0      188.52    141.11      7.0411 3597.5     5434.8    07 2 1 2
    0.0      188.47    140.55      6.0083 3591.3     5425.5    07 2 1 3
    0.0      188.36    140.23      6.1772 3603.8     5455.1    07 2 1 4
```

```
   0.0      188.57     139.84      5.0158 3602.8     5459.0          07 2 1 5
  30.825    272.26     227.21      6.7004    0.0     5419.2          07 2 2 1
  25.875    286.40     224.17      7.0411    0.0     5434.8          07 2 2 2
  26.775    290.21     221.69      6.0083    0.0     5425.5          07 2 2 3
  27.990    293.49     220.17      6.1772    0.0     5455.1          07 2 2 4
  31.815    291.72     216.50      5.0158    0.0     5459.0          07 2 2 5
5047.8        C.35179   62.15      1.3350 9.28E-6                    07 3
   0.0      186.90     149.86      6.7004 3610.5     5041.8          07 3 1 1
   C.C      188.89     148.21      7.0411 3615.8     5061.1          07 3 1 2
   0.0      188.84     147.87      6.0083 3615.8     5047.7          07 3 1 3
   C.C      188.41     147.74      6.1772 3606.5     5023.2          07 3 1 4
   C.0      188.57     146.86      5.0158 3618.5     5065.3          07 3 1 5
  38.880    303.04     254.49      6.7004    0.0     5048.8          07 3 2 1
  30.465    310.07     249.17      7.0411    0.0     5061.1          07 3 2 2
  31.590    314.12     247.52      6.0083    0.0     5047.7          07 3 2 3
  34.920    316.26     245.52      6.1772    0.0     5023.2          07 3 2 4
  37.485    311.74     239.99      5.0158    0.0     5065.3          07 3 2 5
4651.0        C.32425   62.15      1.3515 9.28E-6                    07 4
   0.0      187.12     155.79      6.7004 3606.5     4641.9          07 4 1 1
   0.0      188.62     154.17      7.0411 3619.8     4653.7          07 4 1 2
   0.0      188.95     154.02      6.0083 3613.3     4649.2          07 4 1 3
   C.0      189.06     153.75      6.1772 3616.0     4667.4          07 4 1 4
   0.0      188.52     152.94      5.0158 3605.3     4642.8          07 4 1 5
  43.875    325.50     275.81      6.7004    0.0     4641.9          07 4 2 1
  39.870    331.93     270.76      7.0411    0.0     4653.7          07 4 2 2
  40.140    332.72     268.55      6.0083    0.0     4649.2          07 4 2 3
  40.095    331.78     264.26      6.1772    0.0     4667.4          07 4 2 4
  43.155    332.06     259.01      5.0158    0.0     4642.8          07 4 2 5
4323.1        C.30222   62.15      1.4487 9.28E-6                    07 5
   0.0      161.24     132.64      6.7004 3596.3     4314.4          07 5 1 1
   0.0      163.02     131.30      7.0411 3604.3     4332.2          07 5 1 2
   C.0      163.02     130.44      6.0083 3612.0     4324.4          07 5 1 3
   0.0      162.80     130.25      6.1772 3597.5     4306.7          07 5 1 4
   0.0      162.86     128.98      5.0158 3601.3     4338.1          07 5 1 5
  48.780    318.36     266.33      6.7004    0.0     4314.4          07 5 2 1
  42.750    319.20     259.71      7.0411    0.0     4332.2          07 5 2 2
  42.840    318.15     254.78      6.0083    0.0     4324.4          07 5 2 3
  45.495    317.58     250.82      6.1772    0.0     4306.7          07 5 2 4
  48.375    319.15     244.80      5.0158    0.0     4338.1          07 5 2 5
4065.1        C.28413   62.15      1.5313 9.28E-6                    07 6
   0.0      161.72     137.24      6.7004 3604.0     4040.6          07 6 1 1
   C.0      163.02     134.95      7.0411 3605.0     4080.4          07 6 1 2
   0.0      163.02     134.33      6.0083 3595.0     4091.8          07 6 1 3
   C.0      163.02     133.91      6.1772 3605.5     4072.1          07 6 1 4
   C.0      162.86     133.19      5.0158 3605.3     4040.6          07 6 1 5
  58.590    362.74     280.85      6.7004    0.0     4040.6          07 6 2 1
  45.945    334.07     270.27      7.0411    0.0     4080.4          07 6 2 2
  46.980    332.08     265.73      6.0083    0.0     4091.8          07 6 2 3
  48.285    329.97     261.29      6.1772    0.0     4072.1          07 6 2 4
  51.615    331.80     253.95      5.0158    0.0     4040.6          07 6 2 5
```

```
NASA CONFIGURATION 09
0.7 HUB-TIP RATIO,  8 BLADES, 9-INCH TIP DIAMETER,
3.04-INCH CHORD,  0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.46 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
NOT REPORTED.
09 9 2 5                                                                     09
   3.150     4.50       0.0            8                                    09    1
   4.375    70.00      61.70      0.0714     3.04      65.850                09    1A1
   8.300     0.5        0.020     0.020      0.88472                         09    1B1
   4.075    71.03      55.00      0.0747     3.04      63.015                09    1A2
  16.030     0.5        0.020     0.020      0.94985                         09    1B2
   3.825    70.42      50.64      0.0775     3.04      60.530                09    1A3
  19.780     0.5        0.020     0.020      1.0119                          09    1B3
   3.575    69.08      46.73      0.0803     3.04      57.905                09    1A4
  22.350     0.5        0.020     0.020      1.0827                          09    1B4
   3.275    66.92      41.00      0.0836     3.04      53.960                09    1A5
  25.920     0.5        0.020     0.020      1.1819                          09    1B5
   3.150     4.50                                                            09    2
   4.375     4.075      3.825     3.575      3.275                           09    2
  5782.3     0.4045    62.15      1.3059   9.28E-6                           09 1
   0.0     168.50     124.80      6.7004    3600.0   5768.8                  09 1 1 1
   0.0     171.15     121.84      7.0411    3600.0   5768.8                  09 1 1 2
   0.0     170.74     120.48      6.0083    3600.0   5786.4                  09 1 1 3
   0.0     170.86     119.77      6.1772    3600.0   5794.5                  09 1 1 4
   0.0     170.86     118.71      5.0158    3600.0   5793.1                  09 1 1 5
  21.060   217.74     181.29      6.7004       0.0   5768.8                  09 1 2 1
  21.105   239.46     180.05      7.0411       0.0   5768.8                  09 1 2 2
  18.180   244.38     178.81      6.0083       0.0   5786.4                  09 1 2 3
  19.890   247.02     177.48      6.1772       0.0   5794.5                  09 1 2 4
  21.420   246.08     174.84      5.0158       0.0   5793.1                  09 1 2 5
  5453.5     0.38149   62.15      1.2978   9.28E-6                           09 2
   0.0     167.86     129.70      6.7004    3600.0   5460.7                  09 2 1 1
   0.0     170.86     127.23      7.0411    3600.0   5473.5                  09 2 1 2
   0.0     170.86     126.76      6.0083    3600.0   5459.2                  09 2 1 3
   0.0     170.86     126.34      6.1772    3600.0   5436.4                  09 2 1 4
   0.0     170.80     124.01      5.0158    3600.0   5437.8                  09 2 1 5
  27.585   239.73     204.61      6.7004       0.0   5460.7                  09 2 2 1
  21.960   259.49     202.26      7.0411       0.0   5473.5                  09 2 2 2
  23.220   262.42     200.31      6.0083       0.0   5459.2                  09 2 2 3
  24.840   263.99     198.02      6.1772       0.0   5436.4                  09 2 2 4
  27.225   263.73     195.24      5.0158       0.0   5437.8                  09 2 2 5
  5138.9     0.35948   62.15      1.3089   9.28E-6                           09 3
   0.0     168.80     135.01      6.7004    3600.0   5152.2                  09 3 1 1
   0.0     171.27     132.69      7.0411    3600.0   5147.8                  09 3 1 2
   0.0     171.21     132.06      6.0083    3600.0   5152.3                  09 3 1 3
   0.0     170.56     130.97      6.1772    3600.0   5123.5                  09 3 1 4
   0.0     170.68     129.20      5.0158    3600.0   5118.9                  09 3 1 5
  34.965   258.69     223.37      6.7004       0.0   5152.2                  09 3 2 1
  27.270   275.40     220.72      7.0411       0.0   5147.8                  09 3 2 2
  27.900   279.02     218.72      6.0083       0.0   5152.3                  09 3 2 3
  29.475   279.83     215.44      6.1772       0.0   5123.5                  09 3 2 4
  32.310   279.63     212.08      5.0158       0.0   5118.9                  09 3 2 5
  4651.7     0.32540   62.15      1.2979   9.28E-6                           09 4
   0.0     168.15     141.52      6.7004    3600.0   4676.5                  09 4 1 1
   0.0     171.04     139.68      7.0411    3600.0   4671.5                  09 4 1 2
   0.0     171.04     139.14      6.0083    3600.0   4646.4                  09 4 1 3
   0.0     171.45     138.72      6.1772    3600.0   4644.7                  09 4 1 4
   0.0     171.33     137.39      5.0158    3600.0   4619.5                  09 4 1 5
  44.055   291.14     252.64      6.7004       0.0   4676.5                  09 4 2 1
  35.370   302.09     248.78      7.0411       0.0   4671.5                  09 4 2 2
  35.730   305.66     246.68      6.0083       0.0   4646.4                  09 4 2 3
  37.260   309.32     244.55      6.1772       0.0   4644.7                  09 4 2 4
  41.130   305.75     237.82      5.0158       0.0   4619.5                  09 4 2 5
```

4309.8	C.30148	62.15	1.2948	9.28E-6		09 5
C.0	168.45	145.50	6.7004	3600.0	4328.4	09 5 1 1
C.0	171.27	144.08	7.0411	3600.0	4325.0	09 5 1 2
C.0	171.68	143.99	6.0083	3600.0	4312.3	09 5 1 3
C.0	171.80	143.47	6.1772	3600.0	4299.7	09 5 1 4
C.0	171.68	142.25	5.0158	3600.0	4283.3	09 5 1 5
53.730	314.17	270.56	6.7004	0.0	4328.4	09 5 2 1
40.680	319.62	265.74	7.0411	0.0	4325.0	09 5 2 2
39.915	322.44	262.44	6.0083	0.0	4312.3	09 5 2 3
41.400	324.55	259.02	6.1772	0.0	4299.7	09 5 2 4
46.125	321.39	251.41	5.0158	0.0	4283.3	09 5 2 5
4080.9	C.28547	62.15	1.3011	9.28E-6		09 6
C.0	169.80	148.89	6.7004	3600.0	4091.6	09 6 1 1
C.0	171.80	147.46	7.0411	3600.0	4093.5	09 6 1 2
C.0	171.80	147.04	6.0083	3600.0	4080.1	09 6 1 3
C.0	171.86	146.42	6.1772	3600.0	4078.3	09 6 1 4
C.0	170.92	144.38	5.0158	3600.0	4061.0	09 6 1 5
58.680	335.95	281.80	6.7004	0.0	4091.6	09 6 2 1
45.720	330.41	276.31	7.0411	0.0	4093.5	09 6 2 2
42.660	334.71	272.95	6.0083	0.0	4080.1	09 6 2 3
44.190	335.81	268.77	6.1772	0.0	4078.3	09 6 2 4
49.635	332.99	259.83	5.0158	0.0	4061.0	09 6 2 5
3829.5	C.26788	62.15	1.2994	9.28E-6		09 7
C.0	170.38	151.98	6.7004	3600.0	3836.0	09 7 1 1
C.0	172.15	150.76	7.0411	3600.0	3844.1	09 7 1 2
0.0	171.74	149.96	6.0083	3600.0	3827.8	09 7 1 3
C.0	171.39	148.75	6.1772	3600.0	3817.7	09 7 1 4
0.0	171.80	148.16	5.0158	3600.0	3821.8	09 7 1 5
63.720	367.24	295.19	6.7004	0.0	3836.0	09 7 2 1
52.920	346.69	288.11	7.0411	0.0	3844.1	09 7 2 2
46.530	344.81	282.62	6.0083	0.0	3827.8	09 7 2 3
47.115	344.04	275.50	6.1772	0.0	3817.7	09 7 2 4
52.920	343.61	268.38	5.0158	0.0	3821.8	09 7 2 5
3617.2	C.25303	62.15	1.2946	9.28E-6		09 8
C.0	170.91	154.01	6.7004	3600.0	3627.1	09 8 1 1
C.0	171.97	153.16	7.0411	3600.0	3622.8	09 8 1 2
C.0	172.21	152.68	6.0083	3600.0	3633.6	09 8 1 3
C.0	172.27	152.11	6.1772	3600.0	3605.6	09 8 1 4
C.0	171.92	150.83	5.0158	3600.0	3596.8	09 8 1 5
65.655	389.03	303.41	6.7004	0.0	3627.1	09 8 2 1
59.400	356.36	293.56	7.0411	0.0	3622.8	09 8 2 2
51.165	352.72	289.36	6.0083	0.0	3633.6	09 8 2 3
49.050	353.51	283.46	6.1772	0.0	3605.6	09 8 2 4
53.865	348.13	272.29	5.0158	0.0	3596.8	09 8 2 5
3574.2	C.25002	62.15	1.2945	9.28E-6		09 9
C.0	171.68	154.99	6.7004	3600.0	3518.0	09 9 1 1
0.0	172.39	153.15	7.0411	3600.0	3579.6	09 9 1 2
C.0	171.86	151.80	6.0083	3600.0	3611.9	09 9 1 3
C.0	172.03	151.11	6.1772	3600.0	3573.1	09 9 1 4
C.0	172.27	150.35	5.0158	3600.0	3588.2	09 9 1 5
66.690	390.32	303.13	6.7004	0.0	3518.0	09 9 2 1
60.210	355.72	292.60	7.0411	0.0	3579.6	09 9 2 2
51.120	350.27	287.63	6.0083	0.0	3611.9	09 9 2 3
48.960	352.75	282.87	6.1772	0.0	3573.1	09 9 2 4
53.730	347.96	272.27	5.0158	0.0	3588.2	09 9 2 5

NASA CONFIGURATION 5
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-3024 AND TN D-3602.

5 7 2 7							5
3.6	4.5	0.0		19			5 1
4.46	68.5	39.9	0.0709	1.50	54.200		5 1A1
28.60	50.0	0.010	0.0100	1.0090			5 1B1
4.41	68.6	38.0	0.0720	1.50	53.300		5 1A2
30.60	50.0	0.010	0.0100	1.0204			5 1B2
4.31	68.6	34.2	0.0742	1.50	51.400		5 1A3
34.40	50.0	0.010	0.0100	1.0441			5 1B3
4.26	68.6	32.25	0.0753	1.50	50.475		5 1A4
36.35	50.0	0.010	0.0100	1.0563			5 1B4
4.06	67.7	25.1	0.0798	1.50	46.400		5 1A5
42.60	50.0	0.010	0.0100	1.1084			5 1B5
3.91	65.8	23.1	0.0831	1.50	44.450		5 1A6
42.70	50.0	0.010	0.0100	1.1509			5 1B6
3.71	63.1	20.15	0.0876	1.50	41.625		5 1A7
42.95	50.0	0.010	0.0100	1.2129			5 1B7
3.6	4.5						5 2
4.46	4.41	4.31	4.26	4.06	3.91	3.71	5 2
5120.0	0.60680	62.16	1.3194	9.28E-6			5 1
0.0	231.97	160.64	1.5721	3005.1	5112.8		5 1 1 1
0.0	233.34	158.73	2.0782	3002.5	5101.2		5 1 1 2
0.0	241.43	161.21	2.0310	3004.9	5116.1		5 1 1 3
0.0	240.48	156.63	3.3458	3016.2	5130.2		5 1 1 4
0.0	239.02	152.60	4.4642	3009.9	5112.6		5 1 1 5
0.0	239.60	151.44	4.2993	3017.5	5129.1		5 1 1 6
0.0	240.58	150.49	4.4367	3015.0	5137.7		5 1 1 7
34.425	327.87	249.94	1.6795	0.0	5112.8		5 1 2 1
31.860	333.52	249.41	2.0782	0.0	5101.2		5 1 2 2
29.340	344.65	249.05	2.0310	0.0	5116.1		5 1 2 3
27.450	347.72	245.41	3.3458	0.0	5130.2		5 1 2 4
25.380	358.05	239.46	4.4642	0.0	5112.6		5 1 2 5
25.965	360.78	237.70	4.2993	0.0	5129.1		5 1 2 6
27.540	363.44	233.97	4.6146	0.0	5137.7		5 1 2 7
4830.5	0.57321	62.16	1.2969	9.28E-6			5 2
0.0	230.28	167.48	1.5721	3006.4	4829.0		5 2 1 1
0.0	234.98	167.87	2.0782	3007.4	4831.3		5 2 1 2
0.0	241.84	167.68	2.0310	3013.7	4835.6		5 2 1 3
0.0	241.24	167.44	3.3458	2998.8	4816.5		5 2 1 4
0.0	240.30	163.55	4.4642	2998.9	4823.2		5 2 1 5
0.0	241.25	162.47	4.2993	3006.3	4843.8		5 2 1 6
0.0	241.20	161.39	4.4367	3013.8	4834.1		5 2 1 7
37.575	340.53	272.22	1.6795	0.0	4829.0		5 2 2 1
37.170	352.91	273.48	2.0782	0.0	4831.3		5 2 2 2
31.365	369.29	272.44	2.0310	0.0	4835.6		5 2 2 3
28.935	373.16	269.38	3.3458	0.0	4816.5		5 2 2 4
28.350	378.53	262.92	4.4642	0.0	4823.2		5 2 2 5
30.240	377.38	260.97	4.2993	0.0	4843.8		5 2 2 6
32.085	380.67	256.67	4.6146	0.0	4834.1		5 2 2 7
4427.3	0.52415	62.16	1.3267	9.28E-6			5 3
0.0	231.88	179.37	1.5721	3010.0	4435.0		5 3 1 1
0.0	237.90	181.74	2.0782	3017.6	4420.1		5 3 1 2
0.0	242.56	180.62	2.0310	3016.3	4414.5		5 3 1 3
0.0	241.15	179.11	3.3458	3013.8	4429.4		5 3 1 4
0.0	241.22	176.45	4.4642	3016.4	4426.6		5 3 1 5
0.0	241.99	176.08	4.2993	3013.7	4442.2		5 3 1 6
0.0	242.57	176.02	4.4367	3006.3	4423.1		5 3 1 7
44.640	357.99	295.57	1.6795	0.0	4435.0		5 3 2 1
44.190	370.88	298.74	2.0782	0.0	4420.1		5 3 2 2

36.720	385.51	296.49	2.0310	0.0	4414.5	5 3 2 3
32.445	390.48	292.65	3.3458	0.0	4429.4	5 3 2 4
33.210	395.53	289.29	4.4642	0.0	4426.6	5 3 2 5
34.515	393.97	284.78	4.2993	0.0	4442.2	5 3 2 6
37.395	397.77	279.67	4.6146	0.0	4423.1	5 3 2 7
4093.0	0.48463	62.16	1.3241	9.28E-6		5 4
0.0	233.81	189.01	1.5721	3007.4	4098.2	5 4 1 1
0.0	234.53	186.50	2.0782	3017.6	4103.7	5 4 1 2
0.0	242.75	190.04	2.0310	3008.6	4077.7	5 4 1 3
0.0	242.89	190.14	3.3458	3003.9	4077.4	5 4 1 4
0.0	242.24	186.63	4.4642	3023.7	4109.1	5 4 1 5
0.0	242.90	186.16	4.2993	3017.5	4094.7	5 4 1 6
0.0	243.29	186.46	4.4367	3012.5	4090.5	5 4 1 7
53.280	376.57	313.81	1.6795	0.0	4098.2	5 4 2 1
49.950	379.42	309.10	2.0782	0.0	4103.7	5 4 2 2
42.165	394.68	313.01	2.0310	0.0	4077.7	5 4 2 3
38.475	400.31	311.47	3.3458	0.0	4077.4	5 4 2 4
37.215	407.45	304.45	4.4642	0.0	4109.1	5 4 2 5
37.890	407.90	300.26	4.2993	0.0	4094.7	5 4 2 6
41.490	411.40	295.17	4.6146	0.0	4090.5	5 4 2 7
3807.3	0.45098	62.16	1.2468	9.28E-6		5 5
0.0	237.43	197.88	1.5721	3008.7	3819.2	5 5 1 1
0.0	238.42	197.01	2.0782	3013.7	3817.2	5 5 1 2
0.0	241.39	195.57	2.0310	3011.3	3815.8	5 5 1 3
0.0	243.08	197.24	3.3458	3013.8	3813.6	5 5 1 4
0.0	243.32	195.60	4.4642	3017.5	3803.5	5 5 1 5
0.0	242.65	194.12	4.2993	3008.7	3787.4	5 5 1 6
0.0	241.55	192.51	4.4367	3008.8	3794.0	5 5 1 7
62.460	392.80	323.40	1.6795	0.0	3819.2	5 5 2 1
57.060	395.48	323.81	2.0782	0.0	3817.2	5 5 2 2
46.260	398.60	320.07	2.0310	0.0	3815.8	5 5 2 3
41.715	404.08	320.10	3.3458	0.0	3813.6	5 5 2 4
39.870	417.56	316.76	4.4642	0.0	3803.5	5 5 2 5
40.005	417.64	310.90	4.2993	0.0	3787.4	5 5 2 6
44.460	421.89	303.91	4.6146	0.0	3794.0	5 5 2 7
3450.0	0.40918	62.16	1.2593	9.28E-6		5 6
0.0	239.00	206.87	1.5721	3005.1	3463.7	5 6 1 1
0.0	241.07	206.60	2.0782	3005.1	3441.9	5 6 1 2
0.0	242.77	205.66	2.0310	3006.2	3454.8	5 6 1 3
0.0	242.84	204.91	3.3458	3003.9	3448.7	5 6 1 4
0.0	245.29	206.07	4.4642	3011.3	3453.1	5 6 1 5
0.0	245.15	205.16	4.2993	3012.5	3448.5	5 6 1 6
0.0	244.03	203.57	4.4367	3012.5	3439.5	5 6 1 7
69.435	414.39	337.80	1.6795	0.0	3463.7	5 6 2 1
64.845	415.20	336.74	2.0782	0.0	3441.9	5 6 2 2
55.395	407.12	331.82	2.0310	0.0	3454.8	5 6 2 3
49.455	406.00	328.24	3.3458	0.0	3448.7	5 6 2 4
42.165	426.64	329.02	4.4642	0.0	3453.1	5 6 2 5
42.795	430.86	324.53	4.2993	0.0	3448.5	5 6 2 6
47.565	431.96	315.33	4.6146	0.0	3439.5	5 6 2 7
3191.0	0.37855	62.16	1.3218	9.28E-6		5 7
0.0	239.97	213.76	1.5721	3015.1	3201.2	5 7 1 1
0.0	242.12	213.02	2.0782	2999.9	3189.3	5 7 1 2
0.0	243.81	215.01	2.0310	3004.9	3175.0	5 7 1 3
0.0	242.98	210.89	3.3458	3004.9	3203.7	5 7 1 4
0.0	244.62	211.14	4.4642	3008.7	3201.4	5 7 1 5
0.0	244.85	210.69	4.2993	3011.3	3182.3	5 7 1 6
0.0	244.64	210.27	4.4367	3006.3	3184.4	5 7 1 7
69.615	428.31	346.30	1.6795	0.0	3201.2	5 7 2 1
67.005	428.65	343.60	2.0782	0.0	3189.3	5 7 2 2
59.670	419.65	337.98	2.0310	0.0	3175.0	5 7 2 3
54.990	414.05	336.33	3.3458	0.0	3203.7	5 7 2 4
44.010	426.47	334.51	4.4642	0.0	3201.4	5 7 2 5
44.280	432.39	330.34	4.2993	0.0	3182.3	5 7 2 6
49.995	436.54	320.99	4.6146	0.0	3184.4	5 7 2 7

```
NASA CONFIGURATION  6
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.026-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.
 6 7 2 7                                                                         6
   3.60      4.5       0.0           19                                          6   1
   4.46     68.5      39.9      0.07089    1.50      54.2                        6   1A1
  28.6      50.0       0.010    0.010      1.0090                                6   1B1
   4.41     68.6      38.0      0.0720     1.50      53.3                        6   1A2
  30.6      50.0       0.010    0.010      1.0204                                6   1B2
   4.31     68.6      34.2      0.07422    1.50      51.4                        6   1A3
  34.4      50.0       0.010    0.010      1.0441                                6   1B3
   4.26     68.6      32.25     0.07533    1.50      50.425                      6   1A4
  36.35     50.0       0.010    0.010      1.0563                                6   1B4
   4.06     67.7      25.1      0.07978    1.50      46.4                        6   1A5
  42.6      50.0       0.010    0.010      1.1084                                6   1B5
   3.91     65.8      23.1      0.08311    1.50      44.45                       6   1A6
  42.7      50.0       0.010    0.010      1.1509                                6   1B6
   3.71     63.1      20.15     0.08756    1.50      41.625                      6   1A7
  42.95     50.0       0.010    0.010      1.2129                                6   1B7
   3.60      4.5                                                                 6   2
   4.46      4.41      4.31     4.26       4.06       3.91      3.71             6   2
5098.6       0.60686  62.192    1.1682  9.28E-6                                  6 1
   0.0     264.85    193.61     1.5721 2998.7     5098.2                         6 1 1 1
   0.0     271.01    197.92     2.0782 3012.4     5110.0                         6 1 1 2
   0.0     277.54    196.79     2.0310 2991.3     5074.7                         6 1 1 3
   0.0     277.54    195.38     3.3458 2988.8     5089.4                         6 1 1 4
   0.0     276.36    191.13     4.4642 3005.1     5099.7                         6 1 1 5
   0.0     276.81    189.88     4.2993 2993.7     5110.0                         6 1 1 6
   0.0     276.81    189.39     4.4367 2991.2     5108.5                         6 1 1 7
  31.365   350.82    284.69     1.6116    0.0     5098.2                         6 1 2 1
  31.905   367.76    290.04     2.0782    0.0     5110.0                         6 1 2 2
  29.160   382.15    288.60     2.0310    0.0     5074.7                         6 1 2 3
  27.135   387.76    285.49     3.3458    0.0     5089.4                         6 1 2 4
  24.570   397.13    279.70     4.4642    0.0     5099.7                         6 1 2 5
  25.560   398.82    277.36     4.2993    0.0     5110.0                         6 1 2 6
  28.620   397.02    272.91     4.5524    0.0     5108.5                         6 1 2 7
4830.7       0.57435  62.192    1.1682  9.28E-6                                  6 2
   0.0     266.93    203.92     1.5721 3001.2     4839.1                         6 2 1 1
   0.0     272.73    207.26     2.0782 3002.5     4831.3                         6 2 1 2
   0.0     276.90    204.30     2.0310 3004.9     4839.1                         6 2 1 3
   0.0     277.63    204.11     3.3458 2996.3     4817.4                         6 2 1 4
   0.0     277.72    201.45     4.4642 3002.5     4840.6                         6 2 1 5
   0.0     277.54    199.99     4.2993 2998.7     4822.0                         6 2 1 6
   0.0     277.54    199.52     4.4367 2997.5     4825.1                         6 2 1 7
  38.025   361.21    304.29     1.6116    0.0     4839.1                         6 2 2 1
  39.285   379.14    309.20     2.0782    0.0     4831.3                         6 2 2 2
  33.705   399.13    305.64     2.0310    0.0     4839.1                         6 2 2 3
  29.790   406.59    305.98     3.3458    0.0     4817.4                         6 2 2 4
  27.810   414.54    300.47     4.4642    0.0     4840.6                         6 2 2 5
  29.160   411.55    296.99     4.2993    0.0     4822.0                         6 2 2 6
  31.905   412.23    292.03     4.5524    0.0     4825.1                         6 2 2 7
4423.6       0.52734  62.192    1.1682  9.28E-6                                  6 3
   0.0     265.12    213.11     1.5721 2987.6     4423.7                         6 3 1 1
   0.0     269.92    215.06     2.0782 2990.0     4433.8                         6 3 1 2
   0.0     274.73    213.58     2.0310 3002.5     4443.9                         6 3 1 3
   0.0     274.91    213.42     3.3458 2989.9     4408.4                         6 3 1 4
   0.0     274.18    210.57     4.4642 2987.6     4410.1                         6 3 1 5
   0.0     274.00    208.90     4.2993 2996.4     4418.6                         6 3 1 6
   0.0     274.73    209.05     4.4367 2995.0     4427.0                         6 3 1 7
  47.430   380.28    325.50     1.6116    0.0     4423.7                         6 3 2 1
  47.610   389.01    321.33     2.0782    0.0     4433.8                         6 3 2 2
```

38.570	413.91	326.70	2.0310	0.0	4443.9	6 3 2 3
36.225	415.32	324.75	3.3458	0.0	4408.4	6 3 2 4
32.220	422.45	319.42	4.4642	0.0	4410.1	6 3 2 5
33.255	422.38	315.60	4.2993	0.0	4418.6	6 3 2 6
36.495	425.80	312.12	4.5524	0.0	4427.0	6 3 2 7
4115.3	C.48825	62.192	1.1682	9.28E-6		6 4
C.0	269.74	221.72	1.5721	3001.2	4113.2	6 4 1 1
C.0	270.74	223.76	2.0782	3011.3	4118.7	6 4 1 2
0.0	275.36	222.70	2.0310	3006.2	4116.9	6 4 1 3
C.0	274.37	221.44	3.3458	3002.5	4082.2	6 4 1 4
C.0	274.64	219.07	4.4642	3014.9	4122.3	6 4 1 5
0.0	274.82	218.12	4.2993	3007.5	4127.8	6 4 1 6
C.0	275.63	218.89	4.4367	3005.0	4125.9	6 4 1 7
55.575	396.80	340.48	1.6116	0.0	4113.2	6 4 2 1
53.010	406.44	342.45	2.0782	0.0	4118.7	6 4 2 2
45.405	420.49	340.62	2.0310	0.0	4116.9	6 4 2 3
40.320	426.34	340.07	3.3458	0.0	4082.2	6 4 2 4
35.280	435.59	335.14	4.4642	0.0	4122.3	6 4 2 5
35.865	435.32	329.86	4.2993	0.0	4127.8	6 4 2 6
39.870	440.18	326.66	4.5524	0.0	4125.9	6 4 2 7
3756.9	C.44666	62.192	1.1682	9.28E-6		6 5
C.0	269.29	232.53	1.5721	3002.5	3783.3	6 5 1 1
C.0	272.46	233.35	2.0782	2999.9	3765.5	6 5 1 2
0.0	275.63	231.93	2.0310	2998.8	3747.5	6 5 1 3
C.0	275.36	230.95	3.3458	3006.3	3757.5	6 5 1 4
0.0	275.63	230.00	4.4642	3002.5	3751.5	6 5 1 5
0.0	276.09	229.71	4.2993	2994.9	3743.5	6 5 1 6
C.0	276.00	229.23	4.4367	3000.0	3749.5	6 5 1 7
62.955	423.73	355.44	1.6116	0.0	3783.3	6 5 2 1
60.390	425.11	356.49	2.0782	0.0	3765.5	6 5 2 2
51.570	425.59	351.89	2.0310	0.0	3747.5	6 5 2 3
46.755	428.68	351.13	3.3458	0.0	3757.5	6 5 2 4
38.565	444.67	348.58	4.4642	0.0	3751.5	6 5 2 5
39.195	446.24	342.88	4.2993	0.0	3743.5	6 5 2 6
43.065	452.66	337.55	4.5524	0.0	3749.5	6 5 2 7
3447.9	C.40895	62.192	1.1682	9.28E-6		6 6
C.0	270.11	239.45	1.5721	2998.7	3463.1	6 6 1 1
0.0	274.28	241.11	2.0782	3005.1	3454.4	6 6 1 2
C.0	275.54	238.79	2.0310	3003.8	3447.9	6 6 1 3
0.0	275.63	238.41	3.3458	3007.6	3443.5	6 6 1 4
0.0	276.18	237.67	4.4642	3009.9	3447.9	6 6 1 5
0.0	276.63	237.49	4.2993	3011.3	3434.8	6 6 1 6
C.0	276.72	237.24	4.4367	3018.8	3443.5	6 6 1 7
67.950	443.29	367.12	1.6116	0.0	3463.1	6 6 2 1
66.330	447.46	368.75	2.0782	0.0	3454.4	6 6 2 2
57.600	435.15	360.85	2.0310	0.0	3447.9	6 6 2 3
52.290	432.32	359.07	3.3458	0.0	3443.5	6 6 2 4
41.265	451.72	359.11	4.4642	0.0	3447.9	6 6 2 5
41.085	458.01	354.70	4.2993	0.0	3434.8	6 6 2 6
45.225	463.15	347.10	4.5524	0.0	3443.5	6 6 2 7
3253.8	C.38747	62.192	1.1682	9.28E-6		6 7
C.0	272.46	244.32	1.5721	2991.2	3235.1	6 7 1 1
C.0	270.38	243.29	2.0782	2990.0	3255.8	6 7 1 2
0.0	275.73	243.00	2.0310	2992.4	3255.8	6 7 1 3
C.0	276.63	243.10	3.3458	2998.7	3253.5	6 7 1 4
0.0	276.63	241.97	4.4642	2998.9	3262.7	6 7 1 5
0.0	276.09	240.80	4.2993	3002.5	3260.4	6 7 1 6
C.0	275.73	240.28	4.4367	2997.5	3253.5	6 7 1 7
69.120	450.59	371.65	1.6116	0.0	3235.1	6 7 2 1
67.410	451.76	370.78	2.0782	0.0	3255.8	6 7 2 2
61.425	444.20	365.71	2.0310	0.0	3255.8	6 7 2 3
56.970	439.04	362.21	3.3458	0.0	3253.5	6 7 2 4
44.100	448.36	360.60	4.4642	0.0	3262.7	6 7 2 5
42.570	457.69	355.98	4.2993	0.0	3260.4	6 7 2 6
46.800	462.83	348.04	4.5524	0.0	3253.5	6 7 2 7

NASA CONFIGURATION 8
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.008-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

810 2 7							8
2.000	2.509	0.0	19				8 1
2.459	68.55	38.59	0.07164	0.8333	53.57		8 1A1
29.96	50.0	0.00556	0.00556	1.0203			8 1B1
2.409	68.61	35.08	0.07364	0.8333	51.845		8 1A2
33.53	50.0	0.00556	0.00556	1.0415			8 1B2
2.359	68.55	31.50	0.07564	0.8333	50.025		8 1A3
37.05	50.0	0.00556	0.00556	1.0636			8 1B3
2.259	67.10	25.25	0.07964	0.8333	46.175		8 1A4
41.85	50.0	0.00556	0.00556	1.1107			8 1B4
2.159	65.45	22.75	0.08364	0.8333	44.100		8 1A5
42.70	50.0	0.00556	0.00556	1.1621			8 1B5
2.109	64.20	21.55	0.08564	0.8333	42.875		8 1A6
42.65	50.0	0.00556	0.00556	1.1897			8 1B6
2.059	63.00	20.00	0.08764	0.8333	41.50		8 1A7
43.00	50.0	0.00556	0.00556	1.2186			8 1B7
2.000	2.509						8 2
2.459	2.409	2.359	2.259	2.159	2.109	2.059	8 2
1687.6	0.63821	62.192	1.1682	9.28E-6			8 1
0.0	248.30	176.07	0.97352	5389.850	1676.6		8 1 1 1
0.0	257.46	176.56	0.75681	5382.322	1687.1		8 1 1 2
0.0	265.44	175.99	1.1117	5370.106	1676.1		8 1 1 3
0.0	270.51	174.05	1.4194	5367.390	1693.1		8 1 1 4
0.0	270.42	171.47	1.0174	5379.801	1694.8		8 1 1 5
0.0	266.89	168.75	0.66256	5367.493	1696.4		8 1 1 6
0.0	257.01	168.17	0.89413	5362.486	1689.3		8 1 1 7
30.690	346.63	263.28	1.0326	0.0	1676.6		8 1 2 1
27.945	348.82	259.57	0.75681	0.0	1687.1		8 1 2 2
27.495	357.70	257.03	1.1117	0.0	1676.1		8 1 2 3
25.830	374.22	252.15	1.4194	0.0	1693.1		8 1 2 4
24.345	384.12	247.66	1.0174	0.0	1694.8		8 1 2 5
23.985	381.82	242.54	0.66256	0.0	1696.4		8 1 2 6
24.795	371.15	242.19	0.94974	0.0	1689.3		8 1 2 7
1636.3	0.61704	62.192	1.1682	9.28E-6			8 2
0.0	245.95	180.74	0.97352	5369.820	1636.9		8 2 1 1
0.0	257.55	180.34	0.75681	5392.314	1649.9		8 2 1 2
0.0	266.07	180.09	1.1117	5394.881	1634.0		8 2 1 3
0.0	271.69	179.21	1.4194	5392.749	1630.6		8 2 1 4
0.0	272.33	178.95	1.0174	5387.238	1628.9		8 2 1 5
0.0	271.06	176.48	0.66256	5382.482	1628.9		8 2 1 6
0.0	259.54	176.23	0.89413	5407.509	1644.8		8 2 1 7
32.085	356.05	278.94	1.0326	0.0	1636.9		8 2 2 1
30.600	362.94	277.00	0.75681	0.0	1649.9		8 2 2 2
31.095	371.46	273.83	1.1117	0.0	1634.0		8 2 2 3
28.260	390.89	271.19	1.4194	0.0	1630.6		8 2 2 4
26.550	400.50	267.07	1.0174	0.0	1628.9		8 2 2 5
26.865	400.36	266.43	0.66256	0.0	1628.9		8 2 2 6
28.215	389.63	262.49	0.94974	0.0	1644.8		8 2 2 7
1566.5	0.59343	62.192	1.1682	9.28E-6			8 3
0.0	247.31	186.32	0.97352	5365.156	1570.4		8 3 1 1
0.0	257.19	186.50	0.75681	5355.209	1570.4		8 3 1 2
0.0	264.98	186.31	1.1117	5357.478	1573.9		8 3 1 3
0.0	269.97	185.37	1.4194	5372.455	1569.8		8 3 1 4
0.0	270.78	184.88	1.0174	5377.681	1560.9		8 3 1 5
0.0	269.15	184.69	0.66256	5359.988	1560.3		8 3 1 6
0.0	261.18	183.69	0.89413	5367.493	1559.7		8 3 1 7
35.820	365.94	296.50	1.0326	0.0	1570.4		8 3 2 1
36.270	373.24	293.32	0.75681	0.0	1570.4		8 3 2 2

34.920	381.38	290.25	1.1117	0.0	1573.9	8 3 2 3
29.880	401.40	286.95	1.4194	0.0	1569.8	8 3 2 4
29.115	411.20	283.39	1.0174	0.0	1560.9	8 3 2 5
29.835	407.54	280.62	0.66256	0.0	1560.3	8 3 2 6
32.175	400.47	278.84	0.94974	0.0	1559.7	8 3 2 7
1468.9	0.55595	62.192	1.1682	9.28E-6		8 4
0.0	255.65	200.68	0.97352	5377.268	1476.7	8 4 1 1
0.0	263.53	202.49	0.75681	5372.341	1475.4	8 4 1 2
0.0	270.78	202.59	1.1117	5359.907	1457.7	8 4 1 3
0.0	275.23	201.48	1.4194	5367.390	1467.9	8 4 1 4
0.0	274.59	199.03	1.0174	5367.597	1462.8	8 4 1 5
0.0	272.60	198.22	0.66256	5372.490	1478.6	8 4 1 6
0.0	262.54	196.80	0.89413	5372.501	1463.4	8 4 1 7
35.145	390.90	319.19	1.0326	0.0	1476.7	8 4 2 1
32.220	392.38	317.92	0.75681	0.0	1475.4	8 4 2 2
31.320	398.29	314.94	1.1117	0.0	1457.7	8 4 2 3
30.600	420.46	311.03	1.4194	0.0	1467.9	8 4 2 4
32.310	424.66	305.18	1.0174	0.0	1462.8	8 4 2 5
33.435	421.54	302.56	0.66256	0.0	1478.6	8 4 2 6
35.910	415.41	298.30	0.94974	0.0	1463.4	8 4 2 7
1388.0	0.52529	62.192	1.1682	9.28E-6		8 5
0.0	256.01	208.43	0.97352	5367.482	1390.0	8 5 1 1
0.0	264.26	209.16	0.75681	5369.957	1388.0	8 5 1 2
0.0	270.69	209.41	1.1117	5377.394	1382.0	8 5 1 3
0.0	274.59	207.86	1.4194	5364.846	1394.0	8 5 1 4
0.0	275.23	206.95	1.0174	5370.244	1392.7	8 5 1 5
0.0	272.69	205.62	0.66256	5369.992	1388.0	8 5 1 6
0.0	264.35	204.17	0.89413	5372.501	1381.3	8 5 1 7
43.200	410.00	332.89	1.0326	0.0	1390.0	8 5 2 1
37.980	412.30	331.60	0.75681	0.0	1388.0	8 5 2 2
35.775	419.52	328.90	1.1117	0.0	1382.0	8 5 2 3
34.425	430.72	323.21	1.4194	0.0	1394.0	8 5 2 4
35.325	431.69	317.78	1.0174	0.0	1392.7	8 5 2 5
35.955	428.14	314.18	0.66256	0.0	1388.0	8 5 2 6
39.015	424.96	311.83	0.94974	0.0	1381.3	8 5 2 7
1291.0	0.48861	62.192	1.1682	9.28E-6		8 6
0.0	258.91	217.83	0.97352	5362.360	1291.1	8 6 1 1
0.0	266.16	218.85	0.75681	5367.585	1289.7	8 6 1 2
0.0	271.69	218.46	1.1117	5370.106	1286.1	8 6 1 3
0.0	275.95	218.21	1.4194	5372.455	1289.0	8 6 1 4
0.0	275.77	216.64	1.0174	5379.800	1291.1	8 6 1 5
0.0	273.32	216.18	0.66256	5369.992	1292.5	8 6 1 6
0.0	265.62	213.35	0.89413	5367.493	1297.6	8 6 1 7
49.005	428.17	350.01	1.0326	0.0	1291.1	8 6 2 1
43.830	428.35	348.53	0.75681	0.0	1289.7	8 6 2 2
41.400	431.75	343.93	1.1117	0.0	1286.1	8 6 2 3
37.665	442.07	339.69	1.4194	0.0	1289.0	8 6 2 4
38.790	440.76	332.71	1.0174	0.0	1291.1	8 6 2 5
39.645	438.32	328.99	0.66256	0.0	1292.5	8 6 2 6
42.390	434.76	323.45	0.94974	0.0	1297.6	8 6 2 7
1205.0	0.45577	62.192	1.1682	9.28E-6		8 7
0.0	261.09	225.27	0.97352	5380.064	1205.7	8 7 1 1
0.0	266.98	226.24	0.75681	5359.965	1204.9	8 7 1 2
0.0	272.14	226.22	1.1117	5370.106	1194.1	8 7 1 3
0.0	275.32	224.73	1.4194	5364.846	1205.7	8 7 1 4
0.0	275.50	223.99	1.0174	5379.801	1215.7	8 7 1 5
0.0	273.41	223.16	0.66256	5387.478	1206.5	8 7 1 6
0.0	266.98	222.83	0.89413	5372.501	1202.6	8 7 1 7
55.575	441.68	360.37	1.0326	0.0	1205.7	8 7 2 1
49.005	441.96	359.05	0.75681	0.0	1204.9	8 7 2 2
44.910	443.09	356.54	1.1117	0.0	1194.1	8 7 2 3
40.725	446.93	348.47	1.4194	0.0	1205.7	8 7 2 4
41.265	447.00	342.31	1.0174	0.0	1215.7	8 7 2 5
42.435	444.92	338.29	0.66256	0.0	1206.5	8 7 2 6
45.630	445.89	335.79	0.94974	0.0	1202.6	8 7 2 7

```
1140.1        0.43213   62.192      1.1682 9.28E-6                          8 8
   0.0      263.26     230.93      0.97352 5362.360 1134.4                 8 8 1 1
   0.0      266.07     231.23      0.75681 5377.566 1145.0                 8 8 1 2
   0.0      271.51     230.98      1.1117  5374.965 1130.3                 8 8 1 3
   0.0      275.32     229.44      1.4194  5357.753 1136.0                 8 8 1 4
   0.0      275.32     228.63      1.0174  5352.734 1145.8                 8 8 1 5
   0.0      274.23     228.62      0.66256 5352.493 1145.8                 8 8 1 6
   0.0      267.34     226.89      0.89413 5357.467 1143.3                 8 8 1 7
  59.715    446.32     367.61      1.0326     0.0   1134.4                 8 8 2 1
  54.180    445.63     364.10      0.75681    0.0   1145.0                 8 8 2 2
  49.545    445.37     360.70      1.1117     0.0   1130.3                 8 8 2 3
  43.110    448.62     352.75      1.4194     0.0   1136.0                 8 8 2 4
  42.930    447.38     345.78      1.0174     0.0   1145.8                 8 8 2 5
  43.740    449.10     344.52      0.66256    0.0   1145.8                 8 8 2 6
  46.665    445.39     340.29      0.94974    0.0   1143.3                 8 8 2 7
1075.4        0.40705   62.192      1.1682 9.28E-6                          8 9
   0.0      264.35     234.32      0.97352 5362.360 1087.7                 8 9 1 1
   0.0      268.34     235.85      0.75681 5372.341 1088.5                 8 9 1 2
   0.0      271.78     235.73      1.1117  5372.535 1065.3                 8 9 1 3
   0.0      275.59     234.14      1.4194  5372.455 1085.1                 8 9 1 4
   0.0      275.32     234.34      1.0174  5360.160 1060.0                 8 9 1 5
   0.0      275.05     234.02      0.66256 5372.490 1073.9                 8 9 1 6
   0.0      268.70     233.25      0.89413 5372.501 1067.0                 8 9 1 7
  63.315    448.98     370.27      1.0326     0.0   1087.7                 8 9 2 1
  58.545    448.37     368.89      0.75681    0.0   1088.5                 8 9 2 2
  54.900    445.75     365.11      1.1117     0.0   1065.3                 8 9 2 3
  46.485    445.56     358.55      1.4194     0.0   1085.1                 8 9 2 4
  44.865    451.65     353.13      1.0174     0.0   1060.0                 8 9 2 5
  45.585    454.97     350.71      0.66256    0.0   1073.9                 8 9 2 6
  48.060    455.52     346.54      0.94974    0.0   1067.0                 8 9 2 7
1014.2        0.38376   62.192      1.1682 9.28E-6                          810
   0.0      265.62     239.97      0.97352 5360.034 1027.2                 810 1 1
   0.0      269.43     240.76      0.75681 5372.341 1007.1                 810 1 2
   0.0      272.69     240.28      1.1117  5362.337 1008.9                 810 1 3
   0.0      275.59     239.43      1.4194  5374.959 1019.0                 810 1 4
   0.0      276.13     239.17      1.0174  5361.597 1016.3                 810 1 5
   0.0      275.41     238.47      0.66256 5379.984 1014.4                 810 1 6
   0.0      269.24     237.25      0.89413 5380.007 1006.2                 810 1 7
  65.070    455.42     375.71      1.0326     0.0   1027.2                 810 2 1
  61.380    453.05     374.06      0.75681    0.0   1007.1                 810 2 2
  58.410    447.89     369.02      1.1117     0.0   1008.9                 810 2 3
  50.040    447.43     363.64      1.4194     0.0   1019.0                 810 2 4
  46.125    454.71     358.56      1.0174     0.0   1016.3                 810 2 5
  46.575    458.81     355.49      0.66256    0.0   1014.4                 810 2 6
  48.825    460.61     350.96      0.94974    0.0   1006.2                 810 2 7
```

```
NASA CONFIGURATION  9
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NCT REPORTED.
 9 9 2 7                                                                    9
   2.000      2.509      0.0          19                                    9   1
   2.459     68.55      38.59       0.07164   0.8333    53.57              9   1A1
  29.96      50.0        0.00556    0.00556   1.0203                       9   1B1
   2.409     68.61      35.08       0.07364   0.8333    51.845             9   1A2
  33.53      50.0        0.00556    0.00556   1.0415                       9   1B2
   2.359     68.55      31.50       0.07564   0.8333    50.025             9   1A3
  37.05      50.0        0.00556    0.00556   1.0636                       9   1B3
   2.259     67.10      25.25       0.07964   0.8333    46.175             9   1A4
```

```
  41.85      50.0        0.00556    0.00556    1.1107                          9    1B4
   2.159     65.45      22.75       0.08364    0.8333    44.100                9    1A5
  42.70      50.0        0.00556    0.00556    1.1621                          9    1B5
   2.109     64.20      21.55       0.08564    0.8333    42.875                9    1A6
  42.65      50.0        0.00556    0.00556    1.1897                          9    1B6
   2.059     63.00      20.00       0.08764    0.8333    41.50                 9    1A7
  43.00      50.0        0.00556    0.00556    1.2186                          9    1B7
   2.000      2.509                                                           9    2
   2.459      2.409      2.359      2.259      2.159      2.109      2.059     9    2
1690.7        0.63751   62.192     1.1682 9.28E-6                             9 1
   0.0      242.72     175.48     0.99716 5392.65   1683.2                    9 1 1 1
   0.0      258.85     179.79     0.75681 5382.33   1682.7                    9 1 1 2
   0.0      268.19     176.27     1.1117  5382.26   1686.5                    9 1 1 3
   0.0      272.63     173.91     1.4194  5394.79   1696.4                    9 1 1 4
   0.0      272.90     172.05     1.0174  5397.32   1693.7                    9 1 1 5
   0.0      272.00     170.84     0.66256 5389.99   1693.7                    9 1 1 6
   0.0      267.92     169.57     0.91637 5389.98   1698.6                    9 1 1 7
  31.905    342.27     261.30     1.0563     0.0    1683.2                    9 1 2 1
  28.845    351.00     262.64     0.75681    0.0    1682.7                    9 1 2 2
  27.810    355.96     256.56     1.1117     0.0    1686.5                    9 1 2 3
  24.435    371.74     250.22     1.4194     0.0    1696.4                    9 1 2 4
  22.140    383.01     245.33     1.0174     0.0    1693.7                    9 1 2 5
  22.770    382.89     242.34     0.66256    0.0    1693.7                    9 1 2 6
  25.200    371.63     237.87     0.97198    0.0    1698.6                    9 1 2 7
1647.9        0.62085   62.192     1.1682 9.28E-6                             9 2
   0.0      242.45     179.37     0.99716 5392.65   1645.4                    9 2 1 1
   0.0      258.94     179.74     0.75681 5395.17   1650.4                    9 2 1 2
   0.0      270.09     181.87     1.1117  5385.17   1649.9                    9 2 1 3
   0.0      274.17     179.77     1.4194  5404.93   1646.5                    9 2 1 4
   0.0      273.18     177.21     1.0174  5395.20   1639.7                    9 2 1 5
   0.0      272.90     176.80     0.66256 5392.49   1650.4                    9 2 1 6
   0.0      268.37     175.51     0.91637 5397.49   1653.2                    9 2 1 7
  32.670    354.46     273.43     1.0563     0.0    1645.4                    9 2 2 1
  29.610    362.65     273.24     0.75681    0.0    1650.4                    9 2 2 2
  29.205    371.56     270.95     1.1117     0.0    1649.9                    9 2 2 3
  26.145    385.18     264.66     1.4194     0.0    1646.5                    9 2 2 4
  24.435    392.15     258.33     1.0174     0.0    1639.7                    9 2 2 5
  25.425    391.88     257.07     0.66256    0.0    1650.4                    9 2 2 6
  27.765    381.73     254.87     0.97198    0.0    1653.2                    9 2 2 7
1575.2        0.59404   62.192     1.1682 9.28E-6                             9 3
   0.0      244.89     186.97     0.99716 5380.07   1572.8                    9 3 1 1
   0.0      259.03     188.66     0.75681 5379.95   1569.8                    9 3 1 2
   0.0      268.82     188.89     1.1117  5394.89   1576.9                    9 3 1 3
   0.0      272.99     187.47     1.4194  5402.39   1575.1                    9 3 1 4
   0.0      273.72     186.31     1.0174  5402.63   1578.0                    9 3 1 5
   0.0      273.45     185.23     0.66256 5384.99   1578.0                    9 3 1 6
   0.0      268.73     184.70     0.91637 5380.02   1575.7                    9 3 1 7
  36.990    368.24     292.24     1.0563     0.0    1572.8                    9 3 2 1
  36.180    374.64     287.43     0.75681    0.0    1569.8                    9 3 2 2
  35.235    386.34     288.27     1.1117     0.0    1576.9                    9 3 2 3
  29.025    398.03     281.53     1.4194     0.0    1575.1                    9 3 2 4
  27.900    405.71     279.40     1.0174     0.0    1578.0                    9 3 2 5
  28.575    403.53     275.51     0.66256    0.0    1578.0                    9 3 2 6
  31.815    392.20     271.56     0.97198    0.0    1575.7                    9 3 2 7
1460.1        0.55219   62.192     1.1682 9.28E-6                             9 4
   0.0      248.97     198.80     0.99716 5367.49   1461.5                    9 4 1 1
   0.0      260.49     199.78     0.75681 5372.34   1457.1                    9 4 1 2
   0.0      269.01     200.69     1.1117  5372.54   1460.9                    9 4 1 3
   0.0      273.81     199.77     1.4194  5375.00   1460.9                    9 4 1 4
   0.0      273.81     197.93     1.0174  5379.81   1464.1                    9 4 1 5
   0.0      272.81     196.83     0.66256 5377.49   1471.0                    9 4 1 6
   0.0      269.28     195.23     0.91637 5372.50   1444.9                    9 4 1 7
  36.315    377.26     315.15     1.0563     0.0    1461.5                    9 4 2 1
  34.200    384.73     312.03     0.75681    0.0    1457.1                    9 4 2 2
  33.210    390.79     308.49     1.1117     0.0    1460.9                    9 4 2 3
```

28.755	415.12	305.24	1.4194	0.0	1460.9	9 4 2 4
31.545	417.59	299.60	1.0174	0.0	1464.1	9 4 2 5
33.120	413.11	295.79	0.66256	0.0	1471.0	9 4 2 6
35.555	405.59	292.30	0.97198	0.0	1444.9	9 4 2 7
1382.2	0.52315	62.192	1.1682	9.28E-6		9 5
0.0	251.06	206.85	0.99716	5372.62	1385.3	9 5 1 1
0.0	262.21	208.07	0.75681	5362.35	1387.3	9 5 1 2
0.0	269.64	207.67	1.1117	5362.34	1371.9	9 5 1 3
0.0	273.90	207.53	1.4194	5362.32	1382.6	9 5 1 4
0.0	273.99	205.40	1.0174	5370.25	1387.3	9 5 1 5
0.0	272.90	204.96	0.66256	5379.99	1384.7	9 5 1 6
0.0	270.28	203.79	0.91637	5377.51	1375.9	9 5 1 7
45.675	402.81	329.55	1.0563	0.0	1385.3	9 5 2 1
38.340	407.89	325.27	0.75681	0.0	1387.3	9 5 2 2
34.695	416.34	323.12	1.1117	0.0	1371.9	9 5 2 3
32.760	427.11	318.17	1.4194	0.0	1382.6	9 5 2 4
35.685	420.69	308.88	1.0174	0.0	1387.3	9 5 2 5
35.100	420.27	308.63	0.66256	0.0	1384.7	9 5 2 6
38.790	415.96	305.26	0.97198	0.0	1375.9	9 5 2 7
1292.6	0.48861	62.192	1.1682	9.28E-6		9 6
0.0	253.05	215.00	0.99716	5367.49	1293.3	9 6 1 1
0.0	263.20	217.65	0.75681	5379.95	1286.8	9 6 1 2
0.0	269.64	216.96	1.1117	5390.03	1281.7	9 6 1 3
0.0	274.17	216.20	1.4194	5362.32	1298.3	9 6 1 4
0.0	274.35	214.92	1.0174	5385.11	1296.8	9 6 1 5
0.0	273.81	214.65	0.66256	5377.49	1293.3	9 6 1 6
0.0	270.46	213.07	0.91637	5375.01	1298.3	9 6 1 7
51.480	413.22	341.01	1.0563	0.0	1293.3	9 6 2 1
47.520	418.10	340.93	0.75681	0.0	1286.8	9 6 2 2
44.145	423.75	337.31	1.1117	0.0	1281.7	9 6 2 3
37.395	431.20	330.70	1.4194	0.0	1298.3	9 6 2 4
37.710	430.03	325.39	1.0174	0.0	1296.8	9 6 2 5
38.565	429.04	322.64	0.66256	0.0	1293.3	9 6 2 6
41.985	428.04	318.66	0.97198	0.0	1298.3	9 6 2 7
1197.0	0.45186	62.192	1.1682	9.28E-6		9 7
0.0	255.77	224.34	0.99716	5387.53	1200.3	9 7 1 1
0.0	263.84	224.68	0.75681	5375.20	1195.7	9 7 1 2
0.0	270.55	225.29	1.1117	5382.26	1202.6	9 7 1 3
0.0	274.08	224.53	1.4194	5387.68	1191.0	9 7 1 4
0.0	274.17	223.51	1.0174	5382.46	1194.1	9 7 1 5
0.0	274.44	223.27	0.66256	5384.99	1198.0	9 7 1 6
0.0	271.63	222.57	0.91637	5387.47	1197.2	9 7 1 7
55.350	431.54	354.48	1.0563	0.0	1200.3	9 7 2 1
48.645	426.59	349.64	0.75681	0.0	1195.7	9 7 2 2
44.550	428.81	347.89	1.1117	0.0	1202.6	9 7 2 3
39.465	437.05	342.62	1.4194	0.0	1191.0	9 7 2 4
39.780	438.16	336.00	1.0174	0.0	1194.1	9 7 2 5
40.860	437.98	333.34	0.66256	0.0	1198.0	9 7 2 6
44.460	438.42	329.10	0.97198	0.0	1197.2	9 7 2 7
1139.5	0.43047	62.192	1.1682	9.28E-6		9 8
0.0	258.13	228.86	0.99716	5385.20	1135.2	9 8 1 1
0.0	265.56	230.00	0.75681	5382.33	1149.0	9 8 1 2
0.0	270.64	229.51	1.1117	5382.26	1152.2	9 8 1 3
0.0	273.54	228.42	1.4194	5369.93	1134.4	9 8 1 4
0.0	273.54	227.42	1.0174	5375.03	1131.1	9 8 1 5
0.0	274.44	227.81	0.66256	5389.99	1137.7	9 8 1 6
0.0	272.00	227.20	0.91637	5375.01	1136.8	9 8 1 7
59.175	435.24	359.67	1.0563	0.0	1135.2	9 8 2 1
53.190	433.70	356.75	0.75681	0.0	1149.0	9 8 2 2
48.285	432.26	352.39	1.1117	0.0	1152.2	9 8 2 3
42.345	437.86	345.91	1.4194	0.0	1134.4	9 8 2 4
41.535	440.33	340.32	1.0174	0.0	1131.1	9 8 2 5
42.255	441.57	338.20	0.66256	0.0	1137.7	9 8 2 6
45.630	441.59	333.15	0.97198	0.0	1136.8	9 8 2 7

```
1070.8       0.40472   62.192      1.1682 9.28E-6                          9 9
   0.0      258.40    233.53       0.99716 5385.20  1073.9                 9 9 1 1
   0.0      265.29    233.80       0.75681 5369.96  1071.3                 9 9 1 2
   0.0      270.46    233.68       1.1117  5374.97  1070.5                 9 9 1 3
   0.0      274.35    234.20       1.4194  5385.14  1084.2                 9 9 1 4
   0.0      274.90    233.96       1.0174  5382.46  1068.7                 9 9 1 5
   0.0      274.90    233.56       0.66256 5374.99  1064.4                 9 9 1 6
   0.0      271.73    233.19       0.91637 5369.99  1062.7                 9 9 1 7
  62.100    436.41    360.29       1.0563     0.0   1073.9                 9 9 2 1
  57.735    432.86    357.68       0.75681    0.0   1071.3                 9 9 2 2
  53.505    430.62    353.90       1.1117     0.0   1070.5                 9 9 2 3
  45.450    436.77    349.39       1.4194     0.0   1084.2                 9 9 2 4
  43.065    443.03    345.79       1.0174     0.0   1068.7                 9 9 2 5
  43.695    444.60    342.67       0.66256    0.0   1064.4                 9 9 2 6
  46.440    446.82    338.49       0.97198    0.0   1062.7                 9 9 2 7


NASA CONFIGURATION 10
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.023-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.
1010 2 7                                                                  10
   2.000     2.509     0.0          19                                    10   1
   2.459    68.55     38.59       0.07164   0.8333   53.57                10  1A1
  29.96     50.0       0.00556    0.00556   1.0203                        10  1B1
   2.409    68.61     35.08       0.07364   0.8333   51.845               10  1A2
  33.53     50.0       0.00556    0.00556   1.0415                        10  1B2
   2.359    68.55     31.50       0.07564   0.8333   50.025               10  1A3
  37.05     50.0       0.00556    0.00556   1.0636                        10  1B3
   2.259    67.10     25.25       0.07964   0.8333   46.175               10  1A4
  41.85     50.0       0.00556    0.00556   1.1107                        10  1B4
   2.159    65.45     22.75       0.08364   0.8333   44.100               10  1A5
  42.70     50.0       0.00556    0.00556   1.1621                        10  1B5
   2.109    64.20     21.55       0.08564   0.8333   42.875               10  1A6
  42.65     50.0       0.00556    0.00556   1.1897                        10  1B6
   2.059    63.00     20.00       0.08764   0.8333   41.50                10  1A7
  43.00     50.0       0.00556    0.00556   1.2186                        10  1B7
   2.000     2.509                                                        10  2
   2.459     2.409     2.359       2.259     2.159     2.109    2.059     10  2
1665.3       0.69242   62.192      1.1682 9.28E-6                          10 1
   0.0      238.38    177.16       0.98928 5360.03  1653.8                 10 1 1 1
   0.0      254.36    180.02       0.75681 5359.97  1662.7                 10 1 1 2
   0.0      266.64    177.32       1.1117  5385.17  1663.3                 10 1 1 3
   0.0      271.70    175.46       1.4194  5380.07  1660.5                 10 1 1 4
   0.0      271.88    173.99       1.0174  5377.68  1670.0                 10 1 1 5
   0.0      271.25    172.20       0.66256 5384.99  1671.6                 10 1 1 6
   0.0      268.18    170.29       0.90896 5392.48  1674.9                 10 1 1 7
  31.410    335.13    257.24       1.0642     0.0   1653.8                 10 1 2 1
  29.430    340.67    254.24       0.75681    0.0   1662.7                 10 1 2 2
  28.575    351.16    253.20       1.1117     0.0   1663.3                 10 1 2 3
  23.535    371.59    249.36       1.4194     0.0   1660.5                 10 1 2 4
  21.915    382.89    243.39       1.0174     0.0   1670.0                 10 1 2 5
  22.590    381.80    240.65       0.66256    0.0   1671.6                 10 1 2 6
  24.930    372.22    238.85       0.97939    0.0   1674.9                 10 1 2 7
1637.9       0.61938   62.192      1.1682 9.28E-6                          10 2
   0.0      241.09    178.60       0.98928 5382.40  1638.0                 10 2 1 1
   0.0      256.98    179.64       0.75681 5382.33  1639.1                 10 2 1 2
   0.0      268.00    180.34       1.1117  5370.11  1631.2                 10 2 1 3
   0.0      271.52    178.14       1.4194  5369.93  1638.6                 10 2 1 4
   0.0      271.70    176.84       1.0174  5375.03  1644.2                 10 2 1 5
```

```
   0.0      271.52     176.30      0.66256 5369.99  1636.3          10 2 1 6
   0.0      266.64     173.80      0.90896 5372.50  1638.0          10 2 1 7
 33.750     343.79     264.85      1.0642      0.0  1638.0          10 2 2 1
 32.175     352.95     265.13      0.75681     0.0  1639.1          10 2 2 2
 31.230     358.80     263.10      1.1117      0.0  1631.2          10 2 2 3
 25.920     376.46     256.49      1.4194      0.0  1638.6          10 2 2 4
 23.175     389.33     252.75      1.0174      0.0  1644.2          10 2 2 5
 24.120     386.45     249.71      0.66256     0.0  1636.3          10 2 2 6
 26.280     374.39     246.09      0.97939     0.0  1638.0          10 2 2 7
1574.5        0.59453   62.192     1.1682 9.28E-6                   10 3
   0.0      244.52     186.27      0.98928 5372.62  1572.2          10 3 1 1
   0.0      257.79     186.96      0.75681 5377.57  1575.1          10 3 1 2
   0.0      267.82     187.91      1.1117  5382.26  1571.6          10 3 1 3
   0.0      271.25     185.62      1.4194  5394.78  1582.2          10 3 1 4
   0.0      271.25     183.97      1.0174  5379.81  1575.7          10 3 1 5
   0.0      270.80     183.12      0.66256 5387.49  1571.0          10 3 1 6
   0.0      267.28     181.59      0.90896 5382.52  1573.9          10 3 1 7
 35.460     359.34     285.43      1.0642      0.0  1572.2          10 3 2 1
 34.110     361.73     280.42      0.75681     0.0  1575.1          10 3 2 2
 34.650     364.23     279.40      1.1117      0.0  1571.6          10 3 2 3
 30.240     378.55     273.25      1.4194      0.0  1582.2          10 3 2 4
 25.965     398.19     268.95      1.0174      0.0  1575.7          10 3 2 5
 27.090     396.17     266.38      0.66256     0.0  1571.0          10 3 2 6
 30.510     385.24     263.06      0.97939     0.0  1573.9          10 3 2 7
1520.2        0.57477   62.192     1.1682 9.28E-6                   10 4
   0.0      244.79     191.03      0.98928 5362.36  1518.2          10 4 1 1
   0.0      258.79     193.01      0.75681 5375.20  1523.6          10 4 1 2
   0.0      267.37     192.81      1.1117  5379.83  1521.2          10 4 1 3
   0.0      271.34     192.11      1.4194  5367.39  1515.7          10 4 1 4
   0.0      271.25     190.32      1.0174  5379.81  1521.2          10 4 1 5
   0.0      270.98     188.48      0.66256 5372.49  1515.1          10 4 1 6
   0.0      268.18     187.87      0.90896 5389.98  1526.1          10 4 1 7
 34.605     372.86     295.63      1.0642      0.0  1518.2          10 4 2 1
 31.590     376.08     294.11      0.75681     0.0  1523.6          10 4 2 2
 29.790     377.47     291.53      1.1117      0.0  1521.2          10 4 2 3
 27.495     387.17     287.06      1.4194      0.0  1515.7          10 4 2 4
 28.305     404.59     280.65      1.0174      0.0  1521.2          10 4 2 5
 29.655     401.62     277.30      0.66256     0.0  1515.1          10 4 2 6
 32.805     393.21     274.57      0.97939     0.0  1526.1          10 4 2 7
1464.3        0.55263   62.192     1.1682 9.28E-6                   10 5
   0.0      247.50     197.68      0.98928 5385.20  1467.2          10 5 1 1
   0.0      260.50     198.64      0.75681 5389.94  1469.8          10 5 1 2
   0.0      268.54     199.22      1.1117  5392.46  1464.7          10 5 1 3
   0.0      271.70     197.39      1.4194  5375.00  1452.6          10 5 1 4
   0.0      271.79     195.88      1.0174  5392.54  1465.3          10 5 1 5
   0.0      272.06     196.10      0.66256 5389.99  1467.9          10 5 1 6
   0.0      267.55     193.72      0.90896 5372.50  1462.8          10 5 1 7
 39.655     386.56     308.07      1.0642      0.0  1467.2          10 5 2 1
 35.010     391.49     305.88      0.75681     0.0  1469.8          10 5 2 2
 33.435     396.27     303.43      1.1117      0.0  1464.7          10 5 2 3
 29.475     401.45     295.82      1.4194      0.0  1452.6          10 5 2 4
 30.825     412.65     291.25      1.0174      0.0  1465.3          10 5 2 5
 31.725     410.12     289.59      0.66256     0.0  1467.9          10 5 2 6
 35.190     398.64     283.08      0.97939     0.0  1462.8          10 5 2 7
1383.0        0.52316   62.192     1.1682 9.28E-6                   10 6
   0.0      249.76     205.31      0.98928 5374.95  1378.6          10 6 1 1
   0.0      260.86     205.86      0.75681 5372.34  1386.0          10 6 1 2
   0.0      268.45     206.04      1.1117  5364.77  1380.0          10 6 1 3
   0.0      272.15     205.40      1.4194  5372.46  1387.3          10 6 1 4
   0.0      272.15     204.32      1.0174  5372.37  1382.0          10 6 1 5
   0.0      271.97     203.25      0.66256 5384.99  1392.0          10 6 1 6
   0.0      268.72     202.05      0.90896 5367.49  1375.3          10 6 1 7
 43.830     393.76     320.12      1.0642      0.0  1378.6          10 6 2 1
 39.555     398.47     319.92      0.75681     0.0  1386.0          10 6 2 2
 37.980     400.78     314.90      1.1117      0.0  1380.0          10 6 2 3
```

34.470	408.97	308.42	1.4194	0.0	1387.3	10 6 2 4
33.480	418.51	304.22	1.0174	0.0	1382.0	10 6 2 5
34.290	415.97	300.75	0.66256	0.0	1392.0	10 6 2 6
37.800	407.67	296.47	0.97939	0.0	1375.3	10 6 2 7
1287.7	0.48743	62.192	1.1682	9.28E-6		10 7
0.0	252.47	214.71	0.98928	5369.82	1286.8	10 7 1 1
0.0	261.95	215.18	0.75681	5365.21	1273.0	10 7 1 2
0.0	268.72	215.74	1.1117	5370.11	1298.3	10 7 1 3
0.0	271.88	214.20	1.4194	5364.85	1289.7	10 7 1 4
0.0	272.15	213.53	1.0174	5372.37	1286.1	10 7 1 5
0.0	271.79	212.57	0.66256	5364.99	1284.6	10 7 1 6
0.0	269.44	212.06	0.90896	5377.51	1295.4	10 7 1 7
48.060	407.58	333.23	1.0642	0.0	1286.8	10 7 2 1
44.235	409.54	332.21	0.75681	0.0	1273.0	10 7 2 2
42.390	411.26	326.54	1.1117	0.0	1298.3	10 7 2 3
38.880	418.35	321.33	1.4194	0.0	1289.7	10 7 2 4
36.810	423.34	316.22	1.0174	0.0	1286.1	10 7 2 5
37.125	421.07	312.41	0.66256	0.0	1284.6	10 7 2 6
40.590	418.05	310.43	0.97939	0.0	1295.4	10 7 2 7
1194.1	0.45179	62.192	1.1682	9.28E-6		10 8
0.0	254.99	222.64	0.98928	5369.82	1193.3	10 8 1 1
0.0	263.75	223.95	0.75681	5369.96	1194.1	10 8 1 2
0.0	269.26	223.65	1.1117	5362.34	1198.8	10 8 1 3
0.0	271.97	222.10	1.4194	5375.00	1195.7	10 8 1 4
0.0	272.06	221.48	1.0174	5379.81	1189.4	10 8 1 5
0.0	271.97	220.99	0.66256	5365.00	1193.3	10 8 1 6
0.0	270.25	220.22	0.90896	5380.02	1194.1	10 8 1 7
52.875	417.52	341.95	1.0642	0.0	1193.3	10 8 2 1
48.060	414.15	340.30	0.75681	0.0	1194.1	10 8 2 2
45.495	414.28	336.94	1.1117	0.0	1198.8	10 8 2 3
42.120	419.00	331.58	1.4194	0.0	1195.7	10 8 2 4
39.690	425.83	325.33	1.0174	0.0	1189.4	10 8 2 5
39.465	427.09	322.56	0.66256	0.0	1193.3	10 8 2 6
42.480	426.94	318.83	0.97939	0.0	1194.1	10 8 2 7
1132.7	0.42791	62.192	1.1682	9.28E-6		10 9
0.0	255.99	225.88	0.98928	5369.82	1126.2	10 9 1 1
0.0	264.30	227.60	0.75681	5377.57	1149.8	10 9 1 2
0.0	270.16	228.26	1.1117	5387.60	1131.9	10 9 1 3
0.0	271.88	226.46	1.4194	5382.61	1138.5	10 9 1 4
0.0	271.97	225.82	1.0174	5377.68	1134.4	10 9 1 5
0.0	271.97	225.42	0.66256	5379.99	1122.1	10 9 1 6
0.0	269.80	224.68	0.90896	5385.02	1126.2	10 9 1 7
55.800	421.09	344.81	1.0642	0.0	1126.2	10 9 2 1
51.075	417.17	343.25	0.75681	0.0	1149.8	10 9 2 2
48.420	416.86	342.01	1.1117	0.0	1131.9	10 9 2 3
44.145	418.47	334.84	1.4194	0.0	1138.5	10 9 2 4
41.085	426.97	329.95	1.0174	0.0	1134.4	10 9 2 5
40.770	428.21	326.16	0.66256	0.0	1122.1	10 9 2 6
43.335	429.97	322.96	0.97939	0.0	1126.2	10 9 2 7
1077.2	0.40736	62.192	1.1682	9.28E-6		1010
0.0	258.34	232.20	0.98928	5385.20	1083.4	1010 1 1
0.0	264.66	232.44	0.75681	5377.57	1070.5	1010 1 2
0.0	269.44	232.18	1.1117	5377.40	1081.7	1010 1 3
0.0	272.24	231.57	1.4194	5372.46	1088.4	1010 1 4
0.0	272.33	230.67	1.0174	5379.81	1069.6	1010 1 5
0.0	272.15	230.19	0.66256	5364.99	1074.8	1010 1 6
0.0	270.25	230.05	0.90896	5364.99	1077.4	1010 1 7
59.850	426.36	349.02	1.0642	0.0	1083.4	1010 2 1
56.520	420.67	346.65	0.75681	0.0	1070.5	1010 2 2
52.920	414.12	340.70	1.1117	0.0	1081.7	1010 2 3
46.125	415.23	335.53	1.4194	0.0	1088.4	1010 2 4
42.435	426.10	332.44	1.0174	0.0	1069.6	1010 2 5
41.895	429.62	329.51	0.66256	0.0	1074.8	1010 2 6
44.055	433.90	327.33	0.97939	0.0	1077.4	1010 2 7

```
NASA CONFIGURATION 13 ADJUSTED-SEE ERI-77900
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.
13 9 2 5                                                                       13A
  3.825      4.500      0.0            33                                      13A    1
  4.433     70.30      11.80       0.05668    1.172     41.05                  13A    1A1
 58.5       50.0        0.00977    0.00977    1.3886                           13A    1B1
  4.298     69.80       4.10       0.06208    1.172     36.95                  13A    1A2
 65.7       50.0        0.01011    0.01011    1.4322                           13A    1B2
  4.162     69.20      -3.60       0.06752    1.172     32.80                  13A    1A3
 72.8       50.0        0.01045    0.01045    1.4790                           13A    1B3
  4.028     68.50     -11.80       0.07288    1.172     28.35                  13A    1A4
 80.3       50.0        0.01079    0.01079    1.5282                           13A    1B4
  3.893     67.90     -19.70       0.07828    1.172     24.10                  13A    1A5
 87.6       50.0        0.01113    0.01113    1.5812                           13A    1B5
 3.825       4.5                                                               13A    2
 4.433       4.298      4.162      4.028      3.893                            13A    2
3905.63      0.74649   62.284      0.792   9.28E-6                             13A 1
   0.0     435.098    358.045      3.6088 2421.0     3894.60                   13A 1 1 1
   0.0     435.021    358.111      3.6592 2414.2     3912.08                   13A 1 1 2
   0.0     435.262    357.158      3.5303 2419.0     3914.10                   13A 1 1 3
   0.0     434.860    356.379      3.4040 2426.0     3912.31                   13A 1 1 4
   0.0     434.871    353.861      3.2353 2427.0     3895.07                   13A 1 1 5
  58.729   498.55     406.67       3.6088    0.0     3894.60                   13A 1 2 1
  45.468   500.45     407.21       3.6592    0.0     3912.08                   13A 1 2 2
  32.773   541.83     405.50       3.5303    0.0     3914.10                   13A 1 2 3
  32.989   590.06     404.04       3.4040    0.0     3912.31                   13A 1 2 4
  38.025   608.08     406.08       3.2353    0.0     3895.07                   13A 1 2 5
3796.30      0.72283   62.284      0.800   9.28E-6                             13A 2
   0.0     434.731    363.512      3.6088 2430.0     3792.15                   13A 2 1 1
   0.0     435.069    362.761      3.6592 2427.0     3785.97                   13A 2 1 2
   0.0     435.088    359.596      3.5303 2430.5     3819.26                   13A 2 1 3
   0.0     435.049    359.827      3.4040 2433.2     3790.92                   13A 2 1 4
   0.0     434.867    359.343      3.2353 2432.7     3793.19                   13A 2 1 5
  59.247   519.01     425.98       3.6088    0.0     3792.15                   13A 2 2 1
  47.011   513.70     419.53       3.6592    0.0     3785.97                   13A 2 2 2
  35.338   555.55     418.09       3.5303    0.0     3819.26                   13A 2 2 3
  35.248   596.82     415.90       3.4040    0.0     3790.92                   13A 2 2 4
  39.726   611.31     415.08       3.2353    0.0     3793.19                   13A 2 2 5
3655.39      0.69834   62.284      0.802   9.28E-6                             13A 3
   0.0     435.016    368.447      3.6088 2424.0     3660.70                   13A 3 1 1
   0.0     435.086    367.605      3.6592 2424.7     3669.06                   13A 3 1 2
   0.0     435.074    365.944      3.5303 2427.0     3666.32                   13A 3 1 3
   0.0     434.900    367.179      3.4040 2417.7     3635.91                   13A 3 1 4
   0.0     435.063    365.908      3.2353 2419.2     3644.98                   13A 3 1 5
  59.188   535.14     438.67       3.6088    0.0     3660.70                   13A 3 2 1
  47.196   527.99     429.68       3.6592    0.0     3669.06                   13A 3 2 2
  35.959   565.39     429.48       3.5303    0.0     3666.32                   13A 3 2 3
  36.922   597.01     424.88       3.4040    0.0     3635.91                   13A 3 2 4
  42.421   610.64     422.70       3.2353    0.0     3644.98                   13A 3 2 5
3533.04      0.67629   62.284      0.803   9.28E-6                             13A 4
   0.0     435.052    373.364      3.6088 2413.0     3536.78                   13A 4 1 1
   0.0     434.912    372.084      3.6592 2415.2     3538.23                   13A 4 1 2
   0.0     434.974    371.750      3.5303 2413.2     3525.00                   13A 4 1 3
   0.0     435.148    370.345      3.4040 2423.0     3532.66                   13A 4 1 4
   0.0     435.893    369.321      3.2353 2424.5     3532.54                   13A 4 1 5
  57.631   549.24     451.56       3.6088    0.0     3536.78                   13A 4 2 1
  47.511   542.81     443.15       3.6592    0.0     3538.23                   13A 4 2 2
  37.813   574.07     437.66       3.5303    0.0     3525.00                   13A 4 2 3
  39.105   602.20     433.85       3.4040    0.0     3532.66                   13A 4 2 4
  44.388   613.57     433.73       3.2353    0.0     3532.54                   13A 4 2 5
3399.73      0.64952   62.284      0.792   9.28E-6                             13A 5
   0.0     435.103    377.747      3.6088 2424.2     3402.55                   13A 5 1 1
   0.0     434.904    377.054      3.6592 2420.2     3405.63                   13A 5 1 2
   0.0     434.826    375.530      3.5303 2421.7     3404.37                   13A 5 1 3
   0.0     434.985    376.309      3.4040 2423.0     3387.90                   13A 5 1 4
   0.0     434.895    373.998      3.2353 2423.0     3398.19                   13A 5 1 5
```

```
  57.919    563.70    463.00      3.6088      0.0     3402.55          13A 5 2 1
  47.493    555.96    454.76      3.6592      0.0     3405.63          13A 5 2 2
  39.145    581.27    446.63      3.5303      0.0     3404.37          13A 5 2 3
  40.662    601.84    444.61      3.4040      0.0     3387.90          13A 5 2 4
  46.570    615.72    442.18      3.2353      0.0     3398.19          13A 5 2 5
3277.85       C.62680  62.284      0.792   9.28E-6                      13A 6
   C.0      435.454   382.420     3.6088  2426.2      3276.97          13A 6 1 1
   C.0      435.080   380.280     3.6592  2414.5      3280.11          13A 6 1 2
   C.0      435.209   379.642     3.5303  2424.2      3290.87          13A 6 1 3
   C.0      434.940   380.081     3.4040  2414.0      3269.05          13A 6 1 4
   C.0      435.195   378.268     3.2353  2422.5      3272.26          13A 6 1 5
  58.567    575.28    473.73      3.6088      0.0     3276.97          13A 6 2 1
  47.857    567.19    463.83      3.6592      0.0     3280.11          13A 6 2 2
  40.959    588.86    458.08      3.5303      0.0     3290.87          13A 6 2 3
  42.381    606.50    450.88      3.4040      0.0     3269.05          13A 6 2 4
  49.320    619.57    449.93      3.2353      0.0     3272.26          13A 6 2 5
3117.87       C.59642  62.284      C.791   9.28E-6                      13A 7
   0.0      435.464   387.132     3.6088  2425.5      3117.92          13A 7 1 1
   0.0      435.229   386.045     3.6592  2419.2      3135.11          13A 7 1 2
   0.0      435.394   385.009     3.5303  2424.7      3112.62          13A 7 1 3
   0.0      435.511   385.464     3.4040  2409.0      3106.70          13A 7 1 4
   C.0      435.278   384.377     3.2353  2418.5      3116.96          13A 7 1 5
  58.545    585.08    484.03      3.6088      0.0     3117.92          13A 7 2 1
  48.127    578.50    472.66      3.6592      0.0     3135.11          13A 7 2 2
  43.186    601.46    470.89      3.5303      0.0     3112.62          13A 7 2 3
  44.586    608.15    459.93      3.4040      0.0     3106.70          13A 7 2 4
  51.570    626.15    460.03      3.2353      0.0     3116.96          13A 7 2 5
2965.16       C.56780  62.284      0.791   9.28E-6                      13A 8
   C.0      435.732   391.596     3.6088  2413.5      2976.65          13A 8 1 1
   0.0      434.950   389.646     3.6592  2414.7      2970.44          13A 8 1 2
   0.0      434.949   389.158     3.5303  2418.2      2966.11          13A 8 1 3
   C.0      434.974   389.229     3.4040  2414.7      2946.68          13A 8 1 4
   0.0      435.347   388.774     3.2353  2423.2      2965.89          13A 8 1 5
  60.142    587.37    493.07      3.6088      0.0     2976.65          13A 8 2 1
  49.378    589.27    486.44      3.6592      0.0     2970.44          13A 8 2 2
  45.301    602.25    477.29      3.5303      0.0     2966.11          13A 8 2 3
  47.169    614.70    468.73      3.4040      0.0     2946.68          13A 8 2 4
  56.020    641.27    469.97      3.2353      0.0     2965.89          13A 8 2 5
2832.36       C.54146  62.284      C.800   9.28E-6                      13A 9
   0.0      435.243   395.102     3.6088  2423.7      2836.30          13A 9 1 1
   C.0      435.352   393.436     3.6592  2422.5      2852.96          13A 9 1 2
   0.0      435.483   393.263     3.5303  2416.2      2821.70          13A 9 1 3
   0.0      435.471   393.060     3.4040  2421.2      2813.55          13A 9 1 4
   0.0      435.213   392.355     3.2353  2421.0      2837.30          13A 9 1 5
  61.209    589.04    499.40      3.6088      0.0     2836.30          13A 9 2 1
  51.048    595.25    490.83      3.6592      0.0     2852.96          13A 9 2 2
  45.985    604.25    481.24      3.5303      0.0     2821.70          13A 9 2 3
  47.853    619.17    476.47      3.4040      0.0     2813.55          13A 9 2 4
  56.569    646.17    474.10      3.2353      0.0     2837.30          13A 9 2 5
```

```
NASA CONFIGURATION 14 ADJUSTED-SEE ERI-77900
C.9 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.63 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
C.7 DESIGN FLOW COEFFICIENT,
PRELIMINARY.
14 9 2 5                                                              14A
   4.050      4.50       0.0            19                           14A   1
   4.455     63.37       9.11      0.0705     1.5      36.240          14A   1A1
  54.26      50.0        0.010     0.010      1.010                    14A   1B1
   4.365     62.70       6.45      0.0715     1.5      34.580          14A   1A2
```

56.25	50.0	0.010	0.010	1.031		14A 1B2
4.275	62.09	3.67	0.0725	1.5	32.880	14A 1A3
58.42	50.0	0.010	0.010	1.052		14A 1B3
4.185	61.54	0.83	0.0735	1.5	31.190	14A 1A4
60.71	50.0	0.010	0.010	1.075		14A 1B4
4.095	60.80	-2.16	0.0745	1.5	29.32	14A 1A5
62.96	50.0	0.010	0.010	1.099		14A 1B5
4.050	4.50					14A 2
4.455	4.365	4.275	4.185	4.095		14A 2
3301.03	0.89057	62.265	0.866	9.28E-6		14A 1
0.0	427.0	301.676	2.4149	2508.7	3306.30	14A 1 1 1
0.0	438.0	314.017	2.4683	2495.0	3284.93	14A 1 1 2
0.0	437.4	310.442	2.4175	2504.0	3299.90	14A 1 1 3
0.0	437.6	309.513	2.3666	2507.0	3296.97	14A 1 1 4
0.0	430.0	305.376	2.2521	2512.7	3317.06	14A 1 1 5
28.845	502.23	371.37	2.3793	0.0	3306.30	14A 1 2 1
20.758	542.24	374.44	2.4683	0.0	3284.93	14A 1 2 2
21.370	564.55	368.71	2.4175	0.0	3299.90	14A 1 2 3
29.178	553.06	364.63	2.3666	0.0	3296.97	14A 1 2 4
39.402	538.03	359.66	2.2435	0.0	3317.06	14A 1 2 5
3150.19	0.85496	62.265	0.871	9.28E-6		14A 2
0.0	427.0	312.574	2.4149	2495.7	3171.67	14A 2 1 1
0.0	438.0	323.121	2.4683	2493.7	3157.30	14A 2 1 2
0.0	437.4	323.783	2.4175	2471.2	3127.43	14A 2 1 3
0.0	437.6	319.637	2.3666	2493.5	3146.14	14A 2 1 4
0.0	430.0	316.260	2.2521	2498.7	3148.42	14A 2 1 5
31.117	511.81	391.20	2.3793	0.0	3171.67	14A 2 2 1
24.781	555.87	391.40	2.4683	0.0	3157.30	14A 2 2 2
24.286	569.45	388.77	2.4175	0.0	3127.43	14A 2 2 3
30.566	558.58	380.68	2.3666	0.0	3146.14	14A 2 2 4
39.892	554.31	380.36	2.2435	0.0	3148.42	14A 2 2 5
3031.50	0.82051	62.265	0.875	9.28E-6		14A 3
0.0	427.0	324.154	2.4149	2499.2	3032.01	14A 3 1 1
0.0	438.0	335.571	2.4683	2493.2	3011.86	14A 3 1 2
0.0	437.4	331.906	2.4175	2493.0	3034.50	14A 3 1 3
0.0	437.6	330.171	2.3666	2497.0	3043.03	14A 3 1 4
0.0	430.0	324.224	2.2521	2504.5	3036.11	14A 3 1 5
32.922	526.35	404.74	2.3793	0.0	3032.01	14A 3 2 1
27.229	566.04	411.63	2.4683	0.0	3011.86	14A 3 2 2
25.371	580.89	404.56	2.4175	0.0	3034.50	14A 3 2 3
34.159	569.26	399.21	2.3666	0.0	3043.03	14A 3 2 4
41.607	567.31	396.70	2.2435	0.0	3036.11	14A 3 2 5
2893.09	0.78095	62.265	0.876	9.28E-6		14A 4
0.0	427.0	334.849	2.4149	2491.0	2868.98	14A 4 1 1
0.0	438.0	343.201	2.4683	2502.2	2892.94	14A 4 1 2
0.0	437.4	339.587	2.4175	2512.7	2891.90	14A 4 1 3
0.0	437.6	339.103	2.3666	2515.0	2919.20	14A 4 1 4
0.0	430.0	335.320	2.2521	2499.5	2892.42	14A 4 1 5
32.742	539.07	423.24	2.3793	0.0	2868.98	14A 4 2 1
29.358	577.46	425.80	2.4683	0.0	2892.94	14A 4 2 2
29.835	582.56	416.55	2.4175	0.0	2891.90	14A 4 2 3
36.918	579.88	412.73	2.3666	0.0	2919.20	14A 4 2 4
43.605	578.19	412.56	2.2435	0.0	2892.42	14A 4 2 5
2750.86	0.74011	62.265	0.867	9.28E-6		14A 5
0.0	427.0	341.771	2.4149	2512.0	2757.79	14A 5 1 1
0.0	438.0	350.488	2.4683	2519.2	2762.57	14A 5 1 2
0.0	437.4	349.600	2.4175	2510.7	2730.50	14A 5 1 3
0.0	437.6	346.071	2.3666	2513.2	2746.77	14A 5 1 4
0.0	430.0	343.431	2.2521	2506.7	2756.66	14A 5 1 5
36.072	548.07	437.65	2.3793	0.0	2757.79	14A 5 2 1
32.026	583.74	439.14	2.4683	0.0	2762.57	14A 5 2 2
32.346	588.80	431.32	2.4175	0.0	2730.50	14A 5 2 3
39.019	593.33	430.97	2.3666	0.0	2746.77	14A 5 2 4
45.972	587.08	425.69	2.2435	0.0	2756.66	14A 5 2 5

2599.18	0.69817	62.265	0.867	9.28E-6		14A 6
0.0	427.0	354.463	2.4149	2508.7	2590.64	14A 6 1 1
0.0	438.0	361.142	2.4683	2521.7	2628.90	14A 6 1 2
0.0	437.4	358.613	2.4175	2524.5	2600.80	14A 6 1 3
0.0	437.6	356.883	2.3666	2511.2	2573.36	14A 6 1 4
0.0	430.0	354.941	2.2521	2516.0	2602.18	14A 6 1 5
38.938	566.16	455.58	2.3793	0.0	2590.64	14A 6 2 1
33.736	591.43	454.76	2.4683	0.0	2628.90	14A 6 2 2
35.356	598.07	448.20	2.4175	0.0	2600.80	14A 6 2 3
41.436	598.87	443.21	2.3666	0.0	2573.36	14A 6 2 4
49.113	595.09	439.90	2.2435	0.0	2602.18	14A 6 2 5
2445.83	0.65569	62.265	0.866	9.28E-6		14A 7
0.0	427.0	359.394	2.4149	2522.5	2447.05	14A 7 1 1
0.0	438.0	368.423	2.4683	2519.7	2444.32	14A 7 1 2
0.0	437.4	367.476	2.4175	2521.7	2436.24	14A 7 1 3
0.0	437.6	367.151	2.3666	2524.7	2456.31	14A 7 1 4
0.0	430.0	363.963	2.2521	2518.2	2445.25	14A 7 1 5
41.760	570.39	464.07	2.3793	0.0	2447.05	14A 7 2 1
36.247	597.84	466.21	2.4683	0.0	2444.32	14A 7 2 2
38.097	601.11	460.22	2.4175	0.0	2436.24	14A 7 2 3
43.020	604.41	453.97	2.3666	0.0	2456.31	14A 7 2 4
50.098	598.16	451.23	2.2435	0.0	2445.25	14A 7 2 5
2286.29	0.61670	62.265	0.861	9.28E-6		14A 8
0.0	427.0	369.655	2.4149	2504.5	2285.13	14A 8 1 1
0.0	438.0	376.844	2.4683	2506.5	2307.52	14A 8 1 2
0.0	437.4	375.612	2.4175	2506.5	2267.62	14A 8 1 3
0.0	437.6	372.765	2.3666	2503.0	2283.54	14A 8 1 4
0.0	430.0	372.136	2.2521	2509.2	2287.65	14A 8 1 5
46.237	572.54	471.92	2.3793	0.0	2285.13	14A 8 2 1
39.676	596.65	474.75	2.4683	0.0	2307.52	14A 8 2 2
38.209	603.13	468.06	2.4175	0.0	2267.62	14A 8 2 3
43.686	609.45	465.36	2.3666	0.0	2283.54	14A 8 2 4
49.657	607.32	462.00	2.2435	0.0	2287.65	14A 8 2 5
2167.87	0.58501	62.265	0.861	9.28E-6		14A 9
0.0	427.0	377.240	2.4149	2510.2	2178.71	14A 9 1 1
0.0	438.0	382.422	2.4683	2508.7	2170.44	14A 9 1 2
0.0	437.4	381.980	2.4175	2508.2	2169.15	14A 9 1 3
0.0	437.6	381.857	2.3666	2504.0	2161.92	14A 9 1 4
0.0	430.0	379.359	2.2521	2493.0	2159.14	14A 9 1 5
50.143	572.90	474.44	2.3793	0.0	2178.71	14A 9 2 1
42.669	587.05	478.95	2.4683	0.0	2170.44	14A 9 2 2
38.259	601.02	472.59	2.4175	0.0	2169.15	14A 9 2 3
44.131	614.61	470.01	2.3666	0.0	2161.92	14A 9 2 4
49.662	611.65	466.65	2.2435	0.0	2159.14	14A 9 2 5

NASA CONFIGURATION 15
0.8 HUB-TIP RATIO,19BLADES,9 INCH TIP DIAMETER
1.5 INCH CHORD,0.009-0.010 INCH RADIAL TIP CLEARANCE
0.556 DESIGN TIP D-FACTOR
DOUBLE CIRCULAR ARC BLADE PROFILE
0.466 DESIGN FLOW COEFFICIENT
NOT REPORTED

15 7 2 5						15	
3.6	4.5	0.0		19		15	1
4.410	67.52	42.35	0.072	1.5	54.935	15	1A1
25.17	50.0	0.010	0.010	1.02		15	1B1
4.23	65.86	39.49	0.076	1.5	52.675	15	1A2
26.37	50.0	0.010	0.010	1.064		15	1B2
4.05	64.32	35.33	0.080	1.5	49.825	15	1A3
28.99	50.0	0.010	0.010	1.111		15	1B3
3.87	62.69	31.03	0.084	1.5	47.86	15	1A4
31.66	50.0	0.010	0.010	1.163		15	1B4

3.69	60.66	26.8	0.088	1.5	43.73		15	1A5
33.86	50.C	C.C10	0.010	1.22			15	1B5
3.6	4.5	C.C					15	2
4.41	4.23	4.C5	3.87	3.69			15	2
5191.82	0.61552	62.32	0.65	9.28E-6			15	1
C.0	423.575	348.872	4.84	3005.5	5182.65		15	1 1 1
C.0	422.187	345.523	4.784	3005.7	5179.23		15	1 1 2
0.0	418.556	343.129	4.5804	3003.2	5176.80		15	1 1 3
C.0	417.566	340.616	4.3769	3017.0	5215.81		15	1 1 4
C.0	425.733	340.428	4.0817	3014.2	5204.61		15	1 1 5
26.514	503.44	431.17	4.6415	3005.5	5182.65		15	1 2 1
25.992	525.43	427.98	4.7840	3005.7	5179.23		15	1 2 2
24.583	529.59	423.74	4.5804	3003.2	5176.80		15	1 2 3
25.834	531.73	420.68	4.3769	3017.0	5215.81		15	1 2 4
28.030	527.96	419.12	4.0013	3014.2	5204.61		15	1 2 5
4828.71	C.56962	62.32	0.649	9.28E-6			15	2
C.0	423.622	358.948	4.84	3029.7	4837.23		15	2 1 1
C.0	423.117	357.005	4.784	3020.0	4824.52		15	2 1 2
C.0	420.152	355.105	4.5804	3015.0	4815.02		15	2 1 3
C.0	420.107	353.611	4.3769	3029.7	4831.18		15	2 1 4
C.0	425.429	352.635	4.0817	3026.5	4835.61		15	2 1 5
33.156	527.79	458.43	4.6415	3029.7	4837.23		15	2 2 1
30.420	547.58	453.49	4.784	3020.0	4824.52		15	2 2 2
28.548	551.42	449.32	4.5804	3015.0	4815.02		15	2 2 3
30.654	551.09	446.64	4.3769	3029.7	4831.18		15	2 2 4
34.200	549.77	444.38	4.0013	3026.5	4835.61		15	2 2 5
4480.15	C.53056	62.321	0.6475	9.28E-6			15	3
C.0	423.98	369.29	4.84	3017.2	4474.39		15	3 1 1
C.0	424.68	367.455	4.784	3010.7	4479.66		15	3 1 2
C.0	421.771	365.405	4.58043	3012.0	4476.11		15	3 1 3
C.0	421.786	364.630	4.3769	3018.2	4490.12		15	3 1 4
C.0	426.664	364.362	4.0817	3004.2	4480.48		15	3 1 5
38.965	544.C	477.87	4.6415	3017.2	4474.39		15	3 2 1
34.636	560.32	472.11	4.7840	3010.7	4479.66		15	3 2 2
32.665	561.96	468.51	4.5804	3012.0	4476.11		15	3 2 3
34.636	561.50	464.82	4.3769	3018.2	4490.12		15	3 2 4
38.704	561.32	462.35	4.0013	3004.2	4480.48		15	3 2 5
4032.56	C.47749	62.321	0.6465	9.28E-6			15	4
C.0	425.414	381.051	4.84	3019.2	4048.72		15	4 1 1
0.0	425.996	379.386	4.784	3019.5	4037.03		15	4 1 2
C.0	423.744	378.202	4.5804	3007.2	4022.46		15	4 1 3
0.0	423.348	377.422	4.3769	3006.2	4026.50		15	4 1 4
C.0	427.410	376.698	4.0817	3012.0	4028.07		15	4 1 5
45.477	561.35	503.04	4.6415	3019.2	4048.72		15	4 2 1
40.972	577.41	497.72	4.784	3019.5	4037.03		15	4 2 2
39.024	577.77	491.85	4.5804	3007.2	4022.46		15	4 2 3
40.050	576.76	488.42	4.3769	3006.2	4026.50		15	4 2 4
44.689	582.55	485.92	4.0013	3012.0	4028.07		15	4 2 5
3594.88	C.42514	62.322	0.646	9.28E-6			15	5
C.0	425.584	391.197	4.84	3014.0	3595.25		15	5 1 1
C.0	427.573	390.131	4.784	3019.5	3602.03		15	5 1 2
C.0	425.438	388.808	4.5804	3016.5	3594.24		15	5 1 3
C.0	425.039	388.322	4.3769	3009.0	3588.88		15	5 1 4
C.0	428.073	388.080	4.0817	3024.0	3594.02		15	5 1 5
52.65	578.74	523.10	4.6415	3014.0	3595.25		15	5 2 1
48.46	588.55	516.95	4.7840	3019.5	3602.03		15	5 2 2
44.955	592.97	512.52	4.5804	3016.5	3594.24		15	5 2 3
45.342	593.99	506.20	4.3769	3009.0	3588.88		15	5 2 4
48.645	604.16	504.10	4.0013	3024.0	3594.02		15	5 2 5
3233.02	C.38263	62.322	0.645	9.28E-6			15	6
C.0	426.392	398.951	4.84	3017.0	3240.23		15	6 1 1
C.0	428.073	398.104	4.784	3019.2	3236.58		15	6 1 2
C.0	426.707	397.218	4.5804	3009.2	3228.70		15	6 1 3
C.0	426.344	396.035	4.3769	3008.5	3231.10		15	6 1 4
0.0	428.830	395.341	4.0817	3017.7	3228.47		15	6 1 5

62.145	594.05	536.07	4.6415	3017.0	3240.23	15 6 2 1
54.751	597.15	528.23	4.784	3019.2	3236.58	15 6 2 2
48.915	603.9	523.32	4.5804	3009.2	3228.70	15 6 2 3
48.933	608.02	518.26	4.3769	3008.5	3231.10	15 6 2 4
52.717	613.87	513.26	4.0013	3017.7	3228.47	15 6 2 5
2949.34	0.34904	62.322	0.643	9.28E-6		15 7
0.0	428.370	405.617	4.84	3006.0	2943.03	15 7 1 1
0.0	429.183	404.175	4.784	3012.7	2957.27	15 7 1 2
0.0	428.083	403.444	4.5804	3018.2	2951.81	15 7 1 3
0.0	427.545	402.652	4.3769	3022.2	2951.05	15 7 1 4
0.0	429.593	402.703	4.0817	3013.2	2943.53	15 7 1 5
69.43	604.63	540.87	4.6415	3006.0	2943.03	15 7 2 1
62.199	604.83	532.43	4.784	3012.7	2957.27	15 7 2 2
54.157	609.96	527.61	4.5804	3018.2	2951.81	15 7 2 3
51.984	617.34	523.54	4.3769	3022.2	2951.05	15 7 2 4
55.084	618.38	515.57	4.0013	3018.2	2943.53	15 7 2 5

NASA CONFIGURATION 16
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
CUBIC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

1610 2 5						16
3.825	4.500	0.0	33			16 1
4.433	70.30	11.80	0.05668	1.172	41.05	16 1A1
58.5	58.0	0.00977	0.00977	1.3886		16 1B1
4.298	69.80	4.10	0.06208	1.172	36.95	16 1A2
65.7	60.0	0.01011	0.01011	1.4322		16 1B2
4.162	69.20	-3.60	0.06752	1.172	32.80	16 1A3
72.8	61.0	0.01045	0.01045	1.4790		16 1B3
4.028	68.50	-11.80	0.07288	1.172	28.35	16 1A4
80.3	63.0	0.01079	0.01079	1.5282		16 1B4
3.893	67.90	-19.70	0.07828	1.172	24.10	16 1A5
87.6	65.0	0.01113	0.01113	1.5812		16 1B5
3.825	4.500					16 2
4.433	4.298	4.162	4.028	3.893		16 2
2944.65	0.54432	62.306	0.709	9.28E-6		16 1
0.0	431.036	394.454	3.6088	2510.2	2952.43	16 1 1 1
0.0	436.278	393.335	3.6592	2506.0	2947.20	16 1 1 2
0.0	433.862	392.734	3.5303	2505.2	2949.60	16 1 1 3
0.0	433.117	391.650	3.4040	2500.2	2937.81	16 1 1 4
0.0	432.161	391.001	3.2345	2496.7	2936.22	16 1 1 5
55.228	529.94	445.21	3.5046	0.0	2952.43	16 1 2 1
48.487	515.81	439.66	3.6592	0.0	2947.20	16 1 2 2
43.920	520.55	435.87	3.5303	0.0	2949.60	16 1 2 3
41.953	529.10	433.85	3.4040	0.0	2937.81	16 1 2 4
42.376	544.05	437.41	3.1936	0.0	2936.22	16 1 2 5
2897.89	0.53519	62.305	0.712	9.28E-6		16 2
0.0	431.685	396.320	3.6088	2510.7	2894.34	16 2 1 1
0.0	435.677	395.136	3.6592	2507.2	2901.51	16 2 1 2
0.0	433.938	394.037	3.5303	2507.2	2891.97	16 2 1 3
0.0	433.555	393.389	3.4040	2500.2	2898.71	16 2 1 4
0.0	432.667	392.423	3.2345	2504.5	2902.92	16 2 1 5
55.323	542.85	453.20	3.5046	0.0	2894.34	16 2 2 1
49.423	527.30	446.71	3.6592	0.0	2901.51	16 2 2 2
45.585	529.26	441.54	3.5303	0.0	2891.97	16 2 2 3
44.271	540.04	440.34	3.4040	0.0	2898.71	16 2 2 4
43.173	550.45	441.81	3.1936	0.0	2902.92	16 2 2 5
2860.93	0.52852	62.305	0.712	9.28E-6		16 3
0.0	431.184	396.890	3.6088	2505.5	2859.60	16 3 1 1

0.0	436.157	396.376	3.6592	2503.7	2858.74	16 3 1 2
0.0	434.008	395.527	3.5303	2505.7	2857.09	16 3 1 3
0.0	433.495	394.133	3.4040	2505.2	2864.06	16 3 1 4
0.0	432.912	393.775	3.2345	2506.0	2865.26	16 3 1 5
56.727	548.85	460.20	3.5046	0.0	2859.60	16 3 2 1
50.332	533.83	452.66	3.6592	0.0	2858.74	16 3 2 2
46.251	533.93	446.58	3.5303	0.0	2857.09	16 3 2 3
45.261	547.95	447.93	3.4040	0.0	2864.06	16 3 2 4
44.748	556.63	448.21	3.1936	0.0	2865.26	16 3 2 5
2804.94	C.51832	62.304	0.718	9.28E-6		16 4
0.0	431.519	399.278	3.6088	2496.0	2800.02	16 4 1 1
0.0	435.431	397.793	3.6592	2503.0	2803.69	16 4 1 2
0.0	434.148	397.228	3.5303	2503.2	2796.58	16 4 1 3
0.0	433.660	396.276	3.4040	2510.5	2814.07	16 4 1 4
0.0	433.380	395.793	3.2345	2510.0	2810.34	16 4 1 5
56.988	555.69	466.72	3.5046	0.0	2800.02	16 4 2 1
51.124	540.20	459.28	3.6592	0.0	2803.69	16 4 2 2
47.218	542.39	455.44	3.5303	0.0	2796.58	16 4 2 3
46.170	556.24	457.07	3.4040	0.0	2814.07	16 4 2 4
45.445	563.51	455.68	3.1936	0.0	2810.34	16 4 2 5
2722.00	C.50258	62.303	0.722	9.28E-6		16 5
0.0	432.179	401.625	3.6088	2505.5	2719.30	16 5 1 1
0.0	435.986	400.806	3.6592	2505.2	2721.74	16 5 1 2
0.0	434.575	399.234	3.5303	2508.7	2726.86	16 5 1 3
0.0	434.144	398.836	3.4040	2504.5	2716.00	16 5 1 4
0.0	434.297	398.620	3.2345	2509.0	2726.08	16 5 1 5
58.752	566.73	478.69	3.5046	0.0	2719.30	16 5 2 1
51.772	553.84	473.21	3.6592	0.0	2721.74	16 5 2 2
48.978	552.35	463.35	3.5303	0.0	2726.86	16 5 2 3
48.253	564.02	464.20	3.4040	0.0	2716.00	16 5 2 4
47.421	570.15	464.65	3.1936	0.0	2726.08	16 5 2 5
2654.02	C.49024	62.300	0.734	9.28E-6		1610
0.0	431.937	402.434	3.6088	2518.2	2665.75	1610 1 1
0.0	436.267	401.721	3.6592	2502.2	2643.23	1610 1 2
0.0	434.514	401.235	3.5303	2502.0	2650.26	1610 1 3
0.0	434.701	400.855	3.4040	2502.7	2657.29	1610 1 4
0.0	434.408	400.047	3.2345	2502.5	2653.57	1610 1 5
62.086	566.89	484.38	3.5046	0.0	2665.75	1610 2 1
54.144	555.44	478.15	3.6592	0.0	2643.23	1610 2 2
50.670	558.91	472.38	3.5303	0.0	2650.26	1610 2 3
49.540	574.17	472.76	3.4040	0.0	2657.29	1610 2 4
48.069	580.56	471.19	3.1936	0.0	2653.57	1610 2 5
2575.25	C.47564	62.302	0.725	9.28E-6		16 6
0.0	432.536	404.968	3.6088	2508.2	2579.34	16 6 1 1
0.0	436.028	404.481	3.6592	2501.7	2576.27	16 6 1 2
0.0	435.107	403.839	3.5303	2508.7	2570.94	16 6 1 3
0.0	434.967	403.702	3.4040	2499.5	2568.28	16 6 1 4
0.0	434.910	402.468	3.2345	2510.7	2581.43	16 6 1 5
64.057	565.42	488.48	3.5046	0.0	2579.34	16 6 2 1
54.841	557.86	483.53	3.6592	0.0	2576.27	16 6 2 2
51.691	564.58	478.76	3.5303	0.0	2570.94	16 6 2 3
49.738	580.82	477.93	3.4040	0.0	2568.28	16 6 2 4
48.433	589.21	476.02	3.1936	0.0	2581.43	16 6 2 5
2503.57	C.46231	62.301	0.728	9.28E-6		16 7
0.0	432.938	406.916	3.6088	2509.2	2510.07	16 7 1 1
0.0	436.266	406.441	3.6592	2510.2	2503.06	16 7 1 2
0.0	435.274	405.613	3.5303	2500.7	2488.64	16 7 1 3
0.0	435.088	405.038	3.4040	2507.5	2517.40	16 7 1 4
0.0	435.089	404.634	3.2345	2503.7	2498.70	16 7 1 5
67.873	568.28	494.58	3.5046	0.0	2510.07	16 7 2 1
56.272	562.36	486.93	3.6592	0.0	2503.06	16 7 2 2
52.389	569.41	486.43	3.5303	0.0	2488.64	16 7 2 3
50.917	583.53	478.74	3.4040	0.0	2517.40	16 7 2 4
48.865	595.05	480.01	3.1936	0.0	2498.70	16 7 2 5

0.0	436.516	407.514	3.6592	2509.5	2457.55	16 8 1 2
0.0	435.630	406.987	3.5303	2510.0	2462.61	16 8 1 3
0.0	435.363	406.887	3.4040	2494.5	2452.32	16 8 1 4
0.0	435.330	406.458	3.2345	2495.2	2444.27	16 8 1 5
70.366	566.82	495.00	3.5046	0.0	2437.68	16 8 2 1
58.842	564.29	490.06	3.6592	0.0	2457.55	16 8 2 2
53.136	573.31	485.66	3.5303	0.0	2462.61	16 8 2 3
50.962	589.06	483.59	3.4040	0.0	2452.32	16 8 2 4
48.672	601.23	483.52	3.1936	0.0	2444.27	16 8 2 5
2291.91	0.42302	62.300	0.732	9.28E-6		16 9
0.0	434.803	411.662	3.6088	2511.2	2302.74	16 9 1 1
0.0	437.664	411.513	3.6592	2511.0	2280.02	16 9 1 2
0.0	437.068	411.889	3.5303	2496.7	2259.82	16 9 1 3
0.0	437.081	410.269	3.4040	2506.5	2312.67	16 9 1 4
0.0	435.902	409.844	3.2345	2512.0	2304.32	16 9 1 5
71.874	580.16	500.99	3.5046	0.0	2302.74	16 9 2 1
62.496	569.33	491.97	3.6592	0.0	2280.02	16 9 2 2
55.849	580.37	488.49	3.5303	0.0	2259.82	16 9 2 3
52.114	598.10	486.13	3.4040	0.0	2312.67	16 9 2 4
50.445	606.73	486.90	3.1936	0.0	2304.32	16 9 2 5
2450.89	0.45306	62.301	0.731	9.28E-6		16 8
0.0	433.725	408.444	3.6088	2509.0	2437.68	16 8 1 1

APPENDIX F

PARAMETER EQUATIONS

The equations used in calculating parameters are presented. All symbols are defined in appendix A. The sign convention is shown in figure 14. Integrals are approximated by finite summations. Also, in several instances, different formulae for calculating the value of a particular parameter for a rotor, stator, or stage are required.

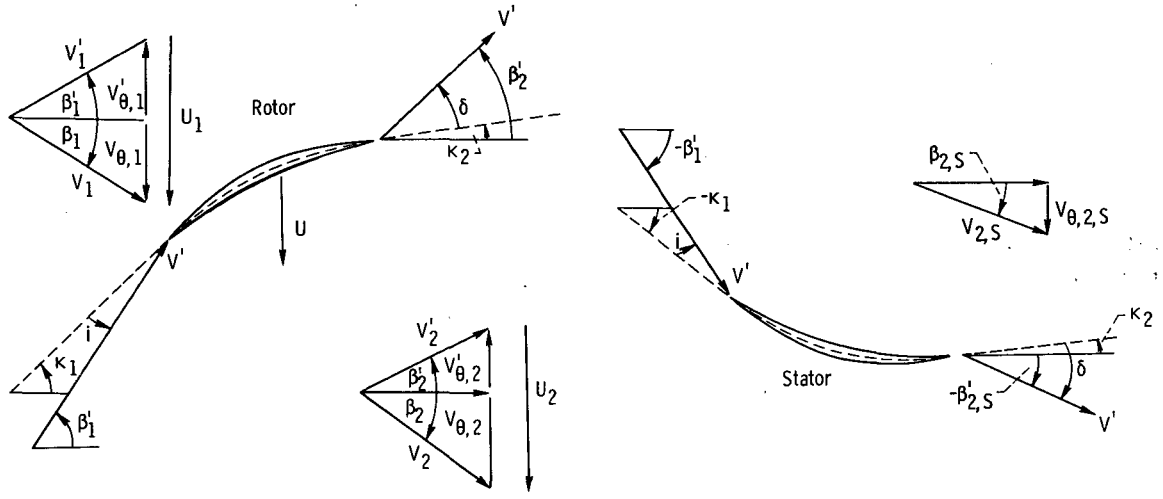


Figure 14. - Sign convention for blade-element parameters. Absolute tangential component of velocity is positive (+) in direction of blade velocity for stators and rotors; relative tangential component of velocity is positive (+) in direction opposite to blade velocity for stators and rotors.

Blade-Element Parameter Equations

Spanwise location as fraction of total passage height from annulus outer surface, FLOHIT(I1, J1):

$$FFT_1 = \frac{r_{1,t} - r_1}{r_{1,t} - r_{1,h}} \tag{F1}$$

$$FFT_2 = \frac{r_{2,t} - r_2}{r_{2,t} - r_{2,h}} \tag{F2}$$

Spanwise location as fraction of tip radius, RRT(I1, J1):

$$RR_1 = \frac{r_1}{r_{1,t}} \tag{F3}$$

$$RR_2 = \frac{r_2}{r_{2,t}} \tag{F4}$$

Absolute fluid velocity, XV(L1, I1, J1):

$$V_1 = \sqrt{2g_c(H_1 - h_1)} \tag{F5}$$

$$V_2 = \sqrt{2g_c(H_2 - h_2)} \tag{F6}$$

Tangential component of absolute fluid velocity (see fig. 14 for sign convention), VU(L1, I1, J1):

$$V_{\theta,1} = V_1 \sin \beta_1 \tag{F7}$$

$$V_{\theta,2} = V_2 \sin \beta_2 \tag{F8}$$

Axial component of fluid velocity, VZ(L1, I1, J1):

$$V_{z,1} = V_1 \cos \beta_1 \tag{F9}$$

$$V_{z,2} = V_2 \cos \beta_2 \tag{F10}$$

Total-head rise, DELTAH(L1, I1, J1):

$$\Delta H = H_2 - H_1 \tag{F11}$$

Static-head rise, DELTAP(L1, I1, J1):

$$\Delta h = h_2 - h_1 \tag{F12}$$

Blade velocity at blade-row inlet, U1(L1, I1, J1):

$$U_1 = r_1 N\pi/360.0 \tag{F13}$$

Blade velocity at blade-row outlet, U2(L1, I1, J1):

$$U_2 = r_2 N\pi/360.0 \tag{F14}$$

Tangential component of inlet relative fluid velocity (see fig. 14 for sign convention), VUP1(L1, I1, J1):

$$V'_{\theta,1} = U_1 - V_{\theta,1} \tag{F15}$$

Tangential component of outlet relative fluid velocity (see fig. 14 for sign convention), VUP2(L1, I1, J1):

$$V'_{\theta,2} = U_2 - V_{\theta,2} \tag{F16}$$

Inlet relative fluid velocity, XVP1(L1, I1, J1):

$$V'_1 = \sqrt{\left(V'_{\theta,1}\right)^2 + \left(V_{z,1}\right)^2} \tag{F17}$$

Outlet relative fluid velocity, XVP2(L1, I1, J1):

$$V'_2 = \sqrt{\left(V'_{\theta,2}\right)^2 + \left(V_{z,2}\right)^2} \tag{F18}$$

Reynolds number, REC(L1, I1, J1):

$$Re_c = \frac{cV'_1}{12.0\,\nu} \tag{F19}$$

Inlet relative axisymmetric flow angle (see fig. 14 for sign convention), BETAP1(L1, I1, J1):

$$\beta'_1 = \frac{180.0}{\pi} \sin^{-1} \frac{V'_{\theta,1}}{V'_1} \tag{F20}$$

Outlet relative axisymmetric flow angle (see fig. 14 for sign convention), BETAP2(L1, I1, J1):

$$\beta'_2 = \frac{180.0}{\pi} \sin^{-1} \frac{V'_{\theta,2}}{V'_2} \tag{F21}$$

Incidence angle (see fig. 14 for sign convention), FNC1(L1, I1, J1):

$$i = |\beta_1'| - |\kappa_1| \tag{F22}$$

Deviation angle for rotor (see fig. 14 for sign convention), DEL2(L1, I1, J1):

$$\delta_R = \beta_{2,R}' - \kappa_{2,R} \tag{F23}$$

Deviation angle for stator (see fig. 14 for sign convention), DEL2(L1, I1, J1):

$$\delta_S = \kappa_{2,S} - \beta_{2,S}' \tag{F24}$$

Diffusion factor for rotor, XD(L1, I1, J1):

$$D_R = 1 - \frac{V_{2,R}'}{V_{1,R}'} - \frac{r_{1,R}V_{\theta,1,R} - r_{2,R}V_{\theta,2,R}}{\sigma V_{1,R}'(r_{2,R} + r_{1,R})} \tag{F25}$$

Diffusion factor for stator, XD(L1, I1, J1):

$$D_S = 1 - \frac{V_{2,S}}{V_{1,S}} - \frac{r_{2,S}V_{\theta,2,S} - r_1 V_{\theta,1,S}}{\sigma V_{1,S}(r_{2,S} + r_{1,S})} \tag{F26}$$

Head-rise coefficient for rotor, XPSI(L1, I1, J1):

$$\psi_R = \frac{g_c(H_{2,R} - H_{1,R})}{\left(U_{2,t,R}\right)^2} \tag{F27}$$

Head-rise coefficient for stage, XPSI(L1, I1, J1):

$$\psi_{stage} = \frac{g_c(H_{2,S} - H_{1,R})}{\left(U_{2,t,R}\right)^2} \tag{F28}$$

Ideal head-rise coefficient for rotor, XPSII(L1, I1, J1):

$$\psi_{i,R} = \frac{U_{2,R}V_{\theta,2,R} - U_{1,R}V_{\theta,1,R}}{\left(U_{2,t,R}\right)^2} \tag{F29}$$

Ideal-head-rise coefficient for stage, XPSII(L1, I1, J1):

$$\psi_{i,stage} = \frac{U_{2,R}V_{\theta,1,S} - U_{1,R}V_{\theta,1,R}}{\left(U_{2,t,R}\right)^2} \tag{F30}$$

Hydraulic efficiency for rotor, XEFF(L1, I1, J1):

$$\eta_R = \frac{\psi_R}{\psi_{i,R}} \tag{F31}$$

Hydraulic efficiency for stage, XEFF(L1, I1, J1):

$$\eta_{stage} = \frac{\psi_{stage}}{\psi_{i,stage}} \tag{F32}$$

Inlet flow coefficient for rotor, XPHI1(L1, I1, J1):

$$\varphi_{1,R} = \frac{V_{z,1,R}}{U_{1,t,R}} \tag{F33}$$

Outlet flow coefficient for rotor, XPHI2(L1, I1, J1):

$$\varphi_{2,R} = \frac{V_{z,2,R}}{U_{2,t,R}} \tag{F34}$$

Inlet flow coefficient for stator, XPHI1(L1, I1, J1):

$$\varphi_{1,S} = \frac{V_{z,1,S}}{U_{1,t,R}} \tag{F35}$$

Outlet flow coefficient for stator, XPHI2(L1, I1, J1):

$$\varphi_{2,S} = \frac{V_{z,2,S}}{U_{1,t,R}} \tag{F36}$$

Total-head loss coefficient for rotor, OMEGB(L1, I1, J1):

$$\overline{\omega}_R = 2(\psi_{i,R} - \psi_R) \frac{\left(U_{2,t,R}\right)^2}{\left(V'_{1,R}\right)^2} \tag{F37}$$

Total-head loss coefficient for stator, OMEGB(L1, I1, J1):

$$\overline{\omega}_S = -2g_c \frac{H_{2,S} - H_{1,S}}{\left(V_{1,S}\right)^2} \tag{F38}$$

Wake momentum thickness parameter for rotor, TCA(L1, I1, J1):

$$(\theta/c)_{A,R} = \frac{\overline{\omega}_R \cos \beta'_{2,R}}{2\sigma_R} \tag{F39}$$

Wake momentum thickness parameters for stator, TCA(L1, I1, J1):

$$(\theta/c)_{A,S} = \frac{\overline{\omega}_S \cos \beta_{2,S}}{2\sigma_S} \tag{F40}$$

Mass-Averaged Parameter Equations

Head-rise coefficient for rotor, RHRCO(L1, I1):

$$\overline{\psi}_R = \frac{\sum_{J1=1}^{J1=J} \psi_{R,J1} V_{z,2,R,J1} \Delta A_{2,R,J1}}{\sum_{J1=1}^{J1=J} V_{z,2,R,J1} \Delta A_{2,R,J1}} \tag{F41}$$

Head-rise coefficient for stage, RHRCO(L1, I1):

$$\overline{\psi}_{stage} = \frac{\sum_{J1=1}^{J1=J} \psi_{stage,\,J1} V_{z,\,2,\,S,\,J1}\ \Delta A_{2,\,S,\,J1}}{\sum_{J1=1}^{J1=J} V_{z,\,2,\,S,\,J1}\ \Delta A_{2,\,S,\,J1}} \tag{F42}$$

Ideal head-rise coefficient for rotor, RHRCOI(L1, I1):

$$\overline{\psi}_{i,\,R} = \frac{\sum_{J1=1}^{J1=J} \psi_{i,\,R,\,J1} V_{z,\,2,\,R,\,J1}\ \Delta A_{2,\,R,\,J1}}{\sum_{J1=1}^{J1=J} V_{z,\,2,\,R,\,J1}\ \Delta A_{2,\,R,\,J1}} \tag{F43}$$

Ideal head-rise coefficient for stage, RHRCOI(L1, I1):

$$\overline{\psi}_{i,\,stage} = \frac{\sum_{J1=1}^{J1=J} \psi_{i,\,stage,\,J1} V_{z,\,2,\,S,\,J1}\ \Delta A_{2,\,S,\,J1}}{\sum_{J1=1}^{J1=J} V_{z,\,2,\,S,\,J1}\ \Delta A_{2,\,S,\,J1}} \tag{F44}$$

Hydraulic efficiency for rotor, RMAE(L1, I1):

$$\overline{\eta}_R = \frac{\overline{\psi}_R}{\overline{\psi}_{i,\,R}} \tag{F45}$$

Hydraulic efficiency for stage, RMAE(L1, I1):

$$\bar{\eta}_{stage} = \frac{\bar{\psi}_{stage}}{\bar{\psi}_{i,\,stage}} \tag{F46}$$

Net positive suction head (rotor only), HSVB(L1, I1):

$$\bar{H}_{sv} = \frac{\sum_{J1=1}^{J1=J} (H_{1,R,J1} - h_{v,J1}) V_{z,1,R,J1}\, \Delta A_{1,R,J1}}{\sum_{J1=1}^{J1=J} V_{z,1,R,J1}\, \Delta A_{1,R,J1}} \tag{F47}$$

Integrated and venturi-metered flow-rate comparison at blade-row inlet, QERR1(L1, I1):

$$FRC_1 = \frac{\left\{\sum_{J1=1}^{J1=J} V_{z,1,J1}\, \Delta A_{1,J1}\left(\frac{720.0}{231.0}\right)\right\} - Q_{v,a}}{Q_{v,a}} \tag{F48}$$

Integrated and venturi-metered flow-rate comparison at blade-row outlet, QERR2(L1, I1):

$$FRC_2 = \frac{\left\{\sum_{J1=1}^{J1=J} V_{z,2,J1}\, \Delta A_{2,J1}\left(\frac{720.0}{231.0}\right)\right\} - Q_{v,a}}{Q_{v,a}} \tag{F49}$$

Average Parameter Equations

Average venturi-metered flow rate, GPMA(L1) (calculated external to the program and read in):

$$Q_{v,a} = \frac{\sum_{J1=1}^{J1=J} Q_{v,J1}}{J} \tag{F50}$$

Average rotational speed, RNA(L1, I1):

$$N_a = \frac{\sum_{J1=1}^{J1=J} N_{J1}}{J} \tag{F51}$$

Average blade-tip velocity at rotor inlet, UTIP1A(L1, I1):

$$U_{1,t,a} = \frac{\sum_{J1=1}^{J1=J} U_{1,t,J1}}{J} \tag{F52}$$

Average blade-tip velocity at rotor outlet, UTIP2A(L1, I1):

$$U_{2,t,a} = \frac{\sum_{J1=1}^{J1=J} U_{2,t,J1}}{J} \tag{F53}$$

Average flow coefficient, PH1B(L1) (calculated external to the program and read in):

$$\overline{\varphi} = \frac{144.0\, Q_{v,a}}{448.8\pi \left(r_{1,t}^2 - r_{1,h}^2\right) U_{1,t}} \tag{F54}$$

Average ideal flow coefficient (design calculation parameter not used in computer program):

$$\overline{\varphi}_i = \frac{144.0\, Q}{448.8\pi \left[r_{1,t}^2 - r_{1,h}^2\right] U_{1,t}} \tag{F55}$$

TABLE I. - OVERALL ROTOR DESIGN PARAMETERS

Configuration	Hub-tip radius ratio,[a] r_h/r_t	Average ideal flow coefficient, $\overline{\varphi}_i$	Average head-rise coefficient, $\overline{\psi}$	Average hydraulic efficiency, $\overline{\eta}$	Average ideal head-rise coefficient, $\overline{\psi}_i$	Energy addition distribution	Blade-tip diffusion factor, D_t	Blade chord, c, in.	Number of blades, NB	Radial tip clearance, in.	Experimental flow coefficient to use when comparing data with design values, $\overline{\varphi}$	References	Minimum blade-chord Reynolds number, Re_c
02	0.4	0.293	0.145	0.90	0.161	Approximately radially constant	0.24	1.50	16	0.013 to 0.020	0.284	None	1.0×10^6
07	.7	.294	.269	.917	.294	Radially constant	.43	1.52	19	0.005 to 0.012	.284	1, 2	1.5
09	.7	.294	-----	-----	-----	Approximately radially constant	----	3.04	8	0.013 to 0.020	.284	None	3
5	.8	.466	0.427	.928	.460	Increasing hub to tip	.66	1.50	19	0.015 to 0.017	.452	3, 4	1.5
6	↓	↓	↓	↓	↓	↓	↓	1.50	↓	0.025 to 0.027	.452	None	1.5
8								.833		0.007 to 0.009	.435	↓	8.0×10^5
9								.833		0.015 to 0.017	.435		8.0
10								.833		0.022 to 0.024	.435		8.0
13A	.85	0.500	None	None	0.7225	Radially constant	0.72	1.17	33	0.009 to 0.011	.491	↓	1.0×10^6
14A	.9	.700	0.558	0.865	.645	Radially constant	.63	1.50	19	0.009 to 0.011	.670	5	1.5
15	.8	.466	.365	.929	.393	Increasing hub to tip	.56	1.50	19	0.009 to 0.010	.460	6	1.5
16	.85	.500	None	None	0.7225	Radially constant	.72	1.17	33	0.009 to 0.011	.491	None	1.0

[a]Configurations 8, 9, and 10 have a 5-in. tip diameter. All other configurations have a 9-in. tip diameter.

TABLE II. - DESIGN VELOCITY DIAGRAM PARAMETERS

Configuration	Radius ratio, r/r_t	Inlet flow coefficient, φ_1	Exit flow coefficient, φ_2	Relative inlet flow angle, β_1', deg	Change in relative flow angle, $\Delta\beta'$, deg	Head-rise coefficient, ψ	Ideal head-rise coefficient, ψ_i	D-factor, D	Loss coefficient, $\overline{\omega}$
02	1.00	0.293	0.293	73.6	2.8	0.288	0.320	0.238	0.030
	.90	↓	↓	71.9	4.2	.291	.323	.279	.036
	.80			69.8	6.1	.291	.324	.331	.045
	.70			67.2	9.4	.291	.323	.397	.056
	.60			63.8	15.1	.288	.320	.479	.072
	.50			59.5	27.6	.286	.318	.568	.095
	.40			53.6	52.9	.288	.316	.591	.129
07	1.00	0.294	0.233	73.6	1.8	0.238	0.294	0.426	0.100
	.95	↓	.305	72.8	8.4	.279	↓	.433	.030
	.90		.312	71.9	10.4	.281		.464	.025
	.85		.308	70.9	12.5	.280		.505	.032
	.80		.297	69.8	14.4	.273		.555	.055
	.75		.281	68.6	16.8	.263		.615	.090
	.70		.254	67.2	19.5	.249		.693	.150
5, 6, 8, 9, 10	1.00	0.466	0.415	65.0	16.0	0.438	0.533	0.664	0.1396
	.95	↓	.457	63.9	20.2	.437	.488	.632	.0906
	.90		.499	62.6	24.2	.439	.454	.595	.0291
	.85		.479	61.3	25.5	.414	.429	.614	.0319
	.80		.454	59.8	26.7	.387	.403	.631	.0364
13A, 16	1.00	0.500	0.500	63.4	34.4	-----	0.723	0.725	------
	.975	↓	↓	62.9	37.8	-----	↓	.737	------
	.950			62.2	41.5	-----		.748	------
	.925			61.6	45.6	-----		.756	------
	.900			61.0	50.0	-----		.762	------
	.875			60.3	54.6	-----		.763	------
	.850			59.5	59.5	-----		.761	------
14A	1.000	0.700	0.692	55.0	27.8	0.552	0.645	0.627	0.125
	.975	↓	.696	54.3	30.0	.555	↓	.633	.125
	.950		.700	53.6	32.4	.558		.637	.125
	.925		.704	52.9	35.0	.561		.640	.125
	.900		.708	52.1	37.6	.564		.641	.125
15	1.00	0.466	0.425	65.0	11.2	0.350	0.420	0.556	0.1152
	.95	↓	.448	63.9	13.9	.357	.395	.526	.0690
	.90		.473	62.6	17.8	.365	.388	.536	.0437
	.85		.491	61.3	22.2	.373	.384	.536	.0240
	.80		.488	59.8	26.5	.371	.383	.555	.0266

TABLE III. - BLADE DESIGN PARAMETERS

[Leading- and trailing-edge radii are radially constant at 0.010 in., except configurations 8, 9, and 10 (0.0055 in.) and configurations 13A and 16 (linear variation from 0.0096 in. at tip to 0.0113 in. at hub).]

Configuration	Radius ratio, r/r_t	Incidence angle, i, deg	Deviation angle, δ, deg	Camber angle, ω^o, deg	Blade setting angle, γ, deg	Solidity, σ	Ratio of maximum thickness to chord, t_{max}/c
02	1.00	0.7	3.4	5.4	70.2	0.84	0.070
	.90	.6	3.8	7.2	67.6	.94	.075
	.80	.6	4.5	9.8	64.1	1.05	.080
	.70	.7	5.5	13.9	59.4	1.20	.085
	.60	.7	7.0	21.3	52.5	1.40	.090
	.50	1.3	9.0	35.2	40.6	1.68	.095
	.40	3.0	11.6	61.4	20.0	2.11	.100
07	1.00	6.4	4.6	0	67.1	1.01	0.0700
	.95	2.0	5.4	11.8	64.9	1.06	.0725
	.90	.9	6.9	16.4	62.8	1.12	.0750
	.85	.5	7.8	19.8	60.5	1.19	.0775
	.80	.6	8.3	22.1	58.2	1.26	.0800
	.75	1.0	8.8	24.6	55.3	1.35	.0825
	.70	1.2	9.3	27.6	52.2	1.44	.0850
5, 6, 8, 9, 10	1.00	-3.5	7.5	27.0	55.0	1.00	0.070
	.95	-4.8	11.0	35.8	50.7	1.05	.075
	.90	-5.1	13.7	42.7	46.2	1.11	.080
	.85	-3.4	13.8	42.6	43.3	1.18	.085
	.80	-1.7	15.0	43.4	39.8	1.25	.090
13A	1.00	-7.2	13.1	54.7	43.2	1.37	0.0540
	.975	-7.3	15.7	60.8	39.7	1.40	.0578
	.950	-7.5	18.1	67.1	36.2	1.44	.0618
	.925	-7.6	19.7	72.8	32.8	1.48	.0660
	.900	-7.7	21.4	79.0	29.1	1.52	.0707
	.875	-7.8	22.5	85.0	25.6	1.56	.0757
	.850	-8.3	23.5	91.3	22.2	1.61	.0810
14A	1.000	-8.6	16.7	53.3	37.0	1.00	0.0700
	.975	-8.5	17.1	55.7	35.0	1.03	.0713
	.950	-8.5	17.5	58.4	32.9	1.05	.0725
	.925	-8.5	17.8	61.2	30.7	1.08	.0737
	.900	-8.3	18.2	63.9	28.4	1.11	.0750
15	1.00	-3.5	10.5	25.1	55.9	1.00	0.070
	.95	-2.4	9.7	26.0	53.3	1.05	.075
	.90	-1.7	9.5	29.0	49.8	1.11	.080
	.85	-1.0	9.1	32.3	46.1	1.18	.085
	.80	.3	8.5	34.7	42.1	1.25	.090
16	1.000	-7.2	13.1	54.7	48.4	1.37	0.0540
	.975	-7.3	15.7	60.8	46.7	1.40	.0578
	.950	-7.5	18.1	67.1	45.0	1.44	.0618
	.925	-7.6	19.7	72.8	43.2	1.48	.0660
	.900	-7.7	21.4	79.0	41.2	1.52	.0707
	.875	-7.8	22.5	85.0	39.1	1.56	.0757
	.850	-8.3	23.5	91.3	36.9	1.61	.0810

TABLE IV. - OVERALL PERFORMANCE PARAMETERS

NASA CONFIGURATION 02
0.4 HUB-TIP RATIO, 16 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.24 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.293 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.337000	0.101020	0.127422	0.792800	111.570	-0.018	0.039	3898.797	153.105	153.105
0.325000	0.112376	0.138759	0.809865	111.840	-0.020	0.032	3909.098	153.510	153.510
0.315000	0.121993	0.148368	0.822231	112.180	-0.018	0.017	3912.098	153.628	153.628
0.302000	0.134648	0.152519	0.882827	112.410	-0.019	0.017	3910.000	153.545	153.545
0.292000	0.144280	0.159171	0.906446	112.490	-0.017	0.011	3918.598	153.883	153.883
0.282000	0.154756	0.171468	0.902530	112.770	-0.015	-0.002	3917.699	153.848	153.848
0.273000	0.164227	0.178709	0.918964	111.760	-0.016	-0.009	3915.898	153.777	153.777
0.262000	0.164857	0.173768	0.948716	112.030	-0.018	0.001	3913.598	153.687	153.687

NASA CONFIGURATION 07
0.7 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.005-0.012-INCH RADIAL TIP CLEARANCE,
0.43 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-2295 AND TN D-2481.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.405110	0.120986	0.147660	0.819358	186.522	-0.024	0.012	3595.759	141.205	141.205
0.380790	0.160098	0.182897	0.875346	186.366	-0.028	-0.004	3596.837	141.247	141.247
0.351790	0.196333	0.214450	0.915518	186.982	-0.030	-0.001	3613.419	141.899	141.899
0.324250	0.227623	0.250425	0.908948	187.095	-0.027	-0.015	3612.178	141.850	141.850
0.302220	0.250580	0.271067	0.924421	161.134	0.008	-0.012	3602.279	141.461	141.461
0.284130	0.281533	0.313286	0.898647	161.198	0.004	0.019	3602.959	141.488	141.488

NASA CONFIGURATION 09
0.7 HUB-TIP RATIO, 8 BLADES, 9-INCH TIP DIAMETER,
3.04-INCH CHORD, 0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.46 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.404500	0.111263	0.128487	0.865950	169.114	-0.063	-0.038	3600.000	141.372	141.372
0.381490	0.141924	0.151052	0.939573	168.941	-0.068	-0.035	3600.000	141.372	141.372
0.359480	0.168255	0.178739	0.941345	169.203	-0.069	-0.036	3600.000	141.372	141.372
0.325400	0.213363	0.222154	0.960428	169.296	-0.073	-0.033	3600.000	141.372	141.372
0.301480	0.240948	0.251554	0.957836	169.670	-0.069	-0.027	3600.000	141.372	141.372
0.285470	0.261675	0.276518	0.946321	169.959	-0.067	-0.016	3600.000	141.372	141.372
0.267880	0.284588	0.309161	0.921811	170.199	-0.066	-0.012	3600.000	141.372	141.372
0.253030	0.301638	0.333904	0.903366	170.560	-0.064	-0.007	3600.000	141.372	141.372
0.250020	0.300132	0.334525	0.897189	170.754	-0.042	-0.006	3600.000	141.372	141.372

NASA CONFIGURATION 5
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-3024 AND TN D-3602.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.606800	0.263254	0.297436	0.885079	237.613	-0.004	0.021	3010.156	118.208	118.208
0.573210	0.307428	0.325829	0.943525	238.538	-0.003	0.027	3006.469	118.064	118.064
0.524150	0.343206	0.357096	0.961105	239.537	-0.004	0.021	3013.441	118.338	118.338
0.484630	0.369894	0.388136	0.953002	240.180	-0.004	0.014	3013.028	118.321	118.321
0.450980	0.392489	0.411072	0.954793	240.550	-0.005	0.022	3011.784	118.272	118.272
0.409180	0.413616	0.437054	0.946374	242.368	-0.004	0.022	3008.085	118.127	118.127
0.378550	0.425092	0.452229	0.939992	242.512	-0.012	0.040	3007.298	118.096	118.096

TABLE IV. - Continued. OVERALL PERFORMANCE PARAMETERS

NASA CONFIGURATION 6
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.026-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.606860	0.265615	0.291669	0.910676	274.432	-0.007	0.007	2997.313	117.704	117.704
0.574350	0.299381	0.320479	0.934168	275.249	-0.010	0.000	3000.513	117.830	117.830
0.527340	0.334310	0.354300	0.943579	272.287	-0.010	-0.014	2992.713	117.523	117.523
0.488250	0.360119	0.377325	0.954400	273.068	-0.008	-0.011	3006.942	118.082	118.082
0.446660	0.384946	0.405634	0.948999	273.901	-0.015	-0.006	3000.698	117.837	117.837
0.408950	0.404864	0.424944	0.952746	274.514	-0.015	0.011	3007.883	118.119	118.119
0.387470	0.411798	0.441486	0.932755	274.290	-0.013	0.016	2995.885	117.648	117.648

NASA CONFIGURATION 8
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.008-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.638210	0.243051	0.288483	0.842516	262.159	-0.042	-0.019	5374.203	117.669	117.669
0.617040	0.274682	0.309365	0.887890	263.348	-0.039	-0.028	5389.570	118.005	118.005
0.593430	0.302363	0.331385	0.912421	262.673	-0.038	-0.047	5365.063	117.469	117.469
0.555950	0.330680	0.329622	1.003210	267.596	-0.042	-0.015	5369.926	117.575	117.575
0.525290	0.359730	0.367209	0.979633	267.941	-0.038	-0.007	5370.344	117.584	117.584
0.488610	0.384675	0.396076	0.971214	269.278	-0.039	-0.012	5369.969	117.576	117.576
0.455770	0.404204	0.420304	0.961694	269.731	-0.041	-0.012	5373.535	117.654	117.654
0.432130	0.411147	0.434248	0.946804	270.116	-0.037	-0.022	5362.191	117.406	117.406
0.407050	0.416183	0.446736	0.931610	270.633	-0.034	-0.041	5369.262	117.561	117.561
0.383760	0.420885	0.453839	0.927387	271.303	-0.036	-0.046	5371.043	117.600	117.600

NASA CONFIGURATION 9
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.637510	0.232421	0.281966	0.824290	264.927	-0.029	-0.012	5389.902	118.013	118.013
0.620850	0.257081	0.298131	0.862310	265.745	-0.026	-0.009	5394.727	118.118	118.118
0.594040	0.287009	0.331150	0.866705	265.781	-0.030	-0.028	5389.273	117.999	117.999
0.552190	0.313570	0.324474	0.966398	266.672	-0.026	-0.018	5373.879	117.662	117.662
0.523150	0.345922	0.362933	0.953131	267.431	-0.025	0.003	5369.625	117.569	117.569
0.488610	0.363269	0.393156	0.923982	268.030	-0.033	-0.034	5376.770	117.725	117.725
0.451860	0.380714	0.403483	0.943569	268.785	-0.035	-0.003	5383.941	117.882	117.882
0.430470	0.387819	0.418327	0.927071	269.082	-0.032	-0.012	5379.961	117.795	117.795
0.404720	0.389952	0.429903	0.907070	269.487	-0.033	-0.018	5377.527	117.742	117.742

NASA CONFIGURATION 10
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.023-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.692420	0.231265	0.279496	0.827435	263.429	-0.034	0.004	5377.195	117.734	117.734
0.619380	0.245111	0.297450	0.824041	263.882	-0.027	-0.006	5374.609	117.678	117.678
0.594530	0.262656	0.315448	0.832643	264.227	-0.030	-0.038	5382.434	117.849	117.849
0.574770	0.284559	0.308837	0.921389	264.464	-0.031	-0.006	5375.293	117.693	117.693
0.552630	0.309227	0.336957	0.917704	265.355	-0.029	0.008	5385.375	117.913	117.913
0.523160	0.324997	0.360274	0.902085	265.971	-0.026	-0.011	5372.766	117.637	117.637
0.487430	0.345539	0.385568	0.896182	266.501	-0.031	-0.010	5369.266	117.561	117.561
0.451790	0.354420	0.398171	0.890121	267.228	-0.030	-0.011	5371.707	117.614	117.614
0.427910	0.357122	0.406439	0.878660	267.438	-0.022	-0.007	5380.039	117.797	117.797
0.407360	0.358334	0.417422	0.858447	267.888	-0.029	-0.019	5374.629	117.678	117.678

TABLE IV. - Concluded. OVERALL PERFORMANCE PARAMETERS

NASA CONFIGURATION 13 ADJUSTED-SEE ERI-77900
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.746490	0.437047	0.576877	0.757608	434.234	-0.013	-0.023	2421.440	95.090	95.090
0.722830	0.468886	0.596611	0.785917	434.162	-0.013	-0.025	2430.680	95.453	95.453
0.698340	0.491888	0.610765	0.805364	434.227	-0.017	-0.011	2422.520	95.132	95.132
0.676290	0.518752	0.625559	0.829260	434.382	-0.015	0.002	2417.780	94.946	94.946
0.649520	0.538578	0.632527	0.851469	434.151	-0.017	0.012	2422.419	95.128	95.128
0.626800	0.563620	0.647741	0.870132	434.385	-0.014	0.016	2420.280	95.044	95.044
0.596420	0.590950	0.660805	0.894288	434.584	-0.014	0.034	2419.380	95.009	95.009
0.567800	0.617249	0.677721	0.910771	434.397	-0.008	0.020	2416.859	94.910	94.910
0.541460	0.629318	0.681309	0.923690	434.553	-0.004	0.040	2420.919	95.069	95.069

NASA CONFIGURATION 14 ADJUSTED-SEE ERI-77900
0.9 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.63 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.7 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.890570	0.357243	0.459651	0.777204	433.202	0.013	0.036	2505.479	98.390	98.390
0.854960	0.394659	0.488176	0.808436	433.200	0.014	0.037	2490.559	97.804	97.804
0.820510	0.431477	0.510388	0.845389	433.195	0.006	0.037	2497.380	98.072	98.072
0.780950	0.458520	0.534556	0.857759	433.227	0.007	0.041	2504.080	98.335	98.335
0.740110	0.484700	0.556831	0.870462	433.231	0.015	0.038	2512.359	98.660	98.660
0.698170	0.513935	0.576805	0.891002	433.267	0.005	0.039	2516.419	98.820	98.820
0.655690	0.527094	0.589158	0.894657	433.239	0.010	0.047	2521.359	99.013	99.013
0.616700	0.545394	0.599069	0.910402	433.289	0.015	0.067	2505.940	98.408	98.408
0.585010	0.545891	0.603799	0.904095	433.312	0.005	0.078	2504.819	98.364	98.364

NASA CONFIGURATION 15
0.8 HUB-TIP RATIO,19BLADES,9 INCH TIP DIAMETER
1.5 INCH CHORD,0.009-0.010 INCH RADIAL TIP CLEARANCE
0.556 DESIGN TIP D-FACTOR
DOUBLE CIRCULAR ARC BLADE PROFILE
0.466 DESIGN FLOW COEFFICIENT
NOT REPORTED

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.615520	0.237020	0.267124	0.887306	420.885	-0.039	-0.042	3009.119	118.168	118.168
0.569620	0.282403	0.305588	0.924127	421.837	-0.041	-0.040	3024.180	118.759	118.759
0.530560	0.309480	0.333438	0.928149	423.118	-0.042	-0.051	3012.459	118.299	118.299
0.477490	0.346106	0.365278	0.947512	424.535	-0.042	-0.073	3012.819	118.313	118.313
0.425140	0.380291	0.397361	0.957043	425.775	-0.041	-0.081	3016.600	118.462	118.462
0.382630	0.406427	0.428451	0.948596	426.619	-0.040	-0.087	3014.319	118.372	118.372
0.349040	0.421059	0.461873	0.911634	427.911	-0.044	-0.104	3014.459	118.377	118.377

NASA CONFIGURATION 16
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
CUBIC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

PHIB1	RCTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.544320	0.315972	0.508550	0.621319	432.654	-0.057	-0.049	2503.659	98.318	98.318
0.535190	0.347545	0.530411	0.655237	432.839	-0.058	-0.034	2505.959	98.409	98.409
0.528520	0.368080	0.539195	0.682648	432.895	-0.059	-0.043	2505.219	98.380	98.380
0.518320	0.392571	0.544816	0.720556	432.949	-0.064	-0.039	2504.540	98.353	98.353
0.502580	0.421790	0.557436	0.756660	433.547	-0.061	-0.044	2506.580	98.433	98.433
0.490240	0.443187	0.565466	0.783755	433.669	-0.056	-0.066	2505.520	98.391	98.391
0.475640	0.458807	0.567056	0.809103	434.009	-0.061	-0.061	2505.759	98.401	98.401
0.462310	0.473116	0.573656	0.824739	434.228	-0.060	-0.070	2506.259	98.421	98.421
0.453060	0.487568	0.582237	0.838093	434.604	-0.059	-0.071	2503.640	98.318	98.318
0.423020	0.507762	0.610396	0.831856	435.799	-0.041	-0.041	2507.479	98.468	98.468

TABLE V. - BLADE-ELEMENT DATA FOR CONFIGURATION 02

NASA CONFIGURATION 02
0.4 HUB-TIP RATIO, 16 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.24 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.293 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.350000	72.400	4.350000	66.380	0.878100	0.072000	1.500000	6.020	69.390
2	4.250000	72.000	4.250000	65.600	0.898800	0.073000	1.500000	6.400	68.800
3	3.700000	69.500	3.700000	60.500	1.032400	0.079000	1.500000	9.000	65.000
4	3.150000	66.400	3.150000	52.400	1.212600	0.085000	1.500000	14.000	59.400
5	2.600000	62.400	2.600000	38.400	1.469100	0.091000	1.500000	24.000	50.400
6	2.050000	55.400	2.050000	10.000	1.863300	0.097000	1.500000	45.400	32.700
7	1.950000	53.530	1.950000	3.500	1.958800	0.098000	1.500000	50.030	28.520

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
1.800000	4.500000	1.800000	4.500000	16

FLOW RATE # 1 8603. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.002	47.410	47.410	0.000	0.000	155.410	148.002	72.238	112.900	77.969	4.72760
2	0.092593	0.944444	144.600	49.980	49.980	0.000	0.000	152.994	144.600	70.933	112.900	74.080	8.44890
3	0.296296	0.822222	125.887	52.430	52.430	0.000	0.000	136.368	125.887	67.389	112.900	70.181	12.78630
4	0.500000	0.700000	107.174	53.680	53.680	0.000	0.000	119.866	107.174	63.395	112.900	68.119	10.88560
5	0.703704	0.577778	88.461	53.920	53.920	0.000	0.000	103.599	88.461	58.636	112.900	67.718	8.98490
6	0.907407	0.455556	69.748	54.130	54.130	0.000	0.000	88.289	69.748	52.186	112.900	67.365	4.41590
7	0.944445	0.433333	66.346	53.260	53.260	0.000	0.000	85.079	66.346	51.244	112.900	68.817	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.002	51.673	45.720	24.079	27.774	132.088	123.923	69.749	172.500	131.005	4.72760
2	0.092593	0.944444	144.600	56.824	52.748	21.133	21.833	134.262	123.467	66.867	179.580	129.401	8.44890
3	0.296296	0.822222	125.887	59.646	55.770	21.148	20.767	118.661	104.738	61.966	180.140	124.853	12.78630
4	0.500000	0.700000	107.174	63.193	57.020	27.241	25.536	98.186	79.933	54.498	186.540	124.481	10.88560
5	0.703704	0.577778	88.461	67.231	58.076	33.869	30.250	79.707	54.592	43.229	194.410	124.167	8.98490
6	0.907407	0.455556	69.748	75.910	59.381	47.289	38.533	63.486	22.459	20.717	205.390	115.840	4.41590
7	0.944445	0.433333	66.346	75.477	56.229	50.349	41.842	58.461	15.997	15.880	203.800	115.269	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	-0.162	0.309658	3898.800	8602.602	62.150	0.9280E-05	0.2093E 07
2	0.092593	0.944444	-1.067	0.326442	3898.800	8602.602	62.150	0.9280E-05	0.2061E 07
3	0.296296	0.822222	-2.111	0.342442	3898.800	8602.602	62.150	0.9280E-05	0.1837E 07
4	0.500000	0.700000	-3.005	0.350609	3898.800	8602.602	62.150	0.9280E-05	0.1615E 07
5	0.703704	0.577778	-3.764	0.352176	3898.800	8602.602	62.150	0.9280E-05	0.1395E 07
6	0.907407	0.455556	-3.214	0.353549	3898.800	8602.602	62.150	0.9280E-05	0.1189E 07
7	0.944445	0.433333	-2.286	0.347866	3898.800	8602.602	62.150	0.9280E-05	0.1146E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.369	0.298618	0.081803	0.152028	0.538080	0.136315	0.238292	59.600	53.036	0.02687
2	0.092593	0.944444	1.267	0.344519	0.091521	0.130360	0.702063	0.077791	0.199273	66.680	55.321	0.01700
3	0.296296	0.822222	1.466	0.364262	0.092289	0.113574	0.812594	0.053659	0.204958	67.240	54.672	0.01221
4	0.500000	0.700000	2.098	0.372423	0.101073	0.124547	0.811530	0.076594	0.274575	73.640	56.362	0.01834
5	0.703704	0.577778	4.829	0.379323	0.111875	0.127813	0.875305	0.069618	0.341890	81.510	56.449	0.01726
6	0.907407	0.455556	10.717	0.387842	0.126946	0.140707	0.902202	0.082765	0.424657	92.490	48.475	0.02077
7	0.944445	0.433333	12.390	0.367260	0.124763	0.142503	0.875516	0.114896	0.463926	90.900	46.452	0.02821

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.337000	0.101020	0.127422	0.792800	111.570	-0.018	0.039	3898.797	153.105	153.105

TABLE V. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 02

FLOW RATE # 2 8314. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.393	45.370	45.370	0.000	0.000	155.174	148.393	72.999	113.170	81.181	4.72760
2	0.092593	0.944444	144.982	48.490	48.490	0.000	0.000	152.876	144.982	71.507	113.170	76.630	8.44890
3	0.296296	0.822222	126.219	50.700	50.700	0.000	0.000	136.021	126.219	68.115	113.170	73.223	12.78630
4	0.500000	0.700000	107.457	51.780	51.780	0.000	0.000	119.282	107.457	64.272	113.170	71.503	10.88560
5	0.703704	0.577778	88.695	51.970	51.970	0.000	0.000	102.799	88.695	59.632	113.170	71.197	8.98490
6	0.907407	0.455556	69.932	52.280	52.280	0.000	0.000	87.314	69.932	53.219	113.170	70.695	4.41590
7	0.944445	0.433333	66.521	51.230	51.230	0.000	0.000	83.961	66.521	52.399	113.170	72.384	1.58600

PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.393	52.938	45.670	26.771	30.378	129.914	121.622	59.419	191.000	147.449	4.72760
2	0.092593	0.944444	144.982	56.513	50.600	25.167	26.444	130.062	119.815	67.105	193.370	143.738	8.44890
3	0.296296	0.822222	126.219	58.565	53.499	23.827	24.007	115.526	102.392	62.413	189.580	136.278	12.78630
4	0.500000	0.700000	107.457	62.025	54.608	29.412	28.307	95.253	78.045	55.020	193.890	134.104	10.88560
5	0.703704	0.577778	88.695	65.420	55.479	34.667	32.000	77.440	54.027	44.240	199.660	133.150	8.98490
6	0.907407	0.455556	69.932	73.663	55.958	47.906	40.567	60.137	22.026	21.486	210.010	125.683	4.41590
7	0.944445	0.433333	66.521	73.354	53.070	50.640	43.658	55.395	15.881	16.659	209.390	125.769	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	0.599	0.295550	3909.100	8313.699	62.150	0.9280E-05	0.2090E 07
2	0.092593	0.944444	-0.493	0.315875	3909.100	8313.699	62.150	0.9280E-05	0.2059E 07
3	0.296296	0.822222	-1.385	0.330273	3909.100	8313.699	62.150	0.9280E-05	0.1832E 07
4	0.500000	0.700000	-2.128	0.337308	3909.100	8313.699	62.150	0.9280E-05	0.1607E 07
5	0.703704	0.577778	-2.768	0.338545	3909.100	8313.699	62.150	0.9280E-05	0.1385E 07
6	0.907407	0.455556	-2.181	0.340563	3909.100	8313.699	62.150	0.9280E-05	0.1176E 07
7	0.944445	0.433333	-1.131	0.333723	3909.100	8313.699	62.150	0.9280E-05	0.1131E 07

PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.039	0.297505	0.106262	0.169578	0.630343	0.121974	0.261018	77.830	66.268	0.02442
2	0.092593	0.944444	1.505	0.329620	0.109498	0.154833	0.707201	0.091424	0.240811	80.200	67.108	0.01979
3	0.296296	0.822222	1.913	0.348505	0.104323	0.127622	0.817444	0.059348	0.235514	76.410	63.055	0.01331
4	0.500000	0.700000	2.620	0.355730	0.110208	0.134118	0.821726	0.079201	0.303123	80.720	62.601	0.01872
5	0.703704	0.577778	5.840	0.361405	0.118086	0.130490	0.905009	0.055278	0.361463	86.490	61.953	0.01348
6	0.907407	0.455556	11.486	0.364523	0.132217	0.142155	0.930021	0.061503	0.458484	96.840	54.988	0.01536
7	0.944445	0.433333	13.159	0.345709	0.131370	0.142949	0.919001	0.077411	0.494189	96.220	53.385	0.01893

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.325000	0.112376	0.138759	0.809865	111.840	-0.020	0.032	3909.098	153.510	153.510

FLOW RATE # 3 8066. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.507	44.350	44.350	0.000	0.000	154.988	148.507	73.372	113.510	82.943	4.72760
2	0.092593	0.944444	145.093	46.960	46.960	0.000	0.000	152.503	145.093	72.065	113.510	79.239	8.44890
3	0.296296	0.822222	126.316	49.320	49.320	0.000	0.000	135.603	126.316	68.672	113.510	75.708	12.78630
4	0.500000	0.700000	107.539	50.390	50.390	0.000	0.000	118.760	107.539	64.893	113.510	74.050	10.88560
5	0.703704	0.577778	88.763	50.590	50.590	0.000	0.000	102.167	88.763	60.319	113.510	73.736	8.98490
6	0.907407	0.455556	69.986	50.580	50.580	0.000	0.000	86.350	69.986	54.144	113.510	73.752	4.41590
7	0.944445	0.433333	66.572	49.270	49.270	0.000	0.000	82.821	66.572	53.495	113.510	75.785	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.507	52.074	43.502	28.624	33.345	127.531	119.883	70.056	197.450	155.308	4.72760
2	0.092593	0.944444	145.093	56.099	49.230	26.897	28.650	128.039	118.196	67.388	201.470	152.563	8.44890
3	0.296296	0.822222	126.316	57.893	52.070	25.305	25.919	113.642	101.011	62.729	199.710	147.624	12.78630
4	0.500000	0.700000	107.539	60.628	51.020	32.754	32.700	90.531	74.786	55.698	202.370	145.246	10.88560
5	0.703704	0.577778	88.763	64.364	52.520	37.207	35.315	73.596	51.556	44.469	206.060	141.680	8.98490
6	0.907407	0.455556	69.986	72.154	53.480	48.437	42.167	57.658	21.549	21.947	212.000	131.093	4.41590
7	0.944445	0.433333	66.572	71.870	50.657	50.982	45.183	53.002	15.590	17.106	212.280	132.009	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	0.972	0.288685	3912.100	8065.801	62.150	0.9280E-05	0.2088E 07
2	0.092593	0.944444	0.065	0.305676	3912.100	8065.801	62.150	0.9280E-05	0.2054E 07
3	0.296296	0.822222	-0.828	0.321037	3912.100	8065.801	62.150	0.9280E-05	0.1827E 07
4	0.500000	0.700000	-1.507	0.328002	3912.100	8065.801	62.150	0.9280E-05	0.1600E 07
5	0.703704	0.577778	-2.081	0.329304	3912.100	8065.801	62.150	0.9280E-05	0.1376E 07
6	0.907407	0.455556	-1.256	0.329238	3912.100	8065.801	62.150	0.9280E-05	0.1163E 07
7	0.944445	0.433333	-0.035	0.320710	3912.100	8065.801	62.150	0.9280E-05	0.1116E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.676	0.283163	0.114429	0.180111	0.635321	0.129070	0.282315	83.940	72.365	0.02507
2	0.092593	0.944444	1.788	0.320452	0.119909	0.165352	0.725172	0.092232	0.258534	87.960	73.324	0.01973
3	0.296296	0.822222	2.229	0.339936	0.117509	0.135434	0.867650	0.046013	0.252330	86.200	71.916	0.01021
4	0.500000	0.700000	3.298	0.332098	0.121136	0.149242	0.811671	0.094068	0.351420	88.860	71.196	0.02186
5	0.703704	0.577778	6.069	0.341866	0.126166	0.139931	0.901627	0.062250	0.403600	92.550	67.944	0.01512
6	0.907407	0.455556	11.947	0.348114	0.134263	0.143630	0.934788	0.059295	0.482796	98.490	57.341	0.01476
7	0.944445	0.433333	13.606	0.329739	0.134645	0.143803	0.936319	0.063018	0.517173	98.770	56.224	0.01537

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.315000	0.121993	0.148368	0.822231	112.180	-0.018	0.017	3912.098	153.628	153.628

TABLE V. - Continued. BLADE ELEMENT DATA FOR CONFIGURATION 02

FLOW RATE # 4 7734. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	SIRTUB1 SQ IN
1	0.055555	0.966667	148.427	42.840	42.840	0.000	0.000	154.486	148.427	73.900	113.740	85.219	4.72760
2	0.092593	0.944444	145.015	45.050	45.050	0.000	0.000	151.851	145.015	72.742	113.740	82.201	8.44890
3	0.296296	0.822222	126.248	47.310	47.310	0.000	0.000	134.822	126.248	69.457	113.740	78.957	12.78630
4	0.500000	0.700000	107.482	48.220	48.220	0.000	0.000	117.803	107.482	65.837	113.740	77.606	10.88560
5	0.703704	0.577778	88.715	48.470	48.470	0.000	0.000	101.093	88.715	61.350	113.740	77.230	8.98490
6	0.907407	0.455556	69.948	48.090	48.090	0.000	0.000	84.885	69.948	55.491	113.740	77.800	4.41590
7	0.944445	0.433333	66.536	46.860	46.860	0.000	0.000	81.382	66.536	54.844	113.740	79.615	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	SIRTUB2 SQ IN
1	0.055555	0.966667	148.427	52.775	43.541	29.822	34.408	126.345	118.605	69.841	211.720	168.436	4.72760
2	0.092593	0.944444	145.015	55.951	48.150	28.498	30.620	126.074	116.517	67.548	215.620	166.970	8.44890
3	0.296296	0.822222	126.248	56.649	49.810	26.982	28.444	111.063	99.267	63.353	210.470	160.599	12.78630
4	0.500000	0.700000	107.482	58.602	49.290	31.697	32.744	90.404	75.734	56.960	210.300	156.930	10.88560
5	0.703704	0.577778	88.715	62.393	49.880	37.482	36.923	71.504	51.233	45.767	213.820	153.322	8.98490
6	0.907407	0.455556	69.948	69.182	48.919	48.919	45.000	53.248	21.029	23.262	213.810	139.431	4.41590
7	0.944445	0.433333	66.536	69.686	46.069	52.286	48.617	48.222	14.250	17.188	215.960	140.493	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	1.500	0.279006	3910.000	7734.301	62.150	0.9280E-05	0.2081E 07
2	0.092593	0.944444	0.742	0.293396	3910.000	7734.301	62.150	0.9280E-05	0.2045E 07
3	0.296296	0.822222	-0.043	0.308116	3910.000	7734.301	62.150	0.9280E-05	0.1816E 07
4	0.500000	0.700000	-0.563	0.314043	3910.000	7734.301	62.150	0.9280E-05	0.1587E 07
5	0.703704	0.577778	-1.050	0.315673	3910.000	7734.301	62.150	0.9280E-05	0.1362E 07
6	0.907407	0.455556	0.091	0.313199	3910.000	7734.301	62.150	0.9280E-05	0.1143E 07
7	0.944445	0.433333	1.314	0.305188	3910.000	7734.301	62.150	0.9280E-05	0.1096E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.461	0.283574	0.133712	0.187751	0.712175	0.106767	0.292082	97.980	83.217	0.02095
2	0.092593	0.944444	1.948	0.313585	0.139034	0.175290	0.793164	0.074140	0.274158	101.880	84.769	0.01575
3	0.296296	0.822222	2.853	0.324402	0.132006	0.144485	0.913627	0.032373	0.273149	96.730	81.642	0.00703
4	0.500000	0.700000	4.560	0.321015	0.131774	0.144505	0.911897	0.043258	0.343532	96.560	79.324	0.00973
5	0.703704	0.577778	7.367	0.324855	0.136577	0.141042	0.968344	0.020600	0.418879	100.080	76.092	0.00489
6	0.907407	0.455556	13.262	0.318596	0.136564	0.145138	0.940922	0.056111	0.527353	100.070	61.631	0.01383
7	0.944445	0.433333	13.688	0.300033	0.139498	0.147560	0.945361	0.057402	0.571451	102.220	60.878	0.01400

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.302000	0.13464E	0.152519	0.882827	112.410	-0.019	0.017	3910.000	153.545	153.545

FLOW RATE # 5 7481. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.754	41.960	41.960	0.000	0.000	154.558	148.754	74.247	113.820	86.459	4.72760
2	0.092593	0.944444	145.334	43.840	43.840	0.000	0.000	151.802	145.334	73.214	113.820	83.952	8.44890
3	0.296296	0.822222	126.526	45.890	45.890	0.000	0.000	134.591	126.526	70.065	113.820	81.093	12.78630
4	0.500000	0.700000	107.718	46.780	46.780	0.000	0.000	117.437	107.718	66.526	113.820	79.812	10.88560
5	0.703704	0.577778	88.910	46.640	46.640	0.000	0.000	100.401	88.910	62.320	113.820	80.015	8.98490
6	0.907407	0.455556	70.102	46.150	46.150	0.000	0.000	83.930	70.102	56.642	113.820	80.721	4.41590
7	0.944445	0.433333	66.683	45.200	45.200	0.000	0.000	80.558	66.683	55.869	113.820	82.070	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.754	53.572	43.424	31.374	35.848	125.155	117.380	69.698	223.460	178.860	4.72760
2	0.092593	0.944444	145.334	55.955	47.190	30.067	32.503	124.553	115.267	67.736	225.550	176.994	8.44890
3	0.296296	0.822222	126.526	55.438	47.834	28.192	30.362	109.505	98.504	64.099	219.550	171.789	12.78630
4	0.500000	0.700000	107.718	58.565	48.610	32.664	33.900	89.420	75.054	57.070	218.870	165.568	10.88560
5	0.703704	0.577778	88.910	61.405	46.889	39.648	40.217	68.010	49.262	46.414	217.570	158.973	8.98490
6	0.907407	0.455556	70.102	66.973	43.872	50.603	49.075	48.010	19.499	23.963	215.310	145.604	4.41590
7	0.944445	0.433333	66.683	68.782	41.832	54.599	52.542	43.542	12.083	16.112	218.590	145.068	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	1.847	0.272673	3918.600	7481.000	62.150	0.9280E-05	0.2082E 07
2	0.092593	0.944444	1.214	0.284892	3918.600	7481.000	62.150	0.9280E-05	0.2045E 07
3	0.296296	0.822222	0.565	0.298215	3918.600	7481.000	62.150	0.9280E-05	0.1813E 07
4	0.500000	0.700000	0.126	0.303996	3918.600	7481.000	62.150	0.9280E-05	0.1582E 07
5	0.703704	0.577778	-0.080	0.303087	3918.600	7481.000	62.150	0.9280E-05	0.1352E 07
6	0.907407	0.455556	1.242	0.299905	3918.600	7481.000	62.150	0.9280E-05	0.1131E 07
7	0.944445	0.433333	2.339	0.293730	3918.600	7481.000	62.150	0.9280E-05	0.1085E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.318	0.282187	0.148968	0.197083	0.755864	0.095391	0.305826	109.640	92.401	0.01885
2	0.092593	0.944444	2.136	0.306662	0.151807	0.184533	0.822659	0.067257	0.289689	111.730	92.942	0.01418
3	0.296296	0.822222	3.599	0.310848	0.143655	0.149724	0.959469	0.015866	0.287223	105.730	90.696	0.00336
4	0.500000	0.700000	4.670	0.315888	0.142731	0.148587	0.960588	0.020110	0.353260	105.050	85.756	0.00451
5	0.703704	0.577778	8.014	0.304707	0.140965	0.148866	0.946926	0.037120	0.457019	103.750	78.958	0.00871
6	0.907407	0.455556	13.963	0.285102	0.137894	0.149805	0.920493	0.080078	0.539756	101.490	64.883	0.01964
7	0.944445	0.433333	12.612	0.271842	0.142351	0.153751	0.925854	0.083195	0.632499	104.770	62.998	0.02040

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.292000	0.144280	0.159171	0.906446	112.490	-0.017	0.011	3918.598	153.883	153.883

TABLE V. - Continued. BLADE ELEMENT DATA FOR CONFIGURATION 02

FLOW RATE # 6 7216. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.719	40.480	40.480	0.000	0.000	154.130	148.719	74.774	114.100	88.635	4.72760
2	0.092593	0.944444	145.301	42.680	42.680	0.000	0.000	151.439	145.301	73.631	114.100	85.792	8.44890
3	0.296296	0.822222	126.497	44.390	44.390	0.000	0.000	134.059	126.497	70.663	114.100	83.478	12.78630
4	0.500000	0.700000	107.693	45.160	45.160	0.000	0.000	116.779	107.693	67.250	114.100	82.406	10.88560
5	0.703704	0.577778	88.890	44.970	44.970	0.000	0.000	99.618	88.890	63.165	114.100	82.672	8.98490
6	0.907407	0.455556	70.086	44.500	44.500	0.000	0.000	83.020	70.086	57.587	114.100	83.326	4.41590
7	0.944445	0.433333	66.667	42.740	42.740	0.000	0.000	79.191	66.667	57.336	114.100	85.712	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.719	54.330	42.710	33.579	38.175	122.806	115.140	69.648	235.340	189.469	4.72760
2	0.092593	0.944444	145.301	56.117	46.140	31.941	34.693	122.390	113.360	67.853	236.530	187.591	8.44890
3	0.296296	0.822222	126.497	55.133	45.220	31.539	34.894	105.175	94.958	64.535	227.080	179.843	12.78630
4	0.500000	0.700000	107.693	58.812	46.860	35.538	37.176	86.037	72.155	56.999	227.420	173.668	10.88560
5	0.703704	0.577778	88.890	60.162	43.808	41.235	43.267	64.731	47.655	47.409	222.950	166.702	8.98490
6	0.907407	0.455556	70.086	65.313	40.249	51.438	51.958	44.359	18.648	24.859	217.630	151.337	4.41590
7	0.944445	0.433333	66.667	66.658	37.467	55.131	55.800	39.203	11.536	17.114	223.460	154.410	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	2.374	0.263117	3917.700	7216.000	62.150	0.9280E-05	0.2076E 07
2	0.092593	0.944444	1.631	0.277416	3917.700	7216.000	62.150	0.9280E-05	0.2040E 07
3	0.296296	0.822222	1.163	0.288531	3917.700	7216.000	62.150	0.9280E-05	0.1806E 07
4	0.500000	0.700000	0.850	0.293538	3917.700	7216.000	62.150	0.9280E-05	0.1573E 07
5	0.703704	0.577778	0.765	0.292304	3917.700	7216.000	62.150	0.9280E-05	0.1342E 07
6	0.907407	0.455556	2.187	0.289247	3917.700	7216.000	62.150	0.9280E-05	0.1116E 07
7	0.944445	0.433333	3.606	0.277807	3917.700	7216.000	62.150	0.9280E-05	0.1067E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGA2	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.268	0.277612	0.164804	0.210987	0.781111	0.092028	0.327283	121.240	100.834	0.01922
2	0.092593	0.944444	2.253	0.299908	0.166422	0.196078	0.848754	0.061214	0.309149	122.430	101.799	0.01284
3	0.296296	0.822222	4.035	0.293930	0.153576	0.168558	0.911121	0.039460	0.329397	112.980	96.365	0.00822
4	0.500000	0.700000	4.599	0.304589	0.154039	0.161696	0.952643	0.026581	0.388734	113.320	91.262	0.00597
5	0.703704	0.577778	9.009	0.284748	0.147962	0.154858	0.955470	0.032894	0.491084	108.850	84.030	0.00758
6	0.907407	0.455556	14.859	0.261613	0.140731	0.152312	0.923963	0.079544	0.631946	103.530	68.011	0.01937
7	0.944445	0.433333	13.614	0.243533	0.148656	0.155284	0.957312	0.050037	0.682664	109.360	68.698	0.01221

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIE	ROTOR EFFE	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.282000	0.154756	0.171468	0.902530	112.770	-0.015	-0.002	3917.699	153.848	153.848

FLOW RATE # 7 6984. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.055555	0.966667	148.651	39.120	39.120	0.000	0.000	153.713	148.651	75.256	113.090	89.307	4.72760
2	0.092593	0.944444	145.234	41.340	41.340	0.000	0.000	151.003	145.234	74.111	113.090	86.531	8.44890
3	0.296296	0.822222	126.439	43.060	43.060	0.000	0.000	133.570	126.439	71.193	113.090	84.275	12.78630
4	0.500000	0.700000	107.644	43.610	43.610	0.000	0.000	116.142	107.644	67.946	113.090	83.535	10.88560
5	0.703704	0.577778	88.849	43.620	43.620	0.000	0.000	98.979	88.849	63.851	113.090	83.521	8.98490
6	0.907407	0.455556	70.054	42.420	42.420	0.000	0.000	81.896	70.054	58.804	113.090	85.126	4.41590
7	0.944445	0.433333	66.637	40.990	40.990	0.000	0.000	78.234	66.637	58.403	113.090	86.979	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.651	54.541	41.825	35.005	39.928	121.098	113.646	69.795	244.580	198.352	4.72760
2	0.092593	0.944444	145.234	56.391	44.930	34.077	37.179	119.893	111.156	67.991	244.410	194.992	8.44890
3	0.296296	0.822222	126.439	54.937	44.170	32.666	36.485	103.655	93.773	64.778	234.160	187.258	12.78630
4	0.500000	0.700000	107.644	58.093	44.330	37.545	40.263	82.939	70.099	57.691	233.090	180.644	10.88560
5	0.703704	0.577778	88.849	59.415	42.120	41.906	44.854	63.069	46.943	48.100	225.700	170.839	8.98490
6	0.907407	0.455556	70.054	62.741	36.640	50.931	54.269	41.330	19.123	27.560	218.480	157.305	4.41590
7	0.944445	0.433333	66.637	66.170	35.370	55.923	57.688	36.957	10.713	16.851	225.100	157.057	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	2.856	0.254395	3915.900	6983.602	62.150	0.9280E-05	0.2070E 07
2	0.092593	0.944444	2.111	0.268833	3915.900	6983.602	62.150	0.9280E-05	0.2034E 07
3	0.296296	0.822222	1.693	0.280018	3915.900	6983.602	62.150	0.9280E-05	0.1799E 07
4	0.500000	0.700000	1.546	0.283590	3915.900	6983.602	62.150	0.9280E-05	0.1564E 07
5	0.703704	0.577778	1.451	0.283658	3915.900	6983.602	62.150	0.9280E-05	0.1333E 07
6	0.907407	0.455556	3.404	0.275852	3915.900	6983.602	62.150	0.9280E-05	0.1103E 07
7	0.944445	0.433333	4.873	0.266555	3915.900	6983.602	62.150	0.9280E-05	0.1054E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	3.415	0.271982	0.178902	0.220050	0.813005	0.082366	0.341856	131.490	109.045	0.01620
2	0.092593	0.944444	2.391	0.292174	0.178670	0.209292	0.853690	0.063514	0.331562	131.320	108.461	0.01324
3	0.296296	0.822222	4.278	0.287233	0.164725	0.174661	0.943114	0.026339	0.342410	121.070	102.983	0.00544
4	0.500000	0.700000	5.291	0.288274	0.163269	0.170908	0.955303	0.026784	0.419177	120.000	97.109	0.00590
5	0.703704	0.577778	9.700	0.273903	0.153214	0.157450	0.973094	0.020451	0.506896	112.610	87.318	0.00465
6	0.907407	0.455556	17.560	0.238266	0.143391	0.150881	0.950355	0.052820	0.662223	105.390	72.179	0.01257
7	0.944445	0.433333	13.351	0.230006	0.152398	0.157588	0.967065	0.040105	0.710081	112.010	70.078	0.00980

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.273000	0.164227	0.178709	0.918964	111.760	-0.016	-0.009	3915.898	153.777	153.777

TABLE V. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 02

FLOW RATE # 8 6713. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ.IN
1	0.055555	0.966667	148.564	37.960	37.960	0.000	0.000	153.337	148.564	75.667	113.360	90.967	4.72760
2	0.092593	0.944444	145.149	39.960	39.960	0.000	0.000	150.549	145.149	74.608	113.360	88.545	8.44890
3	0.296296	0.822222	126.365	41.590	41.590	0.000	0.000	133.033	126.365	71.782	113.360	86.479	12.78630
4	0.500000	0.700000	107.581	41.920	41.920	0.000	0.000	115.459	107.581	68.711	113.360	86.051	10.88560
5	0.703704	0.577778	88.797	41.420	41.420	0.000	0.000	97.982	88.797	64.993	113.360	86.698	8.98490
6	0.907407	0.455556	70.013	39.980	39.980	0.000	0.000	80.624	70.013	60.272	113.360	88.520	4.41590
7	0.944445	0.433333	66.598	38.300	38.300	0.000	0.000	76.825	66.598	60.097	113.360	90.564	1.58600

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.055555	0.966667	148.564	54.824	43.348	33.564	37.750	122.899	115.000	69.346	248.980	202.271	4.72760
2	0.092593	0.944444	145.149	56.815	45.940	33.429	36.042	120.796	111.720	67.647	246.880	196.716	8.44890
3	0.296296	0.822222	126.365	55.739	45.745	31.848	34.846	105.005	94.517	64.174	233.640	185.358	12.78630
4	0.500000	0.700000	107.581	59.089	46.518	36.436	38.070	85.003	71.145	56.821	235.620	181.360	10.88560
5	0.703704	0.577778	88.797	60.005	43.410	41.427	43.661	64.252	47.370	47.497	226.730	170.774	8.98490
6	0.907407	0.455556	70.013	37.592	16.871	33.593	63.333	40.138	36.420	65.144	173.580	151.619	4.41590
7	0.944445	0.433333	66.598	10.831	4.529	-9.839	-65.283	76.570	76.436	86.610	162.720	160.897	1.58600

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.055555	0.966667	3.267	0.246994	3913.600	6712.699	62.150	0.9280E-05	0.2065E 07
2	0.092593	0.944444	2.608	0.260009	3913.600	6712.699	62.150	0.9280E-05	0.2028E 07
3	0.296296	0.822222	2.282	0.270616	3913.600	6712.699	62.150	0.9280E-05	0.1792E 07
4	0.500000	0.700000	2.311	0.272762	3913.600	6712.699	62.150	0.9280E-05	0.1555E 07
5	0.703704	0.577778	2.593	0.269512	3913.600	6712.699	62.150	0.9280E-05	0.1320E 07
6	0.907407	0.455556	4.872	0.260140	3913.600	6712.699	62.150	0.9280E-05	0.1086E 07
7	0.944445	0.433333	6.567	0.249207	3913.600	6712.699	62.150	0.9280E-05	0.1035E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.055555	0.966667	2.966	0.282057	0.184738	0.211112	0.875069	0.052990	0.323144	135.620	111.304	0.01064
2	0.092593	0.944444	2.047	0.298919	0.181877	0.205428	0.885353	0.049085	0.321149	133.520	108.171	0.01038
3	0.296296	0.822222	3.674	0.297648	0.163842	0.170385	0.961598	0.017465	0.326628	120.280	98.879	0.00368
4	0.500000	0.700000	4.421	0.302683	0.166539	0.165954	1.003524	-0.002072	0.393904	122.260	95.309	-0.00047
5	0.703704	0.577778	9.097	0.282459	0.154430	0.155743	0.991564	0.006465	0.488147	113.370	84.076	0.00149
6	0.907407	0.455556	55.144	0.109778	0.082030	0.099576	0.823792	0.127514	0.613969	60.220	63.099	0.01438
7	0.944445	0.433333	83.110	0.029467	0.067237	-0.027741	-2.423771	-0.760179	-0.029369	49.360	70.333	-0.01148

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.262000	0.164857	0.173768	0.948716	112.030	-0.018	0.001	3913.598	153.687	153.687

TABLE VI. - BLADE-ELEMENT DATA FOR CONFIGURATION 07

NASA CONFIGURATION 07
0.7 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.005-0.012-INCH RADIAL TIP CLEARANCE,
0.43 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-2295 AND TN D-2481.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.375000	70.000	4.375000	61.700	1.050600	0.071380	1.520000	8.300	65.850
2	4.075000	71.030	4.075000	55.000	1.127900	0.074720	1.520000	16.030	63.015
3	3.825000	70.420	3.825000	50.640	1.201700	0.077500	1.520000	19.780	60.530
4	3.575000	69.080	3.575000	46.730	1.285700	0.080270	1.520000	22.350	57.905
5	3.275000	66.920	3.275000	41.000	1.403500	0.083610	1.520000	25.920	53.960

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.150000	4.500000	3.150000	4.500000	19

TABLE VI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 07

FLOW RATE # 1 5784. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.303	55.928	55.928	0.000	0.000	148.257	137.303	67.837	185.660	137.050	6.70040
2	0.314815	0.905555	127.753	58.936	58.936	0.000	0.000	140.692	127.753	65.235	188.520	134.540	7.04110
3	0.500000	0.850000	120.166	59.388	59.388	0.000	0.000	134.040	120.166	63.701	188.460	133.650	6.00830
4	0.685185	0.794444	111.922	58.958	58.958	0.000	0.000	126.501	111.922	62.221	188.360	134.340	6.17720
5	0.907407	0.727778	102.959	59.814	59.814	0.000	0.000	119.072	102.959	59.845	188.360	132.760	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.303	53.289	49.038	20.856	23.040	126.352	116.448	67.163	241.740	197.610	6.70040
2	0.314815	0.905555	127.753	65.188	61.455	21.744	19.485	122.534	106.009	59.898	260.400	194.360	7.04110
3	0.500000	0.850000	120.166	68.865	63.828	25.853	22.050	113.881	94.313	55.911	267.260	193.560	6.00830
4	0.685185	0.794444	111.922	70.841	65.805	26.234	21.735	108.041	85.688	52.477	271.480	193.490	6.17720
5	0.907407	0.727778	102.959	71.650	65.185	29.741	24.525	98.030	73.217	48.321	271.720	191.940	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	-2.163	0.396018	3596.300	5784.500	62.150	0.9280E-05	0.2024E 07
2	0.314815	0.905555	-5.795	0.417760	3592.500	5781.602	62.150	0.9280E-05	0.1920E 07
3	0.500000	0.850000	-6.719	0.420083	3600.000	5788.199	62.150	0.9280E-05	0.1830E 07
4	0.685185	0.794444	-6.859	0.418498	3587.500	5777.898	62.150	0.9280E-05	0.1727E 07
5	0.907407	0.727778	-7.075	0.422806	3602.500	5789.602	62.150	0.9280E-05	0.1625E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	5.463	0.347229	0.090465	0.143574	0.630095	0.096382	0.214701	56.080	60.560	0.01780
2	0.314815	0.905555	4.898	0.435613	0.116198	0.139573	0.832523	0.047007	0.197577	71.880	59.820	0.01045
3	0.500000	0.850000	5.271	0.451493	0.126855	0.155442	0.816089	0.063601	0.230645	78.800	59.910	0.01483
4	0.685185	0.794444	5.747	0.467097	0.134743	0.147934	0.910832	0.032721	0.226580	83.120	59.150	0.00775
5	0.907407	0.727778	7.321	0.460773	0.134009	0.153000	0.875877	0.053614	0.265698	83.360	59.180	0.01270

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.405110	0.120986	0.147660	0.819358	186.522	-0.024	0.012	3595.759	141.205	141.205

FLOW RATE # 2 5439. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.017	52.116	52.116	0.000	0.000	146.594	137.017	69.175	184.690	142.480	6.70040
2	0.314815	0.905555	127.931	55.233	55.233	0.000	0.000	139.345	127.931	66.648	188.520	141.110	7.04110
3	0.500000	0.850000	119.875	55.530	55.530	0.000	0.000	132.112	119.875	65.145	188.470	140.550	6.00830
4	0.685185	0.794444	112.430	55.651	55.651	0.000	0.000	125.450	112.430	63.665	188.360	140.230	6.17720
5	0.907407	0.727778	102.967	55.997	55.997	0.000	0.000	117.209	102.967	61.461	188.570	139.840	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.017	53.841	46.235	27.589	30.825	118.795	109.428	67.095	272.260	227.210	6.70040
2	0.314815	0.905555	127.931	63.280	56.936	27.616	25.875	115.346	100.315	60.422	286.400	224.170	7.04110
3	0.500000	0.850000	119.875	66.401	59.282	29.913	26.775	107.739	89.963	56.617	290.210	221.690	6.00830
4	0.685185	0.794444	112.430	68.688	60.653	32.236	27.990	100.548	80.194	52.899	293.490	220.170	6.17720
5	0.907407	0.727778	102.967	69.572	59.119	36.677	31.815	88.823	66.290	48.273	291.720	216.500	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	-0.825	0.369799	3588.800	5419.199	62.150	0.9280E-05	0.2001E 07
2	0.314815	0.905555	-4.382	0.390969	3597.500	5434.801	62.150	0.9280E-05	0.1902E 07
3	0.500000	0.850000	-5.275	0.393744	3591.300	5425.500	62.150	0.9280E-05	0.1803E 07
4	0.685185	0.794444	-5.415	0.393238	3603.800	5455.102	62.150	0.9280E-05	0.1712E 07
5	0.907407	0.727778	-5.459	0.395791	3602.800	5459.000	62.150	0.9280E-05	0.1600E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EPF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	5.395	0.328069	0.141854	0.190325	0.745327	0.089597	0.279203	87.570	64.730	0.01660
2	0.314815	0.905555	5.422	0.403021	0.157739	0.177017	0.891378	0.039528	0.260080	97.880	83.060	0.00865
3	0.500000	0.850000	5.977	0.420349	0.164579	0.180288	0.912866	0.035803	0.278702	101.740	81.140	0.00820
4	0.685185	0.794444	6.169	0.428581	0.168885	0.180962	0.933260	0.030740	0.298432	105.130	79.940	0.00721
5	0.907407	0.727778	7.273	0.417857	0.165796	0.188665	0.878787	0.066642	0.353662	103.150	76.660	0.01580

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.380790	0.160098	0.182897	0.875346	186.366	-0.028	-0.004	3596.837	141.247	141.247

TABLE VI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 07

FLOW RATE # 3 5048. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.846	48.821	48.821	0.000	0.000	146.236	137.846	70.497	186.900	149.860	6.70040
2	0.314815	0.905555	128.582	51.163	51.163	0.000	0.000	138.387	128.582	68.302	188.890	148.210	7.04110
3	0.500000	0.850000	120.693	51.345	51.345	0.000	0.000	131.161	120.693	66.954	188.840	147.870	6.00830
4	0.685185	0.794444	112.515	51.157	51.157	0.000	0.000	123.598	112.515	65.550	188.410	147.740	6.17720
5	0.907407	0.727778	103.416	51.807	51.807	0.000	0.000	115.667	103.416	63.391	188.570	146.860	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.846	55.894	43.511	35.084	38.880	111.594	102.762	67.051	303.040	254.490	6.70040
2	0.314815	0.905555	128.582	62.600	53.958	31.739	30.465	110.860	96.843	60.875	310.070	249.170	7.04110
3	0.500000	0.850000	120.693	65.464	55.764	34.293	31.590	102.833	86.401	57.161	314.120	247.520	6.00830
4	0.685185	0.794444	112.515	67.468	55.321	38.621	34.920	92.307	73.894	53.180	316.260	245.520	6.17720
5	0.907407	0.727778	103.416	67.948	53.918	41.350	37.485	82.215	62.066	49.018	311.740	239.990	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	0.497	0.344331	3610.500	5041.801	62.150	0.9280E-05	0.1996E 07
2	0.314815	0.905555	-2.728	0.360324	3615.800	5061.102	62.150	0.9280E-05	0.1889E 07
3	0.500000	0.850000	-3.466	0.361607	3615.800	5047.699	62.150	0.9280E-05	0.1790E 07
4	0.685185	0.794444	-3.530	0.361209	3606.500	5023.199	62.150	0.9280E-05	0.1687E 07
5	0.907407	0.727778	-3.529	0.364585	3618.500	5065.301	62.150	0.9280E-05	0.1579E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAD	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	5.351	0.306883	0.185880	0.240573	0.772655	0.102828	0.351070	116.140	104.630	0.01908
2	0.314815	0.905555	5.875	0.380004	0.193378	0.202416	0.955350	0.019030	0.300585	121.180	100.960	0.00411
3	0.500000	0.850000	6.521	0.392724	0.199921	0.205284	0.973875	0.012571	0.324763	125.280	99.650	0.00284
4	0.685185	0.794444	6.450	0.390609	0.205076	0.216641	0.946614	0.030371	0.374685	127.850	97.780	0.00708
5	0.907407	0.727778	8.018	0.379440	0.196261	0.211781	0.926715	0.046848	0.416567	123.470	93.130	0.01095

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.351790	0.196333	0.214450	0.915518	186.982	-0.030	-0.001	3613.419	141.899	141.899

FLOW RATE # 4 4651. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.693	44.900	44.900	0.000	0.000	144.829	137.693	71.939	187.120	155.790	6.70040
2	0.314815	0.905555	128.724	47.083	47.083	0.000	0.000	137.064	128.724	69.909	188.620	154.170	7.04110
3	0.500000	0.850000	120.610	47.410	47.410	0.000	0.000	129.593	120.610	68.541	188.950	154.020	6.00830
4	0.685185	0.794444	112.811	47.667	47.667	0.000	0.000	122.468	112.811	67.094	189.060	153.750	6.17720
5	0.907407	0.727778	103.039	47.849	47.849	0.000	0.000	113.607	103.039	65.091	188.520	152.940	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.693	56.546	40.761	39.191	43.875	106.602	98.502	67.520	325.500	275.810	6.70040
2	0.314815	0.905555	128.724	62.739	48.152	40.219	39.870	100.756	88.505	61.451	331.930	270.760	7.04110
3	0.500000	0.850000	120.610	64.259	49.124	41.425	40.140	93.185	79.185	58.186	332.720	268.550	6.00830
4	0.685185	0.794444	112.811	65.915	50.423	42.453	40.095	86.561	70.358	54.372	331.780	264.260	6.17720
5	0.907407	0.727778	103.039	68.561	50.016	46.894	43.155	75.192	56.145	48.304	332.060	259.010	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	1.939	0.317031	3606.500	4641.898	62.150	0.9280E-05	0.1977E 07
2	0.314815	0.905555	-1.121	0.331221	3619.800	4653.699	62.150	0.9280E-05	0.1871E 07
3	0.500000	0.850000	-1.879	0.334120	3613.300	4649.199	62.150	0.9280E-05	0.1769E 07
4	0.685185	0.794444	-1.986	0.335682	3616.000	4667.398	62.150	0.9280E-05	0.1672E 07
5	0.907407	0.727778	-1.829	0.337963	3605.300	4642.801	62.150	0.9280E-05	0.1551E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	5.820	0.287808	0.221966	0.269035	0.825045	0.090022	0.392728	138.380	120.020	0.01638
2	0.314815	0.905555	6.451	0.338743	0.228188	0.256211	0.890625	0.060281	0.394976	143.310	116.590	0.01277
3	0.500000	0.850000	7.546	0.346203	0.229745	0.248151	0.925824	0.044134	0.413944	143.770	114.530	0.00968
4	0.685185	0.794444	7.642	0.355095	0.227726	0.237511	0.958805	0.026308	0.428005	142.720	110.510	0.00596
5	0.907407	0.727778	7.304	0.353269	0.230396	0.241054	0.955786	0.033105	0.485192	143.540	106.070	0.00785

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.324250	0.227623	0.250425	0.908948	187.095	-0.027	-0.015	3612.178	141.850	141.850

TABLE VI. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 07

FLOW RATE # 5 4323. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.303	42.899	42.899	0.000	0.000	143.849	137.303	72.649	161.240	132.640	6.70040
2	0.314815	0.905555	128.173	45.179	45.179	0.000	0.000	135.902	128.173	70.583	163.020	131.300	7.04110
3	0.500000	0.850000	120.566	45.787	45.787	0.000	0.000	128.968	120.566	69.205	163.020	130.440	6.00830
4	0.685185	0.794444	112.234	45.766	45.766	0.000	0.000	121.206	112.234	67.816	162.800	130.250	6.17720
5	0.907407	0.727778	102.924	46.692	46.692	0.000	0.000	113.020	102.924	65.599	162.860	128.980	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.303	57.862	38.128	43.523	48.780	101.235	93.780	67.875	318.360	266.330	6.70040
2	0.314815	0.905555	128.173	61.871	45.434	41.998	42.750	97.418	86.174	62.201	319.200	259.710	7.04110
3	0.500000	0.850000	120.566	63.857	46.824	43.420	42.840	90.244	77.147	58.745	318.150	254.780	6.00830
4	0.685185	0.794444	112.234	65.543	45.944	46.744	45.495	79.998	65.489	54.949	317.580	250.820	6.17720
5	0.907407	0.727778	102.924	69.168	45.945	51.704	48.375	68.808	51.220	48.108	319.150	244.800	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	2.649	0.303763	3596.300	4314.398	62.150	0.9280E-05	0.1963E 07
2	0.314815	0.905555	-0.447	0.319193	3604.300	4332.199	62.150	0.9280E-05	0.1855E 07
3	0.500000	0.850000	-1.215	0.322801	3612.000	4324.398	62.150	0.9280E-05	0.1760E 07
4	0.685185	0.794444	-1.264	0.323953	3597.500	4306.699	62.150	0.9280E-05	0.1654E 07
5	0.907407	0.727778	-1.321	0.330157	3601.300	4338.102	62.150	0.9280E-05	0.1543E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	6.175	0.269981	0.253457	0.299618	0.845934	0.088986	0.440236	157.120	133.690	0.01595
2	0.314815	0.905555	7.201	0.320993	0.250824	0.268699	0.933475	0.038778	0.420171	156.180	128.410	0.00802
3	0.500000	0.850000	8.105	0.330108	0.248076	0.260195	0.953424	0.029319	0.440339	155.130	124.340	0.00633
4	0.685185	0.794444	8.219	0.325211	0.249516	0.262865	0.949217	0.036271	0.489966	154.780	120.570	0.00810
5	0.907407	0.727778	7.108	0.324879	0.251419	0.266074	0.944919	0.045895	0.554168	156.290	115.820	0.01092

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.302220	0.250580	0.271067	0.924421	161.134	0.008	-0.012	3602.279	141.461	141.461

FLOW RATE # 6 .. 4065. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.597	39.689	39.689	0.000	0.000	143.207	137.597	73.910	161.720	137.240	6.70040
2	0.314815	0.905555	128.198	42.500	42.500	0.000	0.000	135.059	128.198	71.659	163.020	134.950	7.04110
3	0.500000	0.850000	119.999	42.967	42.967	0.000	0.000	127.459	119.999	70.300	163.020	134.330	6.00830
4	0.685185	0.794444	112.484	43.280	43.280	0.000	0.000	120.523	112.484	68.955	163.020	133.910	6.17720
5	0.907407	0.727778	103.039	43.694	43.694	0.000	0.000	111.920	103.039	67.020	162.860	133.190	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.597	72.591	37.831	61.953	58.590	84.577	75.644	63.429	362.740	280.850	6.70040
2	0.314815	0.905555	128.198	64.073	44.553	46.048	45.945	93.454	82.150	61.527	334.070	270.270	7.04110
3	0.500000	0.850000	119.999	65.341	44.579	47.772	46.980	84.877	72.227	58.317	332.080	265.730	6.00830
4	0.685185	0.794444	112.484	66.479	44.237	49.624	48.285	76.865	62.860	54.865	329.970	261.290	6.17720
5	0.907407	0.727778	103.039	70.778	43.949	55.480	51.615	64.756	47.559	47.259	331.800	253.950	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	3.910	0.280433	3604.000	4040.600	62.150	0.9280E-05	0.1955E 07
2	0.314815	0.905555	0.629	0.300209	3605.000	4080.400	62.150	0.9280E-05	0.1843E 07
3	0.500000	0.850000	-0.120	0.304350	3595.000	4091.800	62.150	0.9280E-05	0.1740E 07
4	0.685185	0.794444	-0.125	0.305677	3605.500	4072.100	62.150	0.9280E-05	0.1645E 07
5	0.907407	0.727778	0.100	0.308621	3605.300	4040.600	62.150	0.9280E-05	0.1528E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	1.729	0.267306	0.322890	0.425585	0.758697	0.200603	0.615299	201.020	143.610	0.04270
2	0.314815	0.905555	6.527	0.314713	0.274598	0.294550	0.932265	0.043842	0.459194	171.050	135.320	0.00927
3	0.500000	0.850000	7.677	0.315773	0.272916	0.287630	0.948843	0.036103	0.490035	169.060	131.400	0.00789
4	0.685185	0.794444	8.135	0.312433	0.267942	0.278438	0.962302	0.028973	0.522360	166.950	127.380	0.00648
5	0.907407	0.727778	6.259	0.310418	0.271166	0.285187	0.950833	0.044876	0.598004	168.940	120.760	0.01085

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.284130	0.281533	0.313286	0.898647	161.198	0.004	0.019	3602.959	141.488	141.488

TABLE VII. - BLADE-ELEMENT DATA FOR CONFIGURATION 09

NASA CONFIGURATION 09
0.7 HUB-TIP RATIO, 8 BLADES, 9-INCH TIP DIAMETER,
3.04-INCH CHORD, 0.013-0.020-INCH RADIAL TIP CLEARANCE,
0.46 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.294 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.375000	70.000	4.375000	61.700	0.884720	0.071400	3.040000	8.300	65.850
2	4.075000	71.030	4.075000	55.000	0.949850	0.074700	3.040000	16.030	63.015
3	3.825000	70.420	3.825000	50.640	1.011900	0.077500	3.040000	19.780	60.530
4	3.575000	69.080	3.575000	46.730	1.082700	0.080300	3.040000	22.350	57.905
5	3.275000	66.920	3.275000	41.000	1.181900	0.083600	3.040000	25.920	53.960

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.150000	4.500000	3.150000	4.500000	8

FLOW RATE # 1 5782. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1 0.092593	0.972222	137.445	53.028	53.028	0.000	0.000	147.320	137.445	68.903	168.500	124.800	6.70040
2 0.314815	0.905555	128.020	56.329	56.329	0.000	0.000	139.865	128.020	66.250	171.150	121.840	7.04110
3 0.500000	0.850000	120.166	56.869	56.869	0.000	0.000	132.943	120.166	64.674	170.740	120.480	6.00830
4 0.685185	0.794444	112.312	57.337	57.337	0.000	0.000	126.101	112.312	62.955	170.860	119.770	6.17720
5 0.907407	0.727778	102.887	57.929	57.929	0.000	0.000	118.074	102.887	60.619	170.860	118.710	5.01580

PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1 0.092593	0.972222	137.445	48.430	45.195	17.403	21.060	128.268	120.042	69.369	217.740	181.290	6.70040
2 0.314815	0.905555	128.020	61.830	57.682	22.264	21.105	120.464	105.756	61.391	239.460	180.050	7.04110
3 0.500000	0.850000	120.166	64.956	61.714	20.266	18.180	117.424	99.899	58.294	244.380	178.810	6.00830
4 0.685185	0.794444	112.312	66.894	62.903	22.758	19.890	109.438	89.554	54.915	247.020	177.480	6.17720
5 0.907407	0.727778	102.887	67.706	63.030	24.726	21.420	100.408	78.161	51.117	246.080	174.840	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1 0.092593	0.972222	-1.097	0.375099	3600.000	5768.801	62.150	0.9280E-05	0.4022E 07
2 0.314815	0.905555	-4.780	0.398449	3600.000	5768.801	62.150	0.9280E-05	0.3818E 07
3 0.500000	0.850000	-5.746	0.402269	3600.000	5786.398	62.150	0.9280E-05	0.3629E 07
4 0.685185	0.794444	-6.125	0.405577	3600.000	5794.500	62.150	0.9280E-05	0.3442E 07
5 0.907407	0.727778	-6.301	0.409763	3600.000	5793.102	62.150	0.9280E-05	0.3223E 07

PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1 0.092593	0.972222	7.669	0.319691	0.079268	0.119683	0.662318	0.074434	0.196086	49.240	56.490	0.01482
2 0.314815	0.905555	6.391	0.408019	0.109968	0.142609	0.771113	0.066697	0.222499	68.310	58.210	0.01681
3 0.500000	0.850000	7.654	0.436534	0.118548	0.121853	0.972879	0.007474	0.192062	73.640	58.330	0.00194
4 0.685185	0.794444	8.186	0.444949	0.122605	0.127891	0.958667	0.013288	0.215487	76.160	57.710	0.00353
5 0.907407	0.727778	10.117	0.445844	0.121091	0.127291	0.951295	0.017775	0.238209	75.220	56.130	0.00472

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.404500	0.111263	0.128487	0.865950	169.114	-0.063	-0.038	3600.000	141.372	141.372

TABLE VII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 09

FLOW RATE # 2 5454. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	49.553	49.553	0.000	0.000	146.105	137.445	70.174	167.860	129.700	6.70040
2	0.314815	0.905555	128.020	52.986	52.986	0.000	0.000	138.552	128.020	67.516	170.860	127.230	7.04110
3	0.500000	0.850000	120.166	53.271	53.271	0.000	0.000	131.444	120.166	66.092	170.860	126.760	6.00830
4	0.685185	0.794444	112.312	53.524	53.524	0.000	0.000	124.414	112.312	64.519	170.860	126.340	6.17720
5	0.907407	0.727778	102.887	54.871	54.871	0.000	0.000	116.604	102.887	61.928	170.800	124.010	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	47.538	42.134	22.013	27.585	122.881	115.431	69.947	239.730	204.610	6.70040
2	0.314815	0.905555	128.020	60.685	56.282	22.694	21.960	119.420	105.326	61.882	259.490	202.260	7.04110
3	0.500000	0.850000	120.166	63.219	58.098	24.925	23.220	111.563	95.241	58.616	262.420	200.310	6.00830
4	0.685185	0.794444	112.312	65.154	59.126	27.370	24.840	103.494	84.942	55.159	263.990	198.020	6.17720
5	0.907407	0.727778	102.887	66.387	59.032	30.371	27.225	93.506	72.516	50.853	263.730	195.240	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	0.174	0.350517	3600.000	5460.699	62.150	0.9280E-05	0.3988E 07
2	0.314815	0.905555	-3.514	0.374798	3600.000	5473.500	62.150	0.9280E-05	0.3782E 07
3	0.500000	0.850000	-4.328	0.376812	3600.000	5459.199	62.150	0.9280E-05	0.3588E 07
4	0.685185	0.794444	-4.561	0.378602	3600.000	5436.398	62.150	0.9280E-05	0.3396E 07
5	0.907407	0.727778	-4.992	0.388134	3600.000	5437.801	62.150	0.9280E-05	0.3183E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	8.247	0.298040	0.115699	0.151387	0.764256	0.066828	0.244103	71.870	74.910	0.01295
2	0.314815	0.905555	6.882	0.398112	0.142679	0.145364	0.981533	0.005590	0.224300	88.630	75.030	0.00139
3	0.500000	0.850000	7.976	0.410960	0.147396	0.149861	0.983548	0.005704	0.244951	91.560	73.550	0.00147
4	0.685185	0.794444	8.429	0.418232	0.149924	0.153808	0.974743	0.010032	0.269741	93.130	71.680	0.00265
5	0.907407	0.727778	9.853	0.417567	0.149602	0.156349	0.956844	0.019836	0.308280	92.930	71.230	0.00530

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.381490	0.141924	0.151052	0.939573	168.941	-0.068	-0.035	3600.000	141.372	141.372

FLOW RATE # 3 5139. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	46.630	46.630	0.000	0.000	145.139	137.445	71.260	168.800	135.010	6.70040
2	0.314815	0.905555	128.020	49.825	49.825	0.000	0.000	137.374	128.020	68.734	171.270	132.690	7.04110
3	0.500000	0.850000	120.166	50.192	50.192	0.000	0.000	130.227	120.166	67.330	171.210	132.060	6.00830
4	0.685185	0.794444	112.312	50.473	50.473	0.000	0.000	123.132	112.312	65.801	170.560	130.970	6.17720
5	0.907407	0.727778	102.887	51.664	51.664	0.000	0.000	115.130	102.887	63.337	170.680	129.200	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	47.674	39.069	27.321	34.965	116.849	110.124	70.467	258.690	223.370	6.70040
2	0.314815	0.905555	128.020	59.317	52.725	27.178	27.270	113.793	100.842	62.397	275.400	220.720	7.04110
3	0.500000	0.850000	120.166	62.231	55.051	29.148	27.900	106.371	91.018	58.833	279.020	218.720	6.00830
4	0.685185	0.794444	112.312	64.389	56.038	31.672	29.475	98.199	80.640	55.204	279.830	215.440	6.17720
5	0.907407	0.727778	102.887	65.929	55.722	35.239	32.310	87.642	67.648	50.522	279.630	212.080	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	1.250	0.329837	3600.000	5152.199	62.150	0.9280E-05	0.3962E 07
2	0.314815	0.905555	-2.296	0.352441	3600.000	5147.801	62.150	0.9280E-05	0.3750E 07
3	0.500000	0.850000	-3.090	0.355035	3600.000	5152.301	62.150	0.9280E-05	0.3555E 07
4	0.685185	0.794444	-3.279	0.357024	3600.000	5123.500	62.150	0.9280E-05	0.3361E 07
5	0.907407	0.727778	-3.583	0.365447	3600.000	5118.898	62.150	0.9280E-05	0.3143E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	8.767	0.276354	0.144708	0.187885	0.770191	0.081930	0.301300	89.890	88.360	0.01548
2	0.314815	0.905555	7.397	0.372950	0.167632	0.174090	0.962901	0.013680	0.275797	104.130	88.030	0.00334
3	0.500000	0.850000	8.193	0.389404	0.173556	0.175252	0.990322	0.003998	0.293781	107.810	86.660	0.00102
4	0.685185	0.794444	8.474	0.396386	0.175906	0.177984	0.988325	0.005478	0.321281	109.270	84.470	0.00144
5	0.907407	0.727778	9.522	0.394149	0.175391	0.181411	0.966816	0.018154	0.368244	108.950	82.880	0.00488

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.359480	0.168255	0.178739	0.941345	169.203	-0.069	-0.036	3600.000	141.372	141.372

TABLE VII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 09

FLOW RATE # 4 4652. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	41.395	41.395	0.000	0.000	143.543	137.445	73.239	168.150	141.520	6.70040
2	0.314815	0.905555	128.020	44.922	44.922	0.000	0.000	135.673	128.020	70.664	171.040	139.680	7.04110
3	0.500000	0.850000	120.166	45.307	45.307	0.000	0.000	128.423	120.166	69.342	171.040	139.140	6.00830
4	0.685185	0.794444	112.312	45.892	45.892	0.000	0.000	121.326	112.312	67.774	171.450	138.720	6.17720
5	0.907407	0.727778	102.887	46.733	46.733	0.000	0.000	113.003	102.887	65.572	171.330	137.390	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	49.773	35.771	34.610	44.055	108.879	102.835	70.820	291.140	252.640	6.70040
2	0.314815	0.905555	128.020	58.570	47.759	33.903	35.370	105.541	94.117	63.094	302.090	248.780	7.04110
3	0.500000	0.850000	120.166	61.606	50.010	35.976	35.730	97.923	84.190	59.289	305.660	246.680	6.00830
4	0.685185	0.794444	112.312	64.559	51.382	39.086	37.260	89.455	73.226	54.943	309.320	244.550	6.17720
5	0.907407	0.727778	102.887	66.115	49.799	43.488	41.130	77.512	59.399	50.024	305.750	237.820	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	3.239	0.292813	3600.000	4676.500	62.150	0.9280E-05	0.3919E 07
2	0.314815	0.905555	-0.366	0.317756	3600.000	4671.500	62.150	0.9280E-05	0.3704E 07
3	0.500000	0.850000	-1.078	0.320480	3600.000	4646.398	62.150	0.9280E-05	0.3506E 07
4	0.685185	0.794444	-1.306	0.324622	3600.000	4644.699	62.150	0.9280E-05	0.3312E 07
5	0.907407	0.727778	-1.348	0.330569	3600.000	4619.500	62.150	0.9280E-05	0.3085E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	9.120	0.253026	0.197993	0.238014	0.831854	0.077639	0.377756	122.990	111.120	0.01442
2	0.314815	0.905555	8.094	0.337829	0.210968	0.217167	0.971457	0.013460	0.353632	131.050	109.100	0.00321
3	0.500000	0.850000	8.649	0.353748	0.216715	0.216303	1.001904	-0.000998	0.375913	134.620	107.540	-0.00025
4	0.685185	0.794444	8.213	0.363453	0.221947	0.219645	1.010482	-0.006252	0.411467	137.870	105.830	-0.00166
5	0.907407	0.727778	9.024	0.352255	0.216393	0.223876	0.966576	0.023423	0.476876	134.420	100.430	0.00637

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIP1	ROTOR PSIP	ROTOR PSIIP	ROTOR EFFP	HSVP FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.325400	0.213363	0.222154	0.960428	169.296	-0.073	-0.033	3600.000	141.372	141.372

FLOW RATE # 5 4310. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	38.429	38.429	0.000	0.000	142.716	137.445	74.379	168.450	145.500	6.70040
2	0.314815	0.905555	128.020	41.828	41.828	0.000	0.000	134.680	128.020	71.906	171.270	144.080	7.04110
3	0.500000	0.850000	120.166	42.211	42.211	0.000	0.000	127.364	120.166	70.645	171.680	143.990	6.00830
4	0.685185	0.794444	112.312	42.696	42.696	0.000	0.000	120.154	112.312	69.185	171.800	143.470	6.17720
5	0.907407	0.727778	102.887	43.517	43.517	0.000	0.000	111.712	102.887	67.073	171.680	142.250	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	52.974	31.339	42.709	53.730	99.784	94.735	71.696	314.170	270.560	6.70040
2	0.314815	0.905555	128.020	58.882	44.654	38.381	40.680	100.145	89.639	63.520	319.620	265.740	7.04110
3	0.500000	0.850000	120.166	62.136	47.658	39.870	39.915	93.374	80.296	59.310	322.440	262.440	6.00830
4	0.685185	0.794444	112.312	64.936	48.709	42.943	41.400	84.762	69.369	54.924	324.550	259.020	6.17720
5	0.907407	0.727778	102.887	67.105	46.510	48.373	46.125	71.659	54.514	49.531	321.390	251.410	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	4.379	0.271829	3600.000	4328.398	62.150	0.9280E-05	0.3896E 07
2	0.314815	0.905555	0.676	0.295876	3600.000	4325.000	62.150	0.9280E-05	0.3677E 07
3	0.500000	0.850000	0.225	0.298584	3600.000	4312.301	62.150	0.9280E-05	0.3477E 07
4	0.685185	0.794444	0.105	0.302015	3600.000	4299.699	62.150	0.9280E-05	0.3280E 07
5	0.907407	0.727778	0.153	0.307822	3600.000	4283.301	62.150	0.9280E-05	0.3050E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	9.996	0.221676	0.234584	0.293715	0.798680	0.116044	0.469947	145.720	125.060	0.02060
2	0.314815	0.905555	8.520	0.315861	0.238819	0.245850	0.971398	0.015496	0.406435	148.350	121.660	0.00364
3	0.500000	0.850000	8.670	0.337112	0.242698	0.239716	1.012438	-0.007347	0.421548	150.760	118.450	-0.00185
4	0.685185	0.794444	8.194	0.344549	0.245902	0.241321	1.018983	-0.012683	0.459603	152.750	115.550	-0.00337
5	0.907407	0.727778	8.531	0.328988	0.241008	0.249022	0.967818	0.025669	0.541727	149.710	109.160	0.00705

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.301480	0.240948	0.251554	0.957836	169.670	-0.069	-0.027	3600.000	141.372	141.372

TABLE VII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 09

FLOW RATE # 6 4081. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	36.681	36.681	0.000	0.000	142.255	137.445	75.057	169.800	148.890	6.70040
2	0.314815	0.905555	128.020	39.576	39.576	0.000	0.000	133.997	128.020	72.822	171.800	147.460	7.04110
3	0.500000	0.850000	120.166	39.916	39.916	0.000	0.000	126.622	120.166	71.625	171.800	147.040	6.00830
4	0.685185	0.794444	112.312	40.460	40.460	0.000	0.000	119.377	112.312	70.189	171.860	146.420	6.17720
5	0.907407	0.727778	102.887	41.325	41.325	0.000	0.000	110.876	102.887	68.117	170.920	144.380	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	59.029	30.684	50.427	58.680	92.269	87.017	70.576	335.950	281.800	6.70040
2	0.314815	0.905555	128.020	39.002	41.193	42.242	45.720	95.157	85.778	64.348	330.410	276.310	7.04110
3	0.500000	0.850000	120.166	63.041	46.359	42.719	42.660	90.262	77.447	59.095	334.710	272.950	6.00830
4	0.685185	0.794444	112.312	65.680	47.095	45.782	44.190	81.512	66.530	54.706	335.810	268.770	6.17720
5	0.907407	0.727778	102.887	68.613	44.437	52.278	49.635	67.349	50.609	48.715	332.990	259.830	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	5.057	0.259467	3600.000	4091.600	62.150	0.9280E-05	0.3883E 07
2	0.314815	0.905555	1.792	0.279940	3600.000	4093.500	62.150	0.9280E-05	0.3658E 07
3	0.500000	0.850000	1.205	0.282345	3600.000	4080.100	62.150	0.9280E-05	0.3457E 07
4	0.685185	0.794444	1.109	0.286196	3600.000	4078.300	62.150	0.9280E-05	0.3259E 07
5	0.907407	0.727778	1.197	0.292318	3600.000	4061.000	62.150	0.9280E-05	0.3027E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	8.676	0.217048	0.267473	0.346791	0.771281	0.156671	0.551721	166.150	132.910	0.02945
2	0.314815	0.905555	9.348	0.291381	0.255335	0.270578	0.943666	0.033933	0.455805	158.610	128.850	0.00773
3	0.500000	0.850000	8.455	0.327926	0.262257	0.256851	1.021049	-0.013479	0.453861	162.910	125.910	-0.00342
4	0.685185	0.794444	7.976	0.333128	0.263932	0.257272	1.025884	-0.018679	0.494298	163.950	122.350	-0.00498
5	0.907407	0.727778	7.715	0.314329	0.260905	0.269127	0.969450	0.026733	0.592040	162.070	115.450	0.00746

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.285470	0.261675	0.276518	0.946321	169.959	-0.067	-0.016	3600.000	141.372	141.372

FLOW RATE # 7 3830. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	34.409	34.409	0.000	0.000	141.686	137.445	75.945	170.380	151.980	6.70040
2	0.314815	0.905555	128.020	37.100	37.100	0.000	0.000	133.287	128.020	73.838	172.150	150.760	7.04110
3	0.500000	0.850000	120.166	37.437	37.437	0.000	0.000	125.862	120.166	72.696	171.740	149.960	6.00830
4	0.685185	0.794444	112.312	38.169	38.169	0.000	0.000	118.620	112.312	71.230	171.390	148.750	6.17720
5	0.907407	0.727778	102.887	39.002	39.002	0.000	0.000	110.032	102.887	69.239	171.800	148.160	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	68.090	30.147	61.052	63.720	82.126	76.392	69.464	367.240	295.190	6.70040
2	0.314815	0.905555	128.020	61.396	37.018	48.982	52.920	87.277	79.038	64.904	346.690	288.110	7.04110
3	0.500000	0.850000	120.166	63.260	43.521	45.910	46.530	96.070	74.256	59.626	344.810	282.620	6.00830
4	0.685185	0.794444	112.312	66.411	45.195	48.661	47.115	78.064	63.651	54.624	344.040	275.500	6.17720
5	0.907407	0.727778	102.887	69.577	41.950	55.508	52.920	63.282	47.379	48.478	343.610	268.380	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	5.945	0.243396	3600.000	3836.000	62.150	0.9280E-05	0.3868E 07
2	0.314815	0.905555	2.803	0.262428	3600.000	3844.100	62.150	0.9280E-05	0.3639E 07
3	0.500000	0.850000	2.276	0.264810	3600.000	3827.800	62.150	0.9280E-05	0.3436E 07
4	0.685185	0.794444	2.150	0.269987	3600.000	3817.700	62.150	0.9280E-05	0.3238E 07
5	0.907407	0.727778	2.319	0.275885	3600.000	3821.800	62.150	0.9280E-05	0.3004E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	6.764	0.213250	0.316911	0.419861	0.754799	0.204987	0.663892	196.860	143.210	0.04253
2	0.314815	0.905555	9.904	0.261846	0.280980	0.313751	0.895550	0.073735	0.538638	174.540	137.350	0.01646
3	0.500000	0.850000	8.986	0.307849	0.278613	0.276033	1.009346	-0.006510	0.496394	173.070	132.660	-0.00163
4	0.685185	0.794444	7.894	0.319686	0.277937	0.273451	1.016407	-0.012745	0.531343	172.650	126.750	-0.00341
5	0.907407	0.727778	7.478	0.296734	0.276585	0.285753	0.967917	0.030268	0.638292	171.810	120.220	0.00849

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVR FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.267880	0.284986	0.309161	0.921811	170.199	-0.066	-0.012	3600.000	141.372	141.372

TABLE VII. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 09

FLOW RATE # 8 3617. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	32.977	32.977	0.000	0.000	141.345	137.445	76.508	170.910	154.010	6.70040
2	0.314815	0.905555	128.020	34.791	34.791	0.000	0.000	132.663	128.020	74.797	171.970	153.160	7.04110
3	0.500000	0.850000	120.166	35.450	35.450	0.000	0.000	125.286	120.166	73.563	172.210	152.680	6.00830
4	0.685185	0.794444	112.312	36.017	36.017	0.000	0.000	117.946	112.312	72.219	172.270	152.110	6.17720
5	0.907407	0.727778	102.887	36.839	36.839	0.000	0.000	109.283	102.887	70.300	171.920	150.830	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	74.226	30.598	67.626	65.655	76.230	69.819	66.335	389.030	303.410	6.70040
2	0.314815	0.905555	128.020	63.569	32.359	54.717	59.400	80.128	73.303	66.181	356.360	293.560	7.04110
3	0.500000	0.850000	120.166	63.852	40.040	49.738	51.165	81.014	70.428	60.381	352.720	289.360	6.00830
4	0.685185	0.794444	112.312	67.138	44.003	50.708	49.050	75.705	61.603	54.462	353.510	283.460	6.17720
5	0.907407	0.727778	102.887	69.858	41.195	56.419	53.865	62.099	46.468	48.442	348.130	272.290	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	6.508	0.233264	3600.000	3627.100	62.150	0.9280E-05	0.3859E 07
2	0.314815	0.905555	3.767	0.246093	3600.000	3622.800	62.150	0.9280E-05	0.3622E 07
3	0.500000	0.850000	3.143	0.250759	3600.000	3633.600	62.150	0.9280E-05	0.3420E 07
4	0.685185	0.794444	3.139	0.254771	3600.000	3605.600	62.150	0.9280E-05	0.3220E 07
5	0.907407	0.727778	3.380	0.260581	3600.000	3596.800	62.150	0.9280E-05	0.2983E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	4.635	0.216438	0.351136	0.465066	0.755025	0.227944	0.731078	218.120	149.400	0.05171
2	0.314815	0.905555	11.181	0.228896	0.296937	0.350488	0.846925	0.121851	0.613117	184.390	140.400	0.02590
3	0.500000	0.850000	9.741	0.283227	0.290591	0.299050	0.971714	0.021541	0.549527	180.510	136.680	0.00526
4	0.685185	0.794444	7.732	0.311254	0.291766	0.284958	1.023889	-0.019560	0.556685	181.240	131.350	-0.00525
5	0.907407	0.727778	7.442	0.291392	0.283668	0.290446	0.976665	0.022684	0.650171	176.210	121.460	0.00637

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.253030	0.301638	0.333904	0.903366	170.560	-0.064	-0.007	3600.000	141.372	141.372

FLOW RATE # 9 3574. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.092593	0.972222	137.445	32.771	32.771	0.000	0.000	141.298	137.445	76.589	171.680	154.990	6.70040
2	0.314815	0.905555	128.020	35.186	35.186	0.000	0.000	132.767	128.020	74.632	172.390	153.150	7.04110
3	0.500000	0.850000	120.166	35.929	35.928	0.000	0.000	125.422	120.166	73.354	171.860	151.800	6.00830
4	0.685185	0.794444	112.312	36.690	36.690	0.000	0.000	118.153	112.312	71.909	172.030	151.110	6.17720
5	0.907407	0.727778	102.887	37.557	37.557	0.000	0.000	109.527	102.887	69.946	172.270	150.350	5.01580

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.092593	0.972222	137.445	74.903	29.640	68.790	66.690	74.780	68.655	66.649	390.320	303.130	6.70040
2	0.314815	0.905555	128.020	63.731	31.663	55.309	60.210	79.306	72.711	66.469	355.720	292.600	7.04110
3	0.500000	0.850000	120.166	63.468	39.851	49.423	51.120	81.195	70.743	60.606	350.270	287.630	6.00830
4	0.685185	0.794444	112.312	67.057	44.029	50.578	48.960	75.826	61.734	54.504	352.750	282.870	6.17720
5	0.907407	0.727778	102.887	69.789	41.286	56.266	53.730	62.274	46.621	48.472	347.960	272.270	5.01580

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.092593	0.972222	6.589	0.231811	3600.000	3513.000	62.150	0.9280E-05	0.3857E 07
2	0.314815	0.905555	3.602	0.248890	3600.000	3579.600	62.150	0.9280E-05	0.3624E 07
3	0.500000	0.850000	2.934	0.254139	3600.000	3611.900	62.150	0.9280E-05	0.3424E 07
4	0.685185	0.794444	2.829	0.259529	3600.000	3573.100	62.150	0.9280E-05	0.3225E 07
5	0.907407	0.727778	3.026	0.265659	3600.000	3588.200	62.150	0.9280E-05	0.2990E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.092593	0.972222	4.949	0.209658	0.351973	0.473070	0.744020	0.242447	0.745901	218.640	148.140	0.05431
2	0.314815	0.905555	11.469	0.223970	0.295130	0.354282	0.833039	0.134134	0.621961	183.330	139.450	0.02819
3	0.500000	0.850000	9.966	0.281839	0.287210	0.297158	0.966522	0.025279	0.547336	178.410	135.830	0.00613
4	0.685185	0.794444	7.774	0.311439	0.290329	0.284224	1.023589	-0.019198	0.555923	180.720	131.760	-0.00515
5	0.907407	0.727778	7.472	0.292042	0.282831	0.289658	0.976430	0.022749	0.648758	175.690	121.920	0.00638

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.250020	0.300132	0.334525	0.897189	170.754	-0.042	-0.006	3600.000	141.372	141.372

TABLE VIII. - BLADE-ELEMENT DATA FOR CONFIGURATION 5

NASA CONFIGURATION 5
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
REPORTED IN NASA TN D-3024 AND TN D-3602.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1. (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.460000	68.500	4.460000	39.900	1.009000	0.070900	1.500000	28.600	54.200
2	4.410000	68.600	4.410000	38.000	1.020400	0.072000	1.500000	30.600	53.300
3	4.310000	68.600	4.310000	34.200	1.044100	0.074200	1.500000	34.400	51.400
4	4.260000	68.600	4.260000	32.250	1.056300	0.075300	1.500000	36.350	50.475
5	4.060000	67.700	4.060000	25.100	1.108400	0.079800	1.500000	42.600	46.400
6	3.910000	65.800	3.910000	23.100	1.150900	0.083100	1.500000	42.700	44.450
7	3.710000	63.100	3.710000	20.150	1.212900	0.087600	1.500000	42.950	41.625

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.600000	4.500000	3.600000	4.500000	19

FLOW RATE # 1 5120. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.961	67.749	67.749	0.000	0.000	135.166	116.961	59.919	231.970	160.640	1.57210
2	0.100000	0.980000	115.550	69.289	69.289	0.000	0.000	134.732	115.550	59.051	233.340	158.730	2.07820
3	0.211111	0.957778	113.020	71.847	71.847	0.000	0.000	133.923	113.020	57.556	241.430	161.210	2.03100
4	0.266666	0.946667	112.129	73.455	73.455	0.000	0.000	134.046	112.129	56.772	240.480	156.630	3.34580
5	0.488889	0.902222	106.641	74.572	74.572	0.000	0.000	130.128	106.641	55.036	239.020	152.600	4.46420
6	0.655556	0.868889	102.961	75.319	75.319	0.000	0.000	127.569	102.961	53.813	239.600	151.440	4.29930
7	0.877778	0.824444	97.613	76.139	76.139	0.000	0.000	123.796	97.613	52.046	240.580	150.490	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.961	70.814	58.412	40.033	34.425	96.591	76.928	52.790	327.870	249.940	1.67950
2	0.100000	0.980000	115.550	73.568	62.485	38.833	31.860	98.944	76.717	50.838	333.520	249.410	2.07820
3	0.211111	0.957778	113.020	78.433	68.372	38.431	29.340	101.184	74.589	47.490	344.650	249.050	2.03100
4	0.266666	0.946667	112.129	81.138	72.003	37.403	27.450	103.771	74.726	46.063	347.720	245.410	3.34580
5	0.488889	0.902222	106.641	87.356	78.925	37.442	25.380	104.965	69.199	41.243	358.050	239.460	4.46420
6	0.655556	0.868889	102.961	88.994	80.011	38.964	25.965	102.457	63.997	38.655	360.780	237.700	4.29930
7	0.877778	0.824444	97.613	91.275	80.932	42.203	27.540	98.084	55.411	34.398	363.440	233.970	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-8.581	0.574096	3005.100	5112.801	62.160	0.9280E-05	0.1821E 07
2	0.100000	0.980000	-9.549	0.587656	3002.500	5101.199	62.160	0.9280E-05	0.1815E 07
3	0.211111	0.957778	-11.044	0.608962	3004.900	5116.102	62.160	0.9280E-05	0.1804E 07
4	0.266666	0.946667	-11.828	0.620153	3016.200	5130.199	62.160	0.9280E-05	0.1806E 07
5	0.488889	0.902222	-12.664	0.630903	3009.900	5112.602	62.160	0.9280E-05	0.1753E 07
6	0.655556	0.868889	-11.987	0.635618	3017.500	5129.102	62.160	0.9280E-05	0.1718E 07
7	0.877778	0.824444	-11.054	0.643070	3015.000	5137.699	62.160	0.9280E-05	0.1668E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	12.890	0.494977	0.221558	0.336220	0.658966	0.174805	0.432155	95.900	89.300	0.05238
2	0.100000	0.980000	12.838	0.529944	0.231846	0.322761	0.718322	0.139254	0.406858	100.180	90.680	0.04309
3	0.211111	0.957778	13.290	0.579411	0.238500	0.311931	0.764592	0.114019	0.381887	103.220	87.840	0.03690
4	0.266666	0.946667	13.813	0.607900	0.245936	0.298937	0.822701	0.082765	0.357934	107.240	88.780	0.02718
5	0.488889	0.902222	16.143	0.667730	0.274118	0.285802	0.959119	0.019280	0.323172	119.030	86.860	0.00654
6	0.655556	0.868889	15.555	0.675217	0.277665	0.285704	0.971865	0.013871	0.329543	121.180	86.260	0.00471
7	0.877778	0.824444	14.248	0.683558	0.281982	0.293869	0.959550	0.021746	0.348232	122.860	83.480	0.00740

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.606800	0.263254	0.297436	0.985079	237.613	-0.004	0.021	3010.156	118.208	118.208

TABLE VIII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 5

FLOW RATE # 2 4831. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	117.012	63.569	63.569	0.000	0.000	133.164	117.012	61.486	230.280	167.480	1.57210
2	0.100000	0.980000	115.738	65.714	65.714	0.000	0.000	133.093	115.738	60.413	234.980	167.870	2.07820
3	0.211111	0.957778	113.351	69.080	69.080	0.000	0.000	132.742	113.351	58.640	241.840	167.680	2.03100
4	0.266666	0.946667	111.482	68.912	68.912	0.000	0.000	131.061	111.482	58.278	241.240	167.440	3.34580
5	0.488889	0.902222	106.252	70.276	70.276	0.000	0.000	127.390	106.252	56.519	240.300	163.550	4.46420
6	0.655556	0.868889	102.578	71.199	71.199	0.000	0.000	124.867	102.578	55.236	241.250	162.470	4.29930
7	0.877778	0.824444	97.574	71.663	71.663	0.000	0.000	121.063	97.574	53.705	241.200	161.390	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	117.012	66.299	52.546	40.429	37.575	92.876	76.582	55.545	340.530	272.220	1.67950
2	0.100000	0.980000	115.738	71.492	56.968	43.194	37.170	92.239	72.544	51.858	352.910	273.480	2.07820
3	0.211111	0.957778	113.351	78.944	67.408	41.089	31.365	98.821	72.262	46.990	369.290	272.440	2.03100
4	0.266666	0.946667	111.482	81.719	71.518	39.537	28.935	101.444	71.945	45.170	373.160	269.380	3.34580
5	0.488889	0.902222	106.252	86.251	75.907	40.957	28.350	100.126	65.295	40.702	378.530	262.920	4.46420
6	0.655556	0.868889	102.578	86.549	74.772	43.588	30.240	95.240	58.990	38.271	377.380	260.970	4.29930
7	0.877778	0.824444	97.574	89.326	75.683	47.448	32.085	90.777	50.126	33.517	380.670	256.670	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-7.014	0.538444	3006.400	4829.000	62.160	0.9280E-05	0.1794E 07
2	0.100000	0.980000	-8.187	0.556429	3007.400	4831.301	62.160	0.9280E-05	0.1793E 07
3	0.211111	0.957778	-9.960	0.583704	3013.700	4835.602	62.160	0.9280E-05	0.1788E 07
4	0.266666	0.946667	-10.322	0.585178	2998.800	4816.500	62.160	0.9280E-05	0.1765E 07
5	0.488889	0.902222	-11.181	0.596740	2998.900	4823.199	62.160	0.9280E-05	0.1716E 07
6	0.655556	0.868889	-10.564	0.603091	3006.300	4843.801	62.160	0.9280E-05	0.1682E 07
7	0.877778	0.824444	-9.395	0.605511	3013.800	4834.102	62.160	0.9280E-05	0.1631E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	15.645	0.445075	0.254490	0.339400	0.749822	0.133483	0.452996	110.250	104.740	0.03742
2	0.100000	0.980000	13.858	0.482373	0.272036	0.358428	0.758970	0.136049	0.465986	117.930	105.610	0.04117
3	0.211111	0.957778	12.790	0.569572	0.292769	0.332532	0.880424	0.063213	0.403778	127.450	104.760	0.02065
4	0.266666	0.946667	12.920	0.607308	0.306056	0.317830	0.962954	0.019012	0.368776	131.920	101.940	0.00634
5	0.488889	0.902222	15.602	0.644551	0.320674	-0.313775	1.021985	-0.011791	0.359051	139.230	99.370	-0.00403
6	0.655556	0.868889	15.171	0.633352	0.314249	0.320804	0.979567	0.011719	0.388920	136.130	98.500	0.00400
7	0.877778	0.824444	13.367	0.639472	0.320359	0.330525	0.969243	0.019431	0.411735	139.470	95.280	0.00668

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.573210	0.307428	0.325829	0.943525	238.538	-0.003	0.027	3006.469	118.064	118.064

FLOW RATE # 3 4427. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	117.152	58.128	58.128	0.000	0.000	130.780	117.152	63.610	231.880	179.370	1.57210
2	0.100000	0.980000	116.131	60.115	60.115	0.000	0.000	130.768	116.131	62.632	237.900	181.740	2.07820
3	0.211111	0.957778	113.449	63.133	63.133	0.000	0.000	129.832	113.449	60.905	242.560	180.620	2.03100
4	0.266666	0.946667	112.040	63.183	63.183	0.000	0.000	128.627	112.040	60.580	241.150	179.110	3.34580
5	0.488889	0.902222	106.872	64.559	64.559	0.000	0.000	124.857	106.872	58.865	241.220	176.450	4.46420
6	0.655556	0.868889	102.831	65.124	65.124	0.000	0.000	121.718	102.831	57.653	241.990	176.080	4.29930
7	0.877778	0.824444	97.332	65.440	65.440	0.000	0.000	117.285	97.332	56.086	242.570	176.020	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	117.152	63.377	45.095	44.532	44.640	85.482	72.620	58.161	357.990	295.570	1.67950
2	0.100000	0.980000	116.131	63.133	48.853	47.491	44.190	84.250	68.640	54.559	370.880	298.740	2.07820
3	0.211111	0.957778	113.449	75.685	60.667	45.253	36.720	91.275	68.196	48.344	385.510	296.490	2.03100
4	0.266666	0.946667	112.040	79.342	66.957	42.566	32.445	96.487	69.473	46.057	390.480	292.650	3.34580
5	0.488889	0.902222	106.872	82.682	69.178	45.286	33.210	92.619	61.586	41.677	395.530	289.290	4.46420
6	0.655556	0.868889	102.831	83.822	69.068	47.495	34.515	88.501	55.336	38.701	393.970	284.780	4.29930
7	0.877778	0.824444	97.332	87.175	69.258	52.942	37.395	82.262	44.389	32.657	397.770	279.670	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-4.890	0.491770	3010.000	4435.000	62.160	0.9280E-05	0.1762E 07
2	0.100000	0.980000	-5.966	0.507294	3017.600	4420.102	62.160	0.9280E-05	0.1761E 07
3	0.211111	0.957778	-7.695	0.532990	3016.300	4414.500	62.160	0.9280E-05	0.1749E 07
4	0.266666	0.946667	-8.020	0.533862	3013.800	4429.398	62.160	0.9280E-05	0.1733E 07
5	0.488889	0.902222	-8.835	0.545012	3016.400	4426.602	62.160	0.9280E-05	0.1682E 07
6	0.655556	0.868889	-8.147	0.550279	3013.700	4442.199	62.160	0.9280E-05	0.1640E 07
7	0.877778	0.824444	-7.014	0.554306	3006.300	4423.102	62.160	0.9280E-05	0.1580E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	18.261	0.331504	0.290403	0.373391	0.777746	0.135585	0.515102	126.110	116.200	0.03544
2	0.100000	0.980000	16.559	0.412261	0.304683	0.392751	0.775766	0.144541	0.533684	132.980	117.000	0.04110
3	0.211111	0.957778	14.144	0.512173	0.327809	0.365910	0.895873	0.063427	0.463887	142.950	115.870	0.02019
4	0.266666	0.946667	13.807	0.565749	0.343007	0.340477	1.007431	-0.004284	0.406513	149.330	113.540	-0.00141
5	0.488889	0.902222	16.577	0.584004	0.353836	0.344926	1.025829	-0.016038	0.421813	154.310	112.840	-0.00540
6	0.655556	0.868889	15.601	0.583599	0.349117	0.348703	1.001187	-0.000783	0.442430	151.980	108.700	-0.00027
7	0.877778	0.824444	12.507	0.586647	0.358272	0.369717	0.969042	0.023194	0.484694	155.200	103.650	0.00805

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.524150	0.343206	0.357096	0.961105	239.537	-0.004	0.021	3013.441	118.338	118.338

TABLE VIII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 5

FLOW RATE # 4 4093. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	117.051	53.692	53.692	0.000	0.000	128.777	117.051	65.359	233.810	189.010	1.57210
2	0.100000	0.980000	116.131	55.593	55.593	0.000	0.000	128.752	116.131	64.419	234.530	186.500	2.07820
3	0.211111	0.957778	113.159	58.239	58.239	0.000	0.000	127.266	113.159	62.767	242.750	190.040	2.03100
4	0.266666	0.946667	111.672	58.261	58.261	0.000	0.000	125.956	111.672	62.448	242.890	190.140	3.34580
5	0.488889	0.902222	107.130	59.820	59.820	0.000	0.000	122.700	107.130	60.822	242.240	186.630	4.46420
6	0.655556	0.868889	102.961	60.424	60.424	0.000	0.000	119.382	102.961	59.593	242.900	186.160	4.29930
7	0.877778	0.824444	97.532	60.472	60.472	0.000	0.000	114.758	97.532	58.200	243.290	186.460	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	117.051	63.549	37.996	50.939	53.280	76.253	66.112	60.113	376.570	313.810	1.67950
2	0.100000	0.980000	116.131	67.268	43.284	51.492	49.950	77.792	64.639	56.193	379.420	309.100	2.07820
3	0.211111	0.957778	113.159	72.493	53.733	48.662	42.165	83.947	64.497	50.202	394.680	313.010	2.03100
4	0.266666	0.946667	111.672	75.609	59.193	47.042	38.475	87.640	64.630	47.514	400.310	311.470	3.34580
5	0.488889	0.902222	107.130	81.412	64.834	49.238	37.215	86.919	57.892	41.763	407.450	304.450	4.46420
6	0.655556	0.868889	102.961	83.225	65.680	51.112	37.890	83.679	51.848	38.288	407.900	300.260	4.29930
7	0.877778	0.824444	97.532	86.482	64.781	57.293	41.490	76.261	40.239	31.846	411.400	295.170	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-3.141	0.454627	3007.400	4098.199	62.160	0.9280E-05	0.1735E 07
2	0.100000	0.980000	-4.181	0.469140	3017.600	4103.699	62.160	0.9280E-05	0.1734E 07
3	0.211111	0.957778	-5.833	0.492935	3008.600	4077.700	62.160	0.9280E-05	0.1714E 07
4	0.266666	0.946667	-6.152	0.493894	3003.900	4077.400	62.160	0.9280E-05	0.1697E 07
5	0.488889	0.902222	-6.878	0.503785	3023.700	4109.102	62.160	0.9280E-05	0.1653E 07
6	0.655556	0.868889	-6.207	0.509923	3017.500	4094.700	62.160	0.9280E-05	0.1608E 07
7	0.877778	0.824444	-4.900	0.511175	3012.500	4090.500	62.160	0.9280E-05	0.1546E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	20.213	0.321729	0.329314	0.427484	0.770353	0.165133	0.603886	142.760	124.800	0.04078
2	0.100000	0.980000	18.193	0.365261	0.331971	0.425840	0.779568	0.159033	0.591766	144.890	122.600	0.04336
3	0.211111	0.957778	16.002	0.454798	0.350187	0.394489	0.887698	0.076361	0.523494	151.930	122.970	0.02341
4	0.266666	0.946667	15.264	0.501790	0.363378	0.377515	0.964140	0.023748	0.480987	157.420	121.330	0.00759
5	0.488889	0.902222	16.663	0.546013	0.377002	0.374126	1.007687	-0.005387	0.472636	165.210	117.820	-0.00181
6	0.655556	0.868889	15.188	0.554280	0.378072	0.374786	1.008766	-0.006474	0.485068	165.000	114.100	-0.00221
7	0.877778	0.824444	11.696	0.547599	0.386478	0.389282	0.967932	0.027214	0.541272	168.110	108.710	0.00953

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.484630	0.369894	0.388136	0.953002	240.180	-0.004	0.014	3013.028	118.321	118.321

FLOW RATE # 5 3807. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	117.101	50.448	50.448	0.000	0.000	127.505	117.101	66.693	237.430	197.880	1.57210
2	0.100000	0.980000	115.981	51.620	51.620	0.000	0.000	126.950	115.981	66.007	238.420	197.010	2.07820
3	0.211111	0.957778	113.261	54.299	54.299	0.000	0.000	125.604	113.261	64.386	241.390	195.570	2.03100
4	0.266666	0.946667	112.040	54.311	54.311	0.000	0.000	124.509	112.040	64.138	243.080	197.240	3.34580
5	0.488889	0.902222	106.911	55.414	55.414	0.000	0.000	120.418	106.911	62.601	243.320	195.600	4.46420
6	0.655556	0.868889	102.660	55.882	55.882	0.000	0.000	116.884	102.660	61.439	242.650	194.120	4.29930
7	0.877778	0.824444	97.412	56.175	56.175	0.000	0.000	112.449	97.412	60.029	241.550	192.510	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	117.101	66.826	30.898	59.254	62.460	65.582	57.847	61.892	392.800	323.400	1.67950
2	0.100000	0.980000	115.981	67.910	36.927	56.993	57.060	69.593	58.988	57.953	395.480	323.810	2.07820
3	0.211111	0.957778	113.261	71.086	49.148	51.359	46.260	79.040	61.902	51.552	398.600	320.070	2.03100
4	0.266666	0.946667	112.040	73.512	54.874	48.916	41.715	83.640	63.123	48.999	404.090	320.100	3.34580
5	0.488889	0.902222	106.911	80.537	61.813	51.628	39.870	82.927	55.262	41.808	417.560	316.760	4.46420
6	0.655556	0.868889	102.660	82.876	63.482	53.277	40.005	80.428	49.383	37.879	417.640	310.900	4.29930
7	0.877778	0.824444	97.412	87.131	62.189	61.027	44.460	72.051	36.385	30.331	421.890	303.910	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-1.807	0.426974	3008.700	3819.200	62.160	0.9280E-05	0.1717E 07
2	0.100000	0.980000	-2.593	0.436175	3013.700	3817.200	62.160	0.9280E-05	0.1710E 07
3	0.211111	0.957778	-4.214	0.459178	3011.300	3815.800	62.160	0.9280E-05	0.1692E 07
4	0.266666	0.946667	-4.462	0.458897	3013.800	3813.600	62.160	0.9280E-05	0.1677E 07
5	0.488889	0.902222	-5.099	0.467639	3017.500	3803.500	62.160	0.9280E-05	0.1622E 07
6	0.655556	0.868889	-4.361	0.472970	3008.700	3787.400	62.160	0.9280E-05	0.1574E 07
7	0.877778	0.824444	-3.071	0.475433	3008.800	3794.000	62.160	0.9280E-05	0.1515E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PST	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	21.992	0.261515	0.358092	0.497052	0.720432	0.238638	0.715941	155.370	125.520	0.05571
2	0.100000	0.980000	19.953	0.312021	0.360787	0.471942	0.764473	0.193204	0.671792	157.060	126.800	0.05023
3	0.211111	0.957778	17.352	0.415616	0.361708	0.415973	0.869546	0.096199	0.566530	157.210	124.500	0.02865
4	0.266666	0.946667	16.749	0.463650	0.369813	0.391271	0.945159	0.038775	0.514210	161.000	122.860	0.01204
5	0.488889	0.902222	16.708	0.521638	0.399244	0.393092	1.015650	-0.011914	0.504746	174.240	121.160	-0.00401
6	0.655556	0.868889	14.779	0.537297	0.403311	0.391804	1.029369	-0.023516	0.509925	174.990	116.780	-0.00806
7	0.877778	0.824444	10.181	0.526330	0.415614	0.425827	0.976018	0.022550	0.582984	180.340	111.400	0.00802

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.450980	0.392489	0.411072	0.954793	240.550	-0.005 -	0.022	3011.784	118.272	118.272

TABLE VIII. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 5

FLOW RATE # 6 3450. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.961	45.470	45.470	0.000	0.000	125.489	116.961	68.756	239.000	206.870	1.57210
2	0.100000	0.980000	115.650	47.096	47.096	0.000	0.000	124.872	115.650	67.842	241.070	206.600	2.07820
3	0.211111	0.957778	113.069	48.867	48.867	0.000	0.000	123.177	113.069	66.627	242.770	205.660	2.03100
4	0.266666	0.946667	111.672	49.404	49.404	0.000	0.000	122.112	111.672	66.135	242.840	204.910	3.34580
5	0.488889	0.902222	106.691	50.237	50.237	0.000	0.000	117.927	106.691	64.786	245.290	206.070	4.46420
6	0.655556	0.868889	102.790	50.727	50.727	0.000	0.000	114.626	102.790	63.733	245.150	205.160	4.29930
7	0.877778	0.824444	97.532	51.025	51.025	0.000	0.000	110.073	97.532	62.383	244.030	203.570	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.961	70.203	24.660	65.729	69.435	56.858	51.232	64.297	414.390	337.800	1.67950
2	0.100000	0.980000	115.650	71.054	30.203	64.316	64.845	59.560	51.334	59.529	415.200	336.740	2.07820
3	0.211111	0.957778	113.069	69.609	39.532	57.294	55.395	68.364	55.775	54.672	407.120	331.820	2.03100
4	0.266666	0.946667	111.672	70.737	45.982	53.753	49.455	73.952	57.919	51.554	406.000	328.240	3.34580
5	0.488889	0.902222	106.691	79.257	58.746	53.203	42.165	79.449	53.488	42.318	426.640	329.020	4.46420
6	0.655556	0.868889	102.790	82.717	60.697	56.196	42.795	76.519	46.594	37.512	430.860	324.530	4.29930
7	0.877778	0.824444	97.532	86.631	58.454	63.937	47.565	67.421	33.595	29.887	431.960	315.330	4.61460

FOTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	0.256	0.385305	3005.100	3463.700	62.160	0.9280E-05	0.1690E 07
2	0.100000	0.980000	-0.758	0.399089	3005.100	3441.900	62.160	0.9280E-05	0.1682E 07
3	0.211111	0.957778	-1.973	0.413938	3006.200	3454.800	62.160	0.9280E-05	0.1659E 07
4	0.266666	0.946667	-2.465	0.418807	3003.900	3448.700	62.160	0.9280E-05	0.1645E 07
5	0.488889	0.902222	-2.914	0.424822	3011.300	3453.100	62.160	0.9280E-05	0.1588E 07
6	0.655556	0.868889	-2.067	0.428801	3012.500	3448.500	62.160	0.9280E-05	0.1544E 07
7	0.877778	0.824444	-0.717	0.431314	3012.500	3439.500	62.160	0.9280E-05	0.1483E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	24.397	0.208966	0.405202	0.552026	0.734028	0.259690	0.806461	175.390	130.930	0.05581
2	0.100000	0.980000	21.529	0.255936	0.402291	0.534102	0.753210	0.235446	0.775408	174.130	130.140	0.05850
3	0.211111	0.957778	20.472	0.334866	0.379419	0.464834	0.816247	0.156913	0.667742	164.350	126.160	0.04345
4	0.266666	0.946667	19.304	0.389802	0.377249	0.431371	0.874534	0.101014	0.602752	163.160	123.330	0.02973
5	0.488889	0.902222	17.218	0.496783	0.417248	0.405912	1.027927	-0.022798	0.529799	181.350	122.950	-0.00760
6	0.655556	0.868889	14.412	0.513074	0.426940	0.412746	1.034388	-0.030236	0.545437	185.710	119.370	-0.01042
7	0.877778	0.824444	9.737	0.494118	0.432043	0.445583	0.969613	0.031279	0.626944	187.930	111.760	0.01118

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.409180	0.413616	0.437054	0.946374	242.368	-0.004	0.022	3008.085	118.127	118.127

FLOW RATE # 7 3191. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	117.350	41.068	41.068	0.000	0.000	124.329	117.350	70.712	239.970	213.760	1.57210
2	0.100000	0.980000	115.450	43.273	43.273	0.000	0.000	123.293	115.450	69.453	242.120	213.020	2.07820
3	0.211111	0.957778	113.020	43.049	43.049	0.000	0.000	120.941	113.020	69.148	243.810	215.010	2.03100
4	0.266666	0.946667	111.709	45.441	45.441	0.000	0.000	120.597	111.709	67.864	242.980	210.890	3.34580
5	0.488889	0.902222	106.599	46.415	46.415	0.000	0.000	116.265	106.599	66.471	244.620	211.140	4.46420
6	0.655556	0.868889	102.749	46.884	46.884	0.000	0.000	112.940	102.749	65.473	244.850	210.690	4.29930
7	0.877778	0.824444	97.332	47.028	47.028	0.000	0.000	108.097	97.332	64.211	244.640	210.270	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	117.350	72.644	25.304	68.095	69.615	55.375	49.255	62.809	428.310	346.300	1.67950
2	0.100000	0.980000	115.450	73.978	28.900	68.100	67.005	55.472	47.350	58.602	428.650	343.600	2.07820
3	0.211111	0.957778	113.020	72.493	36.608	62.571	59.670	62.331	50.449	54.034	419.650	337.980	2.03100
4	0.266666	0.946667	111.709	70.719	40.573	57.922	54.990	67.373	53.786	52.972	414.050	336.330	3.34580
5	0.488889	0.902222	106.599	76.925	55.326	53.446	44.010	76.721	53.153	43.852	426.470	334.510	4.46420
6	0.655556	0.868889	102.749	81.035	58.016	56.576	44.280	74.147	46.173	38.515	432.390	330.340	4.29930
7	0.877778	0.824444	97.332	86.229	55.433	56.050	49.995	63.650	31.281	29.437	436.540	320.990	4.61460

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	2.212	0.346848	3015.100	3201.200	62.160	0.9280E-05	0.1675E 07
2	0.100000	0.980000	0.853	0.367322	2999.900	3189.300	62.160	0.9280E-05	0.1661E 07
3	0.211111	0.957778	0.548	0.364316	3004.900	3175.000	62.160	0.9280E-05	0.1629E 07
4	0.266666	0.946667	-0.736	0.385090	3004.900	3203.700	62.160	0.9280E-05	0.1624E 07
5	0.488889	0.902222	-1.229	0.392845	3008.700	3201.400	62.160	0.9280E-05	0.1566E 07
6	0.655556	0.868889	-0.327	0.396472	3011.300	3182.300	62.160	0.9280E-05	0.1521E 07
7	0.877778	0.824444	1.111	0.398350	3006.300	3184.400	62.160	0.9280E-05	0.1456E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	22.909	0.213711	0.432239	0.569999	0.758316	0.249880	0.826015	188.340	132.540	0.05658
2	0.100000	0.980000	20.602	0.245316	0.432434	0.566507	0.763334	0.244809	0.820726	186.530	130.580	0.06249
3	0.211111	0.957778	19.834	0.310229	0.406296	0.507867	0.800005	0.193390	0.732373	175.840	122.970	0.05439
4	0.266666	0.946667	20.722	0.343830	0.395275	0.464678	0.850642	0.132897	0.668687	171.070	125.440	0.03788
5	0.488889	0.902222	18.752	0.468262	0.419122	0.408123	1.026951	-0.022718	0.547487	181.850	123.370	-0.00739
6	0.655556	0.868889	15.415	0.490607	0.431490	0.415702	1.037979	-0.034617	0.561111	187.540	119.650	-0.01177
7	0.877778	0.824444	9.287	0.469540	0.442992	0.461258	0.960400	0.043574	0.663068	191.900	110.720	0.01564

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.378550	0.425092	0.452229	0.939992	242.512	-0.012	0.040	3007.298	118.096	118.096

TABLE IX. - BLADE-ELEMENT DATA FOR CONFIGURATION 6

NASA CONFIGURATION 6
0.8 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.026-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.460000	68.500	4.460000	39.900	1.009000	0.070890	1.500000	28.600	54.200
2	4.410000	68.600	4.410000	38.000	1.020400	0.072000	1.500000	30.600	53.300
3	4.310000	68.600	4.310000	34.200	1.044100	0.074220	1.500000	34.400	51.400
4	4.260000	68.600	4.260000	32.250	1.056300	0.075330	1.500000	36.350	50.425
5	4.060000	67.700	4.060000	25.100	1.108400	0.079780	1.500000	42.600	46.400
6	3.910000	65.800	3.910000	23.100	1.150900	0.083110	1.500000	42.700	44.450
7	3.710000	63.100	3.710000	20.150	1.212900	0.087560	1.500000	42.950	41.625

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.600000	4.500000	3.600000	4.500000	19

FLOW RATE # 1 5099. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.712	67.706	67.706	0.000	0.000	134.929	116.712	59.881	264.850	193.610	1.57210
2	0.100000	0.980000	115.931	68.580	68.580	0.000	0.000	134.696	115.931	59.393	271.010	197.920	2.07820
3	0.211111	0.957778	112.508	72.084	72.084	0.000	0.000	133.620	112.508	57.352	277.540	196.790	2.03100
4	0.266666	0.946667	111.110	72.711	72.711	0.000	0.000	132.787	111.110	56.799	277.540	195.380	3.34580
5	0.488889	0.902222	106.471	74.057	74.057	0.000	0.000	129.694	106.471	55.179	276.360	191.130	4.46420
6	0.655556	0.868889	102.149	74.792	74.792	0.000	0.000	126.602	102.149	53.789	276.810	189.880	4.29930
7	0.877778	0.824444	96.843	75.002	75.002	0.000	0.000	122.490	96.843	52.243	276.810	189.390	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.712	65.233	55.700	33.953	31.365	99.758	82.759	56.058	350.820	284.690	1.61160
2	0.100000	0.980000	115.931	70.719	60.035	37.376	31.905	98.869	78.555	52.612	367.760	290.040	2.07820
3	0.211111	0.957778	112.508	77.587	67.754	37.804	29.160	100.853	74.704	47.793	382.150	288.600	2.03100
4	0.266666	0.946667	111.110	81.123	72.194	36.999	27.135	103.462	74.111	45.751	387.760	285.490	3.34580
5	0.488889	0.902222	106.471	86.927	79.056	36.145	24.570	105.810	70.326	41.655	397.130	279.700	4.46420
6	0.655556	0.868889	102.149	88.406	79.754	38.143	25.560	102.262	64.005	38.748	398.820	277.360	4.29930
7	0.877778	0.824444	96.843	89.366	78.447	42.806	28.620	95.257	54.037	34.560	397.020	272.910	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-8.619	0.574959	2998.700	5098.199	62.192	0.9280E-05	0.1817E 07
2	0.100000	0.980000	-9.207	0.579728	3012.400	5110.000	62.192	0.9280E-05	0.1814E 07
3	0.211111	0.957778	-11.248	0.613648	2991.300	5074.699	62.192	0.9280E-05	0.1800E 07
4	0.266666	0.946667	-11.801	0.619500	2988.800	5089.398	62.192	0.9280E-05	0.1789E 07
5	0.488889	0.902222	-12.521	0.627545	3005.100	5099.699	62.192	0.9280E-05	0.1747E 07
6	0.655556	0.868889	-12.011	0.636186	2993.700	5110.000	62.192	0.9280E-05	0.1705E 07
7	0.877778	0.824444	-10.857	0.638510	2991.200	5108.500	62.192	0.9280E-05	0.1650E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	16.158	0.473005	0.199465	0.285764	0.698005	0.131465	0.385362	85.970	91.080	0.03637
2	0.100000	0.980000	14.612	0.507494	0.222439	0.309630	0.718404	0.134503	0.401953	96.750	92.120	0.04002
3	0.211111	0.957778	13.593	0.576735	0.243915	0.308238	0.791320	0.099425	0.380713	104.610	91.810	0.03199
4	0.266666	0.946667	13.501	0.615096	0.257426	0.298422	0.862623	0.064059	0.352732	110.220	90.110	0.02116
5	0.488889	0.902222	16.555	0.669913	0.279014	0.276338	1.009682	-0.004430	0.309876	120.770	88.570	-0.00149
6	0.655556	0.868889	15.648	0.678402	0.284030	0.281914	1.007505	-0.003649	0.323152	122.010	87.480	-0.00124
7	0.877778	0.824444	14.410	0.667835	0.280398	0.300442	0.932984	0.037032	0.366393	120.210	83.520	0.01257

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.606860	0.265615	0.291669	0.910676	274.432	-0.007	0.007	2997.313	117.704	117.704

TABLE IX. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 6

FLOW RATE # 2 4831. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.809	63.675	63.675	0.000	0.000	133.037	116.809	61.404	266.930	203.920	1.57210
2	0.100000	0.980000	115.550	64.907	64.907	0.000	0.000	132.531	115.550	60.676	272.730	207.260	2.07820
3	0.211111	0.957778	113.020	68.350	68.350	0.000	0.000	132.080	113.020	58.836	276.900	204.300	2.03100
4	0.266666	0.946667	111.389	68.781	68.781	0.000	0.000	130.914	111.389	58.305	277.630	204.110	3.34580
5	0.488889	0.902222	106.379	70.056	70.056	0.000	0.000	127.375	106.379	56.633	277.720	201.450	4.46420
6	0.655556	0.868889	102.319	70.641	70.641	0.000	0.000	124.336	102.319	55.379	277.540	199.990	4.29930
7	0.877778	0.824444	97.047	70.855	70.855	0.000	0.000	120.160	97.047	53.866	277.540	199.520	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.809	60.520	47.674	37.281	38.025	92.723	79.529	59.059	361.210	304.290	1.61160
2	0.100000	0.980000	115.550	67.086	51.925	42.477	39.285	89.642	73.073	54.603	379.140	309.200	2.07820
3	0.211111	0.957778	113.020	77.562	64.524	43.041	33.705	95.187	69.979	47.322	399.130	305.640	2.03100
4	0.266666	0.946667	111.389	80.462	69.829	39.975	29.790	99.880	71.414	45.643	406.590	305.980	3.34580
5	0.488889	0.902222	106.379	85.675	75.779	39.971	27.810	100.760	66.408	41.229	414.540	300.470	4.46420
6	0.655556	0.868889	102.319	85.859	74.977	41.835	29.160	96.332	60.485	38.893	411.550	296.990	4.29930
7	0.877778	0.824444	97.047	87.947	74.660	46.481	31.905	90.172	50.566	34.109	412.230	292.030	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-7.096	0.540278	3001.200	4839.102	62.192	0.9280E-05	0.1792E 07
2	0.100000	0.980000	-7.924	0.550485	3002.500	4831.301	62.192	0.9280E-05	0.1785E 07
3	0.211111	0.957778	-9.764	0.579223	3004.900	4839.102	62.192	0.9280E-05	0.1779E 07
4	0.266666	0.946667	-10.295	0.584554	2996.300	4817.398	62.192	0.9280E-05	0.1763E 07
5	0.488889	0.902222	-11.067	0.594157	3002.500	4840.602	62.192	0.9280E-05	0.1716E 07
6	0.655556	0.868889	-10.421	0.593882	2998.700	4822.000	62.192	0.9280E-05	0.1675E 07
7	0.877778	0.824444	-9.234	0.601938	2997.500	4825.102	62.192	0.9280E-05	0.1619E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	19.159	0.404510	0.218381	0.313510	0.696568	0.149315	0.441892	94.280	100.370	0.03804
2	0.100000	0.980000	16.603	0.440384	0.246264	0.353052	0.697529	0.169044	0.480663	106.410	101.940	0.04798
3	0.211111	0.957778	13.122	0.546807	0.282425	0.349343	0.808445	0.106827	0.435378	122.230	101.340	0.03468
4	0.266666	0.946667	13.393	0.593457	0.299689	0.321619	0.931814	0.035431	0.381594	128.960	101.870	0.01173
5	0.488889	0.902222	16.129	0.642699	0.316642	0.305854	1.035274	-0.018489	0.350506	136.820	99.020	-0.00627
6	0.655556	0.868889	15.793	0.636702	0.310926	0.308679	1.007277	-0.004030	0.371398	134.010	97.000	-0.00136
7	0.877778	0.824444	13.959	0.634264	0.312753	0.325549	0.960694	-0.024559	0.409029	134.690	92.510	0.00838

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIE	ROTOR EFFE	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.574350	0.299381	0.320479	0.934168	275.249	-0.010	0.000	3000.513	117.830	117.830

FLOW RATE # 3 4424. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.280	57.851	57.851	0.000	0.000	129.876	116.280	63.549	265.120	213.110	1.57210
2	0.100000	0.980000	115.069	59.415	59.415	0.000	0.000	129.503	115.069	62.691	269.920	215.060	2.07820
3	0.211111	0.957778	112.930	62.729	62.729	0.000	0.000	129.182	112.930	60.949	274.730	213.580	2.03100
4	0.266666	0.946667	111.151	62.903	62.903	0.000	0.000	127.716	111.151	60.494	274.910	213.420	3.34580
5	0.488889	0.902222	105.851	63.978	63.978	0.000	0.000	123.684	105.851	58.851	274.180	210.570	4.46420
6	0.655556	0.868889	102.241	64.723	64.723	0.000	0.000	121.005	102.241	57.664	274.000	208.900	4.29930
7	0.877778	0.824444	96.966	65.011	65.011	0.000	0.000	116.742	96.966	56.160	274.730	209.050	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.280	59.372	40.164	43.724	47.430	82.931	72.556	61.033	380.280	325.500	1.61160
2	0.100000	0.980000	115.069	65.993	44.491	48.741	47.610	79.868	66.328	56.148	389.010	321.330	2.07820
3	0.211111	0.957778	112.930	74.912	58.242	47.113	38.970	87.886	65.816	48.494	413.910	326.700	2.03100
4	0.266666	0.946667	111.151	76.341	61.585	45.114	36.225	90.297	66.037	46.998	415.320	324.750	3.34580
5	0.488889	0.902222	105.851	81.423	68.885	43.413	32.220	92.971	62.439	42.190	422.450	319.420	4.46420
6	0.655556	0.868889	102.241	82.892	69.317	45.455	33.255	89.607	56.786	39.325	422.380	315.600	4.29930
7	0.877778	0.824444	96.966	85.528	68.757	50.868	36.495	82.780	46.098	33.840	425.800	312.120	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-4.951	0.493093	2987.600	4423.699	62.192	0.9280E-05	0.1749E 07
2	0.100000	0.980000	-5.909	0.506016	2990.000	4433.801	62.192	0.9280E-05	0.1744E 07
3	0.211111	0.957778	-7.651	0.532014	3002.500	4443.898	62.192	0.9280E-05	0.1740E 07
4	0.266666	0.946667	-8.106	0.535739	2989.900	4408.398	62.192	0.9280E-05	0.1720E 07
5	0.488889	0.902222	-8.849	0.545315	2987.600	4410.102	62.192	0.9280E-05	0.1666E 07
6	0.655556	0.868889	-8.136	0.550045	2996.400	4418.602	62.192	0.9280E-05	0.1630E 07
7	0.877778	0.824444	-6.940	0.552748	2995.000	4427.000	62.192	0.9280E-05	0.1572E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	21.133	0.342340	0.269179	0.369371	0.728751	0.163519	0.528292	115.160	112.390	0.03924
2	0.100000	0.980000	18.148	0.378911	0.277919	0.406804	0.683177	0.211903	0.567696	119.090	106.270	0.05784
3	0.211111	0.957778	14.294	0.493963	0.322104	0.382704	0.841652	0.100969	0.494322	139.180	113.120	0.03204
4	0.266666	0.946667	14.748	0.524513	0.327696	0.363744	0.900895	0.060935	0.460194	140.410	111.330	0.01967
5	0.488889	0.902222	17.090	0.587139	0.346572	0.333847	1.038117	-0.022900	0.406648	148.270	108.850	-0.00765
6	0.655556	0.868889	16.225	0.589091	0.344795	0.335650	1.027244	-0.017294	0.422670	148.380	106.700	-0.00581
7	0.877778	0.824444	13.690	0.584601	0.351374	0.356574	0.985417	0.010556	0.470541	151.070	103.070	0.00361

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.527340	0.334310	0.354300	0.943579	272.287	-0.010	-0.014	2992.713	117.523	117.523

TABLE IX. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 6

FLOW RATE # 4 4115. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1 0.044444	0.991111	116.809	55.588	55.588	0.000	0.000	129.361	116.809	64.551	269.740	221.720	1.57210
2 0.100000	0.980000	115.888	54.982	54.982	0.000	0.000	128.270	115.888	64.618	270.740	223.760	2.07820
3 0.211111	0.957778	113.069	58.211	58.211	0.000	0.000	127.174	113.069	62.759	275.360	222.700	2.03100
4 0.266666	0.946667	111.619	58.360	58.360	0.000	0.000	125.956	111.619	62.397	274.370	221.440	3.34580
5 0.488889	0.902222	106.818	59.798	59.798	0.000	0.000	122.417	106.818	60.759	274.640	219.070	4.46420
6 0.655556	0.868889	102.619	60.403	60.403	0.000	0.000	119.077	102.619	59.518	274.820	218.120	4.29930
7 0.877778	0.824444	97.289	60.424	60.424	0.000	0.000	114.527	97.289	58.156	275.630	218.890	4.43670

PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1 0.044444	0.991111	116.809	60.200	34.033	49.657	55.575	75.284	67.152	63.124	396.800	340.480	1.61160
2 0.100000	0.980000	115.888	64.169	38.609	51.254	53.010	75.288	64.634	59.148	406.440	342.450	2.07820
3 0.211111	0.957778	113.069	71.690	50.333	51.050	45.405	79.874	62.019	50.938	420.490	340.620	2.03100
4 0.266666	0.946667	111.619	74.507	56.807	48.210	40.320	85.134	63.409	48.143	426.340	340.070	3.34580
5 0.488889	0.902222	106.818	80.398	65.632	46.435	35.280	89.183	60.383	42.615	435.590	335.140	4.46420
6 0.655556	0.868889	102.619	82.378	66.759	48.263	35.865	86.089	54.356	39.153	435.320	329.860	4.29930
7 0.877778	0.824444	97.289	85.468	65.597	54.789	39.870	78.161	42.500	32.939	440.180	326.660	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1 0.044444	0.991111	-3.949	0.471654	3001.200	4113.199	62.192	0.9280E-05	0.1742E 07
2 0.100000	0.980000	-3.982	0.464954	3011.300	4118.699	62.192	0.9280E-05	0.1728E 07
3 0.211111	0.957778	-5.841	0.493095	3006.200	4116.898	62.192	0.9280E-05	0.1713E 07
4 0.266666	0.946667	-6.203	0.494967	3002.500	4082.200	62.192	0.9280E-05	0.1697E 07
5 0.488889	0.902222	-6.941	0.505073	3014.900	4122.301	62.192	0.9280E-05	0.1649E 07
6 0.655556	0.868889	-6.282	0.511439	3007.500	4127.801	62.192	0.9280E-05	0.1604E 07
7 0.877778	0.824444	-4.944	0.512044	3005.000	4125.898	62.192	0.9280E-05	0.1543E 07

PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1 0.044444	0.991111	23.224	0.288765	0.294310	0.417590	0.704781	0.204656	0.608257	127.060	118.760	0.04585
2 0.100000	0.980000	21.148	0.326491	0.312217	0.424756	0.735048	0.191300	0.608850	135.700	118.690	0.04807
3 0.211111	0.957778	16.738	0.426358	0.335047	0.414170	0.808961	0.136362	0.564164	145.130	117.920	0.04115
4 0.266666	0.946667	15.893	0.481794	0.351704	0.387073	0.908623	0.061989	0.505273	151.970	116.630	0.01958
5 0.488889	0.902222	17.515	0.554346	0.369429	0.353859	1.044001	-0.029128	0.442595	160.950	116.070	-0.00967
6 0.655556	0.868889	16.053	0.565256	0.370211	0.355072	1.042635	-0.029785	0.453113	160.500	111.740	-0.01003
7 0.877778	0.824444	12.789	0.555876	0.380184	0.382781	0.993216	0.005514	0.514737	164.550	107.770	0.00191

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIP	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.488250	0.360119	0.377325	0.954400	273.068	-0.008	-0.011	3006.942	118.082	118.082

FLOW RATE # 5 3757. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.860	48.636	48.636	0.000	0.000	126.577	116.860	67.403	269.290	232.530	1.57210
2	0.100000	0.980000	115.450	50.166	50.166	0.000	0.000	125.878	115.450	66.514	272.460	233.350	2.07820
3	0.211111	0.957778	112.790	53.028	53.028	0.000	0.000	124.634	112.790	64.819	275.630	231.930	2.03100
4	0.266666	0.946667	111.761	53.457	53.457	0.000	0.000	123.888	111.761	64.437	275.360	230.950	3.34580
5	0.488889	0.902222	106.379	54.187	54.187	0.000	0.000	119.385	106.379	63.007	275.630	230.000	4.46420
6	0.655556	0.868889	102.189	54.630	54.630	0.000	0.000	115.876	102.189	61.871	276.090	229.710	4.29930
7	0.877778	0.824444	97.128	54.859	54.859	0.000	0.000	111.550	97.128	60.541	276.000	229.230	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.860	66.290	30.141	59.041	62.955	65.204	57.819	62.467	423.730	355.440	1.61160
2	0.100000	0.980000	115.450	66.450	32.832	57.772	60.390	66.368	57.678	60.350	425.110	356.490	2.07820
3	0.211111	0.957778	112.790	68.865	42.804	53.947	51.570	72.765	58.843	53.967	425.590	351.890	2.03100
4	0.266666	0.946667	111.761	70.641	48.398	51.457	46.755	77.323	60.303	51.251	428.680	351.130	3.34580
5	0.488889	0.902222	106.379	78.633	61.483	49.020	38.565	84.085	57.359	43.012	444.670	348.580	4.46420
6	0.655556	0.868889	102.189	81.554	63.204	51.539	39.195	80.995	50.651	38.708	446.240	342.880	4.29930
7	0.877778	0.824444	97.128	86.064	62.877	58.767	43.065	73.655	38.360	31.387	452.660	337.550	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	-1.097	0.412489	3002.500	3783.300	62.192	0.9280E-05	0.1705E 07
2	0.100000	0.980000	-2.086	0.425838	2999.900	3765.500	62.192	0.9280E-05	0.1696E 07
3	0.211111	0.957778	-3.781	0.450298	2998.800	3747.500	62.192	0.9280E-05	0.1679E 07
4	0.266666	0.946667	-4.163	0.452810	3006.300	3757.500	62.192	0.9280E-05	0.1669E 07
5	0.488889	0.902222	-4.693	0.459567	3002.500	3751.500	62.192	0.9280E-05	0.1608E 07
6	0.655556	0.868889	-3.929	0.464506	2994.900	3743.500	62.192	0.9280E-05	0.1561E 07
7	0.877778	0.824444	-2.559	0.465661	3000.000	3749.500	62.192	0.9280E-05	0.1503E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	22.567	0.255634	0.357420	0.496286	0.720189	0.240993	0.716010	154.440	122.910	0.05520
2	0.100000	0.980000	22.350	0.278700	0.353890	0.480592	0.736364	0.221944	0.697649	152.650	123.140	0.05380
3	0.211111	0.957778	19.767	0.363476	0.347909	0.438758	0.792942	0.162214	0.623454	149.960	119.960	0.04570
4	0.266666	0.946667	19.001	0.409951	0.353931	0.412621	0.857763	0.106591	0.572470	153.320	120.180	0.03158
5	0.488889	0.902222	17.912	0.521453	0.391209	0.375098	1.042951	-0.031429	0.480906	169.040	118.580	-0.01037
6	0.655556	0.868889	15.608	0.537407	0.395779	0.380765	1.039431	-0.030933	0.494245	170.150	113.170	-0.01049
7	0.877778	0.824444	11.237	0.533716	0.409525	0.411259	0.995785	0.003867	0.556889	176.660	108.320	0.00136

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.446660	0.384946	0.405634	0.948999	273.901	-0.015	-0.006	3000.698	117.937	117.837

TABLE IX. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 6

FLOW RATE # 6 3448. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.712	44.418	44.418	0.000	0.000	124.878	116.712	69.164	270.110	239.450	1.57210
2	0.100000	0.980000	115.650	46.200	46.200	0.000	0.000	124.536	115.650	68.224	274.280	241.110	2.07820
3	0.211111	0.957778	112.978	48.629	48.629	0.000	0.000	123.000	112.978	66.712	275.540	238.790	2.03100
4	0.266666	0.946667	111.809	48.939	48.939	0.000	0.000	122.050	111.809	66.361	275.630	238.410	3.34580
5	0.488889	0.902222	106.641	49.780	49.780	0.000	0.000	117.688	106.641	64.977	276.180	237.670	4.46420
6	0.655556	0.868889	102.749	50.185	50.185	0.000	0.000	114.350	102.749	63.968	276.630	237.490	4.29930
7	0.877778	0.824444	97.736	50.403	50.403	0.000	0.000	109.967	97.736	62.720	276.720	237.240	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.712	70.010	26.283	64.889	67.950	58.107	51.823	63.107	443.290	367.120	1.61160
2	0.100000	0.980000	115.650	71.168	28.572	65.180	66.330	57.996	50.469	60.485	447.460	368.750	2.07820
3	0.211111	0.957778	112.978	69.145	37.050	58.381	57.600	65.981	54.597	55.839	435.150	360.850	2.03100
4	0.266666	0.946667	111.809	68.655	41.994	54.314	52.290	71.198	57.495	53.856	432.320	359.070	3.34580
5	0.488889	0.902222	106.641	77.196	58.026	50.914	41.265	80.452	55.727	43.842	451.720	359.110	4.46420
6	0.655556	0.868889	102.749	81.534	61.455	53.582	41.085	78.703	49.167	38.661	458.010	354.700	4.29930
7	0.877778	0.824444	97.736	86.415	60.864	61.344	45.225	70.914	36.392	30.876	463.150	347.100	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	0.664	0.377191	2998.700	3463.100	62.192	0.9280E-05	0.1682E 07
2	0.100000	0.980000	-0.376	0.391491	3005.100	3454.400	62.192	0.9280E-05	0.1677E 07
3	0.211111	0.957778	-1.888	0.412255	3003.800	3447.900	62.192	0.9280E-05	0.1657E 07
4	0.266666	0.946667	-2.239	0.414357	3007.600	3443.500	62.192	0.9280E-05	0.1644E 07
5	0.488889	0.902222	-2.723	0.421155	3009.900	3447.900	62.192	0.9280E-05	0.1585E 07
6	0.655556	0.868889	-1.832	0.424388	3011.300	3434.800	62.192	0.9280E-05	0.1540E 07
7	0.877778	0.824444	-0.380	0.425169	3018.800	3443.500	62.192	0.9280E-05	0.1481E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	23.207	0.223192	0.401806	0.546136	0.735725	0.256684	0.792185	173.180	127.670	0.05753
2	0.100000	0.980000	22.485	0.242111	0.400097	0.541283	0.739163	0.253554	0.790769	173.180	127.640	0.06121
3	0.211111	0.957778	21.639	0.314091	0.369065	0.474030	0.778568	0.193076	0.690862	159.610	122.060	0.05192
4	0.266666	0.946667	21.606	0.355554	0.361399	0.435340	0.830153	0.138484	0.627297	156.690	120.660	0.03866
5	0.488889	0.902222	18.742	0.490919	0.404257	0.388634	1.040200	-0.031519	0.511551	175.540	121.440	-0.01025
6	0.655556	0.868889	15.561	0.519689	0.417318	0.393706	1.059974	-0.050503	0.515312	181.380	117.210	-0.01713
7	0.877778	0.824444	10.726	0.513415	0.426808	0.426619	1.000442	-0.000438	0.585095	186.430	109.860	-0.00015

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.408950	0.404864	0.424944	0.952746	274.514	-0.015	0.011	3007.883	118.119	118.119

FLOW RATE # 7 3254. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.044444	0.991111	116.420	42.553	42.553	0.000	0.000	123.953	116.420	69.922	272.460	244.320	1.57210
2	0.100000	0.980000	115.069	41.751	41.751	0.000	0.000	122.409	115.069	70.057	270.380	243.290	2.07820
3	0.211111	0.957778	112.550	45.892	45.892	0.000	0.000	121.546	112.550	67.817	275.730	243.000	2.03100
4	0.266666	0.946667	111.478	46.450	46.450	0.000	0.000	120.768	111.478	67.380	276.630	243.100	3.34580
5	0.488889	0.902222	106.252	47.226	47.226	0.000	0.000	116.274	106.252	66.036	276.630	241.970	4.46420
6	0.655556	0.868889	102.449	47.653	47.653	0.000	0.000	112.989	102.449	65.055	276.090	240.800	4.29930
7	0.877778	0.824444	97.047	47.761	47.761	0.000	0.000	108.163	97.047	63.796	275.730	240.280	4.43670

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.044444	0.991111	116.420	71.272	25.402	66.591	69.120	55.930	49.829	62.988	450.590	371.650	1.61160
2	0.100000	0.980000	115.069	72.187	27.729	66.648	67.410	55.798	48.421	60.201	451.760	370.780	2.07820
3	0.211111	0.957778	112.550	71.068	33.992	62.411	61.425	60.575	50.138	55.864	444.200	365.710	2.03100
4	0.266666	0.946667	111.478	70.313	38.326	58.949	56.970	65.024	52.529	53.885	439.040	362.210	3.34580
5	0.488889	0.902222	106.252	75.148	53.966	52.296	44.100	76.312	53.955	44.995	448.360	360.600	4.46420
6	0.655556	0.868889	102.449	80.900	59.579	54.728	42.570	76.334	47.721	38.693	457.690	355.980	4.29930
7	0.877778	0.824444	97.047	85.945	58.833	62.651	46.800	68.150	34.396	30.312	462.830	348.040	4.55240

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.044444	0.991111	1.422	0.362263	2991.200	3235.100	62.192	0.9280E-05	0.1670E 07
2	0.100000	0.980000	1.457	0.355582	2990.000	3255.800	62.192	0.9280E-05	0.1649E 07
3	0.211111	0.957778	-0.783	0.390536	2992.400	3255.800	62.192	0.9280E-05	0.1637E 07
4	0.266666	0.946667	-1.220	0.394449	2998.700	3253.500	62.192	0.9280E-05	0.1627E 07
5	0.488889	0.902222	-1.664	0.401014	2998.900	3262.700	62.192	0.9280E-05	0.1566E 07
6	0.655556	0.868889	-0.745	0.404158	3002.500	3260.400	62.192	0.9280E-05	0.1522E 07
7	0.877778	0.824444	0.696	0.405746	2997.500	3253.500	62.192	0.9280E-05	0.1457E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSTI	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.044444	0.991111	23.088	0.216254	0.415367	0.561866	0.739263	0.263125	0.814998	178.130	127.330	0.05922
2	0.100000	0.980000	22.201	0.236151	0.423285	0.555267	0.760938	0.244714	0.810957	181.360	127.490	0.05959
3	0.211111	0.957778	21.664	0.289270	0.392526	0.508685	0.771649	0.217149	0.747525	168.470	122.710	0.05835
4	0.266666	0.946667	21.635	0.325461	0.376819	0.473893	0.795155	0.184593	0.692627	162.410	119.110	0.05150
5	0.488889	0.902222	19.895	0.458242	0.398390	0.400647	0.994365	0.004632	0.546583	171.730	119.630	0.00148
6	0.655556	0.868889	15.593	0.505301	0.420276	0.403304	1.042083	-0.036964	0.534841	181.600	115.180	-0.01253
7	0.877778	0.824444	10.162	0.499809	0.434451	0.438804	0.990080	0.010311	0.608711	187.100	107.760	0.00367

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.387470	0.411798	0.441486	0.932755	274.290	-0.013	0.016	2995.985	117.648	117.648

TABLE X. - BLADE-ELEMENT DATA FOR CONFIGURATION 8

NASA CONFIGURATION 8
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.008-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	2.459000	68.550	2.459000	38.590	1.020300	0.071640	0.833300	29.960	53.570
2	2.409000	68.610	2.409000	35.080	1.041500	0.073640	0.833300	33.530	51.845
3	2.359000	68.550	2.359000	31.500	1.063600	0.075640	0.833300	37.050	50.025
4	2.259000	67.100	2.259000	25.250	1.110700	0.079640	0.833300	41.850	46.175
5	2.159000	65.450	2.159000	22.750	1.162100	0.083640	0.833300	42.700	44.100
6	2.109000	64.200	2.109000	21.550	1.189700	0.085640	0.833300	42.650	42.875
7	2.059000	63.000	2.059000	20.000	1.218600	0.087640	0.833300	43.000	41.500

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
2.000000	2.509000	2.000000	2.509000	19

FLOW RATE # 1 1688. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.660	68.175	68.175	0.000	0.000	134.257	115.660	59.483	248.300	176.070	0.97352
2	0.196463	0.960144	113.150	72.151	72.151	0.000	0.000	134.196	113.150	57.476	257.460	176.560	0.75681
3	0.294695	0.940215	110.550	75.868	75.868	0.000	0.000	134.079	110.550	55.539	265.440	175.990	1.11170
4	0.491159	0.900359	105.810	78.785	78.785	0.000	0.000	131.920	105.810	53.329	270.510	174.050	1.41940
5	0.687622	0.860502	101.360	79.795	79.795	0.000	0.000	129.000	101.360	51.789	270.420	171.470	1.01740
6	0.785854	0.840574	98.786	79.468	79.468	0.000	0.000	126.782	98.786	51.185	266.890	168.750	0.66256
7	0.884086	0.820646	96.354	75.609	75.609	0.000	0.000	122.478	96.354	51.879	257.010	168.170	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.660	73.235	62.978	37.379	30.690	100.470	78.281	51.183	346.630	263.280	1.03260
2	0.196463	0.960144	113.150	75.783	66.946	35.514	27.945	102.514	77.636	49.228	348.820	259.570	0.75681
3	0.294695	0.940215	110.550	80.485	71.395	37.158	27.495	102.389	73.392	45.790	357.700	257.030	1.11170
4	0.491159	0.900359	105.810	88.628	79.773	38.616	25.830	104.302	67.194	40.108	374.220	252.150	1.41940
5	0.687622	0.860502	101.360	93.707	85.374	38.629	24.345	105.943	62.731	36.308	384.120	247.660	1.01740
6	0.785854	0.840574	98.786	94.670	86.495	38.483	23.985	105.441	60.303	34.883	381.820	242.540	0.66256
7	0.884086	0.820646	96.354	91.095	82.697	38.203	24.795	101.096	58.151	35.114	371.150	242.190	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-9.067	0.577699	5389.852	1676.600	62.192	0.9280E-05	0.1005E 07
2	0.196463	0.960144	-11.134	0.612243	5382.320	1687.100	62.192	0.9280E-05	0.1004E 07
3	0.294695	0.940215	-13.011	0.645248	5370.105	1676.100	62.192	0.9280E-05	0.1003E 07
4	0.491159	0.900359	-13.771	0.670394	5367.391	1693.100	62.192	0.9280E-05	0.9871E 06
5	0.687622	0.860502	-13.661	0.677425	5379.801	1694.800	62.192	0.9280E-05	0.9653E 06
6	0.785854	0.840574	-13.015	0.676193	5367.492	1696.400	62.192	0.9280E-05	0.9487E 06
7	0.884086	0.820646	-11.121	0.643958	5362.484	1689.300	62.192	0.9280E-05	0.9165E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	12.593	0.533659	0.227165	0.310425	0.731786	0.128659	0.388100	98.330	87.210	0.03952
2	0.196463	0.960144	14.148	0.568081	0.211654	0.289344	0.731496	0.119826	0.363134	91.360	83.010	0.03757
3	0.294695	0.940215	14.290	0.607205	0.214712	0.297130	0.722621	0.126762	0.366631	92.260	81.040	0.04155
4	0.491159	0.900359	14.858	0.678808	0.241603	0.295846	0.816652	0.086095	0.341125	103.710	78.100	0.02964
5	0.687622	0.860502	13.558	0.724791	0.263656	0.282194	0.934308	0.030913	0.307575	113.700	76.190	0.01072
6	0.785854	0.840574	13.333	0.735992	0.267732	0.275249	0.972689	0.012918	0.295896	114.930	73.790	0.00445
7	0.884086	0.820646	15.114	0.704333	0.266388	0.267016	0.997649	0.001154	0.302557	114.140	74.020	0.00039

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.638210	0.243051	0.288483	0.842516	262.159	-0.042	-0.019	5374.203	117.669	117.669

TABLE X. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 8

FLOW RATE # 2 1636. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.230	64.778	64.778	0.000	0.000	132.190	115.230	60.657	245.950	180.740	0.97352
2	0.196463	0.960144	113.360	70.486	70.486	0.000	0.000	133.487	113.360	58.127	257.550	180.340	0.75681
3	0.294695	0.940215	111.060	74.382	74.382	0.000	0.000	133.667	111.060	56.188	266.070	180.090	1.11170
4	0.491159	0.900359	106.310	77.142	77.142	0.000	0.000	131.349	106.310	54.034	271.690	179.210	1.41940
5	0.687622	0.860502	101.500	77.517	77.517	0.000	0.000	127.715	101.500	52.631	272.330	178.950	1.01740
6	0.785854	0.840574	99.062	78.013	78.013	0.000	0.000	126.092	99.062	51.779	271.060	176.480	0.66256
7	0.884086	0.820646	97.163	73.218	73.218	0.000	0.000	121.661	97.163	53.000	259.540	176.230	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.230	70.441	59.682	37.416	32.085	98.065	77.814	52.512	356.050	278.940	1.03260
2	0.196463	0.960144	113.360	74.364	64.009	37.855	30.600	98.986	75.505	49.711	362.940	277.000	0.75681
3	0.294695	0.940215	111.060	79.261	67.872	40.935	31.095	97.592	70.125	45.935	371.460	273.830	1.11170
4	0.491159	0.900359	106.310	87.764	77.303	41.554	28.260	100.842	64.756	39.953	390.890	271.190	1.41940
5	0.687622	0.860502	101.500	92.660	82.889	41.417	26.550	102.374	60.083	35.937	400.500	267.070	1.01740
6	0.785854	0.840574	99.062	92.834	82.815	41.951	26.865	100.598	57.111	34.591	400.360	266.430	0.66256
7	0.884086	0.820646	97.163	90.450	79.703	42.763	28.215	96.498	54.400	34.315	389.630	262.490	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-7.893	0.550956	5369.820	1636.900	62.192	0.9280E-05	0.9892E 06
2	0.196463	0.960144	-10.483	0.597010	5392.313	1649.900	62.192	0.9280E-05	0.9989E 06
3	0.294695	0.940215	-12.362	0.629704	5394.883	1634.000	62.192	0.9280E-05	0.1000E 07
4	0.491159	0.900359	-13.066	0.653331	5392.750	1630.600	62.192	0.9280E-05	0.9829E 06
5	0.687622	0.860502	-12.819	0.657174	5387.238	1628.900	62.192	0.9280E-05	0.9557E 06
6	0.785854	0.840574	-12.421	0.661968	5382.480	1628.900	62.192	0.9280E-05	0.9435E 06
7	0.884086	0.820646	-10.000	0.618402	5407.508	1644.800	62.192	0.9280E-05	0.9104E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.922	0.507613	0.256258	0.311898	0.821609	0.088031	0.396855	110.100	98.200	0.02625
2	0.196463	0.960144	14.631	0.542144	0.243253	0.307844	0.790182	0.101059	0.394604	105.390	96.660	0.03137
3	0.294695	0.940215	14.435	0.574594	0.243021	0.325830	0.745852	0.129336	0.413858	105.390	93.740	0.04229
4	0.491159	0.900359	14.703	0.654693	0.275084	0.316860	0.868156	0.067518	0.374677	119.200	91.980	0.02330
5	0.687622	0.860502	13.187	0.702719	0.296390	0.302147	0.980945	0.009822	0.337944	128.170	88.120	0.00342
6	0.785854	0.840574	13.041	0.702711	0.299532	0.299216	1.001055	-0.000552	0.342013	129.300	89.950	-0.00019
7	0.884086	0.820646	14.315	0.673175	0.298578	0.296401	1.007346	-0.004124	0.351051	130.090	86.260	-0.00140

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.617040	0.274682	0.309365	0.887890	263.348	-0.039	-0.028	5389.570	118.005	118.005

FLOW RATE # 3 1567. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.130	62.646	62.646	0.000	0.000	131.070	115.130	61.448	247.310	186.320	0.97352
2	0.196463	0.960144	112.580	67.444	67.444	0.000	0.000	131.236	112.580	59.075	257.190	186.500	0.75681
3	0.294695	0.940215	110.290	71.150	71.150	0.000	0.000	131.248	110.290	57.173	264.980	186.310	1.11170
4	0.491159	0.900359	105.910	73.782	73.782	0.000	0.000	129.076	105.910	55.137	269.970	185.370	1.41940
5	0.687622	0.860502	101.320	74.347	74.347	0.000	0.000	125.671	101.320	53.729	270.780	184.880	1.01740
6	0.785854	0.840574	98.648	73.721	73.721	0.000	0.000	123.151	98.648	53.229	269.150	184.690	0.66256
7	0.884086	0.820646	96.444	70.614	70.614	0.000	0.000	119.531	96.444	53.789	261.180	183.690	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.130	66.845	54.202	39.121	35.820	93.356	76.009	54.507	365.940	296.500	1.03260
2	0.196463	0.960144	112.580	71.713	57.817	42.424	36.270	90.910	70.155	50.507	373.240	293.320	0.75681
3	0.294695	0.940215	110.290	76.577	62.789	43.835	34.920	91.426	66.455	46.624	381.380	290.250	1.11170
4	0.491159	0.900359	105.910	85.817	74.410	42.753	29.880	97.599	63.157	40.324	401.400	286.950	1.41940
5	0.687622	0.860502	101.320	90.698	79.229	44.126	29.115	97.716	57.194	35.825	411.200	283.390	1.01740
6	0.785854	0.840574	98.648	90.372	78.394	44.960	29.835	95.016	53.688	34.405	407.540	280.620	0.66256
7	0.884086	0.820646	96.444	88.468	74.882	47.110	32.175	89.672	49.334	33.378	400.470	278.840	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-7.102	0.533294	5365.156	1570.400	62.192	0.9280E-05	0.9808E 06
2	0.196463	0.960144	-9.535	0.575204	5355.211	1570.400	62.192	0.9280E-05	0.9820E 06
3	0.294695	0.940215	-11.377	0.606546	5357.477	1573.900	62.192	0.9280E-05	0.9821E 06
4	0.491159	0.900359	-11.963	0.627237	5372.453	1569.800	62.192	0.9280E-05	0.9659E 06
5	0.687622	0.860502	-11.721	0.631424	5377.680	1560.900	62.192	0.9280E-05	0.9404E 06
6	0.785854	0.840574	-10.971	0.628175	5359.388	1560.300	62.192	0.9280E-05	0.9215E 06
7	0.884086	0.820646	-9.211	0.600856	5367.492	1559.700	62.192	0.9280E-05	0.8944E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.917	0.461410	0.276591	0.326388	0.847432	0.079998	0.434011	118.630	110.180	0.02276
2	0.196463	0.960144	15.427	0.493099	0.271582	0.347399	0.781760	0.121041	0.462474	116.050	106.820	0.03696
3	0.294695	0.940215	15.124	0.535276	0.272171	0.351351	0.774641	0.126495	0.460418	116.400	103.940	0.04084
4	0.491159	0.900359	15.074	0.632571	0.305603	0.327236	0.933893	0.035932	0.392971	131.430	101.580	0.01233
5	0.687622	0.860502	13.075	0.672887	0.325873	0.322477	1.010529	-0.005961	0.373516	140.420	98.510	-0.00208
6	0.785854	0.840574	12.855	0.667991	0.323286	0.322028	1.003906	-0.002285	0.381898	138.390	95.930	-0.00079
7	0.884086	0.820646	13.378	0.637172	0.324479	0.328964	0.986364	0.008672	0.411512	139.290	95.150	0.00297

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.593430	0.302363	0.331385	0.912421	262.673	-0.038	-0.047	5365.063	117.469	117.469

TABLE X. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 8

FLOW RATE # 4 1469. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.390	59.474	59.474	0.000	0.000	129.815	115.390	62.732	255.650	200.680	0.97352
2	0.196463	0.960144	112.940	62.672	62.672	0.000	0.000	129.164	112.940	60.973	263.530	202.490	0.75681
3	0.294695	0.940215	110.340	66.241	66.241	0.000	0.000	128.696	110.340	59.022	270.780	202.590	1.11170
4	0.491159	0.900359	105.810	68.889	68.889	0.000	0.000	126.259	105.810	56.933	275.230	201.480	1.41940
5	0.687622	0.860502	101.130	69.729	69.729	0.000	0.000	122.839	101.130	55.414	274.590	199.030	1.01740
6	0.785854	0.840574	98.878	69.182	69.182	0.000	0.000	120.677	98.878	55.020	272.600	198.220	0.66256
7	0.884086	0.820646	96.534	65.040	65.040	0.000	0.000	116.400	96.534	56.030	262.540	196.800	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.390	67.929	55.546	39.103	35.145	94.366	76.286	53.941	390.900	319.190	1.03260
2	0.196463	0.960144	112.940	69.220	58.560	36.906	32.220	95.971	76.034	52.397	392.380	317.920	0.75681
3	0.294695	0.940215	110.340	73.235	62.563	38.069	31.320	95.589	72.271	49.118	398.290	314.940	1.11170
4	0.491159	0.900359	105.810	83.914	72.228	42.716	30.600	95.905	63.094	41.138	420.460	311.030	1.41940
5	0.687622	0.860502	101.130	87.683	74.107	46.867	32.310	91.850	54.263	36.213	424.560	305.180	1.01740
6	0.785854	0.840574	98.878	87.499	73.019	48.211	33.435	88.876	50.667	34.756	421.540	302.560	0.66256
7	0.884086	0.820646	96.534	86.809	70.310	50.915	35.910	83.813	45.619	32.977	415.410	298.300	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-5.818	0.505150	5377.270	1476.700	62.192	0.9280E-05	0.9714E 06
2	0.196463	0.960144	-7.637	0.532799	5372.340	1475.400	62.192	0.9280E-05	0.9665E 06
3	0.294695	0.940215	-9.528	0.564447	5359.906	1457.700	62.192	0.9280E-05	0.9630E 06
4	0.491159	0.900359	-10.167	0.586188	5367.391	1467.900	62.192	0.9280E-05	0.9448E 06
5	0.687622	0.860502	-10.036	0.593316	5367.598	1462.800	62.192	0.9280E-05	0.9192E 06
6	0.785854	0.840574	-9.180	0.588129	5372.488	1478.600	62.192	0.9280E-05	0.9030E 06
7	0.884086	0.820646	-6.970	0.552915	5372.500	1463.400	62.192	0.9280E-05	0.8710E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.351	0.471781	0.313922	0.325508	0.964407	0.019060	0.420690	135.250	118.510	0.00550
2	0.196463	0.960144	17.317	0.497842	0.299617	0.301245	0.994593	0.002702	0.394152	128.850	115.430	0.00079
3	0.294695	0.940215	17.618	0.533107	0.297878	0.304995	0.976665	0.011836	0.396311	127.510	112.350	0.00364
4	0.491159	0.900359	15.888	0.614607	0.338328	0.327260	1.033821	-0.019179	0.392710	145.230	109.550	-0.00650
5	0.687622	0.860502	13.463	0.630566	0.349577	0.343152	1.018723	-0.011762	0.416431	150.070	106.150	-0.00408
6	0.785854	0.840574	13.206	0.620745	0.346313	0.344509	1.005237	-0.003428	0.431428	148.940	104.340	-0.00118
7	0.884086	0.820646	12.977	0.597713	0.355450	0.355201	1.000700	-0.000509	0.459432	152.870	101.500	-0.00018

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.555950	0.330680	0.329622	1.003210	267.596	-0.042	-0.015	5369.926	117.575	117.575

FLOW RATE # 5 1388. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.180	55.332	55.332	0.000	0.000	127.781	115.180	64.340	256.010	208.430	0.97352
2	0.196463	0.960144	112.890	59.545	59.545	0.000	0.000	127.631	112.890	62.190	264.260	209.160	0.75681
3	0.294695	0.940215	110.700	62.795	62.795	0.000	0.000	127.270	110.700	60.436	270.690	209.410	1.11170
4	0.491159	0.900359	105.760	65.528	65.528	0.000	0.000	124.415	105.760	58.218	274.590	207.860	1.41940
5	0.687622	0.860502	101.180	66.285	66.285	0.000	0.000	120.959	101.180	56.770	275.230	206.950	1.01740
6	0.785854	0.840574	98.832	65.695	65.695	0.000	0.000	118.674	98.832	56.388	272.690	205.620	0.66256
7	0.884086	0.820646	96.534	62.229	62.229	0.000	0.000	114.853	96.534	57.193	264.350	204.170	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.180	70.441	51.349	48.220	43.200	84.382	66.960	52.517	410.000	332.890	1.03260
2	0.196463	0.960144	112.890	72.062	56.801	44.346	37.980	89.020	68.544	50.352	412.300	331.600	0.75681
3	0.294695	0.940215	110.700	76.362	61.954	44.642	35.775	90.565	66.058	46.836	419.520	328.900	1.11170
4	0.491159	0.900359	105.760	83.175	68.608	47.021	34.425	90.318	58.739	40.568	430.720	323.210	1.41940
5	0.687622	0.860502	101.180	85.615	69.852	49.504	35.325	86.889	51.676	36.494	431.690	317.780	1.01740
6	0.785854	0.840574	98.832	85.633	69.318	50.280	35.955	84.631	48.552	35.008	428.140	314.180	0.66256
7	0.884086	0.820646	96.534	85.321	66.293	53.712	39.015	78.921	42.822	32.861	424.960	311.830	0.94974

FOTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-4.210	0.470827	5367.480	1390.000	62.192	0.9280E-05	0.9562E 06
2	0.196463	0.960144	-6.420	0.506436	5369.957	1388.000	62.192	0.9280E-05	0.9551E 06
3	0.294695	0.940215	-8.114	0.533343	5377.395	1382.000	62.192	0.9280E-05	0.9524E 06
4	0.491159	0.900359	-8.882	0.557857	5364.848	1394.000	62.192	0.9280E-05	0.9310E 06
5	0.687622	0.860502	-8.680	0.563732	5370.242	1392.700	62.192	0.9280E-05	0.9051E 06
6	0.785854	0.840574	-7.612	0.558740	5369.992	1388.000	62.192	0.9280E-05	0.8880E 06
7	0.884086	0.820646	-5.807	0.529017	5372.500	1381.300	62.192	0.9280E-05	0.8594E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.927	0.436932	0.358724	0.402129	0.892062	0.073430	0.524564	153.990	124.460	0.02190
2	0.196463	0.960144	15.272	0.483099	0.344546	0.362134	0.951431	0.029853	0.469322	148.040	122.440	0.00914
3	0.294695	0.940215	15.336	0.526201	0.345427	0.356491	0.968963	0.018938	0.453299	148.830	119.490	0.00609
4	0.491159	0.900359	15.318	0.584077	0.364066	0.360414	1.010133	-0.006511	0.444193	156.130	115.350	-0.00223
5	0.687622	0.860502	13.744	0.594067	0.364103	0.362282	1.005028	-0.003442	0.457751	156.460	110.830	-0.00119
6	0.785854	0.840574	13.458	0.589559	0.361786	0.359457	1.006481	-0.004574	0.464926	155.450	108.560	-0.00157
7	0.884086	0.820646	12.861	0.563563	0.373447	0.374714	0.996619	0.002658	0.504737	160.610	107.660	0.00092

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	FOTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.525290	0.359730	0.367209	0.979633	267.941	-0.038	-0.007	5370.344	117.584	117.584

TABLE X. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 8

FLOW RATE # 6 1291. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.070	51.414	51.414	0.000	0.000	126.034	115.070	65.925	258.910	217.830	0.97352
2	0.196463	0.960144	112.840	55.175	55.175	0.000	0.000	125.607	112.840	63.943	266.160	218.850	0.75681
3	0.294695	0.940215	110.550	58.526	58.526	0.000	0.000	125.086	110.550	62.103	271.690	218.460	1.11170
4	0.491159	0.900359	105.910	60.954	60.954	0.000	0.000	122.198	105.910	60.078	275.950	218.210	1.41940
5	0.687622	0.860502	101.360	61.684	61.684	0.000	0.000	118.654	101.360	58.677	275.770	216.640	1.01740
6	0.785854	0.840574	98.832	60.637	60.637	0.000	0.000	115.951	98.832	58.469	273.320	216.180	0.66256
7	0.884086	0.820646	96.444	57.995	57.995	0.000	0.000	112.538	96.444	58.980	265.620	213.350	0.89413

PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.070	70.918	46.522	53.527	49.005	77.148	61.543	52.913	428.170	350.010	1.03260
2	0.196463	0.960144	112.840	71.668	51.701	49.631	43.830	81.660	63.209	50.719	428.350	348.530	0.75681
3	0.294695	0.940215	110.550	75.173	56.388	49.713	41.400	82.950	60.837	47.173	431.750	343.930	1.11170
4	0.491159	0.900359	105.910	81.166	64.251	49.596	37.665	85.437	56.314	41.233	442.070	339.690	1.41940
5	0.687622	0.860502	101.360	83.383	64.993	52.237	38.790	81.469	49.123	37.083	440.760	332.710	1.01740
6	0.785854	0.840574	98.832	83.876	64.585	53.515	39.645	78.898	45.317	35.056	438.320	328.990	0.66256
7	0.884086	0.820646	96.444	84.632	62.507	57.057	42.390	73.881	39.387	32.216	434.760	323.450	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-2.625	0.437903	5362.359	1291.100	62.192	0.9280E-05	0.9431E 06
2	0.196463	0.960144	-4.667	0.469480	5367.586	1289.700	62.192	0.9280E-05	0.9399E 06
3	0.294695	0.940215	-6.447	0.497754	5370.105	1286.100	62.192	0.9280E-05	0.9360E 06
4	0.491159	0.900359	-7.022	0.518185	5372.453	1289.000	62.192	0.9280E-05	0.9144E 06
5	0.687622	0.860502	-6.773	0.523670	5379.801	1291.100	62.192	0.9280E-05	0.8879E 06
6	0.785854	0.840574	-5.731	0.515723	5369.992	1292.500	62.192	0.9280E-05	0.8677E 06
7	0.884086	0.820646	-4.020	0.493486	5367.492	1297.600	62.192	0.9280E-05	0.8421E 06

PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	14.323	0.396237	0.395050	0.446814	0.884149	0.039844	0.596004	169.260	132.180	0.02655
2	0.196463	0.960144	15.639	0.439918	0.377812	0.405476	0.931773	0.048437	0.539573	162.190	129.680	0.01472
3	0.294695	0.940215	15.673	0.479578	0.372500	0.397527	0.937042	0.044227	0.523686	160.060	125.470	0.01413
4	0.491159	0.900359	15.983	0.546209	0.386266	0.379614	1.017522	-0.012327	0.483542	166.120	121.480	-0.00417
5	0.687622	0.860502	14.333	0.551753	0.382591	0.381607	1.002577	-0.001939	0.502811	164.990	116.070	-0.00067
6	0.785854	0.840574	13.506	0.549305	0.384013	0.382589	1.003722	-0.002929	0.513528	165.000	112.810	-0.00101
7	0.884086	0.820646	12.216	0.531874	0.394014	0.398421	0.988939	0.009611	0.551525	169.140	110.100	0.00334

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.488610	0.384675	0.396076	0.971214	269.278	-0.039	-0.012	5369.969	117.576	117.576

FLOW RATE # 7 1205. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.450	48.010	48.010	0.000	0.000	125.034	115.450	67.420	261.090	225.270	0.97352
2	0.196463	0.960144	112.680	51.201	51.201	0.000	0.000	123.767	112.680	65.563	266.980	226.240	0.75681
3	0.294695	0.940215	110.550	54.359	54.359	0.000	0.000	123.191	110.550	63.816	272.140	226.220	1.11170
4	0.491159	0.900359	105.760	57.056	57.056	0.000	0.000	120.169	105.760	61.654	275.320	224.730	1.41940
5	0.687622	0.860502	101.360	57.572	57.572	0.000	0.000	116.569	101.360	60.404	275.500	223.990	1.01740
6	0.785854	0.840574	99.154	56.864	56.864	0.000	0.000	114.302	99.154	60.166	273.410	223.160	0.66256
7	0.884086	0.820646	96.534	53.301	53.301	0.000	0.000	110.271	96.534	61.095	266.980	222.830	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.450	72.333	40.892	59.665	55.575	69.167	55.784	53.757	441.680	360.370	1.03260
2	0.196463	0.960144	112.680	73.042	47.915	55.129	49.005	74.886	57.550	50.220	441.960	359.050	0.75681
3	0.294695	0.940215	110.550	74.628	52.853	52.687	44.910	78.368	57.863	47.591	443.090	356.540	1.11170
4	0.491159	0.900359	105.760	79.597	60.323	51.931	40.725	80.847	53.828	41.744	446.930	348.470	1.41940
5	0.687622	0.860502	101.360	82.077	61.694	54.133	41.265	77.695	47.227	37.434	447.000	342.310	1.01740
6	0.785854	0.840574	99.154	82.834	61.135	55.892	42.435	74.893	43.262	35.285	444.920	338.290	0.66256
7	0.884086	0.820646	96.534	84.171	58.860	60.168	45.630	69.187	36.365	31.709	445.890	335.790	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-1.130	0.407564	5380.063	1205.700	62.192	0.9280E-05	0.9356E 06
2	0.196463	0.960144	-3.047	0.436283	5359.965	1204.900	62.192	0.9280E-05	0.9261E 06
3	0.294695	0.940215	-4.734	0.462314	5370.105	1194.100	62.192	0.9280E-05	0.9218E 06
4	0.491159	0.900359	-5.446	0.485730	5364.848	1205.700	62.192	0.9280E-05	0.8992E 06
5	0.687622	0.860502	-5.046	0.488764	5379.801	1215.700	62.192	0.9280E-05	0.8723E 06
6	0.785854	0.840574	-4.034	0.482061	5387.477	1206.500	62.192	0.9280E-05	0.8553E 06
7	0.884086	0.820646	-1.905	0.453115	5372.500	1202.600	62.192	0.9280E-05	0.8252E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.167	0.347139	0.418724	0.496415	0.843496	0.137916	0.680667	180.590	135.100	0.03996
2	0.196463	0.960144	15.140	0.408282	0.408765	0.451035	0.906283	0.076010	0.608786	174.980	132.810	0.02335
3	0.294695	0.940215	16.091	0.449507	0.397844	0.421308	0.944308	0.042749	0.564907	170.950	130.320	0.01355
4	0.491159	0.900359	16.494	0.513541	0.400163	0.398053	1.005301	-0.004032	0.521758	171.610	123.740	-0.00135
5	0.687622	0.860502	14.684	0.523759	0.397686	0.395458	1.005634	-0.004551	0.533288	171.500	118.320	-0.00155
6	0.785854	0.840574	13.735	0.518269	0.396577	0.398285	0.995711	0.003639	0.550285	171.510	115.130	0.00125
7	0.884086	0.820646	11.709	0.500372	0.415998	0.419759	0.991039	0.008561	0.596451	178.910	112.960	0.00299

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSITB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.455770	0.404204	0.420304	0.961694	269.731	-0.041	-0.012	5373.535	117.654	117.654

TABLE X. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 8

FLOW RATE # 8 1140. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.070	45.611	45.611	0.000	0.000	123.780	115.070	68.378	263.260	230.930	0.97352
2	0.196463	0.960144	113.050	48.689	48.689	0.000	0.000	123.089	113.050	66.699	268.070	231.230	0.75681
3	0.294695	0.940215	110.650	51.069	51.069	0.000	0.000	121.866	110.650	65.225	271.510	230.980	1.11170
4	0.491159	0.900359	105.620	54.335	54.335	0.000	0.000	118.777	105.620	62.777	275.320	229.440	1.41940
5	0.687622	0.860502	100.850	54.813	54.813	0.000	0.000	114.783	100.850	61.476	275.320	228.630	1.01740
6	0.785854	0.840574	98.510	54.175	54.175	0.000	0.000	112.424	98.510	61.192	274.230	228.620	0.66256
7	0.884086	0.820646	96.264	51.018	51.018	0.000	0.000	108.948	96.264	62.077	267.340	226.890	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.070	71.168	35.890	61.455	59.715	64.518	53.615	56.201	446.320	367.610	1.03260
2	0.196463	0.960144	113.050	72.431	42.390	58.732	54.180	68.901	54.318	52.032	445.630	364.100	0.75681
3	0.294695	0.940215	110.650	73.813	47.894	56.165	49.545	72.542	54.484	48.683	445.370	360.700	1.11170
4	0.491159	0.900359	105.620	78.543	57.340	53.677	43.110	77.369	51.943	42.173	448.620	352.750	1.41940
5	0.687622	0.860502	100.850	80.856	59.202	55.072	42.930	74.837	45.778	37.713	447.380	345.780	1.01740
6	0.785854	0.840574	98.510	82.034	59.268	56.717	43.740	72.521	41.793	35.190	449.100	344.520	0.66256
7	0.884086	0.820646	96.264	83.788	57.500	60.943	46.665	67.482	35.321	31.561	449.390	340.290	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-0.172	0.388478	5362.359	1134.400	62.192	0.9280E-05	0.9262E 06
2	0.196463	0.960144	-1.911	0.413518	5377.566	1145.000	62.192	0.9280E-05	0.9211E 06
3	0.294695	0.940215	-3.325	0.433942	5374.965	1130.300	62.192	0.9280E-05	0.9119E 06
4	0.491159	0.900359	-4.323	0.463179	5357.754	1136.000	62.192	0.9280E-05	0.8888E 06
5	0.687622	0.860502	-3.974	0.467688	5352.734	1145.800	62.192	0.9280E-05	0.8589E 06
6	0.785854	0.840574	-3.008	0.462268	5352.492	1145.800	62.192	0.9280E-05	0.8413E 06
7	0.884086	0.820646	-0.923	0.434930	5357.469	1143.300	62.192	0.9280E-05	0.8152E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	17.611	0.305681	0.427259	0.512994	0.832873	0.154276	0.722070	183.060	136.680	0.04206
2	0.196463	0.960144	16.952	0.360020	0.412081	0.478932	0.860416	0.122340	0.669300	177.560	132.870	0.03613
3	0.294695	0.940215	17.183	0.406962	0.403885	0.448717	0.900088	0.083618	0.621401	173.860	129.720	0.02595
4	0.491159	0.900359	16.923	0.488795	0.405175	0.411974	0.983496	0.013264	0.552052	173.300	123.310	0.00443
5	0.687622	0.860502	14.963	0.505140	0.403030	0.404349	0.996739	0.002750	0.554448	172.060	117.150	0.00094
6	0.785854	0.840574	13.640	0.505728	0.409650	0.406804	1.006995	-0.006185	0.566954	174.870	115.900	-0.00212
7	0.884086	0.820646	11.561	0.490188	0.425677	0.426356	0.998406	0.001576	0.610119	182.050	113.400	0.00055

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.432130	0.411147	0.434248	0.946804	270.116	-0.037	-0.022	5362.191	117.406	117.406

FLOW RATE # 9 1075. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.070	43.959	43.959	0.000	0.000	123.181	115.070	69.092	264.350	234.320	0.97352
2	0.196463	0.960144	112.940	45.724	45.724	0.000	0.000	121.845	112.940	67.959	268.340	235.850	0.75681
3	0.294695	0.940215	110.800	48.164	48.164	0.000	0.000	120.632	110.800	66.468	271.780	235.730	1.11170
4	0.491159	0.900359	105.910	51.645	51.645	0.000	0.000	117.831	105.910	64.005	275.590	234.140	1.41940
5	0.687622	0.860502	100.990	51.352	51.352	0.000	0.000	113.296	100.990	63.047	275.320	234.340	1.01740
6	0.785854	0.840574	98.878	51.383	51.383	0.000	0.000	111.432	98.878	62.541	275.050	234.020	0.66256
7	0.884086	0.820646	96.534	47.761	47.761	0.000	0.000	107.703	96.534	63.676	268.700	233.250	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.070	71.168	31.960	63.587	53.315	60.596	51.482	58.168	448.980	370.270	1.03260
2	0.196463	0.960144	112.940	71.515	37.319	61.006	58.545	63.952	51.934	54.300	448.370	368.890	0.75681
3	0.294695	0.940215	110.800	72.035	41.420	58.935	54.900	66.218	51.665	51.280	445.750	365.110	1.11170
4	0.491159	0.900359	105.910	76.527	52.692	55.497	46.485	72.924	50.413	43.734	449.560	358.550	1.41940
5	0.687622	0.860502	100.990	79.621	56.433	56.168	44.865	72.067	44.822	38.458	451.650	353.130	1.01740
6	0.785854	0.840574	98.878	81.908	57.323	58.506	45.585	70.113	40.372	35.156	454.970	350.710	0.66256
7	0.884086	0.820646	96.534	83.895	56.071	62.405	48.060	65.641	34.129	31.328	455.920	346.540	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	0.542	0.374405	5362.359	1087.700	62.192	0.9280E-05	0.9218E 06
2	0.196463	0.960144	-0.651	0.389715	5372.340	1088.500	62.192	0.9280E-05	0.9118E 06
3	0.294695	0.940215	-2.082	0.409443	5372.535	1065.300	62.192	0.9280E-05	0.9027E 06
4	0.491159	0.900359	-3.095	0.439046	5372.453	1085.100	62.192	0.9280E-05	0.8817E 06
5	0.687622	0.860502	-2.403	0.437550	5360.169	1060.000	62.192	0.9280E-05	0.8478E 06
6	0.785854	0.840574	-1.659	0.436813	5372.488	1073.900	62.192	0.9280E-05	0.8338E 06
7	0.884086	0.820646	0.676	0.406023	5372.500	1067.000	62.192	0.9280E-05	0.8059E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	19.578	0.272212	0.430923	0.530793	0.811846	0.181465	0.761041	184.630	135.950	0.04690
2	0.196463	0.960144	19.220	0.317259	0.418627	0.497962	0.840680	0.147879	0.715504	180.030	133.040	0.04143
3	0.294695	0.940215	19.780	0.352117	0.404506	0.471059	0.858716	0.126569	0.680741	173.970	129.380	0.03722
4	0.491159	0.900359	18.484	0.447944	0.404518	0.424777	0.952307	0.040380	0.593134	173.970	124.410	0.01313
5	0.687622	0.860502	15.708	0.480850	0.411883	0.411827	1.000148	-0.000131	0.577206	176.330	118.790	-0.00004
6	0.785854	0.840574	13.606	0.487313	0.418348	0.418074	1.000654	-0.000610	0.591458	179.920	116.690	-0.00021
7	0.884086	0.820646	11.328	0.476669	0.435320	0.435362	0.999905	0.000099	0.628272	187.220	113.290	0.00003

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.407050	0.416183	0.446736	0.931610	270.633	-0.034	-0.041	5369.262	117.561	117.561

TABLE X. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 8

FLOW RATE #10 1014. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.020	40.627	40.627	0.000	0.000	121.984	115.020	70.546	265.620	239.970	0.97352
2	0.196463	0.960144	112.940	42.952	42.952	0.000	0.000	120.832	112.940	69.178	269.430	240.760	0.75681
3	0.294695	0.940215	110.390	45.667	45.667	0.000	0.000	119.463	110.390	67.525	272.690	240.280	1.11170
4	0.491159	0.900359	105.960	48.237	48.237	0.000	0.000	116.423	105.960	65.523	275.590	239.430	1.41940
5	0.687622	0.860502	101.130	48.768	48.768	0.000	0.000	112.275	101.130	64.255	276.130	239.170	1.01740
6	0.785854	0.840574	99.016	48.755	48.755	0.000	0.000	110.368	99.016	63.785	275.410	238.470	0.66256
7	0.884086	0.820646	96.669	45.371	45.371	0.000	0.000	106.786	96.669	64.857	269.240	237.250	0.89413

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.020	71.618	30.188	64.945	65.070	58.471	50.075	58.916	455.420	375.710	1.03260
2	0.196463	0.960144	112.940	71.294	34.150	62.583	61.380	60.844	50.357	55.857	453.050	374.060	0.75681
3	0.294695	0.940215	110.390	71.240	37.318	60.683	58.410	62.156	49.707	53.102	447.890	369.020	1.11170
4	0.491159	0.900359	105.960	73.428	47.160	56.282	50.040	68.497	49.678	46.490	447.430	363.640	1.41940
5	0.687622	0.860502	101.130	78.658	54.517	56.701	46.125	70.328	44.429	39.179	454.710	358.560	1.01740
6	0.785854	0.840574	99.016	81.538	56.050	59.219	46.575	68.741	39.797	35.376	458.810	355.490	0.66256
7	0.884086	0.820646	96.669	83.999	55.301	63.226	48.825	64.627	33.443	31.163	460.610	350.960	0.94974

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	1.996	0.346176	5360.035	1027.200	62.192	0.9280E-05	0.9128E 06
2	0.196463	0.960144	0.568	0.365148	5372.340	1007.100	62.192	0.9280E-05	0.9042E 06
3	0.294695	0.940215	-1.025	0.388960	5362.336	1008.900	62.192	0.9280E-05	0.8939E 06
4	0.491159	0.900359	-1.577	0.409879	5375.000	1019.000	62.192	0.9280E-05	0.8712E 06
5	0.687622	0.860502	-1.195	0.414959	5367.598	1016.300	62.192	0.9280E-05	0.8401E 06
6	0.785854	0.840574	-0.415	0.413891	5379.984	1014.400	62.192	0.9280E-05	0.8259E 06
7	0.884086	0.820646	1.857	0.385162	5380.008	1006.200	62.192	0.9280E-05	0.7991E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	20.326	0.257227	0.443373	0.542361	0.817487	0.183247	0.781578	189.800	135.740	0.04636
2	0.196463	0.960144	20.777	0.290320	0.426975	0.510836	0.835835	0.158947	0.745103	183.620	133.300	0.04283
3	0.294695	0.940215	21.602	0.317847	0.408917	0.485954	0.841472	0.148822	0.718501	175.200	128.740	0.04200
4	0.491159	0.900359	21.240	0.400722	0.399187	0.430587	0.927076	0.064171	0.629275	171.840	124.210	0.01989
5	0.687622	0.860502	16.429	0.463876	0.415989	0.415157	1.002003	-0.001823	0.590894	178.580	119.390	-0.00061
6	0.785854	0.840574	13.826	0.475820	0.425252	0.422579	1.006327	-0.006091	0.602667	183.400	117.020	-0.00209
7	0.884086	0.820646	11.163	0.469467	0.443729	0.440473	1.007390	-0.007922	0.637734	191.370	113.710	-0.00278

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.383760	0.420885	0.453839	0.927387	271.303	-0.036	-0.046	5371.043	117.600	117.600

TABLE XI. - BLADE-ELEMENT DATA FOR CONFIGURATION 9

NASA CONFIGURATION 9
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.016-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	2.459000	68.550	2.459000	38.590	1.020300	0.071640	0.833300	29.960	53.570
2	2.409000	68.610	2.409000	35.080	1.041500	0.073640	0.833300	33.530	51.845
3	2.359000	68.550	2.359000	31.500	1.063600	0.075640	0.833300	37.050	50.025
4	2.259000	67.100	2.259000	25.250	1.110700	0.079640	0.833300	41.850	46.175
5	2.159000	65.450	2.159000	22.750	1.162100	0.083640	0.833300	42.700	44.100
6	2.109000	64.200	2.109000	21.550	1.189700	0.085640	0.833300	42.650	42.875
7	2.059000	63.000	2.059000	20.000	1.218600	0.087640	0.833300	43.000	41.500

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
2.000000	2.509000	2.000000	2.509000	19

TABLE XI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 9

FLOW RATE # 1 1691. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.720	65.778	65.778	0.000	0.000	133.108	115.720	60.385	242.720	175.480	0.99716
2	0.196463	0.960144	113.150	71.326	71.326	0.000	0.000	133.754	113.150	57.774	258.850	179.790	0.75681
3	0.294695	0.940215	110.800	76.908	76.908	0.000	0.000	134.876	110.800	55.235	268.190	176.270	1.11170
4	0.491159	0.900359	106.350	79.702	79.702	0.000	0.000	132.901	106.350	53.151	272.630	173.910	1.41940
5	0.687622	0.860502	101.690	80.557	80.557	0.000	0.000	129.732	101.690	51.614	272.900	172.050	1.01740
6	0.785854	0.840574	99.200	80.681	80.681	0.000	0.000	127.867	99.200	50.878	272.000	170.840	0.66256
7	0.884086	0.820646	96.848	79.553	79.553	0.000	0.000	125.332	96.848	50.600	267.920	169.570	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.720	72.182	61.277	38.149	31.905	98.854	77.571	51.693	342.270	261.300	1.05630
2	0.196463	0.960144	113.150	75.404	66.049	36.378	28.845	101.274	76.772	49.294	351.000	262.640	0.75681
3	0.294695	0.940215	110.800	79.976	70.739	37.312	27.810	102.002	73.488	46.092	355.960	256.560	1.11170
4	0.491159	0.900359	106.350	88.428	80.508	36.579	24.435	106.534	69.771	40.913	371.740	250.220	1.41940
5	0.687622	0.860502	101.690	94.125	87.184	35.473	22.140	109.480	66.217	37.217	383.010	245.330	1.01740
6	0.785854	0.840574	99.200	95.100	87.689	36.807	22.770	107.621	62.393	35.433	382.890	242.340	0.66256
7	0.884086	0.820646	96.848	92.775	83.945	39.502	25.200	101.663	57.346	34.339	371.630	237.870	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-8.165	0.557097	5392.648	1683.200	62.192	0.9280E-05	0.9960E 06
2	0.196463	0.960144	-10.836	0.605241	5382.328	1682.700	62.192	0.9280E-05	0.1001E 07
3	0.294695	0.940215	-13.315	0.652619	5382.262	1686.500	62.192	0.9280E-05	0.1009E 07
4	0.491159	0.900359	-13.949	0.674757	5394.789	1696.400	62.192	0.9280E-05	0.9945E 06
5	0.687622	0.860502	-13.836	0.681678	5397.320	1693.700	62.192	0.9280E-05	0.9708E 06
6	0.785854	0.840574	-13.322	0.683654	5389.988	1693.700	62.192	0.9280E-05	0.9568E 06
7	0.884086	0.820646	-12.400	0.674092	5389.980	1698.600	62.192	0.9280E-05	0.9379E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.103	0.518978	0.229745	0.316659	0.725528	0.136776	0.397792	99.550	85.820	0.04155
2	0.196463	0.960144	14.214	0.560461	0.213483	0.296386	0.720287	0.128712	0.373410	92.150	82.850	0.04030
3	0.294695	0.940215	14.592	0.600268	0.203341	0.297690	0.683064	0.144053	0.373782	87.770	80.290	0.04696
4	0.491159	0.900359	15.663	0.681579	0.228548	0.278823	0.819690	0.079426	0.322300	99.110	76.310	0.02702
5	0.687622	0.860502	14.467	0.737755	0.253676	0.258298	0.982106	0.007670	0.273752	110.110	73.280	0.00263
6	0.785854	0.840574	13.883	0.743034	0.256168	0.262163	0.977136	0.010212	0.279318	110.890	71.500	0.00350
7	0.884086	0.820646	14.339	0.711313	0.239583	0.274685	0.872207	0.062247	0.318169	103.710	68.300	0.02109

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.637510	0.232421	0.281966	0.824290	264.927	-0.029	-0.012	5389.902	118.013	118.013

FLOW RATE # 2 1648. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.720	63.711	63.711	0.000	0.000	132.099	115.720	61.165	242.450	179.370	0.99716
2	0.196463	0.960144	113.420	71.389	71.389	0.000	0.000	134.017	113.420	57.813	258.940	179.740	0.75681
3	0.294695	0.940215	110.860	75.344	75.344	0.000	0.000	134.040	110.860	55.799	270.090	181.870	1.11170
4	0.491159	0.900359	106.550	77.939	77.939	0.000	0.000	132.013	106.550	53.815	274.170	179.770	1.41940
5	0.687622	0.860502	101.650	78.584	78.584	0.000	0.000	128.484	101.650	52.293	273.180	177.210	1.01740
6	0.785854	0.840574	99.246	78.637	78.637	0.000	0.000	126.624	99.246	51.609	272.900	176.800	0.66256
7	0.884086	0.820646	96.983	77.300	77.300	0.000	0.000	124.020	96.983	51.443	268.370	175.510	0.91637

	PASS.HI.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.720	72.209	60.785	38.978	32.670	97.898	76.742	51.618	354.460	273.430	1.05630
2	0.196463	0.960144	113.420	75.851	65.945	37.477	29.610	100.579	75.943	49.030	362.650	273.240	0.75681
3	0.294695	0.940215	110.860	80.462	70.233	39.260	29.205	100.296	71.600	45.552	371.560	270.950	1.11170
4	0.491159	0.900359	106.550	88.064	79.053	38.805	26.145	104.110	67.745	40.595	385.180	264.660	1.41940
5	0.687622	0.860502	101.650	92.796	84.484	38.386	24.435	105.546	63.264	36.827	392.150	258.330	1.01740
6	0.785854	0.840574	99.246	93.138	84.118	39.987	25.425	102.895	59.259	35.164	391.880	257.070	0.66256
7	0.884086	0.820646	96.983	90.350	79.948	42.089	27.765	96.979	54.894	34.474	381.730	254.870	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-7.385	0.539589	5392.648	1645.400	62.192	0.9280E-05	0.9885E 06
2	0.196463	0.960144	-10.797	0.604333	5395.172	1650.400	62.192	0.9280E-05	0.1003E 07
3	0.294695	0.940215	-12.751	0.639004	5385.172	1649.900	62.192	0.9280E-05	0.1003E 07
4	0.491159	0.900359	-13.285	0.658590	5404.930	1646.500	62.192	0.9280E-05	0.9878E 06
5	0.687622	0.860502	-13.157	0.665242	5395.199	1639.700	62.192	0.9280E-05	0.9614E 06
6	0.785854	0.840574	-12.591	0.666027	5392.488	1650.400	62.192	0.9280E-05	0.9475E 06
7	0.884086	0.820646	-11.557	0.654097	5397.488	1653.200	62.192	0.9280E-05	0.9280E 06

	PASS.HI.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.028	0.514809	0.258501	0.323542	0.798972	0.103925	0.403501	112.010	94.060	0.03162
2	0.196463	0.960144	13.950	0.558253	0.239122	0.304616	0.784995	0.101770	0.383759	103.710	93.500	0.03203
3	0.294695	0.940215	14.052	0.595655	0.234827	0.313062	0.750096	0.121076	0.389439	101.470	89.080	0.03986
4	0.491159	0.900359	15.345	0.668003	0.255030	0.295232	0.863830	0.064613	0.343691	111.010	84.890	0.02209
5	0.687622	0.860502	14.077	0.715186	0.274304	0.279620	0.980987	0.008988	0.307075	118.970	81.120	0.00310
6	0.785854	0.840574	13.614	0.712443	0.274603	0.284680	0.964600	0.017524	0.320115	118.980	80.270	0.00602
7	0.884086	0.820646	14.474	0.676499	0.261147	0.292273	0.893505	0.056525	0.357285	113.360	79.360	0.01912

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.620850	0.257081	0.298131	0.862310	265.745	-0.026	-0.009	5394.727	118.118	118.118

TABLE XI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 9

FLOW RATE # 3 1575. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.450	61.049	61.049	0.000	0.000	130.598	115.450	62.130	244.890	186.970	0.99716
2	0.196463	0.960144	113.100	67.292	67.292	0.000	0.000	131.605	113.100	59.248	259.030	188.660	0.75681
3	0.294695	0.940215	111.060	71.717	71.717	0.000	0.000	132.203	111.060	57.148	268.820	198.890	1.11170
4	0.491159	0.900359	106.500	74.182	74.182	0.000	0.000	129.789	106.500	55.141	272.990	187.470	1.41940
5	0.687622	0.860502	101.790	74.998	74.998	0.000	0.000	126.435	101.790	53.618	273.720	186.310	1.01740
6	0.785854	0.840574	99.108	75.344	75.344	0.000	0.000	124.496	99.108	52.757	273.450	185.230	0.66256
7	0.884086	0.820646	96.669	73.533	73.533	0.000	0.000	121.458	96.669	52.741	268.730	184.700	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.450	69.932	55.857	42.076	36.990	92.216	73.374	52.719	368.240	292.240	1.05630
2	0.196463	0.960144	113.100	74.912	60.466	44.222	36.180	91.653	68.878	48.721	374.640	287.430	0.75681
3	0.294695	0.940215	111.060	79.439	64.885	45.831	35.235	92.005	65.229	45.151	386.340	288.270	1.11170
4	0.491159	0.900359	106.500	86.583	75.708	42.009	29.025	99.453	64.491	40.425	398.030	281.530	1.41940
5	0.687622	0.860502	101.790	90.154	79.675	42.186	27.900	99.503	59.604	36.800	405.710	279.400	1.01740
6	0.785854	0.840574	99.108	90.762	79.707	43.412	28.575	97.238	55.695	34.944	403.530	275.510	0.66256
7	0.884086	0.820646	96.669	88.107	74.870	46.448	31.815	90.153	50.221	33.853	392.200	271.560	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-6.420	0.518258	5380.070	1572.800	62.192	0.9280E-05	0.9773E 06
2	0.196463	0.960144	-9.362	0.571262	5379.949	1569.800	62.192	0.9280E-05	0.9848E 06
3	0.294695	0.940215	-11.402	0.607144	5394.891	1576.900	62.192	0.9280E-05	0.9893E 06
4	0.491159	0.900359	-11.959	0.627144	5402.391	1575.100	62.192	0.9280E-05	0.9712E 06
5	0.687622	0.860502	-11.832	0.634008	5402.629	1578.000	62.192	0.9280E-05	0.9461E 06
6	0.785854	0.840574	-11.443	0.639026	5384.988	1578.000	62.192	0.9280E-05	0.9316E 06
7	0.884086	0.820646	-10.259	0.624242	5380.020	1575.700	62.192	0.9280E-05	0.9089E 06

	PASS.HT.2 FROM TIP	R2/RT	DFV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	14.129	0.474181	0.286004	0.350073	0.816984	0.104250	0.451780	123.350	105.270	0.03095
2	0.196463	0.960144	13.641	0.513319	0.268070	0.360455	0.743699	0.148027	0.464888	115.610	98.770	0.04688
3	0.294695	0.940215	13.651	0.549309	0.270992	0.364802	0.742846	0.149781	0.467033	117.520	99.380	0.04966
4	0.491159	0.900359	15.175	0.640045	0.287532	0.319760	0.899212	0.053537	0.379443	125.040	94.060	0.01835
5	0.687622	0.860502	14.050	0.673551	0.303487	0.306878	0.988949	0.005937	0.356571	131.990	93.090	0.00205
6	0.785854	0.840574	13.394	0.676025	0.301058	0.309498	0.972731	0.015139	0.365499	130.080	90.280	0.00522
7	0.884086	0.820646	13.853	0.635586	0.286288	0.323589	0.884726	0.070172	0.414653	123.470	86.860	0.02391

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR ESIB	ROTOR ESIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.594040	0.287009	0.331150	0.866705	265.781	-0.030	-0.028	5389.273	117.999	117.999

FLOW RATE # 4 1460. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.180	56.818	56.818	0.000	0.000	128.432	115.180	63.743	248.970	198.800	0.99716
2	0.196463	0.960144	112.940	62.503	62.503	0.000	0.000	129.081	112.940	61.039	260.490	199.780	0.75681
3	0.294695	0.940215	110.600	66.304	66.304	0.000	0.000	128.952	110.600	59.057	269.010	200.690	1.11170
4	0.491159	0.900359	105.960	69.024	69.024	0.000	0.000	126.459	105.960	56.919	273.810	199.770	1.41940
5	0.687622	0.860502	101.360	69.877	69.877	0.000	0.000	123.112	101.360	55.418	273.810	197.930	1.01740
6	0.785854	0.840574	98.970	69.923	69.923	0.000	0.000	121.178	98.970	54.759	272.810	196.830	0.66256
7	0.884086	0.820646	96.534	69.029	69.029	0.000	0.000	118.675	96.534	54.433	269.280	195.230	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.180	63.219	50.940	37.440	36.315	92.943	77.740	56.765	377.260	315.150	1.05630
2	0.196463	0.960144	112.940	68.397	56.569	38.445	34.200	93.540	74.495	52.788	384.730	312.030	0.75681
3	0.294695	0.940215	110.600	72.773	60.886	39.858	33.210	93.336	70.742	49.282	390.790	308.490	1.11170
4	0.491159	0.900359	105.960	84.087	73.717	40.451	28.755	98.619	65.509	41.626	415.120	305.240	1.41940
5	0.687622	0.860502	101.360	87.134	74.259	45.586	31.545	92.871	55.774	36.909	417.590	299.600	1.01740
6	0.785854	0.840574	98.970	86.867	72.770	47.474	33.120	89.147	51.496	35.285	413.110	295.790	0.66256
7	0.884086	0.820646	96.534	85.532	69.236	50.220	35.955	83.298	46.314	33.780	405.990	292.300	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-4.807	0.483471	5367.488	1461.500	62.192	0.9280E-05	0.9610E 06
2	0.196463	0.960144	-7.571	0.531357	5372.340	1457.100	62.192	0.9280E-05	0.9659E 06
3	0.294695	0.940215	-9.493	0.563655	5372.539	1460.900	62.192	0.9280E-05	0.9649E 06
4	0.491159	0.900359	-10.181	0.586509	5375.000	1460.900	62.192	0.9280E-05	0.9463E 06
5	0.687622	0.860502	-10.032	0.593221	5379.809	1464.100	62.192	0.9280E-05	0.9212E 06
6	0.785854	0.840574	-9.441	0.593868	5377.488	1471.000	62.192	0.9280E-05	0.9068E 06
7	0.884086	0.820646	-8.567	0.586821	5372.500	1444.900	62.192	0.9280E-05	0.8880E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	18.175	0.433453	0.298855	0.312229	0.957164	0.022398	0.419182	128.290	116.350	0.00602
2	0.196463	0.960144	17.708	0.480918	0.288897	0.313805	0.920627	0.041368	0.418326	124.240	112.250	0.01201
3	0.294695	0.940215	17.782	0.517599	0.283156	0.318579	0.888810	0.058954	0.421503	121.760	107.800	0.01808
4	0.491159	0.900359	16.376	0.626389	0.328266	0.309471	1.060730	-0.032555	0.364149	141.310	105.470	-0.01095
5	0.687622	0.860502	14.159	0.630423	0.333406	0.333018	1.001164	-0.000710	0.404951	143.780	101.670	-0.00024
6	0.785854	0.840574	13.735	0.618053	0.325618	0.338929	0.960727	0.025133	0.428981	140.300	98.960	0.00862
7	0.884086	0.820646	13.780	0.588585	0.317875	0.350355	0.907294	0.063823	0.471727	136.710	97.070	0.02177

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.552190	0.313570	0.324474	0.966398	266.672	-0.026	-0.018	5373.879	117.662	117.662

TABLE XI - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 9

FLOW RATE # 5 1382. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.290	53.337	53.337	0.000	0.000	127.030	115.290	65.173	251.060	206.850	0.99716
2	0.196463	0.960144	112.730	59.024	59.024	0.000	0.000	127.247	112.730	62.364	262.210	208.070	0.75681
3	0.294695	0.940215	110.390	63.148	63.148	0.000	0.000	127.175	110.390	60.229	269.640	207.670	1.11170
4	0.491159	0.900359	105.710	65.351	65.351	0.000	0.000	124.279	105.710	58.275	273.900	207.530	1.41940
5	0.687622	0.860502	101.180	66.435	66.435	0.000	0.000	121.041	101.180	56.711	273.990	205.400	1.01740
6	0.785854	0.840574	99.016	66.120	66.120	0.000	0.000	119.063	99.016	56.266	272.900	204.960	0.66256
7	0.884086	0.820646	96.624	65.410	65.410	0.000	0.000	116.682	96.624	55.904	270.280	203.790	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.290	68.660	47.974	49.118	45.675	81.733	66.172	54.058	402.810	329.550	1.05630
2	0.196463	0.960144	112.730	72.914	57.189	45.230	38.340	88.469	67.500	49.727	407.890	325.270	0.75681
3	0.294695	0.940215	110.390	77.450	63.679	44.085	34.695	91.931	66.305	46.157	416.340	323.120	1.11170
4	0.491159	0.900359	105.710	83.726	70.409	45.306	32.760	92.769	60.404	40.626	427.110	318.170	1.41940
5	0.687622	0.860502	101.180	84.822	68.895	49.479	35.685	86.137	51.701	36.886	420.690	308.880	1.01740
6	0.785854	0.840574	99.016	84.757	69.344	48.736	35.100	85.655	50.280	35.945	420.270	308.630	0.66256
7	0.884086	0.820646	96.624	84.400	65.785	52.874	38.790	79.005	43.750	33.626	415.960	305.260	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-3.377	0.453413	5372.621	1385.300	62.192	0.9280E-05	0.9506E 06
2	0.196463	0.960144	-6.246	0.502717	5362.352	1387.300	62.192	0.9280E-05	0.9522E 06
3	0.294695	0.940215	-8.321	0.537843	5362.340	1371.900	62.192	0.9280E-05	0.9516E 06
4	0.491159	0.900359	-8.825	0.556612	5362.320	1382.600	62.192	0.9280E-05	0.9300E 06
5	0.687622	0.860502	-8.739	0.565009	5370.250	1387.300	62.192	0.9280E-05	0.9057E 06
6	0.785854	0.840574	-7.934	0.561307	5379.988	1384.700	62.192	0.9280E-05	0.8909E 06
7	0.884086	0.820646	-7.096	0.555541	5377.512	1375.900	62.192	0.9280E-05	0.8731E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.468	0.407826	0.352830	0.409229	0.862183	0.096729	0.546073	151.750	122.700	0.02782
2	0.196463	0.960144	14.647	0.487094	0.340015	0.369832	0.919254	0.050854	0.475388	145.680	117.200	0.01578
3	0.294695	0.940215	14.657	0.542367	0.342398	0.353035	0.969870	0.018132	0.440092	146.700	115.450	0.00590
4	0.491159	0.900359	15.376	0.599692	0.357595	0.347433	1.029248	-0.018139	0.417653	153.210	110.640	-0.00620
5	0.687622	0.860502	14.136	0.585933	0.341389	0.362102	0.942799	0.039091	0.464247	146.700	103.480	0.01345
6	0.785854	0.840574	14.395	0.588683	0.341709	0.347773	0.982561	0.011873	0.452624	147.370	103.670	0.00404
7	0.884086	0.820646	13.626	0.558726	0.338101	0.368524	0.917445	0.061957	0.508832	145.680	101.470	0.02117

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.523150	0.345922	0.362933	0.953131	267.431	-0.025	0.003	5369.625	117.569	117.569

FLOW RATE # 6 4293. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.180	49.482	49.482	0.000	0.000	125.359	115.180	66.751	253.050	215.000	0.99716
2	0.196463	0.960144	113.100	54.139	54.139	0.000	0.000	125.390	113.100	64.420	263.200	217.650	0.75681
3	0.294695	0.940215	110.960	58.222	58.222	0.000	0.000	125.307	110.960	62.313	269.640	216.960	1.11170
4	0.491159	0.900359	105.710	61.076	61.076	0.000	0.000	122.085	105.710	59.982	274.170	216.200	1.41940
5	0.687622	0.860502	101.460	61.840	61.840	0.000	0.000	118.821	101.460	58.638	274.350	214.920	1.01740
6	0.785854	0.840574	98.970	61.700	61.700	0.000	0.000	116.627	98.970	58.060	273.810	214.650	0.66256
7	0.884086	0.820646	96.579	60.769	60.769	0.000	0.000	114.107	96.579	57.821	270.460	213.070	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.180	68.166	42.453	53.332	51.480	75.016	61.848	55.534	413.220	341.010	1.05630
2	0.196463	0.960144	113.100	70.468	47.589	51.971	47.520	77.469	61.129	52.099	418.100	340.930	0.75681
3	0.294695	0.940215	110.960	74.580	53.517	51.943	44.145	79.668	59.017	47.798	423.750	337.310	1.11170
4	0.491159	0.900359	105.710	80.417	63.889	48.838	37.395	85.535	56.872	41.674	431.200	330.700	1.41940
5	0.687622	0.860502	101.460	82.057	64.917	50.192	37.710	82.720	51.268	38.300	430.030	325.390	1.01740
6	0.785854	0.840574	98.970	82.744	64.698	51.583	38.565	80.196	47.387	36.220	429.040	322.640	0.66256
7	0.884086	0.820646	96.579	83.895	62.361	56.120	41.985	74.336	40.459	32.975	428.040	318.660	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-1.799	0.421042	5367.488	1293.300	62.192	0.9280E-05	0.9381E 06
2	0.196463	0.960144	-4.190	0.459606	5379.949	1286.800	62.192	0.9280E-05	0.9383E 06
3	0.294695	0.940215	-6.237	0.493345	5390.031	1281.700	62.192	0.9280E-05	0.9377E 06
4	0.491159	0.900359	-7.118	0.520197	5362.320	1298.300	62.192	0.9280E-05	0.9136E 06
5	0.687622	0.860502	-6.812	0.524479	5385.109	1296.800	62.192	0.9280E-05	0.8891E 06
6	0.785854	0.840574	-6.140	0.524028	5377.488	1293.300	62.192	0.9280E-05	0.8727E 06
7	0.884086	0.820646	-5.179	0.516367	5375.012	1298.300	62.192	0.9280E-05	0.8539E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	16.944	0.361233	0.373119	0.444763	0.838918	0.125931	0.610077	160.170	126.010	0.03492
2	0.196463	0.960144	17.019	0.404002	0.359174	0.423616	0.847876	0.113743	0.581154	154.900	123.280	0.03354
3	0.294695	0.940215	16.298	0.453477	0.356006	0.413827	0.860277	0.102575	0.559087	154.110	120.350	0.03239
4	0.491159	0.900359	16.424	0.544159	0.366510	0.374518	0.978618	0.014813	0.479465	157.030	114.500	0.00498
5	0.687622	0.860502	15.550	0.550573	0.360290	0.366302	0.983587	0.011840	0.485568	155.680	110.470	0.00400
6	0.785854	0.840574	14.670	0.549494	0.360268	0.368261	0.978296	0.016292	0.498259	155.230	107.990	0.00552
7	0.884086	0.820646	12.975	0.529889	0.366059	0.391336	0.935411	0.053774	0.550344	157.580	105.590	0.01851

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.488610	0.363269	0.393156	0.923982	268.030	-0.033	-0.034	5376.770	117.725	117.725

TABLE XI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 9

FLOW RATE # 7 1197. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.610	44.972	44.972	0.000	0.000	124.049	115.610	68.744	255.770	224.340	0.99716
2	0.196463	0.960144	113.000	50.198	50.198	0.000	0.000	123.648	113.000	66.048	263.840	224.680	0.75681
3	0.294695	0.940215	110.800	53.967	53.967	0.000	0.000	123.244	110.800	64.031	270.550	225.290	1.11170
4	0.491159	0.900359	106.210	56.466	56.466	0.000	0.000	120.287	106.210	62.003	274.080	224.530	1.41940
5	0.687622	0.860502	101.410	57.095	57.095	0.000	0.000	116.378	101.410	60.620	274.170	223.510	1.01740
6	0.785854	0.840574	99.108	57.382	57.382	0.000	0.000	114.521	99.108	59.930	274.440	223.270	0.66256
7	0.884086	0.820646	96.803	56.186	56.186	0.000	0.000	111.927	96.803	59.868	271.630	222.570	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.610	70.418	40.037	57.928	55.350	70.215	57.682	55.235	431.540	354.480	1.05630
2	0.196463	0.960144	113.000	70.368	46.493	52.820	48.645	76.048	60.180	52.311	426.590	349.640	0.75681
3	0.294695	0.940215	110.800	72.160	51.424	50.622	44.550	79.157	60.178	49.485	428.810	347.890	1.11170
4	0.491159	0.900359	106.210	77.951	60.179	49.546	39.465	82.658	56.664	43.277	437.050	342.620	1.41940
5	0.687622	0.860502	101.410	81.079	62.310	51.878	39.780	79.599	49.532	38.483	438.160	336.000	1.01740
6	0.785854	0.840574	99.108	82.057	62.061	53.683	40.860	76.909	45.425	36.202	437.980	333.340	0.66256
7	0.884086	0.820646	96.803	83.872	59.863	58.745	44.460	70.936	38.058	32.446	438.420	329.100	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	0.194	0.381243	5387.531	1200.300	62.192	0.9280E-05	0.9283E 06
2	0.196463	0.960144	-2.562	0.426527	5375.199	1195.700	62.192	0.9280E-05	0.9253E 06
3	0.294695	0.940215	-4.519	0.457944	5382.262	1202.600	62.192	0.9280E-05	0.9222E 06
4	0.491159	0.900359	-5.097	0.478674	5387.680	1191.000	62.192	0.9280E-05	0.9001E 06
5	0.687622	0.860502	-4.830	0.484474	5382.461	1194.100	62.192	0.9280E-05	0.8708E 06
6	0.785854	0.840574	-4.270	0.486678	5384.988	1198.000	62.192	0.9280E-05	0.8570E 06
7	0.884086	0.820646	-3.132	0.476319	5387.469	1197.200	62.192	0.9280E-05	0.8375E 06

	PASS.HT.2 FROM TIP	R2/RT	LEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	16.645	0.339408	0.406419	0.481296	0.844427	0.135415	0.662821	175.770	130.140	0.03784
2	0.196463	0.960144	17.231	0.395047	0.378043	0.430915	0.877302	0.095801	0.590045	162.750	124.960	0.02812
3	0.294695	0.940215	17.985	0.436368	0.366649	0.403885	0.907807	0.068090	0.550818	158.260	122.600	0.02079
4	0.491159	0.900359	18.027	0.510149	0.376802	0.378161	0.996407	0.002613	0.498253	162.970	118.090	0.00086
5	0.687622	0.860502	15.733	0.528721	0.379896	0.378794	1.002909	-0.002260	0.507828	163.990	112.490	-0.00076
6	0.785854	0.840574	14.652	0.526361	0.378498	0.382717	0.998975	0.000945	0.525438	163.540	110.070	0.00303
7	0.884086	0.820646	12.446	0.507486	0.385664	0.408689	0.943663	0.051146	0.581577	166.790	106.530	0.01771

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.451860	0.380714	0.403483	0.943569	268.785	-0.035	-0.003	5383.941	117.882	117.882

FLOW RATE # 8 1140. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.560	43.399	43.399	0.000	0.000	123.441	115.560	69.416	258.130	228.860	0.99716
2	0.196463	0.960144	113.150	47.835	47.835	0.000	0.000	122.846	113.150	67.083	265.560	230.000	0.75681
3	0.294695	0.940215	110.800	51.445	51.445	0.000	0.000	122.161	110.800	65.094	270.640	229.510	1.11170
4	0.491159	0.900359	105.860	53.883	53.883	0.000	0.000	118.784	105.860	63.024	273.540	228.420	1.41940
5	0.687622	0.860502	101.270	54.477	54.477	0.000	0.000	114.993	101.270	61.723	273.540	227.420	1.01740
6	0.785854	0.840574	99.200	54.777	54.777	0.000	0.000	113.319	99.200	61.093	274.440	227.810	0.66256
7	0.884086	0.820646	96.579	53.692	53.692	0.000	0.000	110.500	96.579	60.929	272.000	227.200	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.560	69.734	35.733	59.883	59.175	66.157	55.677	57.308	435.240	359.670	1.05630
2	0.196463	0.960144	113.150	70.367	42.162	56.338	53.190	70.747	56.812	53.420	433.700	356.750	0.75681
3	0.294695	0.940215	110.800	71.690	47.704	53.514	48.285	74.548	57.286	50.214	432.260	352.390	1.11170
4	0.491159	0.900359	105.860	76.921	56.852	51.813	42.345	78.443	54.047	43.551	437.860	345.910	1.41940
5	0.687622	0.860502	101.270	80.221	60.050	53.193	41.535	76.924	48.077	38.682	440.330	340.320	1.01740
6	0.785854	0.840574	99.200	81.558	60.366	54.842	42.255	74.911	44.358	36.309	441.570	338.200	0.66256
7	0.884086	0.820646	96.579	83.534	58.414	59.713	45.630	69.075	36.866	32.256	441.590	333.150	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	0.866	0.368068	5385.199	1135.200	62.192	0.9280E-05	0.9237E 06
2	0.196463	0.960144	-1.327	0.405911	5382.328	1149.000	62.192	0.9280E-05	0.9192E 06
3	0.294695	0.940215	-3.456	0.436550	5382.262	1152.200	62.192	0.9280E-05	0.9141E 06
4	0.491159	0.900359	-4.076	0.458285	5369.930	1134.400	62.192	0.9280E-05	0.8889E 06
5	0.687622	0.860502	-3.727	0.462896	5375.031	1131.100	62.192	0.9280E-05	0.8605E 06
6	0.785854	0.840574	-3.107	0.464156	5389.988	1137.700	62.192	0.9280E-05	0.8498E 06
7	0.884086	0.820646	-2.071	0.456225	5375.012	1136.800	62.192	0.9280E-05	0.8269E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	18.718	0.303052	0.409873	0.497749	0.823453	0.160355	0.701787	177.110	130.810	0.04244
2	0.196463	0.960144	18.340	0.357766	0.389529	0.459007	0.848633	0.127878	0.644264	168.140	126.750	0.03659
3	0.294695	0.940215	18.714	0.404805	0.374434	0.426956	0.876985	0.097754	0.595690	161.620	122.880	0.02941
4	0.491159	0.900359	18.301	0.483539	0.382439	0.396771	0.963878	0.028083	0.535983	164.320	117.490	0.00916
5	0.687622	0.860502	15.932	0.510248	0.387451	0.388934	0.996187	0.003107	0.530076	166.790	112.900	0.00104
6	0.785854	0.840574	14.759	0.511510	0.386090	0.390619	0.988405	0.009824	0.542333	167.130	110.390	0.00333
7	0.884086	0.820646	12.256	0.496354	0.393959	0.416389	0.946132	0.050884	0.596617	169.590	105.950	0.01766

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.430470	0.387819	0.418327	0.927071	269.032	-0.032	-0.012	5379.961	117.795	117.795

TABLE XI. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 9

FLOW RATE # 9 1071. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.560	40.004	40.004	0.000	0.000	122.288	115.560	70.905	258.400	233.530	0.99716
2	0.196463	0.960144	112.890	45.015	45.015	0.000	0.000	121.534	112.890	68.260	265.290	233.800	0.75681
3	0.294695	0.940215	110.650	48.649	48.649	0.000	0.000	120.872	110.650	66.267	270.460	233.680	1.11170
4	0.491159	0.900359	106.160	50.829	50.829	0.000	0.000	117.701	106.160	64.415	274.350	234.200	1.41940
5	0.687622	0.860502	101.410	51.326	51.326	0.000	0.000	113.659	101.410	63.155	274.900	233.960	1.01740
6	0.785854	0.840574	98.924	51.577	51.577	0.000	0.000	111.562	98.924	62.464	274.900	233.560	0.66256
7	0.884086	0.820646	96.489	49.799	49.799	0.000	0.000	108.582	96.489	62.701	271.730	233.190	0.91637

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.560	69.967	32.749	61.852	62.100	62.905	53.708	58.627	436.410	360.290	1.05630
2	0.196463	0.960144	112.890	69.554	37.130	58.814	57.735	65.596	54.076	55.526	432.860	357.680	0.75681
3	0.294695	0.940215	110.650	70.262	41.789	56.484	53.505	68.412	54.165	52.350	430.620	353.900	1.11170
4	0.491159	0.900359	106.160	74.985	52.604	53.437	45.450	74.477	52.723	45.065	436.770	349.390	1.41940
5	0.687622	0.860502	101.410	79.102	57.791	54.013	43.065	74.741	47.397	39.357	443.030	345.790	1.01740
6	0.785854	0.840574	98.924	80.988	58.556	55.948	43.695	72.635	42.976	36.276	444.600	342.670	0.66256
7	0.884086	0.820646	96.489	83.491	57.535	60.502	46.440	67.862	35.986	32.025	446.820	338.490	0.97198

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	2.355	0.339277	5385.199	1073.900	62.192	0.9280E-05	0.9151E 06
2	0.196463	0.960144	-0.350	0.382855	5369.961	1071.300	62.192	0.9280E-05	0.9094E 06
3	0.294695	0.940215	-2.283	0.413380	5374.969	1070.500	62.192	0.9280E-05	0.9045E 06
4	0.491159	0.900359	-2.685	0.431083	5385.141	1084.200	62.192	0.9280E-05	0.8807E 06
5	0.687622	0.860502	-2.295	0.435524	5382.461	1069.700	62.192	0.9280E-05	0.8505E 06
6	0.785854	0.840574	-1.736	0.433255	5374.988	1064.400	62.192	0.9280E-05	0.8348E 06
7	0.884086	0.820646	-0.299	0.423547	5369.988	1062.700	62.192	0.9280E-05	0.8125E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	20.037	0.277746	0.411955	0.514116	0.801288	0.189952	0.733463	178.010	126.760	0.04846
2	0.196463	0.960144	20.446	0.315737	0.389999	0.430280	0.812024	0.168994	0.692584	167.570	123.980	0.04592
3	0.294695	0.940215	20.850	0.355087	0.372059	0.451266	0.824479	0.150171	0.653697	160.160	120.220	0.04312
4	0.491159	0.900359	19.815	0.446145	0.375884	0.408050	0.921172	0.064558	0.571610	162.420	115.190	0.02053
5	0.687622	0.860502	16.607	0.490375	0.389487	0.394389	0.987572	0.010539	0.546879	168.130	111.830	0.00351
6	0.785854	0.840574	14.726	0.497563	0.394218	0.399607	0.986513	0.011995	0.559696	169.700	109.110	0.00406
7	0.884086	0.820646	12.025	0.489341	0.407497	0.422286	0.964978	0.034682	0.603637	175.090	105.300	0.01206

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.404720	0.389952	0.429903	0.907070	269.487	-0.033	-0.018	5377.527	117.742	117.742

TABLE XII. - BLADE-ELEMENT DATA FOR CONFIGURATION 10

NASA CONFIGURATION 10
0.8 HUB-TIP RATIO, 19 BLADES, 5-INCH TIP DIAMETER,
0.834-INCH CHORD, 0.023-INCH RADIAL TIP CLEARANCE,
0.66 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.466 DESIGN FLOW COEFFICIENT.
NOT REPORTED.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	2.459000	68.550	2.459000	38.590	1.020300	0.071640	0.833300	29.960	53.570
2	2.409000	68.610	2.409000	35.080	1.041500	0.073640	0.833300	33.530	51.845
3	2.359000	68.550	2.359000	31.500	1.063600	0.075640	0.833300	37.050	50.025
4	2.259000	67.100	2.259000	25.250	1.110700	0.079640	0.833300	41.850	46.175
5	2.159000	65.450	2.159000	22.750	1.162100	0.083640	0.833300	42.700	44.100
6	2.109000	64.200	2.109000	21.550	1.189700	0.085640	0.833300	42.650	42.875
7	2.059000	63.000	2.059000	20.000	1.218600	0.087640	0.833300	43.000	41.500

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
2.000000	2.509000	2.000000	2.509000	19

TABLE XII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 10

FLOW RATE # 1 1665. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.020	62.765	62.765	0.000	0.000	131.030	115.020	61.379	238.380	177.160	0.98928
2	0.196463	0.960144	112.680	69.164	69.164	0.000	0.000	132.213	112.680	58.458	254.360	180.020	0.75681
3	0.294695	0.940215	110.860	75.813	75.813	0.000	0.000	134.304	110.860	55.633	266.640	177.320	1.11170
4	0.491159	0.900359	106.060	78.695	78.695	0.000	0.000	132.066	106.060	53.425	271.700	175.460	1.41940
5	0.687622	0.860502	101.320	79.366	79.366	0.000	0.000	128.704	101.320	51.928	271.880	173.990	1.01740
6	0.785854	0.840574	99.108	79.835	79.835	0.000	0.000	127.264	99.108	51.147	271.250	172.200	0.66256
7	0.884086	0.820646	96.893	79.366	79.366	0.000	0.000	125.249	96.893	50.679	268.180	170.290	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.020	70.796	60.421	36.896	31.410	98.763	78.124	52.282	335.130	257.240	1.06420
2	0.196463	0.960144	112.680	74.576	64.953	36.644	29.430	100.002	76.036	49.495	340.670	254.240	0.75681
3	0.294695	0.940215	110.860	79.395	69.724	37.975	28.575	100.864	72.885	46.270	351.160	253.200	1.11170
4	0.491159	0.900359	106.060	88.686	81.309	35.413	23.535	107.713	70.647	40.986	371.590	249.360	1.41940
5	0.687622	0.860502	101.320	94.745	87.898	35.362	21.915	109.894	65.958	36.884	382.890	243.390	1.01740
6	0.785854	0.840574	99.108	95.303	87.991	36.609	22.590	107.929	62.499	35.386	381.800	240.650	0.66256
7	0.884086	0.820646	96.893	92.640	84.008	39.049	24.930	101.996	57.844	34.550	372.220	238.850	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-7.171	0.534809	5360.031	1653.800	62.192	0.9280E-05	0.9805E 06
2	0.196463	0.960144	-10.152	0.589343	5359.969	1662.700	62.192	0.9280E-05	0.9893E 06
3	0.294695	0.940215	-12.917	0.642975	5385.172	1663.300	62.192	0.9280E-05	0.1005E 07
4	0.491159	0.900359	-13.675	0.668050	5380.070	1660.500	62.192	0.9280E-05	0.9882E 06
5	0.687622	0.860502	-13.522	0.674052	5377.680	1670.000	62.192	0.9280E-05	0.9631E 06
6	0.785854	0.840574	-13.053	0.677114	5384.988	1671.600	62.192	0.9280E-05	0.9523E 06
7	0.884086	0.820646	-12.321	0.672202	5392.480	1674.900	62.192	0.9280E-05	0.9372E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.692	0.514844	0.226009	0.308120	0.733508	0.131741	0.384250	96.750	80.080	0.03950
2	0.196463	0.960144	14.415	0.553459	0.201625	0.299795	0.672544	0.154695	0.376690	86.310	74.220	0.04824
3	0.294695	0.940215	14.770	0.591335	0.195600	0.302816	0.645937	0.165276	0.381908	84.520	75.880	0.05371
4	0.491159	0.900359	15.736	0.690245	0.231609	0.270673	0.855678	0.062158	0.305113	99.890	73.900	0.02112
5	0.687622	0.860502	14.134	0.746513	0.257621	0.258429	0.996875	0.001352	0.264366	111.010	69.400	0.00047
6	0.785854	0.840574	13.836	0.746290	0.255858	0.260996	0.980313	0.008821	0.272828	110.550	68.450	0.00302
7	0.884086	0.820646	14.550	0.711513	0.240122	0.271409	0.884725	0.055605	0.313570	104.040	68.560	0.01879

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSV3 FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.692420	0.231265	0.279496	0.827435	263.429	-0.034	0.004	5377.195	117.734	117.734

FLOW RATE # 2 1638. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.500	63.412	63.412	0.000	0.000	131.762	115.500	61.232	241.090	178.600	0.98928
2	0.196463	0.960144	113.150	70.546	70.546	0.000	0.000	133.340	113.150	58.058	256.980	179.640	0.75681
3	0.294695	0.940215	110.550	75.105	75.105	0.000	0.000	133.649	110.550	55.809	268.000	180.340	1.11170
4	0.491159	0.900359	105.860	77.517	77.517	0.000	0.000	131.207	105.860	53.786	271.520	178.140	1.41940
5	0.687622	0.860502	101.270	78.128	78.128	0.000	0.000	127.905	101.270	52.350	271.700	176.840	1.01740
6	0.785854	0.840574	98.832	78.277	78.277	0.000	0.000	126.075	98.832	51.620	271.520	176.300	0.66256
7	0.884086	0.820646	96.534	77.292	77.292	0.000	0.000	123.664	96.534	51.317	266.640	173.800	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.500	71.271	59.260	39.596	33.750	96.297	75.904	52.020	343.790	264.850	1.06420
2	0.196463	0.960144	113.150	75.173	63.629	40.030	32.175	96.928	73.120	48.970	352.950	265.130	0.75681
3	0.294695	0.940215	110.550	78.474	67.102	40.587	31.230	96.869	69.863	46.155	358.800	263.100	1.11170
4	0.491159	0.900359	105.860	87.863	79.024	38.406	25.920	103.898	67.454	40.484	376.460	256.490	1.41940
5	0.687622	0.860502	101.270	93.748	86.183	36.894	23.175	107.572	64.376	36.759	389.330	252.750	1.01740
6	0.785854	0.840574	98.832	93.803	85.613	38.332	24.120	104.832	60.500	35.247	386.450	249.710	0.66256
7	0.884086	0.820646	96.534	90.862	81.470	40.230	26.280	99.033	56.304	34.648	374.390	246.090	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-7.318	0.538083	5382.398	1638.000	62.192	0.9280E-05	0.9860E 06
2	0.196463	0.960144	-10.552	0.598620	5382.328	1639.100	62.192	0.9280E-05	0.9978E 06
3	0.294695	0.940215	-12.741	0.638759	5370.109	1631.200	62.192	0.9280E-05	0.1000E 07
4	0.491159	0.900359	-13.314	0.659292	5369.930	1638.600	62.192	0.9280E-05	0.9818E 06
5	0.687622	0.860502	-13.100	0.663865	5375.031	1644.200	62.192	0.9280E-05	0.9571E 06
6	0.785854	0.840574	-12.580	0.665749	5369.989	1636.300	62.192	0.9280E-05	0.9434E 06
7	0.884086	0.820646	-11.683	0.657068	5372.500	1638.000	62.192	0.9280E-05	0.9254E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.430	0.502850	0.237918	0.329238	0.722503	0.146198	0.416429	102.700	86.250	0.04409
2	0.196463	0.960144	13.890	0.539927	0.222333	0.326143	0.681705	0.162174	0.417200	95.970	85.490	0.05111
3	0.294695	0.940215	14.655	0.570697	0.211314	0.325347	0.649504	0.176519	0.418311	90.800	82.760	0.05748
4	0.491159	0.900359	15.234	0.672113	0.244238	0.294103	0.830450	0.080084	0.339903	104.940	78.350	0.02742
5	0.687622	0.860502	14.009	0.732306	0.273254	0.269758	1.012959	-0.005919	0.283070	117.630	75.910	-0.00204
6	0.785854	0.840574	13.697	0.728145	0.267483	0.274044	0.976058	0.011413	0.296278	114.930	73.410	0.00392
7	0.884086	0.820646	14.648	0.692589	0.250538	0.280659	0.892679	0.054507	0.332656	107.750	72.290	0.01840

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.619380	0.245111	0.297450	0.824041	263.882	-0.027	-0.006	5374.609	117.678	117.678

TABLE XII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 10

FLOW RATE # 3 1575. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.290	61.223	61.223	0.000	0.000	130.538	115.290	62.030	244.520	186.270	0.98928
2	0.196463	0.960144	113.050	67.511	67.511	0.000	0.000	131.674	113.050	59.155	257.790	186.960	0.75681
3	0.294695	0.940215	110.800	71.708	71.708	0.000	0.000	131.980	110.800	57.090	267.820	187.910	1.11170
4	0.491159	0.900359	106.350	74.230	74.230	0.000	0.000	129.694	106.350	55.086	271.250	185.620	1.41940
5	0.687622	0.860502	101.360	74.942	74.942	0.000	0.000	126.056	101.360	53.522	271.250	183.970	1.01740
6	0.785854	0.840574	99.154	75.113	75.113	0.000	0.000	124.393	99.154	52.854	270.800	183.120	0.66256
7	0.884086	0.820646	96.714	74.256	74.256	0.000	0.000	121.933	96.714	52.483	267.280	181.590	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.290	68.964	56.172	40.008	35.460	93.929	75.282	53.271	359.340	285.430	1.06420
2	0.196463	0.960144	113.050	72.333	59.889	40.563	34.110	94.027	72.486	50.436	361.730	280.420	0.75681
3	0.294695	0.940215	110.800	73.883	60.779	42.007	34.650	91.796	68.793	48.539	364.230	279.400	1.11170
4	0.491159	0.900359	106.350	82.316	71.114	41.456	30.240	96.273	64.894	42.381	378.550	273.250	1.41940
5	0.687622	0.860502	101.360	91.194	81.989	39.927	25.965	102.451	61.433	36.844	398.190	268.950	1.01740
6	0.785854	0.840574	99.154	91.388	81.362	41.617	27.090	99.651	57.537	35.267	396.170	266.380	0.66256
7	0.884086	0.820646	96.714	88.668	76.391	45.016	30.510	92.240	51.698	34.088	385.240	263.060	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-6.520	0.520453	5372.621	1572.200	62.192	0.9280E-05	0.9768E 06
2	0.196463	0.960144	-9.455	0.573379	5377.570	1575.100	62.192	0.9280E-05	0.9853E 06
3	0.294695	0.940215	-11.460	0.608493	5382.262	1571.600	62.192	0.9280E-05	0.9876E 06
4	0.491159	0.900359	-12.014	0.629432	5394.781	1582.200	62.192	0.9280E-05	0.9705E 06
5	0.687622	0.860502	-11.928	0.636224	5373.809	1575.700	62.192	0.9280E-05	0.9433E 06
6	0.785854	0.840574	-11.346	0.636771	5387.488	1571.000	62.192	0.9280E-05	0.9308E 06
7	0.884086	0.820646	-10.517	0.630085	5382.520	1573.900	62.192	0.9280E-05	0.9124E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	14.681	0.477515	0.266965	0.333328	0.800909	0.107783	0.430638	114.820	99.160	0.03159
2	0.196463	0.960144	15.356	0.508646	0.241223	0.330778	0.729261	0.143214	0.433805	103.940	93.460	0.04379
3	0.294695	0.940215	17.039	0.515751	0.223358	0.335146	0.666449	0.178252	0.454092	96.410	91.490	0.05548
4	0.491159	0.900359	17.131	0.602054	0.247435	0.315996	0.783033	0.113739	0.401584	107.300	87.630	0.03782
5	0.687622	0.860502	14.094	0.696050	0.294357	0.291676	1.009190	-0.004681	0.323536	126.940	84.980	-0.00161
6	0.785854	0.840574	13.717	0.689741	0.289888	0.296560	0.977501	0.012000	0.339511	125.370	83.260	0.00412
7	0.884086	0.820646	14.088	0.648201	0.273258	0.313463	0.871738	0.075118	0.394992	117.960	81.470	0.02553

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.594530	0.262656	0.315448	0.832643	264.227	-0.030	-0.038	5382.434	117.849	117.849

FLOW RATE # 4 1520. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.070	58.816	58.816	0.000	0.000	129.230	115.070	62.927	244.790	191.030	0.98928
2	0.196463	0.960144	113.000	65.060	65.060	0.000	0.000	130.391	113.000	60.069	258.790	193.010	0.75681
3	0.294695	0.940215	110.750	69.266	69.266	0.000	0.000	130.627	110.750	57.977	267.370	192.810	1.11170
4	0.491159	0.900359	105.810	71.402	71.402	0.000	0.000	127.648	105.810	55.988	271.340	192.110	1.41940
5	0.687622	0.860502	101.360	72.164	72.164	0.000	0.000	124.425	101.360	54.551	271.250	190.320	1.01740
6	0.785854	0.840574	98.878	72.861	72.861	0.000	0.000	122.823	98.878	53.614	270.980	188.480	0.66256
7	0.884086	0.820646	96.848	71.887	71.887	0.000	0.000	120.612	96.848	53.415	268.180	187.870	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.070	70.495	58.024	40.035	34.605	94.852	75.034	52.285	372.860	295.630	1.06420
2	0.196463	0.960144	113.000	72.626	61.865	38.044	31.590	97.188	74.956	50.465	376.080	294.110	0.75681
3	0.294695	0.940215	110.750	74.364	64.537	36.946	29.790	98.041	73.804	48.832	377.470	291.530	1.11170
4	0.491159	0.900359	105.810	80.261	71.196	37.054	27.495	98.976	68.756	44.001	387.170	287.060	1.41940
5	0.687622	0.860502	101.360	89.305	78.627	42.345	28.305	98.311	59.015	36.891	404.590	280.650	1.01740
6	0.785854	0.840574	98.878	89.441	77.726	44.253	29.655	95.001	54.625	35.099	401.620	277.300	0.66256
7	0.884086	0.820646	96.848	87.374	73.440	47.338	32.805	88.570	49.510	33.986	393.210	274.570	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-5.623	0.500949	5362.359	1518.200	62.192	0.9280E-05	0.9670E 06
2	0.196463	0.960144	-8.541	0.552805	5375.199	1523.600	62.192	0.9280E-05	0.9757E 06
3	0.294695	0.940215	-10.573	0.588037	5379.828	1521.200	62.192	0.9280E-05	0.9775E 06
4	0.491159	0.900359	-11.112	0.607577	5367.391	1515.700	62.192	0.9280E-05	0.9552E 06
5	0.687622	0.860502	-10.899	0.612643	5379.809	1521.200	62.192	0.9280E-05	0.9311E 06
6	0.785854	0.840574	-10.586	0.619400	5372.488	1515.100	62.192	0.9280E-05	0.9191E 06
7	0.884086	0.820646	-9.585	0.609140	5389.960	1526.100	62.192	0.9280E-05	0.9025E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.695	0.494200	0.298913	0.334194	0.894430	0.058244	0.417839	128.070	104.600	0.01746
2	0.196463	0.960144	15.385	0.525653	0.272447	0.310373	0.877802	0.061797	0.394713	117.290	101.100	0.01888
3	0.294695	0.940215	17.332	0.547891	0.255305	0.294902	0.865729	0.064396	0.382416	110.100	98.720	0.01993
4	0.491159	0.900359	18.751	0.605820	0.269838	0.293885	0.950518	0.023813	0.355298	115.830	94.950	0.00771
5	0.687622	0.860502	14.141	0.667508	0.309198	0.309343	0.999530	0.000260	0.356308	133.340	90.330	0.00009
6	0.785854	0.840574	13.549	0.660761	0.303763	0.316227	0.960585	0.022865	0.377947	130.640	88.820	0.00786
7	0.884086	0.820646	13.986	0.622294	0.288835	0.329175	0.877449	0.077244	0.426700	125.030	86.700	0.02628

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.574770	0.284559	0.308837	0.921389	264.464	-0.031	-0.006	5375.293	117.693	117.693

TABLE XII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 10

FLOW RATE # 5 1464. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.560	56.620	56.620	0.000	0.000	128.685	115.560	63.897	247.500	197.680	0.98928
2	0.196463	0.960144	113.310	63.092	63.092	0.000	0.000	129.691	113.310	60.891	260.500	198.640	0.75681
3	0.294695	0.940215	111.010	66.788	66.788	0.000	0.000	129.552	111.010	58.967	268.540	199.220	1.11170
4	0.491159	0.900359	105.960	69.150	69.150	0.000	0.000	126.527	105.960	56.871	271.700	197.390	1.41940
5	0.687622	0.860502	101.600	69.890	69.890	0.000	0.000	123.317	101.600	55.476	271.790	195.880	1.01740
6	0.785854	0.840574	99.200	69.913	69.913	0.000	0.000	121.361	99.200	54.825	272.060	196.100	0.66256
7	0.884086	0.820646	96.534	68.926	68.926	0.000	0.000	118.615	96.534	54.473	267.550	193.720	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.560	71.068	54.715	45.353	39.655	89.010	70.207	52.069	386.560	308.070	1.06420
2	0.196463	0.960144	113.310	74.222	60.791	42.582	35.010	93.263	70.728	49.321	391.490	305.880	0.75681
3	0.294695	0.940215	111.010	77.292	64.501	42.587	33.435	94.032	68.423	46.690	396.270	303.430	1.11170
4	0.491159	0.900359	105.960	82.444	71.774	40.566	29.475	97.097	65.394	42.337	401.450	295.820	1.41940
5	0.687622	0.860502	101.600	88.385	75.899	45.290	30.825	94.507	56.310	36.572	412.650	291.250	1.01740
6	0.785854	0.840574	99.200	88.067	74.909	46.310	31.725	91.699	52.890	35.225	410.120	289.590	0.66256
7	0.884086	0.820646	96.534	86.232	70.473	49.695	35.190	84.619	46.839	33.610	398.640	283.080	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-4.653	0.480197	5385.199	1467.200	62.192	0.9280E-05	0.9629E 06
2	0.196463	0.960144	-7.719	0.534614	5389.941	1469.800	62.192	0.9280E-05	0.9705E 06
3	0.294695	0.940215	-9.583	0.565668	5392.461	1464.700	62.192	0.9280E-05	0.9694E 06
4	0.491159	0.900359	-10.229	0.587577	5375.000	1452.600	62.192	0.9280E-05	0.9468E 06
5	0.687622	0.860502	-9.974	0.591937	5392.539	1465.300	62.192	0.9280E-05	0.9228E 06
6	0.785854	0.840574	-9.375	0.592413	5389.988	1467.900	62.192	0.9280E-05	0.9081E 06
7	0.884086	0.820646	-8.527	0.585949	5372.500	1462.800	62.192	0.9280E-05	0.8876E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	13.479	0.464044	0.321816	0.376976	0.853678	0.092618	0.481023	139.060	110.390	0.02790
2	0.196463	0.960144	14.241	0.515121	0.302607	0.346444	0.873466	0.072597	0.438510	130.990	107.240	0.02272
3	0.294695	0.940215	15.190	0.546302	0.294800	0.339134	0.869273	0.073646	0.428710	127.730	104.210	0.02375
4	0.491159	0.900359	17.087	0.609871	0.301411	0.310351	0.971194	0.015469	0.376932	129.750	98.430	0.00515
5	0.687622	0.860502	13.822	0.642829	0.325095	0.330074	0.984915	0.009129	0.391648	140.860	95.370	0.00315
6	0.785854	0.840574	13.675	0.634739	0.318934	0.329846	0.966919	0.020637	0.404784	138.060	93.490	0.00708
7	0.884086	0.820646	13.610	0.599100	0.304807	0.346691	0.879189	0.082384	0.458513	131.090	89.360	0.02815

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.552630	0.309227	0.336957	0.917704	265.355	-0.029	0.008	5385.375	117.913	117.913

FLOW RATE # 6 1383. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.340	53.481	53.481	0.000	0.000	127.136	115.340	65.124	249.760	205.310	0.98928
2	0.196463	0.960144	112.940	59.491	59.491	0.000	0.000	127.650	112.940	62.222	260.860	205.860	0.75681
3	0.294695	0.940215	110.440	63.372	63.372	0.000	0.000	127.330	110.440	60.152	269.450	206.040	1.11170
4	0.491159	0.900359	105.910	65.538	65.538	0.000	0.000	124.548	105.910	58.250	272.150	205.400	1.41940
5	0.687622	0.860502	101.220	66.066	66.066	0.000	0.000	120.873	101.220	56.868	272.150	204.320	1.01740
6	0.785854	0.840574	99.108	66.498	66.498	0.000	0.000	119.350	99.108	56.140	271.970	203.250	0.66256
7	0.884086	0.820646	96.444	65.499	65.499	0.000	0.000	116.583	96.444	55.818	268.720	202.050	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.340	68.837	49.659	47.671	43.830	83.935	67.669	53.727	393.760	320.120	1.06420
2	0.196463	0.960144	112.940	71.095	54.815	45.275	39.555	87.082	67.665	50.989	398.470	319.920	0.75681
3	0.294695	0.940215	110.440	74.339	58.596	45.747	37.980	87.285	64.693	47.831	400.780	314.900	1.11170
4	0.491159	0.900359	105.910	80.438	66.314	45.526	34.470	89.688	60.384	42.320	408.970	308.420	1.41940
5	0.687622	0.860502	101.220	85.757	71.528	47.308	33.480	89.570	53.912	37.006	418.510	304.220	1.01740
6	0.785854	0.840574	99.108	86.106	71.140	48.510	34.290	87.299	50.598	35.422	415.970	300.750	0.66256
7	0.884086	0.820646	96.444	84.590	66.839	51.846	37.900	80.352	44.598	33.713	407.670	296.470	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	PEC
1	0.098232	0.980072	-3.426	0.454445	5374.949	1378.600	62.192	0.9280E-05	0.9514E 06
2	0.196463	0.960144	-6.388	0.505752	5372.340	1386.000	62.192	0.9280E-05	0.9552E 06
3	0.294695	0.940215	-8.398	0.539505	5364.770	1380.000	62.192	0.9280E-05	0.9528E 06
4	0.491159	0.900359	-8.850	0.557149	5372.461	1387.300	62.192	0.9280E-05	0.9320E 06
5	0.687622	0.860502	-8.582	0.561648	5372.371	1382.000	62.192	0.9280E-05	0.9045E 06
6	0.785854	0.840574	-8.060	0.563996	5384.988	1392.000	62.192	0.9280E-05	0.8931E 06
7	0.884086	0.820646	-7.182	0.557332	5367.488	1375.300	62.192	0.9280E-05	0.8724E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.137	0.421965	0.334521	0.397002	0.842618	0.107074	0.523553	144.000	114.810	0.03104
2	0.196463	0.960144	15.909	0.466006	0.319986	0.369557	0.865865	0.084184	0.488079	137.610	114.060	0.02544
3	0.294695	0.940215	16.331	0.498845	0.308578	0.366176	0.842705	0.098033	0.483397	132.330	108.860	0.03094
4	0.491159	0.900359	17.070	0.563751	0.318136	0.348457	0.912983	0.054095	0.444441	136.820	103.020	0.01801
5	0.687622	0.860502	14.256	0.608085	0.340330	0.346075	0.983399	0.010882	0.427365	146.360	99.900	0.00374
6	0.785854	0.840574	13.872	0.603368	0.333274	0.345841	0.963663	0.024529	0.439371	144.000	97.500	0.00940
7	0.884086	0.820646	13.713	0.568739	0.323687	0.362035	0.894076	0.077938	0.493239	138.950	94.420	0.02660

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.523160	0.324997	0.360274	0.902085	265.971	-0.026	-0.011	5372.766	117.637	117.637

TABLE XII. - Continued. *BLADE-ELEMENT DATA FOR CONFIGURATION 10*

FLOW RATE # 7 1288. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.230	49.293	49.293	0.000	0.000	125.330	115.230	66.840	252.470	214.710	0.98928
2	0.196463	0.960144	112.790	54.859	54.859	0.000	0.000	125.424	112.790	64.062	261.950	215.180	0.75681
3	0.294695	0.940215	110.550	58.388	58.388	0.000	0.000	125.022	110.550	62.159	268.720	215.740	1.11170
4	0.491159	0.900359	105.760	60.923	60.923	0.000	0.000	122.052	105.760	60.056	271.880	214.200	1.41940
5	0.687622	0.860502	101.220	61.417	61.417	0.000	0.000	118.396	101.220	58.752	272.150	213.530	1.01740
6	0.785854	0.840574	98.740	61.731	61.731	0.000	0.000	116.448	98.740	57.987	271.790	212.570	0.66256
7	0.884086	0.820646	96.624	60.764	60.764	0.000	0.000	114.142	96.624	57.835	269.440	212.060	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.230	69.168	46.229	51.451	48.060	78.771	63.779	54.064	407.530	333.230	1.06420
2	0.196463	0.960144	112.790	70.541	50.542	49.210	44.235	81.221	63.580	51.518	409.540	332.210	0.75681
3	0.294695	0.940215	110.550	73.835	54.532	49.777	42.390	81.652	60.773	48.098	411.260	326.540	1.11170
4	0.491159	0.900359	105.760	79.013	61.509	49.596	38.880	83.293	56.164	42.400	418.350	321.330	1.41940
5	0.687622	0.860502	101.220	83.024	66.471	49.745	36.810	84.072	51.475	37.754	423.340	316.220	1.01740
6	0.785854	0.840574	98.740	83.619	66.671	50.468	37.125	82.311	48.271	35.906	421.070	312.410	0.66256
7	0.884086	0.820646	96.624	83.217	63.194	54.145	40.590	76.144	42.479	33.909	418.050	310.430	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-1.710	0.419253	5369.820	1286.800	62.192	0.9280E-05	0.9378E 06
2	0.196463	0.960144	-4.548	0.466999	5365.211	1273.000	62.192	0.9280E-05	0.9385E 06
3	0.294695	0.940215	-6.391	0.496583	5370.109	1298.300	62.192	0.9280E-05	0.9355E 06
4	0.491159	0.900359	-7.044	0.518650	5364.852	1289.700	62.192	0.9280E-05	0.9133E 06
5	0.687622	0.860502	-6.698	0.522127	5372.371	1286.100	62.192	0.9280E-05	0.8859E 06
6	0.785854	0.840574	-6.213	0.525515	5364.988	1284.600	62.192	0.9280E-05	0.8714E 06
7	0.884086	0.820646	-5.165	0.516081	5377.512	1295.400	62.192	0.9280E-05	0.8541E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	15.474	0.393193	0.361019	0.428885	0.841761	0.119450	0.572667	155.110	118.520	0.03435
2	0.196463	0.960144	16.438	0.430243	0.344106	0.402209	0.855542	0.101937	0.540781	147.590	117.030	0.03045
3	0.294695	0.940215	16.598	0.463791	0.331725	0.393041	0.833397	0.117309	0.534068	142.540	110.800	0.03683
4	0.491159	0.900359	17.150	0.523637	0.341541	0.380149	0.898440	0.071520	0.500487	146.470	107.130	0.02378
5	0.687622	0.860502	15.004	0.565042	0.351561	0.363903	0.966083	0.024366	0.470682	151.190	102.690	0.00829
6	0.785854	0.840574	14.356	0.567569	0.348075	0.361143	0.963816	0.026594	0.475300	149.280	99.840	0.00905
7	0.884086	0.820646	13.909	0.536719	0.344901	0.377383	0.913929	0.069124	0.527533	148.610	98.370	0.02354

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIE	ROTOR EFFE	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.487430	0.345539	0.385568	0.896182	266.501	-0.031	-0.010	5369.266	117.561	117.561

FLOW RATE # 8 1194. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.230	45.625	45.625	0.000	0.000	123.934	115.230	68.399	254.990	222.640	0.98928
2	0.196463	0.960144	112.890	50.607	50.607	0.000	0.000	123.714	112.890	65.854	263.750	223.950	0.75681
3	0.294695	0.940215	110.390	54.175	54.175	0.000	0.000	122.967	110.390	63.860	269.260	223.650	1.11170
4	0.491159	0.900359	105.960	56.648	56.648	0.000	0.000	120.152	105.960	61.870	271.970	222.100	1.41940
5	0.687622	0.860502	101.360	57.050	57.050	0.000	0.000	116.312	101.360	60.627	272.060	221.480	1.01740
6	0.785854	0.840574	98.740	57.275	57.275	0.000	0.000	114.149	98.740	59.884	271.970	220.990	0.66256
7	0.884086	0.820646	96.669	56.739	56.739	0.000	0.000	112.090	96.669	59.590	270.250	220.220	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.230	69.734	42.088	55.600	52.875	72.987	59.630	54.785	417.520	341.950	1.06420
2	0.196463	0.960144	112.890	68.935	46.073	51.277	48.060	76.934	61.613	53.211	414.150	340.300	0.75681
3	0.294695	0.940215	110.390	70.546	49.450	50.312	45.495	77.812	60.078	50.542	414.280	336.940	1.11170
4	0.491159	0.900359	105.960	75.002	55.632	50.303	42.120	78.693	55.657	45.013	419.000	331.580	1.41940
5	0.687622	0.860502	101.360	80.417	61.882	51.357	39.690	79.559	50.003	38.939	425.830	325.330	1.01740
6	0.785854	0.840574	98.740	82.014	63.316	52.129	39.465	78.623	46.611	36.360	427.090	322.560	0.66256
7	0.884086	0.820646	96.669	83.407	61.513	56.327	42.480	73.562	40.342	33.258	426.940	318.830	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	-0.151	0.388058	5369.820	1193.300	62.192	0.9280E-05	0.9274E 06
2	0.196463	0.960144	-2.756	0.430417	5369.961	1194.100	62.192	0.9280E-05	0.9257E 06
3	0.294695	0.940215	-4.690	0.461419	5362.340	1198.800	62.192	0.9280E-05	0.9202E 06
4	0.491159	0.900359	-5.230	0.481350	5375.000	1195.700	62.192	0.9280E-05	0.8991E 06
5	0.687622	0.860502	-4.823	0.484331	5379.809	1189.400	62.192	0.9280E-05	0.8704E 06
6	0.785854	0.840574	-4.316	0.487584	5365.000	1193.300	62.192	0.9280E-05	0.8542E 06
7	0.884086	0.820646	-3.410	0.481672	5380.020	1194.100	62.192	0.9280E-05	0.8388E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	16.195	0.357975	0.378289	0.463474	0.816202	0.153331	0.630930	162.530	119.310	0.04333
2	0.196463	0.960144	18.131	0.391858	0.350037	0.418737	0.835935	0.124104	0.577113	150.400	116.350	0.03568
3	0.294695	0.940215	19.042	0.421180	0.338476	0.402902	0.840096	0.117467	0.559556	145.020	113.290	0.03509
4	0.491159	0.900359	19.763	0.472715	0.341553	0.384840	0.887519	0.083057	0.533518	147.030	109.480	0.02643
5	0.687622	0.860502	16.189	0.525352	0.356572	0.375180	0.950403	0.038168	0.505964	153.770	103.850	0.01277
6	0.785854	0.840574	14.810	0.539008	0.361691	0.373022	0.969623	0.023999	0.503156	155.120	101.570	0.00812
7	0.884086	0.820646	13.256	0.522201	0.363314	0.392411	0.925851	0.064270	0.549912	156.690	98.610	0.02205

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.451790	0.354420	0.398171	0.890121	267.228	-0.030	-0.011	5371.707	117.614	117.614

TABLE XII. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 10

FLOW RATE # 9 1133. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.230	44.017	44.017	0.000	0.000	123.351	115.230	69.093	255.990	225.880	0.98928
2	0.196463	0.960144	113.050	48.596	48.596	0.000	0.000	123.052	113.050	66.739	264.300	227.600	0.75681
3	0.294695	0.940215	110.910	51.925	51.925	0.000	0.000	122.463	110.910	64.912	270.160	228.260	1.11170
4	0.491159	0.900359	106.110	54.062	54.062	0.000	0.000	119.088	106.110	63.002	271.890	226.460	1.41940
5	0.687622	0.860502	101.320	54.495	54.495	0.000	0.000	115.045	101.320	61.727	271.970	225.820	1.01740
6	0.785854	0.840574	99.016	54.730	54.730	0.000	0.000	113.135	99.016	61.069	271.970	225.420	0.66256
7	0.884086	0.820646	96.759	53.883	53.883	0.000	0.000	110.750	96.759	60.887	269.800	224.680	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.230	70.060	39.380	57.946	55.800	69.514	57.284	55.494	421.090	344.810	1.06420
2	0.196463	0.960144	113.050	68.968	43.333	53.655	51.075	73.522	59.395	53.887	417.170	343.250	0.75681
3	0.294695	0.940215	110.910	69.401	46.059	51.914	48.420	74.846	58.996	52.021	416.860	342.010	1.11170
4	0.491159	0.900359	106.110	73.358	52.640	51.092	44.145	76.144	55.018	46.265	418.470	334.840	1.41940
5	0.687622	0.860502	101.320	79.013	59.555	51.926	41.085	77.373	49.394	39.672	426.970	329.950	1.01740
6	0.785854	0.840574	99.016	81.035	61.371	52.918	40.770	76.756	46.098	36.912	428.210	326.160	0.66256
7	0.884086	0.820646	96.759	82.981	60.357	56.947	43.335	72.304	39.812	33.409	429.970	322.960	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	0.543	0.374382	5369.820	1126.200	62.192	0.9280E-05	0.9230E 06
2	0.196463	0.960144	-1.871	0.412731	5377.570	1149.800	62.192	0.9280E-05	0.9208E 06
3	0.294695	0.940215	-3.638	0.440180	5387.602	1131.900	62.192	0.9280E-05	0.9164E 06
4	0.491159	0.900359	-4.098	0.458722	5382.609	1138.500	62.192	0.9280E-05	0.8911E 06
5	0.687622	0.860502	-3.723	0.462818	5377.680	1134.400	62.192	0.9280E-05	0.8609E 06
6	0.785854	0.840574	-3.131	0.464620	5379.988	1122.100	62.192	0.9280E-05	0.8466E 06
7	0.884086	0.820646	-2.113	0.457001	5385.020	1126.200	62.192	0.9280E-05	0.8287E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	16.904	0.334939	0.384270	0.483026	0.795548	0.179441	0.666657	165.100	118.930	0.04982
2	0.196463	0.960144	18.807	0.368030	0.354760	0.437535	0.810861	0.151535	0.611844	152.870	115.650	0.04288
3	0.294695	0.940215	20.521	0.390453	0.339195	0.413777	0.819752	0.138402	0.588108	146.700	113.750	0.04004
4	0.491159	0.900359	21.015	0.446660	0.339569	0.390323	0.869959	0.099422	0.553740	146.590	108.380	0.03094
5	0.687622	0.860502	16.922	0.505795	0.359709	0.379481	0.947096	0.041422	0.521651	155.000	104.130	0.01372
6	0.785854	0.840574	15.362	0.520995	0.362275	0.377616	0.959376	0.033260	0.518138	156.240	100.740	0.01118
7	0.884086	0.820646	13.409	0.511906	0.370694	0.396361	0.935244	0.058181	0.558118	160.170	98.280	0.01993

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.427910	0.357122	0.406439	0.878660	267.438	-0.022	-0.007	5380.039	117.797	117.797

FLOW RATE #10 1077. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.098232	0.980072	115.560	41.013	41.013	0.000	0.000	122.622	115.560	70.460	258.340	232.200	0.98928
2	0.196463	0.960144	113.050	45.533	45.533	0.000	0.000	121.875	113.050	68.062	264.660	232.440	0.75681
3	0.294695	0.940215	110.700	48.965	48.965	0.000	0.000	121.046	110.700	66.139	269.440	232.180	1.11170
4	0.491159	0.900359	105.910	51.157	51.157	0.000	0.000	117.618	105.910	64.218	272.240	231.570	1.41940
5	0.687622	0.860502	101.360	51.776	51.776	0.000	0.000	113.818	101.360	62.942	272.330	230.670	1.01740
6	0.785854	0.840574	98.740	51.962	51.962	0.000	0.000	111.578	98.740	62.244	272.150	230.190	0.66256
7	0.884086	0.820646	96.399	50.860	50.860	0.000	0.000	108.993	96.399	62.184	270.250	230.050	0.90896

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.098232	0.980072	115.560	70.546	35.433	61.002	59.850	65.054	54.558	56.999	426.360	349.020	1.06420
2	0.196463	0.960144	113.050	69.015	38.072	57.564	56.520	67.292	55.486	55.544	420.670	346.650	0.75681
3	0.294695	0.940215	110.700	68.735	41.442	54.836	52.920	69.557	55.864	53.431	414.120	340.700	1.11170
4	0.491159	0.900359	105.910	71.614	49.635	51.623	46.125	73.557	54.287	47.563	415.230	335.530	1.41940
5	0.687622	0.860502	101.360	77.633	57.296	52.383	42.435	75.377	48.977	40.524	426.100	332.440	1.01740
6	0.785854	0.840574	98.740	80.261	59.744	53.596	41.895	74.882	45.144	37.075	429.620	329.510	0.66256
7	0.884086	0.820646	96.399	82.810	59.514	57.582	44.055	71.054	38.817	33.114	433.900	327.330	0.97939

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.098232	0.980072	1.910	0.347833	5385.199	1083.400	62.192	0.9280E-05	0.9176E 06
2	0.196463	0.960144	-0.548	0.386719	5377.570	1070.500	62.192	0.9280E-05	0.9120E 06
3	0.294695	0.940215	-2.411	0.415880	5377.398	1081.700	62.192	0.9280E-05	0.9058E 06
4	0.491159	0.900359	-2.882	0.434894	5372.461	1088.400	62.192	0.9280E-05	0.8801E 06
5	0.687622	0.860502	-2.508	0.439554	5379.809	1069.600	62.192	0.9280E-05	0.8517E 06
6	0.785854	0.840574	-1.956	0.442352	5364.988	1074.800	62.192	0.9280E-05	0.8349E 06
7	0.884086	0.820646	-0.816	0.432976	5364.988	1077.400	62.192	0.9280E-05	0.8156E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.098232	0.980072	18.409	0.300506	0.388836	0.507049	0.766861	0.218603	0.713262	168.020	116.820	0.05835
2	0.196463	0.960144	20.464	0.323347	0.362067	0.469408	0.771327	0.200370	0.674613	156.010	114.210	0.05442
3	0.294695	0.940215	21.931	0.351983	0.335794	0.437898	0.766833	0.193202	0.638328	144.680	108.520	0.05411
4	0.491159	0.900359	22.313	0.421952	0.332482	0.395128	0.841454	0.125320	0.572189	142.990	103.960	0.03807
5	0.687622	0.860502	17.774	0.486421	0.356572	0.382672	0.931794	0.055909	0.535764	153.770	101.770	0.01829
6	0.785954	0.840574	15.525	0.508602	0.367172	0.383522	0.957369	0.036243	0.530756	157.470	99.320	0.01215
7	0.884086	0.820646	13.114	0.506639	0.381581	0.402278	0.948552	0.048079	0.564861	163.650	97.280	0.01652

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.407360	0.358334	0.417422	0.858447	267.888	-0.029	-0.019	5374.629	117.678	117.678

TABLE XIII. - BLADE-ELEMENT DATA FOR CONFIGURATION 13A

NASA CONFIGURATION 13 ADJUSTED-SEE ERI-77900
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.433000	70.300	4.433000	11.800	1.388600	0.056680	1.172000	58.500	41.050
2	4.298000	69.300	4.298000	4.100	1.432200	0.062080	1.172000	65.700	36.950
3	4.162000	69.200	4.162000	-3.600	1.479000	0.067520	1.172000	72.800	32.800
4	4.028000	68.500	4.028000	-11.800	1.528200	0.072880	1.172000	80.300	28.350
5	3.893000	67.900	3.893000	-19.700	1.581200	0.078280	1.172000	87.600	24.100

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.825000	4.500000	3.825000	4.500000	33

FLOW RATE # 1 3906. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.657	70.415	70.415	0.000	0.000	117.174	93.657	53.063	435.098	358.045	3.60880
2	0.299259	0.955111	90.550	70.349	70.349	0.000	0.000	114.666	90.550	52.156	435.021	358.111	3.65920
3	0.500741	0.924889	87.859	70.893	70.893	0.000	0.000	112.894	87.859	51.100	435.262	357.158	3.53030
4	0.699259	0.895111	85.276	71.064	71.064	0.000	0.000	111.005	85.276	50.194	434.860	356.379	3.40400
5	0.899260	0.865111	82.452	72.200	72.200	0.000	0.000	109.595	82.452	48.793	434.871	353.861	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.657	76.891	39.913	65.721	58.729	48.719	27.936	34.989	498.550	406.670	3.60880
2	0.299259	0.955111	90.550	77.458	54.322	55.217	45.468	64.802	35.333	33.041	500.450	407.210	3.65920
3	0.500741	0.924889	87.859	93.662	78.753	50.700	32.773	87.079	37.158	25.260	541.830	405.500	3.53030
4	0.699259	0.895111	85.276	109.408	91.768	59.570	32.989	95.301	25.706	15.649	590.060	404.040	3.40400
5	0.899260	0.865111	82.452	114.010	89.811	70.231	38.025	90.638	12.221	7.749	608.080	406.080	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-17.237	0.740640	2421.000	3894.600	62.284	0.9280E-05	0.1233E 07
2	0.299259	0.955111	-17.644	0.742037	2414.200	3912.080	62.284	0.9280E-05	0.1207E 07
3	0.500741	0.924889	-18.100	0.746291	2419.000	3914.100	62.284	0.9280E-05	0.1188E 07
4	0.699259	0.895111	-18.306	0.745933	2426.000	3912.310	62.284	0.9280E-05	0.1168E 07
5	0.899260	0.865111	-19.107	0.757543	2427.000	3895.070	62.284	0.9280E-05	0.1153E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	23.189	0.419820	0.225861	0.680978	0.331672	0.599235	0.786180	63.452	48.625	0.17677
2	0.299259	0.955111	28.941	0.572986	0.234212	0.556279	0.421033	0.440327	0.602976	65.429	49.099	0.12886
3	0.500741	0.924889	28.860	0.929032	0.379963	0.493633	0.769726	0.160965	0.380487	106.568	48.342	0.04921
4	0.699259	0.895111	27.449	0.963257	0.550168	0.559698	0.982973	0.014039	0.317054	155.200	47.661	0.00442
5	0.899260	0.865111	27.449	0.942318	0.613502	0.637484	0.962380	0.036274	0.375611	173.209	52.219	0.01137

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.746490	0.437047	0.576877	0.757608	434.234	-0.013	-0.023	2421.440	95.090	95.090

TABLE XIII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 13A

FLOW RATE # 2 3796. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	94.005	67.696	67.696	0.000	0.000	115.844	94.005	54.241	434.731	363.512	3.60880
2	0.299259	0.955111	91.030	68.212	68.212	0.000	0.000	113.751	91.030	53.154	435.069	362.761	3.65920
3	0.500741	0.924889	88.276	69.698	69.698	0.000	0.000	112.474	88.276	51.708	435.088	359.596	3.53030
4	0.699259	0.895111	85.529	69.573	69.573	0.000	0.000	110.253	85.529	50.874	435.049	359.827	3.40400
5	0.899260	0.865111	82.646	69.712	69.712	0.000	0.000	108.121	82.646	49.852	434.867	359.343	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	94.005	77.371	39.563	66.491	59.247	48.190	27.514	34.817	519.010	425.980	3.60880
2	0.299259	0.955111	91.030	77.844	53.078	56.941	47.011	63.082	34.088	32.710	513.700	419.530	3.65920
3	0.500741	0.924889	88.276	94.049	76.721	54.398	35.338	83.868	33.878	23.825	555.550	418.090	3.53030
4	0.699259	0.895111	85.529	107.897	88.116	62.269	35.248	91.134	23.260	14.787	596.820	415.900	3.40400
5	0.899260	0.865111	82.646	112.370	86.425	71.818	39.726	87.100	10.828	7.141	611.310	415.080	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-16.059	0.709413	2430.000	3792.150	62.284	0.9280E-05	0.1219E 07
2	0.299259	0.955111	-16.646	0.715700	2427.000	3785.970	62.284	0.9280E-05	0.1197E 07
3	0.500741	0.924889	-17.492	0.730234	2430.500	3819.260	62.284	0.9280E-05	0.1184E 07
4	0.699259	0.895111	-17.626	0.728120	2433.200	3790.920	62.284	0.9280E-05	0.1160E 07
5	0.899260	0.865111	-18.048	0.729728	2432.700	3793.190	62.284	0.9280E-05	0.1138E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	23.017	0.414592	0.297778	0.696409	0.433820	0.527419	0.790685	84.279	62.468	0.15591
2	0.299259	0.955111	28.610	0.556913	0.278509	0.570628	0.488074	0.410146	0.620198	78.631	56.769	0.12048
3	0.500741	0.924889	27.425	0.803821	0.425446	0.527129	0.807101	0.146447	0.417840	120.462	58.494	0.04529
4	0.699259	0.895111	26.587	0.922180	0.570073	0.583329	0.977275	0.019914	0.358197	161.771	56.073	0.00630
5	0.899260	0.865111	26.841	0.904670	0.622032	0.650360	0.956443	0.044230	0.404457	176.443	55.737	0.01388

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.722830	0.468896	0.596611	0.785917	434.162	-0.013	-0.025	2430.680	95.453	95.453

FLOW RATE # 3 3655. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.773	65.449	65.449	0.000	0.000	114.354	93.773	55.087	435.016	368.447	3.60880
2	0.299259	0.955111	90.944	65.896	65.896	0.000	0.000	112.307	90.944	54.074	435.086	367.605	3.65920
3	0.500741	0.924889	88.149	66.696	66.696	0.000	0.000	110.538	88.149	52.888	435.074	365.944	3.53030
4	0.699259	0.895111	84.984	66.013	66.013	0.000	0.000	107.611	84.984	52.161	434.900	367.179	3.40400
5	0.899260	0.865111	82.187	66.708	66.708	0.000	0.000	105.852	82.187	50.935	435.063	365.908	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.773	78.789	40.357	67.668	59.138	48.064	26.105	32.897	535.140	438.670	3.60880
2	0.299259	0.955111	90.944	79.536	54.044	58.355	47.196	63.110	32.589	31.090	527.990	429.680	3.65920
3	0.500741	0.924889	88.149	93.518	75.697	54.914	35.959	82.671	33.235	23.704	565.390	429.480	3.53030
4	0.699259	0.895111	84.984	105.244	84.137	63.223	36.922	86.906	21.762	14.501	597.010	424.880	3.40400
5	0.899260	0.865111	82.187	109.971	81.181	74.183	42.421	81.575	8.004	5.631	610.640	422.700	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-15.213	0.687561	2424.000	3660.700	62.284	0.9280E-05	0.1204E 07
2	0.299259	0.955111	-15.726	0.692054	2424.700	3669.060	62.284	0.9280E-05	0.1182E 07
3	0.500741	0.924889	-16.312	0.699795	2427.000	3666.320	62.284	0.9280E-05	0.1163E 07
4	0.699259	0.895111	-16.339	0.695291	2417.700	3635.910	62.284	0.9280E-05	0.1133E 07
5	0.899260	0.865111	-16.965	0.702179	2419.200	3644.980	62.284	0.9280E-05	0.1114E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	21.097	0.423965	0.355515	0.700295	0.507671	0.477791	0.792758	100.124	70.223	0.14445
2	0.299259	0.955111	26.990	0.567588	0.329689	0.585343	0.563240	0.367537	0.619461	92.904	62.075	0.10988
3	0.500741	0.924889	27.304	0.794231	0.461576	0.532897	0.866163	0.106044	0.420048	130.316	63.536	0.03283
4	0.699259	0.895111	26.301	0.886191	0.578616	0.596057	0.970739	0.027153	0.384626	162.110	57.701	0.00860
5	0.899260	0.865111	25.331	0.854524	0.625906	0.675532	0.926537	0.079948	0.450962	175.577	56.792	0.02516

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.698340	0.491888	0.610765	0.805364	434.227	-0.017	-0.011	2422.520	95.132	95.132

TABLE XIII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 13A

FLOW RATE # 4 3533. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.347	63.004	63.004	0.000	0.000	112.620	93.347	55.983	435.052	373.364	3.60880
2	0.299259	0.955111	90.587	63.584	63.584	0.000	0.000	110.675	90.587	54.935	434.912	372.084	3.65920
3	0.500741	0.924889	87.648	63.784	63.784	0.000	0.000	108.400	87.648	53.956	434.974	371.750	3.53030
4	0.699259	0.895111	85.171	64.575	64.575	0.000	0.000	106.883	85.171	52.831	435.148	370.345	3.40400
5	0.899260	0.865111	82.367	65.451	65.451	0.000	0.000	105.205	82.367	51.529	435.893	369.321	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.347	79.281	42.445	66.962	57.631	49.977	26.385	31.867	549.240	451.560	3.60880
2	0.299259	0.955111	90.587	80.081	54.090	59.052	47.511	62.612	31.535	30.242	542.810	448.150	3.65920
3	0.500741	0.924889	87.648	93.689	74.016	57.440	37.813	79.943	30.208	22.202	574.070	437.660	3.53030
4	0.699259	0.895111	85.171	104.082	80.766	65.649	39.105	83.092	19.522	13.588	602.200	433.850	3.40400
5	0.899260	0.865111	82.367	107.575	76.875	75.250	44.388	77.204	7.117	5.289	613.570	433.730	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-14.317	0.664891	2413.000	3536.780	62.284	0.9280E-05	0.1185E 07
2	0.299259	0.955111	-14.865	0.670396	2415.200	3538.230	62.284	0.9280E-05	0.1165E 07
3	0.500741	0.924889	-15.244	0.673063	2413.200	3525.000	62.284	0.9280E-05	0.1141E 07
4	0.699259	0.895111	-15.669	0.678659	2423.000	3532.660	62.284	0.9280E-05	0.1125E 07
5	0.899260	0.865111	-16.371	0.687434	2424.500	3532.540	62.284	0.9280E-05	0.1107E 07

	PASS.HT.2 FROM TIP	R2/RT	IEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	20.066	0.447927	0.409158	0.696142	0.587751	0.406342	0.770325	114.188	78.196	0.12426
2	0.299259	0.955111	26.142	0.570306	0.385916	0.594670	0.648957	0.306616	0.620546	107.898	71.066	0.09248
3	0.500741	0.924889	25.802	0.781040	0.498325	0.560594	0.888924	0.095181	0.441652	139.096	65.910	0.02979
4	0.699259	0.895111	25.388	0.848824	0.593649	0.617575	0.961258	0.037924	0.423547	167.052	63.505	0.01206
5	0.899260	0.865111	24.989	0.807427	0.630626	0.683749	0.922307	0.087016	0.492339	177.677	64.409	0.02740

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.676290	0.518752	0.625559	0.829260	434.382	-0.015	0.002	2417.780	94.946	94.946

FLOW RATE # 5 3400. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.781	60.751	60.751	0.000	0.000	111.739	93.781	57.065	435.103	377.747	3.60880
2	0.299259	0.955111	90.775	61.013	61.013	0.000	0.000	109.374	90.775	56.094	434.904	377.054	3.65920
3	0.500741	0.924889	87.957	61.770	61.770	0.000	0.000	107.480	87.957	54.920	434.826	375.530	3.53030
4	0.699259	0.895111	85.171	61.447	61.447	0.000	0.000	105.022	85.171	54.191	434.985	376.309	3.40400
5	0.899260	0.865111	82.316	62.599	62.599	0.000	0.000	103.414	82.316	52.748	434.895	373.998	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.781	80.497	42.754	68.205	57.919	49.819	25.575	30.888	563.700	463.000	3.60880
2	0.299259	0.955111	90.775	80.697	54.525	59.489	47.493	62.863	31.285	29.846	555.960	454.760	3.65920
3	0.500741	0.924889	87.957	93.080	72.188	58.760	39.145	77.869	29.197	22.021	581.270	446.630	3.53030
4	0.699259	0.895111	85.171	100.585	76.301	65.541	40.662	78.785	19.630	14.427	601.840	444.610	3.40400
5	0.899260	0.865111	82.316	105.674	72.647	76.742	46.570	72.861	5.574	4.388	615.720	442.180	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-13.235	0.638158	2424.200	3402.550	62.284	0.9280E-05	0.1176E 07
2	0.299259	0.955111	-13.706	0.641961	2420.200	3405.630	62.284	0.9280E-05	0.1151E 07
3	0.500741	0.924889	-14.280	0.649531	2421.700	3404.370	62.284	0.9280E-05	0.1131E 07
4	0.699259	0.895111	-14.309	0.645780	2423.000	3387.900	62.284	0.9280E-05	0.1105E 07
5	0.899260	0.865111	-15.152	0.657888	2423.000	3398.190	62.284	0.9280E-05	0.1088E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	19.088	0.449102	0.456540	0.705789	0.646851	0.361836	0.773933	128.597	85.253	0.11181
2	0.299259	0.955111	25.746	0.573704	0.431190	0.597836	0.721251	0.251665	0.615129	121.056	77.706	0.07621
3	0.500741	0.924889	25.621	0.759075	0.529975	0.571465	0.911648	0.079057	0.460326	146.444	71.100	0.02478
4	0.699259	0.895111	26.227	0.801891	0.592949	0.616562	0.961703	0.038765	0.454008	166.855	68.301	0.01228
5	0.899260	0.865111	24.088	0.763495	0.642594	0.697735	0.920971	0.093362	0.530105	180.825	68.182	0.02944

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.649520	0.538578	0.632527	0.851469	434.151	-0.017	0.012	2422.419	95.128	95.128

TABLE XIII. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 13A

FLOW RATE # 6 3278. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.858	58.418	58.418	0.000	0.000	110.553	93.858	58.102	435.454	382.420	3.60880
2	0.299259	0.955111	90.561	59.382	59.382	0.000	0.000	108.294	90.561	56.746	435.080	380.280	3.65920
3	0.500741	0.924889	88.048	59.796	59.796	0.000	0.000	106.433	88.048	55.818	435.209	379.642	3.53030
4	0.699259	0.895111	84.854	59.414	59.414	0.000	0.000	103.587	84.854	55.001	434.940	380.081	3.40400
5	0.899260	0.865111	82.299	60.524	60.524	0.000	0.000	102.158	82.299	53.669	435.195	378.268	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.858	80.837	42.156	68.974	58.567	48.953	24.884	30.553	575.280	473.730	3.60880
2	0.299259	0.955111	90.561	81.554	54.721	60.470	47.657	62.449	30.091	28.806	567.190	463.830	3.65920
3	0.500741	0.924889	88.048	91.736	69.277	60.134	40.959	74.689	27.913	21.946	588.860	458.080	3.53030
4	0.699259	0.895111	84.854	100.069	73.919	67.452	42.381	75.940	17.402	13.247	606.500	450.880	3.40400
5	0.899260	0.865111	82.299	104.480	68.103	79.233	49.320	68.172	3.066	2.577	619.570	449.930	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-12.198	0.613139	2426.200	3276.970	62.284	0.9280E-05	0.1164E 07
2	0.299259	0.955111	-13.054	0.626233	2414.500	3280.110	62.284	0.9280E-05	0.1140E 07
3	0.500741	0.924889	-13.382	0.628127	2424.200	3290.870	62.284	0.9280E-05	0.1120E 07
4	0.699259	0.895111	-13.499	0.626749	2414.000	3269.050	62.284	0.9280E-05	0.1090E 07
5	0.899260	0.865111	-14.231	0.636214	2422.500	3272.260	62.284	0.9280E-05	0.1075E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	18.753	0.442463	0.495587	0.713153	0.694924	0.323186	0.781850	139.826	91.310	0.10021
2	0.299259	0.955111	24.706	0.577122	0.472787	0.609123	0.776178	0.209028	0.619277	132.110	83.550	0.06394
3	0.500741	0.924889	25.546	0.727712	0.545487	0.584230	0.933684	0.061992	0.489262	153.651	78.438	0.01944
4	0.699259	0.895111	25.047	0.779756	0.614224	0.636908	0.964384	0.037996	0.479950	171.560	70.799	0.01210
5	0.899260	0.865111	22.277	0.715888	0.655480	0.720537	0.909711	0.112830	0.577934	184.375	71.662	0.03564

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.626800	0.563620	0.647741	0.870132	434.385	-0.014	0.016	2420.280	95.044	95.044

FLOW RATE # 7 3118. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.831	55.768	55.768	0.000	0.000	109.153	93.831	59.275	435.464	387.132	3.60880
2	0.299259	0.955111	90.737	56.257	56.257	0.000	0.000	106.762	90.737	58.201	435.229	386.045	3.65920
3	0.500741	0.924889	88.066	56.940	56.940	0.000	0.000	104.870	88.066	57.115	435.394	385.009	3.53030
4	0.699259	0.895111	84.679	56.749	56.749	0.000	0.000	101.936	84.679	56.171	435.511	385.464	3.40400
5	0.899260	0.865111	82.163	57.231	57.231	0.000	0.000	100.131	82.163	55.141	435.278	384.377	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.831	80.637	42.079	68.788	58.545	48.967	25.043	30.759	585.080	484.030	3.60880
2	0.299259	0.955111	90.737	82.526	55.085	61.451	48.127	62.386	29.286	27.997	578.500	472.660	3.65920
3	0.500741	0.924889	88.066	91.662	66.834	62.731	43.186	71.475	25.335	20.761	601.460	470.890	3.53030
4	0.699259	0.895111	84.679	97.661	69.554	68.556	44.586	71.398	16.123	13.051	608.150	459.930	3.40400
5	0.899260	0.865111	82.163	103.390	64.263	80.992	51.570	64.273	1.171	1.044	626.150	460.030	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-11.025	0.585496	2425.500	3117.920	62.284	0.9280E-05	0.1149E 07
2	0.299259	0.955111	-11.599	0.592172	2419.200	3135.110	62.284	0.9280E-05	0.1124E 07
3	0.500741	0.924889	-12.085	0.597999	2424.700	3112.620	62.284	0.9280E-05	0.1104E 07
4	0.699259	0.895111	-12.329	0.599873	2409.000	3106.700	62.284	0.9280E-05	0.1073E 07
5	0.899260	0.865111	-12.759	0.602594	2418.500	3116.960	62.284	0.9280E-05	0.1054E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	18.959	0.441776	0.530592	0.711433	0.745807	0.275410	0.778305	149.616	96.898	0.08522
2	0.299259	0.955111	23.897	0.579829	0.510740	0.617807	0.826698	0.169557	0.616601	143.271	86.615	0.05227
3	0.500741	0.924889	24.361	0.701907	0.583318	0.609328	0.967161	0.032991	0.520667	166.066	85.881	0.01043
4	0.699259	0.895111	24.851	0.735232	0.620655	0.648672	0.956809	0.048261	0.519621	172.639	74.466	0.01538
5	0.899260	0.865111	20.744	0.676634	0.680824	0.737751	0.922836	0.102430	0.613881	190.872	75.653	0.03238

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.596420	0.590950	0.660805	0.894288	434.534	-0.014	0.034	2419.380	95.009	95.009

TABLE XIII. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 13A

FLOW RATE # 8 2965. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.367	53.292	53.292	0.000	0.000	107.505	93.367	60.283	435.732	391.596	3.60880
2	0.299259	0.955111	90.568	53.993	53.993	0.000	0.000	105.441	90.568	59.199	434.950	389.646	3.65920
3	0.500741	0.924889	87.830	54.282	54.282	0.000	0.000	103.250	87.830	58.282	434.949	389.158	3.53030
4	0.699259	0.895111	84.879	54.255	54.255	0.000	0.000	100.737	84.879	57.413	434.974	389.229	3.40400
5	0.899260	0.865111	82.323	54.744	54.744	0.000	0.000	98.863	82.323	56.377	435.347	388.774	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.367	77.897	38.781	67.557	60.142	46.585	25.809	33.644	587.370	493.070	3.60880
2	0.299259	0.955111	90.568	81.344	52.961	61.742	49.378	60.297	28.826	28.559	589.270	486.440	3.65920
3	0.500741	0.924889	87.830	89.671	63.073	63.739	45.301	67.517	24.090	20.904	602.250	477.290	3.53030
4	0.699259	0.895111	84.879	96.917	65.888	71.075	47.169	67.318	13.804	11.833	614.700	468.730	3.40400
5	0.899260	0.865111	82.323	104.990	58.679	87.061	56.020	58.870	-4.738	-4.616	641.270	469.970	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-10.017	0.562285	2413.500	2976.650	62.284	0.9280E-05	0.1131E 07
2	0.299259	0.955111	-10.602	0.569394	2414.700	2970.440	62.284	0.9280E-05	0.1110E 07
3	0.500741	0.924889	-10.918	0.571618	2418.200	2966.110	62.284	0.9280E-05	0.1087E 07
4	0.699259	0.895111	-11.087	0.572159	2414.700	2946.680	62.284	0.9280E-05	0.1060E 07
5	0.899260	0.865111	-11.523	0.575288	2423.200	2965.890	62.284	0.9280E-05	0.1040E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	21.844	0.409183	0.543124	0.702185	0.773478	0.247255	0.792952	151.638	101.474	0.07412
2	0.299259	0.955111	24.459	0.558508	0.552181	0.621888	0.887910	0.112755	0.632569	154.320	96.794	0.03457
3	0.500741	0.924889	24.504	0.664190	0.596897	0.620790	0.961513	0.040422	0.554781	167.301	88.132	0.01277
4	0.699259	0.895111	23.633	0.694835	0.643086	0.670921	0.958512	0.049327	0.562590	179.726	79.501	0.01580
5	0.899260	0.865111	15.084	0.616643	0.731664	0.791490	0.924414	0.110852	0.682996	205.923	81.196	0.03494

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.567800	0.617249	0.677721	0.910771	434.397	-0.008	0.020	2416.859	94.910	94.910

FLOW RATE # 9 2832. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	93.761	50.823	50.823	0.000	0.000	106.650	93.761	61.540	435.243	395.102	3.60880
2	0.299259	0.955111	90.861	51.935	51.935	0.000	0.000	104.656	90.861	60.248	435.352	393.436	3.65920
3	0.500741	0.924889	87.757	52.123	52.123	0.000	0.000	102.069	87.757	59.292	435.483	393.263	3.53030
4	0.699259	0.895111	85.107	52.240	52.240	0.000	0.000	99.861	85.107	58.458	435.471	393.060	3.40400
5	0.899260	0.865111	82.248	52.515	52.515	0.000	0.000	97.584	82.248	57.442	435.213	392.355	3.23530

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	93.761	75.948	36.578	66.560	61.209	45.584	27.201	36.637	589.040	499.400	3.60880
2	0.299259	0.955111	90.861	81.971	51.532	63.746	51.048	58.231	27.115	27.752	595.250	490.830	3.65920
3	0.500741	0.924889	87.757	88.969	61.820	63.983	45.985	66.234	23.775	21.036	604.250	481.240	3.53030
4	0.699259	0.895111	85.107	95.825	64.302	71.047	47.853	65.821	14.060	12.334	619.170	476.470	3.40400
5	0.899260	0.865111	82.248	105.225	57.972	87.816	56.569	58.239	-5.568	-5.486	646.170	474.100	3.23530

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-8.760	0.533976	2423.700	2836.300	62.284	0.9280E-05	0.1122E 07
2	0.299259	0.955111	-9.552	0.545926	2422.500	2852.960	62.284	0.9280E-05	0.1101E 07
3	0.500741	0.924889	-9.908	0.549331	2416.200	2821.700	62.284	0.9280E-05	0.1074E 07
4	0.699259	0.895111	-10.042	0.549434	2421.200	2813.550	62.284	0.9280E-05	0.1051E 07
5	0.899260	0.865111	-10.458	0.552368	2421.000	2837.300	62.284	0.9280E-05	0.1027E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	24.837	0.384310	0.546230	0.688904	0.792897	0.227265	0.797307	153.797	104.298	0.06567
2	0.299259	0.955111	23.652	0.541698	0.568461	0.640009	0.888208	0.118235	0.656248	159.898	97.394	0.03653
3	0.500741	0.924889	24.636	0.651529	0.603125	0.623676	0.967049	0.035518	0.563008	168.767	87.977	0.01121
4	0.699259	0.895111	24.134	0.676292	0.653779	0.668857	0.977456	0.027338	0.573651	183.699	83.410	0.00874
5	0.899260	0.865111	14.214	0.609766	0.750913	0.799078	0.939724	0.091436	0.687755	210.957	81.745	0.02878

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.541460	0.629318	0.681309	0.923690	434.553	-0.004	0.040	2420.919	95.069	95.069

TABLE XIV. - BLADE-ELEMENT DATA FOR CONFIGURATION 14A

NASA CONFIGURATION 14 ADJUSTED-SEE ERI-77900
0.9 HUB-TIP RATIO, 19 BLADES, 9-INCH TIP DIAMETER,
1.5-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.63 DESIGN TIP D-FACTOR,
DOUBLE CIRCULAR ARC BLADE PROFILE,
0.7 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.455000	63.370	4.455000	9.110	1.010000	0.070500	1.500000	54.260	36.240
2	4.365000	62.700	4.365000	6.450	1.031000	0.071500	1.500000	56.250	34.580
3	4.275000	62.090	4.275000	3.670	1.052000	0.072500	1.500000	58.420	32.880
4	4.185000	61.540	4.185000	0.830	1.075000	0.073500	1.500000	60.710	31.190
5	4.095000	60.800	4.095000	-2.160	1.099000	0.074500	1.500000	62.960	29.320

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
4.050000	4.500000	4.050000	4.500000	19

FLOW RATE # 1 3301. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.531	89.802	89.802	0.000	0.000	132.577	97.531	47.363	427.000	301.676	2.41490
2	0.300001	0.970000	95.039	89.320	89.320	0.000	0.000	130.424	95.039	46.777	438.000	314.017	2.46830
3	0.500001	0.950000	93.415	90.385	90.385	0.000	0.000	129.984	93.415	45.944	437.400	310.442	2.41750
4	0.699999	0.930000	91.558	90.786	90.786	0.000	0.000	128.938	91.558	45.243	437.600	309.513	2.36660
5	0.900000	0.910000	89.793	89.551	89.551	0.000	0.000	126.815	89.793	45.077	430.000	305.376	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.531	91.764	80.378	44.271	28.845	96.423	53.261	33.529	502.230	371.370	2.37930
2	0.300001	0.970000	95.039	103.911	97.166	36.828	20.758	113.268	58.211	30.925	542.240	374.440	2.46830
3	0.500001	0.950000	93.415	112.258	104.540	40.906	21.370	116.987	52.510	26.670	564.550	369.710	2.41750
4	0.699999	0.930000	91.558	110.114	96.142	53.683	29.178	103.333	37.875	21.502	553.060	364.630	2.36660
5	0.900000	0.910000	89.793	107.134	82.784	68.004	39.402	85.603	21.789	14.746	538.030	359.660	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-16.007	0.911541	2508.700	3306.300	62.265	0.9280E-05	0.1786E 07
2	0.300001	0.970000	-15.923	0.911629	2495.000	3284.930	62.265	0.9280E-05	0.1757E 07
3	0.500001	0.950000	-16.146	0.919186	2504.000	3299.900	62.265	0.9280E-05	0.1751E 07
4	0.699999	0.930000	-16.297	0.922160	2507.000	3296.970	62.265	0.9280E-05	0.1737E 07
5	0.900000	0.910000	-15.723	0.907544	2512.700	3317.060	62.265	0.9280E-05	0.1708E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	24.419	0.815888	0.249390	0.444879	0.560579	0.215890	0.438012	75.230	69.694	0.08909
2	0.300001	0.970000	24.475	0.991710	0.349364	0.364607	0.958195	0.017204	0.268480	104.240	60.423	0.00716
3	0.500001	0.950000	23.000	1.063135	0.423091	0.395196	1.070582	-0.031927	0.249564	127.150	58.268	-0.01356
4	0.699999	0.930000	20.672	0.976556	0.383273	0.507116	0.755789	0.144400	0.392235	115.460	55.117	0.06249
5	0.900000	0.910000	16.906	0.838968	0.356984	0.627158	0.569209	0.327140	0.568946	109.030	54.284	0.14393

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.890570	0.357243	0.459651	0.777204	433.202	0.013	0.036	2505.479	98.390	98.390

TABLE XIV. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 14A

FLOW RATE # 2 3150. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.026	85.808	85.808	0.000	0.000	129.526	97.026	48.511	427.000	312.574	2.41490
2	0.300001	0.970000	94.990	85.978	85.978	0.000	0.000	128.122	94.990	47.851	438.000	323.121	2.46830
3	0.500001	0.950000	92.192	85.505	85.505	0.000	0.000	125.739	92.192	47.155	437.400	323.783	2.41750
4	0.699999	0.930000	91.065	87.125	87.125	0.000	0.000	126.030	91.065	46.267	437.600	319.637	2.36660
5	0.900000	0.910000	89.293	85.551	85.551	0.000	0.000	123.661	89.293	46.226	430.000	316.260	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.026	88.097	75.421	45.527	31.117	91.326	51.499	34.326	511.810	391.200	2.37930
2	0.300001	0.970000	94.990	102.875	93.402	43.120	24.781	106.838	51.869	29.045	555.870	391.400	2.46830
3	0.500001	0.950000	92.192	107.826	98.284	44.348	24.286	109.310	47.844	25.956	569.450	388.770	2.41750
4	0.699999	0.930000	91.065	106.993	92.107	54.441	30.586	99.121	36.624	21.684	558.590	380.680	2.36660
5	0.900000	0.910000	89.293	105.799	81.174	67.853	39.892	83.958	21.439	14.795	554.310	380.360	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-14.859	0.875543	2495.700	3171.670	62.265	0.9280E-05	0.1745E 07
2	0.300001	0.970000	-14.849	0.877978	2493.700	3157.300	62.265	0.9280E-05	0.1726E 07
3	0.500001	0.950000	-14.935	0.881092	2471.200	3127.430	62.265	0.9280E-05	0.1694E 07
4	0.699999	0.930000	-15.273	0.889757	2493.500	3146.140	62.265	0.9280E-05	0.1698E 07
5	0.900000	0.910000	-14.574	0.871867	2498.700	3148.420	62.265	0.9280E-05	0.1666E 07

	PASS.HT.2 FROM TIP	R2/RT	DFV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	25.216	0.769553	0.284085	0.459890	0.617724	0.201302	0.468931	84.810	78.626	0.08230
2	0.300001	0.970000	22.595	0.953790	0.395458	0.427119	0.925873	0.036993	0.329340	117.870	68.279	0.01568
3	0.500001	0.950000	22.286	1.012775	0.451136	0.434138	1.039154	-0.020250	0.298291	132.050	64.987	-0.00865
4	0.699999	0.930000	20.654	0.940637	0.405957	0.517062	0.785122	0.134139	0.414431	120.980	61.043	0.05798
5	0.900000	0.910000	16.955	0.827266	0.415397	0.629270	0.660125	0.269318	0.570702	124.310	64.100	0.11847

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.854960	0.394659	0.488176	0.808436	433.200	0.014	0.037	2490.559	97.804	97.804

FLOW RATE # 3 3032. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.162	81.351	81.351	0.000	0.000	126.722	97.162	50.062	427.000	324.154	2.41490
2	0.300001	0.970000	94.970	81.186	81.186	0.000	0.000	124.942	94.970	49.475	438.000	335.571	2.46830
3	0.500001	0.950000	93.005	82.391	82.391	0.000	0.000	124.251	93.005	48.463	437.400	331.906	2.41750
4	0.699999	0.930000	91.193	83.144	83.144	0.000	0.000	123.406	91.193	47.644	437.600	330.171	2.36660
5	0.900000	0.910000	89.500	82.501	82.501	0.000	0.000	121.724	89.500	47.330	430.000	324.224	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.162	88.461	74.255	48.078	32.922	89.011	49.084	33.465	526.350	404.740	2.37930
2	0.300001	0.970000	94.970	99.679	88.633	45.608	27.229	101.452	49.362	29.115	566.040	411.630	2.46830
3	0.500001	0.950000	93.005	106.520	96.246	45.641	25.371	107.269	47.363	26.202	580.890	404.560	2.41750
4	0.699999	0.930000	91.193	104.606	86.559	58.735	34.159	92.445	32.458	20.555	569.260	399.210	2.36660
5	0.900000	0.910000	89.500	104.778	78.344	69.574	41.607	80.838	19.925	14.270	567.310	396.700	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-13.308	0.828896	2499.200	3032.010	62.265	0.9280E-05	0.1707E 07
2	0.300001	0.970000	-13.225	0.829205	2493.200	3011.860	62.265	0.9280E-05	0.1683E 07
3	0.500001	0.950000	-13.627	0.841587	2493.000	3034.500	62.265	0.9280E-05	0.1674E 07
4	0.699999	0.930000	-13.896	0.847911	2497.000	3043.030	62.265	0.9280E-05	0.1662E 07
5	0.900000	0.910000	-13.470	0.838841	2504.500	3036.110	62.265	0.9280E-05	0.1640E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	24.355	0.756600	0.331858	0.484980	0.684271	0.183691	0.485405	99.350	80.586	0.07586
2	0.300001	0.970000	22.665	0.905275	0.429751	0.451853	0.951087	0.027144	0.365035	128.040	76.059	0.01150
3	0.500001	0.950000	22.532	0.983109	0.481684	0.442894	1.087583	-0.048163	0.311261	143.490	72.654	-0.02054
4	0.699999	0.930000	19.725	0.882747	0.440557	0.557062	0.790858	0.147116	0.472261	131.660	69.039	0.06407
5	0.900000	0.910000	16.430	0.796574	0.456715	0.643739	0.709473	0.244195	0.595931	137.310	72.476	0.10767

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.820510	0.431477	0.510388	0.845389	433.195	0.006	0.037	2497.380	98.072	98.072

TABLE XIV. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 14A

FLOW RATE # 4 2893. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	96.843	77.005	77.005	0.000	0.000	123.727	96.843	51.510	427.000	334.849	2.41490
2	0.300001	0.970000	95.313	78.103	78.103	0.000	0.000	123.226	95.313	50.668	438.000	343.201	2.46830
3	0.500001	0.950000	93.740	79.335	79.335	0.000	0.000	122.806	93.740	49.758	437.400	339.587	2.41750
4	0.699999	0.930000	91.850	79.612	79.612	0.000	0.000	121.551	91.850	49.083	437.600	339.103	2.36660
5	0.900000	0.910000	89.321	78.054	78.054	0.000	0.000	118.620	89.321	48.851	430.000	335.320	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	96.843	86.333	72.616	46.694	32.742	88.250	50.149	34.629	539.070	423.240	2.37930
2	0.300001	0.970000	95.313	98.788	86.101	48.432	29.358	98.037	46.881	28.568	577.400	425.800	2.46830
3	0.500001	0.950000	93.740	103.356	89.657	51.420	29.835	99.143	42.320	25.268	582.560	416.550	2.41750
4	0.699999	0.930000	91.850	103.710	82.916	62.296	36.918	88.026	29.555	19.618	579.880	412.730	2.36660
5	0.900000	0.910000	89.321	103.237	74.755	71.201	43.605	76.920	18.120	13.625	578.190	412.560	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-11.860	0.787197	2491.000	2868.980	62.265	0.9280E-05	0.1667E 07
2	0.300001	0.970000	-12.032	0.794855	2502.200	2892.940	62.265	0.9280E-05	0.1660E 07
3	0.500001	0.950000	-12.332	0.804017	2512.700	2891.900	62.265	0.9280E-05	0.1654E 07
4	0.699999	0.930000	-12.457	0.806036	2515.000	2919.200	62.265	0.9280E-05	0.1637E 07
5	0.900000	0.910000	-11.949	0.795213	2499.500	2892.420	62.265	0.9280E-05	0.1598E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	25.519	0.742334	0.376814	0.472565	0.797380	0.119705	0.473565	112.070	88.391	0.04876
2	0.300001	0.970000	22.118	0.876244	0.464719	0.478105	0.972002	0.017023	0.395027	139.460	82.599	0.00725
3	0.500001	0.950000	21.598	0.908624	0.479680	0.495056	0.968940	0.019854	0.391688	145.160	76.963	0.00853
4	0.699999	0.930000	13.788	0.839535	0.469302	0.586600	0.800037	0.154883	0.514188	142.280	73.627	0.06786
5	0.900000	0.910000	15.785	0.761604	0.494877	0.660107	0.749692	0.226270	0.624629	148.190	77.240	0.10005

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.780950	0.458520	0.534556	0.857759	433.227	0.007	0.041	2504.080	98.335	98.335

FLOW RATE # 5 2751. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.660	74.056	74.056	0.000	0.000	122.563	97.660	52.827	427.000	341.771	2.41490
2	0.300001	0.970000	95.961	75.041	75.041	0.000	0.000	121.818	95.961	51.975	438.000	350.488	2.46830
3	0.500001	0.950000	93.665	75.165	75.165	0.000	0.000	120.095	93.665	51.254	437.400	349.600	2.41750
4	0.699999	0.930000	91.785	76.744	76.744	0.000	0.000	119.642	91.785	50.100	437.600	346.071	2.36660
5	0.900000	0.910000	89.578	74.636	74.636	0.000	0.000	116.597	89.578	50.199	430.000	343.431	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.660	84.293	68.132	49.632	36.072	83.359	48.028	35.181	548.070	437.650	2.37930
2	0.300001	0.970000	95.961	96.451	81.780	51.154	32.026	93.251	44.807	28.718	583.740	439.140	2.46830
3	0.500001	0.950000	93.665	100.665	85.045	53.859	32.346	93.900	39.806	25.082	588.800	431.320	2.41750
4	0.699999	0.930000	91.785	102.213	79.413	64.351	39.019	84.018	27.433	19.058	593.330	430.970	2.36660
5	0.900000	0.910000	89.578	101.907	70.827	73.271	45.972	72.680	16.307	12.966	587.080	425.690	2.24350

ROTOR BLADE ELEMENT PARAMETERS·
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-10.543	0.750727	2512.000	2757.790	62.265	0.9280E-05	0.1651E 07
2	0.300001	0.970000	-10.725	0.758540	2519.200	2762.570	62.265	0.9280E-05	0.1641E 07
3	0.500001	0.950000	-10.836	0.762359	2510.700	2730.500	62.265	0.9280E-05	0.1618E 07
4	0.699999	0.930000	-11.440	0.777607	2513.200	2746.770	62.265	0.9280E-05	0.1612E 07
5	0.900000	0.910000	-10.601	0.758205	2506.700	2756.660	62.265	0.9280E-05	0.1571E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	26.071	0.690673	0.400298	0.498099	0.803650	0.126712	0.520342	121.070	95.879	0.05127
2	0.300001	0.970000	22.268	0.826659	0.479114	0.501563	0.955241	0.029611	0.438155	145.740	88.652	0.01259
3	0.500001	0.950000	21.412	0.862573	0.501097	0.518952	0.965594	0.024069	0.431271	151.400	81.720	0.01036
4	0.699999	0.930000	18.228	0.804649	0.514403	0.606391	0.848302	0.125191	0.547922	155.730	84.899	0.05504
5	0.900000	0.910000	15.126	0.719507	0.521557	0.677351	0.769994	0.222092	0.662563	157.080	82.259	0.09847

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	PRC1	PRC2	RPMA	UT1A FPS	UT2A FPS
0.740110	0.484700	0.556831	0.870462	433.231	0.015	0.038	2512.359	98.660	98.660

TABLE XIV. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 14A

FLOW RATE # 6 2599. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.531	68.320	68.320	0.000	0.000	119.080	97.531	54.989	427.000	354.463	2.41490
2	0.300001	0.970000	96.056	70.325	70.325	0.000	0.000	119.048	96.056	53.791	438.000	361.142	2.46830
3	0.500001	0.950000	94.180	71.202	71.202	0.000	0.000	118.066	94.180	52.910	437.400	358.613	2.41750
4	0.699999	0.930000	91.712	72.069	72.069	0.000	0.000	116.640	91.712	51.839	437.600	356.883	2.36660
5	0.900000	0.910000	89.911	69.497	69.497	0.000	0.000	113.639	89.911	52.297	430.000	354.941	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.531	84.354	65.613	53.015	38.938	79.289	44.517	34.156	566.160	455.580	2.37930
2	0.300001	0.970000	96.056	93.779	77.987	52.082	33.736	89.530	43.975	29.417	591.430	454.760	2.46830
3	0.500001	0.950000	94.180	98.203	80.092	56.826	35.356	88.374	37.354	25.004	598.070	448.200	2.41750
4	0.699999	0.930000	91.712	100.082	75.031	66.233	41.436	79.239	25.479	18.756	598.870	443.210	2.36660
5	0.900000	0.910000	89.911	99.931	65.412	75.548	49.113	66.970	14.363	12.384	595.090	439.900	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-8.381	0.693488	2508.700	2590.640	62.265	0.9280E-05	0.1604E 07
2	0.300001	0.970000	-8.909	0.710164	2521.700	2628.900	62.265	0.9280E-05	0.1604E 07
3	0.500001	0.950000	-9.180	0.718223	2524.500	2600.800	62.265	0.9280E-05	0.1590E 07
4	0.699999	0.930000	-9.701	0.730818	2511.200	2573.360	62.265	0.9280E-05	0.1571E 07
5	0.900000	0.910000	-8.503	0.703394	2516.000	2602.180	62.265	0.9280E-05	0.1531E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	25.046	0.666008	0.461320	0.532749	0.865923	0.097780	0.554549	139.160	101.117	0.04006
2	0.300001	0.970000	22.967	0.787532	0.502395	0.510155	0.986749	0.009355	0.460111	153.430	93.618	0.00395
3	0.500001	0.950000	21.334	0.807890	0.525981	0.544544	0.965910	0.026176	0.480242	160.670	89.587	0.01128
4	0.699999	0.930000	17.926	0.760851	0.533552	0.624617	0.854206	0.130187	0.584765	161.270	86.327	0.05734
5	0.900000	0.910000	14.544	0.662041	0.544108	0.695814	0.781973	0.229361	0.713138	165.090	84.959	0.10192

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIE	ROTOR EFFE	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.698170	0.513935	0.576805	0.891002	433.257	0.005	0.039	2516.419	98.820	98.820

FLOW RATE # 7 2446. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	98.068	65.957	65.957	0.000	0.000	118.185	98.068	56.077	427.000	359.394	2.41490
2	0.300001	0.970000	95.980	66.911	66.911	0.000	0.000	117.001	95.980	55.118	438.000	368.423	2.46830
3	0.500001	0.950000	94.076	67.078	67.078	0.000	0.000	115.541	94.076	54.510	437.400	367.476	2.41750
4	0.699999	0.930000	92.205	67.330	67.330	0.000	0.000	114.171	92.205	53.862	437.600	367.151	2.36660
5	0.900000	0.910000	89.989	65.187	65.187	0.000	0.000	111.119	89.989	54.081	430.000	363.963	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	98.068	82.713	61.699	55.088	41.760	75.193	42.980	34.861	570.390	464.070	2.37930
2	0.300001	0.970000	95.980	92.033	74.223	54.416	36.247	85.068	41.564	29.248	597.840	466.210	2.46830
3	0.500001	0.950000	94.076	95.216	74.931	58.747	38.097	82.842	35.328	25.243	601.110	460.220	2.41750
4	0.699999	0.930000	92.205	98.390	71.934	67.127	43.020	76.180	25.078	19.220	604.410	453.970	2.36660
5	0.900000	0.910000	89.989	97.235	62.374	74.593	50.098	64.246	15.396	13.866	598.160	451.230	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-7.293	0.665839	2522.500	2447.050	62.265	0.9280E-05	0.1592E 07
2	0.300001	0.970000	-7.582	0.676225	2519.700	2444.320	62.265	0.9280E-05	0.1576E 07
3	0.500001	0.950000	-7.580	0.677371	2521.700	2436.240	62.265	0.9280E-05	0.1556E 07
4	0.699999	0.930000	-7.678	0.679104	2524.700	2456.310	62.265	0.9280E-05	0.1538E 07
5	0.900000	0.910000	-6.719	0.659191	2518.200	2445.250	62.265	0.9280E-05	0.1497E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	25.751	0.622857	0.470156	0.550555	0.853967	0.112965	0.594514	143.390	104.676	0.04589
2	0.300001	0.970000	22.798	0.750115	0.525259	0.533448	0.984649	0.011714	0.498486	159.840	97.787	0.00496
3	0.500001	0.950000	21.573	0.756678	0.537124	0.563595	0.953048	0.038876	0.524668	163.710	92.744	0.01671
4	0.699999	0.930000	18.390	0.725547	0.545994	0.529663	0.867120	0.126190	0.606217	166.810	86.819	0.05542
5	0.900000	0.910000	16.026	0.630744	0.553258	0.686420	0.806004	0.210929	0.727237	168.160	87.267	0.09317

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.655690	0.527094	0.589158	0.894657	433.239	0.010	0.047	2521.359	99.013	99.013

TABLE XIV. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 14A

FLOW RATE # 8 2286. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.368	60.746	60.746	0.000	0.000	114.763	97.368	58.041	427.000	369.655	2.41490
2	0.300001	0.970000	95.477	62.732	62.732	0.000	0.000	114.242	95.477	56.694	438.000	376.844	2.46830
3	0.500001	0.950000	93.508	63.055	63.055	0.000	0.000	112.782	93.508	56.007	437.400	375.612	2.41750
4	0.699999	0.930000	91.412	64.591	64.591	0.000	0.000	111.929	91.412	54.755	437.600	372.765	2.36660
5	0.900000	0.910000	89.668	61.020	61.020	0.000	0.000	108.461	89.668	55.764	430.000	372.136	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.368	80.466	55.656	58.113	46.237	68.107	39.255	35.196	572.540	471.920	2.37930
2	0.300001	0.970000	95.477	88.566	68.167	56.545	39.676	78.501	38.932	29.732	596.650	474.750	2.46830
3	0.500001	0.950000	93.508	93.228	73.255	57.665	38.209	81.554	35.844	26.073	603.130	468.060	2.41750
4	0.699999	0.930000	91.412	96.291	69.631	66.508	43.686	73.951	24.904	19.680	609.450	465.360	2.36660
5	0.900000	0.910000	89.668	96.701	62.600	73.704	49.657	64.604	15.964	14.306	607.320	462.000	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.990000	-5.329	0.617638	2504.500	2285.130	62.265	0.9280E-05	0.1546E 07
2	0.300001	0.970000	-6.006	0.637323	2506.500	2307.520	62.265	0.9280E-05	0.1539E 07
3	0.500001	0.950000	-6.083	0.640607	2506.500	2267.620	62.265	0.9280E-05	0.1519E 07
4	0.699999	0.930000	-6.785	0.657131	2503.000	2283.540	62.265	0.9280E-05	0.1508E 07
5	0.900000	0.910000	-5.036	0.619265	2509.200	2287.650	62.265	0.9280E-05	0.1461E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	26.086	0.565890	0.484089	0.584960	0.827560	0.148167	0.657221	145.540	102.265	0.05994
2	0.300001	0.970000	23.282	0.692539	0.526853	0.557233	0.945480	0.045105	0.552889	158.650	97.906	0.01899
3	0.500001	0.950000	22.403	0.744233	0.550365	0.556550	0.988886	0.009423	0.519897	165.730	92.448	0.00402
4	0.699999	0.930000	18.850	0.708408	0.572285	0.629273	0.909438	0.087896	0.615682	171.850	92.595	0.03849
5	0.900000	0.910000	16.466	0.635305	0.587588	0.680669	0.863251	0.153651	0.713521	177.320	89.864	0.06774

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.616700	0.545394	0.599069	0.910402	433.289	0.015	0.067	2505.940	98.408	98.408

FLOW RATE # 9 2169. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.990000	97.590	56.586	56.586	0.000	0.000	112.808	97.590	59.893	427.000	377.240	2.41490
2	0.300001	0.970000	95.561	59.802	59.802	0.000	0.000	112.731	95.561	57.961	438.000	382.422	2.46830
3	0.500001	0.950000	93.572	59.717	59.717	0.000	0.000	111.004	93.572	57.454	437.400	381.980	2.41750
4	0.699999	0.930000	91.449	59.891	59.891	0.000	0.000	109.315	91.449	56.779	437.600	381.857	2.36660
5	0.900000	0.910000	89.089	57.085	57.085	0.000	0.000	105.809	89.089	57.350	430.000	379.359	2.25210

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.990000	97.590	79.597	51.012	61.102	50.143	62.718	36.487	35.575	572.900	474.440	2.37930
2	0.300001	0.970000	95.561	83.403	61.324	56.527	42.669	72.693	39.034	32.477	587.050	478.950	2.46830
3	0.500001	0.950000	93.572	90.908	71.382	56.292	38.259	80.531	37.280	27.576	601.020	472.590	2.41750
4	0.699999	0.930000	91.449	96.461	69.235	67.166	44.131	73.370	24.283	19.327	614.610	470.010	2.36660
5	0.900000	0.910000	89.089	96.594	62.525	73.628	49.662	64.408	15.461	13.889	611.650	466.650	2.24350

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC.
1	0.100000	0.990000	-3.477	0.574037	2510.200	2173.710	62.265	0.9280E-05	0.1520E 07
2	0.300001	0.970000	-4.739	0.607030	2508.700	2170.440	62.265	0.9280E-05	0.1518E 07
3	0.500001	0.950000	-4.636	0.606287	2508.200	2169.150	62.265	0.9280E-05	0.1495E 07
4	0.699999	0.930000	-4.761	0.609073	2504.000	2161.920	62.265	0.9280E-05	0.1472E 07
5	0.900000	0.910000	-3.450	0.583092	2493.000	2159.140	62.265	0.9280E-05	0.1425E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.990000	26.465	0.517489	0.483085	0.613656	0.787224	0.199404	0.712176	145.900	97.200	0.08029
2	0.300001	0.970000	26.027	0.622480	0.494106	0.556571	0.887768	0.095411	0.598339	149.050	96.528	0.03903
3	0.500001	0.950000	23.906	0.724719	0.542623	0.542931	0.999431	0.000496	0.515542	163.620	90.610	0.00020
4	0.699999	0.930000	18.497	0.704094	0.588999	0.635239	0.927208	0.074831	0.614603	177.010	88.153	0.03284
5	0.900000	0.910000	16.049	0.638653	0.609784	0.684387	0.890993	0.127734	0.707864	181.650	87.291	0.05641

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVE FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.585010	0.545891	0.603799	0.904095	433.312	0.005	0.078	2504.819	98.364	98.364

TABLE XV. - BLADE-ELEMENT DATA FOR CONFIGURATION 15

NASA CONFIGURATION 15
C.8 HUB-TIP RATIC,19BLADES,9 INCH TIP DIAMETER
1.5 INCH CHORD,C.009-C.010 INCH RADIAL TIP CLEARANCE
0.556 DESIGN TIP D-FACTOR
DOUBLE CIRCULAR ARC BLADE PROFILE
C.466 DESIGN FLOW COEFFICIENT
NOT REPORTED

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.410000	67.520	4.410000	42.350	1.020000	0.072000	1.500000	25.170	54.935
2	4.230000	65.860	4.230000	39.490	1.064000	0.076000	1.500000	26.370	52.675
3	4.050000	64.320	4.050000	35.330	1.111000	0.080000	1.500000	28.990	49.825
4	3.870000	62.690	3.870000	31.030	1.163000	0.084000	1.500000	31.660	47.860
5	3.690000	60.660	3.690000	26.800	1.220000	0.088000	1.500000	33.860	43.730

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.600000	4.500000	3.600000	4.500000	19

FLOW RATE # 1 5192. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	115.665	69.332	69.332	0.000	0.000	134.853	115.665	59.061	423.575	348.872	4.84000
2	0.300001	0.940000	110.952	70.237	70.237	0.000	0.000	131.314	110.952	57.665	422.187	345.523	4.78400
3	0.500000	0.900000	106.142	69.668	69.668	0.000	0.000	126.963	106.142	56.721	418.556	343.129	4.58040
4	0.700000	0.860000	101.890	70.367	70.367	0.000	0.000	123.827	101.890	55.370	417.566	340.616	4.37690
5	0.900001	0.820000	97.061	74.089	74.089	0.000	0.000	122.107	97.061	52.645	425.733	340.428	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	115.665	68.194	60.808	30.868	26.914	104.346	84.797	54.356	503.440	431.170	4.64150
2	0.300001	0.940000	110.952	79.188	71.178	34.704	25.992	104.308	76.248	46.969	525.430	427.980	4.78400
3	0.500000	0.900000	106.142	82.530	75.050	34.333	24.583	103.870	71.808	43.736	529.590	423.740	4.58040
4	0.700000	0.860000	101.890	84.533	76.085	36.837	25.834	100.105	65.054	40.531	531.730	420.680	4.37690
5	0.900001	0.820000	97.061	83.688	73.871	39.328	28.030	93.756	57.734	38.009	527.960	419.120	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	-8.459	0.587435	3005.500	5182.648	62.320	0.9280E-05	0.1816E 07
2	0.300001	0.940000	-8.155	0.595056	3005.700	5179.230	62.320	0.9280E-05	0.1769E 07
3	0.500000	0.900000	-7.599	0.590727	3003.200	5176.891	62.320	0.9280E-05	0.1710E 07
4	0.700000	0.860000	-7.320	0.593932	3017.000	5215.809	62.320	0.9280E-05	0.1668E 07
5	0.900001	0.820000	-8.015	0.625925	3014.200	5204.609	62.320	0.9280E-05	0.1645E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	12.006	0.515207	0.184463	0.256307	0.719693	0.110066	0.338432	79.865	82.298	0.03144
2	0.300001	0.940000	7.479	0.603035	0.238426	0.276375	0.862693	0.061321	0.329855	103.243	82.457	0.01966
3	0.500000	0.900000	8.406	0.636363	0.256846	0.262009	0.980297	0.008909	0.303594	111.034	80.611	0.00290
4	0.700000	0.860000	9.501	0.642189	0.261676	0.267368	0.978637	0.010459	0.319475	114.164	80.064	0.00342
5	0.900001	0.820000	11.209	0.624084	0.234751	0.272446	0.861643	0.070843	0.364182	102.227	78.692	0.02288

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.615520	0.237020	0.267124	0.887305	420.865	-0.039	-0.042	3009.119	118.168	118.168

TABLE XV. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 15

FLOW RATE # 2 4829. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	116.596	64.511	64.511	0.000	0.000	133.253	116.596	61.045	423.622	358.948	4.84000
2	0.300001	0.940000	111.479	65.224	65.224	0.000	0.000	129.158	111.479	59.669	423.117	357.005	4.78400
3	0.500000	0.900000	106.559	64.697	64.697	0.000	0.000	124.661	106.559	58.736	420.152	355.105	4.58040
4	0.700000	0.860000	102.319	65.413	65.413	0.000	0.000	121.442	102.319	57.409	420.107	353.611	4.37690
5	0.900001	0.820000	97.457	68.441	68.441	0.000	0.000	119.088	97.457	54.921	425.429	352.635	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	116.596	66.807	55.930	36.538	33.156	97.660	80.058	55.061	527.790	458.430	4.64150
2	0.300001	0.940000	111.479	77.811	67.099	39.396	30.420	98.478	72.081	47.050	547.580	453.490	4.78400
3	0.500000	0.900000	106.559	81.055	71.200	38.736	28.548	98.333	67.823	43.608	551.420	449.320	4.58040
4	0.700000	0.860000	102.319	81.983	70.527	41.799	30.654	92.934	60.520	40.634	551.090	446.640	4.37690
5	0.900001	0.820000	97.457	82.351	68.111	46.288	34.200	85.190	51.169	36.916	549.770	444.380	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	-6.475	0.542217	3029.700	4837.230	62.320	0.9280E-05	0.1795E 07
2	0.300001	0.940000	-6.191	0.549972	3020.000	4824.520	62.320	0.9280E-05	0.1740E 07
3	0.500000	0.900000	-5.584	0.546430	3015.000	4815.020	62.320	0.9280E-05	0.1679E 07
4	0.700000	0.860000	-5.281	0.549801	3029.700	4831.180	62.320	0.9280E-05	0.1636E 07
5	0.900001	0.820000	-5.739	0.575857	3026.500	4835.609	62.320	0.9280E-05	0.1604E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	12.711	0.470093	0.236767	0.300963	0.786697	0.102354	0.401521	104.168	99.482	0.02873
2	0.300001	0.940000	7.560	0.565782	0.284716	0.312275	0.911747	0.046471	0.380883	124.463	96.485	0.01488
3	0.500000	0.900000	8.276	0.601359	0.301279	0.294447	1.023202	-0.012325	0.351038	131.268	94.215	-0.00402
4	0.700000	0.860000	9.604	0.592780	0.297715	0.302138	0.985363	0.008489	0.382721	130.983	93.029	0.00277
5	0.900001	0.820000	10.116	0.573079	0.283216	0.319360	0.886824	0.071999	0.443946	124.341	91.745	0.02359

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.569620	0.282403	0.305588	0.924127	421.837	-0.041	-0.040	3024.180	118.759	118.759

FLOW RATE # 3 4480. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	C.100000	0.980000	116.115	59.323	59.323	0.000	0.000	130.392	116.115	62.938	423.980	369.290	4.84000
2	0.300001	0.940000	111.136	60.682	60.682	0.000	0.000	126.624	111.136	61.365	424.680	367.455	4.78400
3	0.500000	0.900000	106.453	60.225	60.225	0.000	0.000	122.308	106.453	60.501	421.771	365.405	4.58043
4	0.700000	0.860000	101.931	60.645	60.645	0.000	0.000	118.608	101.931	59.249	421.786	364.630	4.37690
5	0.900001	0.820000	96.739	63.317	63.317	0.000	0.000	115.618	96.739	56.795	426.664	364.362	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	116.115	65.233	50.720	41.021	38.965	90.618	75.094	55.964	544.000	477.870	4.64150
2	0.300001	0.940000	111.136	75.340	61.988	42.820	34.636	92.247	68.316	47.780	560.320	472.110	4.78400
3	0.500000	0.900000	106.453	77.546	65.281	41.853	32.665	91.841	64.599	44.699	561.960	468.510	4.58040
4	0.700000	0.860000	101.931	78.874	64.896	44.829	34.636	86.442	57.102	41.344	561.500	464.820	4.37690
5	0.900001	0.820000	96.739	79.803	62.277	49.901	38.704	77.925	46.839	36.947	561.320	462.350	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	C.100000	0.980000	-4.582	0.500677	3017.200	4474.391	62.321	0.9280E-05	0.1756E 07
2	0.300001	0.940000	-4.495	0.513254	3010.700	4479.660	62.321	0.9280E-05	0.1706E 07
3	0.500000	0.900000	-3.819	0.509168	3012.000	4476.109	62.321	0.9280E-05	0.1647E 07
4	0.700000	0.860000	-3.441	0.511671	3016.200	4490.121	62.321	0.9280E-05	0.1598E 07
5	0.900001	0.820000	-3.665	0.536698	3004.200	4480.480	62.321	0.9280E-05	0.1557E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	13.614	0.428075	0.275062	0.339291	0.810698	0.106068	0.459246	120.020	108.580	0.02910
2	0.300001	0.940000	8.290	0.524303	0.312204	0.340448	0.917039	0.049247	0.430398	135.640	104.655	0.01555
3	0.500000	0.900000	9.369	0.551915	0.322396	0.318462	1.012351	-0.007358	0.403107	140.189	103.105	-0.00235
4	0.700000	0.860000	10.314	0.547534	0.319985	0.325275	0.983738	0.010564	0.433692	139.714	100.190	0.00341
5	0.900001	0.820000	10.147	0.527886	0.311281	0.346841	0.897475	0.074049	0.502897	134.656	97.988	0.02425

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIP1	ROTOR PSIP	ROTOR PSIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.530560	0.309480	0.313439	0.928149	423.119	-0.042	-0.051	3012.459	118.299	118.299

TABLE XV. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 15

FLOW RATE # 4 4033. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	116.192	53.429	53.429	0.000	0.000	127.888	116.192	65.305	425.414	381.051	4.84000
2	0.300001	0.940000	111.461	54.766	54.766	0.000	0.000	124.189	111.461	63.833	425.996	379.386	4.78400
3	0.500000	0.900000	106.283	54.134	54.134	0.000	0.000	119.276	106.283	63.008	423.744	378.202	4.58040
4	0.700000	0.860000	101.526	54.362	54.362	0.000	0.000	115.164	101.526	61.833	423.348	377.422	4.37690
5	0.900001	0.820000	96.990	57.125	57.125	0.000	0.000	112.563	96.990	59.503	427.410	376.698	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	116.192	61.255	42.951	43.673	45.477	84.285	72.520	59.363	561.350	503.040	4.64150
2	0.300001	0.940000	111.461	71.609	54.067	46.953	40.972	84.169	64.507	50.032	577.410	497.720	4.78400
3	0.500000	0.900000	106.283	74.356	57.766	46.818	39.024	82.904	59.465	45.831	577.770	491.850	4.58040
4	0.700000	0.860000	101.526	75.396	57.714	48.514	40.050	78.366	53.012	42.568	576.760	488.420	4.37690
5	0.900001	0.820000	96.990	78.854	56.060	55.455	44.689	69.771	41.536	36.535	562.550	485.920	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	OV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	-2.215	0.450637	3019.200	4048.720	62.321	0.9280E-05	0.1723E 07
2	0.300001	0.940000	-2.027	0.461862	3019.500	4037.030	62.321	0.9280E-05	0.1673E 07
3	0.500000	0.900000	-1.312	0.458467	3007.200	4022.460	62.321	0.9280E-05	0.1607E 07
4	0.700000	0.860000	-0.857	0.460488	3006.200	4026.500	62.321	0.9280E-05	0.1551E 07
5	0.900001	0.820000	-1.157	0.482956	3012.000	4028.070	62.321	0.9280E-05	0.1516E 07

	PASS.HT.2 FROM TIP	R2/RT	IFV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	17.013	0.362265	0.311126	0.360981	0.861890	0.085701	0.508346	135.936	121.989	0.02141
2	0.300001	0.940000	10.542	0.455972	0.346482	0.372221	0.930851	0.046929	0.499917	151.414	118.334	0.01417
3	0.500000	0.900000	10.501	0.489156	0.355349	0.356905	0.995919	0.002855	0.481591	154.026	113.648	0.00090
4	0.700000	0.860000	11.538	0.488882	0.354168	0.353416	1.002129	-0.001581	0.500637	153.412	110.998	-0.00050
5	0.900001	0.820000	9.735	0.473956	0.356779	0.364448	0.928030	0.061102	0.582070	155.140	109.222	0.02012

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSITS	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.477490	0.346106	0.365278	0.947512	424.535	-0.042	-0.073	3012.819	118.313	118.313

FLOW RATE # 5 3595. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	115.992	47.312	47.312	0.000	0.000	125.270	115.992	67.810	425.984	391.197	4.84000
2	0.300001	0.940000	111.461	49.085	49.085	0.000	0.000	121.790	111.461	66.232	427.573	390.131	4.78400
3	0.500000	0.900000	106.612	48.550	48.550	0.000	0.000	117.146	106.612	65.516	425.438	388.808	4.58040
4	0.700000	0.860000	101.620	48.607	48.607	0.000	0.000	112.647	101.620	64.437	425.039	388.322	4.37690
5	0.900001	0.820000	97.377	50.729	50.729	0.000	0.000	109.798	97.377	62.482	428.073	388.080	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	115.992	59.836	36.301	47.566	52.650	77.459	68.426	62.053	578.740	523.100	4.64150
2	0.300001	0.940000	111.461	67.877	45.012	50.806	48.460	75.533	60.655	53.421	588.550	516.950	4.78400
3	0.500000	0.900000	106.612	71.950	50.916	50.836	44.955	75.521	55.776	47.608	592.970	512.520	4.58040
4	0.700000	0.860000	101.620	75.161	52.828	53.463	45.342	71.484	48.157	42.352	593.990	506.200	4.37690
5	0.900001	0.820000	97.377	80.241	53.017	60.231	48.645	64.735	37.145	35.016	604.160	504.100	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	0.290	0.399735	3014.000	3595.250	62.322	0.9280E-05	0.1687E 07
2	0.300001	0.940000	0.372	0.413953	3019.500	3602.030	62.322	0.9280E-05	0.1640E 07
3	0.500000	0.900000	1.196	0.409847	3016.500	3594.240	62.322	0.9280E-05	0.1578E 07
4	0.700000	0.860000	1.747	0.411357	3009.000	3588.880	62.322	0.9280E-05	0.1517E 07
5	0.900001	0.820000	1.822	0.427186	3024.000	3594.020	62.322	0.9280E-05	0.1479E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	19.703	0.306704	0.350830	0.393840	0.890794	0.076791	0.567795	152.756	131.903	0.01764
2	0.300001	0.940000	13.931	0.379609	0.368366	0.402758	0.914607	0.065202	0.575847	160.977	126.819	0.01826
3	0.500000	0.900000	12.278	0.429826	0.384128	0.386236	0.994542	0.004311	0.550628	167.532	123.712	0.00131
4	0.700000	0.860000	11.322	0.447080	0.389315	0.389106	1.000537	-0.000460	0.569458	168.951	117.878	-0.00015
5	0.900001	0.820000	8.216	0.446452	0.401743	0.415906	0.965948	0.033133	0.635243	176.087	116.020	0.01112

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.425140	0.380291	0.397361	0.957043	425.775	-0.041	-0.081	3016.600	118.462	118.462

TABLE XV. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 15

FLOW RATE # 6 3233. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	116.108	42.021	42.021	0.000	0.000	123.478	116.108	70.104	426.392	398.951	4.84000
2	0.300001	0.940000	111.450	43.914	43.914	0.000	0.000	119.789	111.450	68.494	428.073	398.104	4.78400
3	0.500000	0.900000	106.354	43.561	43.561	0.000	0.000	114.929	106.354	67.727	426.707	397.218	4.58040
4	0.700000	0.860000	101.603	44.163	44.163	0.000	0.000	110.786	101.603	66.508	426.344	396.035	4.37690
5	0.900001	0.820000	97.174	46.421	46.421	0.000	0.000	107.693	97.174	64.465	428.830	395.341	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	116.108	61.081	28.539	54.004	62.145	68.348	62.104	65.319	594.050	536.070	4.64150
2	0.300001	0.940000	111.450	66.595	38.434	54.385	54.751	68.801	57.065	56.039	597.150	528.230	4.78400
3	0.500000	0.900000	106.354	72.008	47.322	54.275	48.915	70.368	52.079	47.740	603.900	523.320	4.58040
4	0.700000	0.860000	101.603	75.999	49.927	57.299	48.933	66.750	44.304	41.585	608.020	518.260	4.37690
5	0.900001	0.820000	97.174	80.462	48.740	64.019	52.717	58.947	33.154	34.225	613.870	513.260	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	2.584	0.354677	3017.000	3240.230	62.322	0.9280E-05	0.1663E 07
2	0.300001	0.940000	2.634	0.370384	3019.200	3236.580	62.322	0.9280E-05	0.1614E 07
3	0.500000	0.900000	3.407	0.368627	3009.200	3228.700	62.322	0.9280E-05	0.1548E 07
4	0.700000	0.860000	3.818	0.373804	3008.500	3231.100	62.322	0.9280E-05	0.1492E 07
5	0.900001	0.820000	3.805	0.391726	3017.700	3228.470	62.322	0.9280E-05	0.1451E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	22.969	0.240883	0.384290	0.446699	0.860288	0.114914	0.660869	167.658	137.119	0.02352
2	0.300001	0.940000	16.549	0.324162	0.386978	0.431174	0.897497	0.086593	0.638997	169.077	130.126	0.02273
3	0.500000	0.900000	12.410	0.400454	0.408253	0.413362	0.987640	0.010803	0.600264	177.193	126.102	0.00327
4	0.700000	0.860000	10.555	0.422596	0.418777	0.417095	1.004032	-0.003826	0.619844	181.676	122.225	-0.00123
5	0.900001	0.820000	7.425	0.411289	0.423935	0.442986	0.956994	0.046137	0.696267	185.040	117.919	0.01563

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIE	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.382630	0.406427	0.428451	0.948596	426.619	-0.040	-0.087	3014.319	118.372	118.372

FLOW RATE # 7 2949. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.100000	0.980000	115.684	38.264	38.264	0.000	0.000	121.848	115.684	71.698	428.370	405.617	4.84000
2	0.300001	0.940000	111.210	40.115	40.115	0.000	0.000	118.224	111.210	70.165	429.183	404.175	4.78400
3	0.500000	0.900000	106.672	39.818	39.818	0.000	0.000	113.861	106.672	69.531	428.083	403.444	4.58040
4	0.700000	0.860000	102.066	40.023	40.023	0.000	0.000	109.632	102.066	68.589	427.545	402.652	4.37690
5	0.900001	0.820000	97.029	41.597	41.597	0.000	0.000	105.570	97.029	66.795	429.593	402.703	4.08170

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.100000	0.980000	115.684	64.053	22.505	59.969	69.430	60.089	55.715	68.005	604.630	540.870	4.64150
2	0.300001	0.940000	111.210	68.255	31.834	60.377	62.199	59.979	50.833	57.943	604.830	532.430	4.78400
3	0.500000	0.900000	106.672	72.795	42.626	59.009	54.157	63.943	47.663	48.193	609.960	527.610	4.58040
4	0.700000	0.860000	102.066	77.691	47.848	61.208	51.984	62.919	40.858	40.495	617.340	523.540	4.37690
5	0.900001	0.820000	97.029	81.336	46.555	66.695	55.084	55.565	30.334	33.087	616.380	515.570	4.00130

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.100000	0.980000	4.178	0.324145	3006.000	2943.030	62.322	0.9280E-05	0.1641E 07
2	0.300001	0.940000	4.305	0.339072	3012.700	2957.270	62.322	0.9280E-05	0.1592E 07
3	0.500000	0.900000	5.211	0.335947	3018.200	2951.810	62.322	0.9280E-05	0.1534E 07
4	0.700000	0.860000	5.899	0.337226	3022.200	2951.050	62.322	0.9280E-05	0.1477E 07
5	0.900001	0.820000	6.135	0.351541	3013.200	2943.530	62.322	0.9280E-05	0.1422E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.100000	0.980000	25.655	0.190649	0.406968	0.497859	0.817436	0.170612	0.748113	176.260	135.253	0.03132
2	0.300001	0.940000	18.453	0.269080	0.403751	0.479714	0.841650	0.152143	0.732659	175.647	128.255	0.03795
3	0.500000	0.900000	12.863	0.359639	0.416550	0.448078	0.929638	0.068326	0.671649	181.877	124.166	0.02050
4	0.700000	0.860000	9.465	0.403165	0.433535	0.443528	0.977468	0.023423	0.666113	189.795	120.888	0.00766
5	0.900001	0.820000	6.287	0.393439	0.433812	0.462189	0.938601	0.071303	0.732582	188.787	112.867	0.02448

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.349040	0.421059	0.461873	0.911634	427.911	-0.044	-0.104	3014.459	118.377	118.377

TABLE XVI. - BLADE-ELEMENT DATA FOR CONFIGURATION 16

NASA CONFIGURATION 16
0.85 HUB-TIP RATIO, 33 BLADES, 9-INCH TIP DIAMETER,
1.172-INCH CHORD, 0.010-INCH RADIAL TIP CLEARANCE,
0.72 DESIGN TIP D-FACTOR,
CUBIC BLADE PROFILE,
0.5 DESIGN FLOW COEFFICIENT,
PRELIMINARY.

BLADE GEOMETRIC PARAMETERS- BLADE ROW# 1 (ROTOR)
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	R1 INCHES	KAPPA1 DEGREES	R2 INCHES	KAPPA2 DEGREES	SOLIDITY	TMAX/C	CHORD INCHES	CAMBER DEGREES	SETANG DEGREES
1	4.433000	70.300	4.433000	11.800	1.388600	0.056680	1.172000	58.500	41.050
2	4.298000	69.800	4.298000	4.100	1.432200	0.062080	1.172000	65.700	36.950
3	4.162000	69.200	4.162000	-3.600	1.479000	0.067520	1.172000	72.800	32.800
4	4.028000	68.500	4.028000	-11.900	1.528200	0.072880	1.172000	80.300	28.350
5	3.893000	67.900	3.893000	-19.700	1.581200	0.078280	1.172000	87.600	24.100

RHUB1 INCHES	RTIP1 INCHES	RHUB2 INCHES	RTIP2 INCHES	NBLADES
3.825000	4.500000	3.825000	4.500000	33

FLOW RATE # 1 2945. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.108	48.518	48.518	0.000	0.000	108.553	97.108	63.452	431.036	394.454	3.60880
2	0.299259	0.955111	93.993	52.567	52.567	0.000	0.000	107.694	93.993	60.783	436.278	393.335	3.65920
3	0.500741	0.924889	90.990	51.444	51.444	0.000	0.000	104.526	90.990	60.517	433.862	392.734	3.53030
4	0.699259	0.895111	87.884	51.656	51.656	0.000	0.000	101.941	87.884	59.554	433.117	391.650	3.40400
5	0.899260	0.865111	84.820	51.464	51.464	0.000	0.000	99.212	84.820	58.753	432.161	391.001	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.108	73.839	42.111	60.653	55.229	55.698	36.454	40.882	529.940	445.210	3.50460
2	0.299259	0.955111	93.993	70.001	46.395	52.417	48.487	62.299	41.576	41.864	515.810	439.660	3.65920
3	0.500741	0.924889	90.990	73.817	53.171	51.204	43.920	66.409	39.786	36.806	520.550	435.870	3.53030
4	0.699259	0.895111	87.884	78.289	58.223	52.338	41.953	68.216	35.547	31.405	529.100	433.850	3.40400
5	0.899260	0.865111	84.820	82.838	61.195	55.832	42.376	67.714	28.998	25.347	544.050	437.410	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-6.849	0.492189	2510.200	2952.430	62.306	0.9280E-05	0.1142E 07
2	0.299259	0.955111	-9.017	0.534162	2506.000	2947.200	62.306	0.9280E-05	0.1133E 07
3	0.500741	0.924889	-8.683	0.522920	2505.200	2949.600	62.306	0.9280E-05	0.1100E 07
4	0.699259	0.895111	-8.946	0.526120	2500.200	2937.810	62.306	0.9280E-05	0.1073E 07
5	0.899260	0.865111	-9.147	0.524902	2496.700	2936.220	62.306	0.9280E-05	0.1044E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGA3	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	29.082	0.427199	0.327479	0.606139	0.540269	0.459573	0.688096	98.904	50.756	0.12511
2	0.299259	0.955111	37.764	0.471452	0.284220	0.508727	0.519374	0.408340	0.591441	79.532	46.325	0.10617
3	0.500741	0.924889	40.406	0.540473	0.238177	0.481379	0.598649	0.342295	0.530274	86.688	43.136	0.09265
4	0.699259	0.895111	43.205	0.593006	0.320355	0.477152	0.671388	0.290898	0.493805	95.983	42.200	0.08123
5	0.899260	0.865111	45.047	0.624154	0.374490	0.492639	0.760172	0.230772	0.495434	111.889	46.409	0.06595

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.544320	0.315972	0.508550	0.621319	432.654	-0.057	-0.049	2503.659	98.318	98.318

TABLE XVI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 16

FLOW RATE # 2 2898. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.127	47.704	47.704	0.000	0.000	108.210	97.127	63.842	431.685	396.320	3.60880
2	0.299259	0.955111	94.038	51.076	51.076	0.000	0.000	107.013	94.038	61.492	435.677	395.136	3.65920
3	0.500741	0.924889	91.062	50.671	50.671	0.000	0.000	104.211	91.062	60.907	433.938	394.037	3.53030
4	0.699259	0.895111	87.884	50.839	50.839	0.000	0.000	101.530	87.884	59.952	433.555	393.389	3.40400
5	0.899260	0.865111	85.085	50.888	50.888	0.000	0.000	99.142	85.085	59.117	432.667	392.423	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.127	75.953	43.213	62.461	55.323	55.399	34.666	38.737	542.850	453.200	3.50460
2	0.299259	0.955111	94.038	72.013	46.842	54.696	49.423	61.172	39.342	40.026	527.300	446.710	3.65920
3	0.500741	0.924889	91.062	75.131	52.580	53.655	45.585	64.523	37.397	35.422	529.260	441.540	3.53030
4	0.699259	0.895111	87.884	80.097	57.353	55.912	44.271	65.663	31.973	29.138	540.040	440.340	3.40400
5	0.899260	0.865111	85.085	83.611	60.977	57.207	43.173	67.047	27.878	24.570	550.450	441.810	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-6.458	0.483837	2510.700	2894.340	62.305	0.9280E-05	0.1139E 07
2	0.299259	0.955111	-8.308	0.518759	2507.200	2901.510	62.305	0.9280E-05	0.1126E 07
3	0.500741	0.924889	-8.293	0.514648	2507.200	2891.970	62.305	0.9280E-05	0.1097E 07
4	0.699259	0.895111	-8.548	0.517800	2500.200	2898.710	62.305	0.9280E-05	0.1069E 07
5	0.899260	0.865111	-8.783	0.517412	2504.500	2902.920	62.305	0.9280E-05	0.1043E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	26.937	0.438290	0.367929	0.624082	0.589552	0.425312	0.695881	111.165	56.880	0.11946
2	0.299259	0.955111	35.926	0.475758	0.304097	0.530591	0.573129	0.383449	0.606811	91.623	51.574	0.10251
3	0.500741	0.924889	39.022	0.534039	0.316374	0.504117	0.627580	0.335172	0.554933	95.322	47.503	0.09234
4	0.699259	0.895111	40.938	0.584146	0.355406	0.509736	0.697235	0.288645	0.533442	106.485	46.951	0.08249
5	0.899260	0.865111	44.270	0.619986	0.391765	0.503197	0.778552	0.219325	0.506186	117.783	49.387	0.06307

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.535190	0.347545	0.530411	0.655237	432.839	-0.058	-0.034	2505.959	98.409	98.409

FLOW RATE # 3 2861. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	96.926	46.976	46.976	0.000	0.000	107.710	96.926	64.142	431.184	396.890	3.60880
2	0.299259	0.955111	93.907	50.595	50.595	0.000	0.000	106.669	93.907	61.685	436.157	396.376	3.65920
3	0.500741	0.924889	91.008	49.761	49.761	0.000	0.000	103.724	91.008	61.331	434.008	395.527	3.53030
4	0.699259	0.895111	88.060	50.328	50.328	0.000	0.000	101.427	88.060	60.251	433.495	394.133	3.40400
5	0.899260	0.865111	85.136	50.184	50.184	0.000	0.000	98.826	85.136	59.483	432.912	393.775	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	96.926	75.528	41.437	63.146	56.727	53.461	33.780	39.187	548.850	460.200	3.50460
2	0.299259	0.955111	93.907	72.271	46.133	55.631	50.332	59.944	38.275	39.681	533.830	452.660	3.65920
3	0.500741	0.924889	91.008	74.972	51.843	54.158	46.251	63.605	36.850	35.405	533.930	446.580	3.53030
4	0.699259	0.895111	88.060	80.225	56.469	56.986	45.261	64.454	31.074	28.824	547.950	447.930	3.40400
5	0.899260	0.865111	85.136	83.526	59.321	58.801	44.748	64.904	26.334	23.938	556.630	448.210	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-6.158	0.477445	2505.500	2859.600	62.305	0.9280E-05	0.1134E 07
2	0.299259	0.955111	-8.115	0.514592	2503.700	2858.740	62.305	0.9280E-05	0.1123E 07
3	0.500741	0.924889	-7.869	0.505710	2505.700	2857.090	62.305	0.9280E-05	0.1092E 07
4	0.699259	0.895111	-8.249	0.511569	2505.200	2864.060	62.305	0.9280E-05	0.1067E 07
5	0.899260	0.865111	-8.417	0.509943	2506.000	2865.260	62.305	0.9280E-05	0.1040E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	27.387	0.421145	0.391064	0.632235	0.618542	0.402489	0.714757	117.666	63.310	0.11233
2	0.299259	0.955111	35.581	0.469217	0.325084	0.540419	0.601541	0.365891	0.620109	97.673	56.284	0.09831
3	0.500741	0.924889	39.005	0.526868	0.332038	0.509052	0.652267	0.318611	0.563299	99.922	51.053	0.08779
4	0.699259	0.895111	40.624	0.573992	0.380483	0.518489	0.733829	0.259673	0.548350	114.455	53.797	0.07443
5	0.899260	0.865111	43.638	0.602792	0.411013	0.516915	0.795126	0.210028	0.531400	123.718	54.435	0.06070

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.528520	0.368080	0.539195	0.682648	432.895	-0.059	-0.043	2505.219	98.380	98.380

TABLE XVI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 16

FLOW RATE # 4 2805. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HI.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1 0.099260	0.985111	96.558	45.548	45.548	0.000	0.000	106.762	96.558	64.746	431.519	399.278	3.60880
2 0.299259	0.955111	93.880	49.213	49.213	0.000	0.000	105.997	93.880	62.336	435.431	397.793	3.65920
3 0.500741	0.924889	90.917	48.741	48.741	0.000	0.000	103.158	90.917	61.804	434.148	397.228	3.53030
4 0.699259	0.895111	88.246	49.047	49.047	0.000	0.000	100.960	89.246	60.935	433.660	396.276	3.40400
5 0.899260	0.865111	85.272	49.180	49.180	0.000	0.000	98.437	85.272	60.026	433.380	395.793	3.23450

PASS.HI.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1 0.099260	0.985111	96.558	75.664	41.223	63.449	56.998	52.873	33.110	38.771	555.690	466.720	3.50460
2 0.299259	0.955111	93.880	72.160	45.290	56.177	51.124	58.930	37.704	39.777	540.200	459.280	3.65920
3 0.500741	0.924889	90.917	74.800	50.805	54.899	47.218	62.277	36.018	35.335	542.390	455.440	3.53030
4 0.699259	0.895111	88.246	79.884	55.321	57.628	46.170	63.229	30.619	28.963	556.240	457.070	3.40400
5 0.899260	0.865111	85.272	83.299	58.442	59.357	45.445	63.930	25.915	23.914	563.510	455.680	3.19360

FOTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PASS.HI.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1 0.099260	0.985111	-5.554	0.464694	2496.000	2800.020	62.304	0.9280E-05	0.1124E 07
2 0.299259	0.955111	-7.464	0.500679	2503.000	2803.690	62.304	0.9280E-05	0.1116E 07
3 0.500741	0.924889	-7.396	0.495841	2503.200	2796.580	62.304	0.9280E-05	0.1086E 07
4 0.699259	0.895111	-7.565	0.497497	2510.500	2814.070	62.304	0.9280E-05	0.1063E 07
5 0.899260	0.865111	-7.874	0.498544	2510.000	2810.340	62.304	0.9280E-05	0.1036E 07

PASS.HI.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1 0.099260	0.985111	26.971	0.420565	0.415830	0.637679	0.652100	0.373991	0.718748	124.171	67.442	0.10499
2 0.299259	0.955111	35.677	0.460763	0.348896	0.545871	0.639155	0.338760	0.629066	104.769	61.487	0.09089
3 0.500741	0.924889	38.935	0.516834	0.360404	0.516534	0.697736	0.283543	0.576208	108.242	58.212	0.07820
4 0.699259	0.895111	40.763	0.561139	0.405775	0.523225	0.775525	0.223988	0.560479	122.580	60.794	0.06412
5 0.899260	0.865111	43.614	0.592911	0.430939	0.520964	0.827195	0.180526	0.541227	130.130	59.887	0.05218

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	FOTOR PSII3	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.519320	0.392571	0.544816	0.720556	432.949	-0.064	-0.039	2504.540	98.353	98.353

FLOW RATE # 5 2722. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	96.926	44.341	44.341	0.000	0.000	106.587	96.926	65.417	432.179	401.625	3.60880
2	0.299259	0.955111	93.963	47.579	47.579	0.000	0.000	105.322	93.963	63.144	435.986	400.806	3.65920
3	0.500741	0.924889	91.117	47.688	47.689	0.000	0.000	102.842	91.117	62.374	434.575	399.234	3.53030
4	0.699259	0.895111	88.035	47.666	47.666	0.000	0.000	100.111	88.035	61.567	434.144	398.836	3.40400
5	0.899260	0.865111	85.238	47.914	47.914	0.000	0.000	97.782	85.238	60.659	434.297	398.620	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	96.926	75.268	39.045	64.348	58.752	50.850	32.577	39.840	566.730	478.690	3.50460
2	0.299259	0.955111	93.963	72.030	44.572	56.584	51.772	58.171	37.379	39.984	553.840	473.210	3.65920
3	0.500741	0.924889	91.117	75.677	49.670	57.095	48.978	60.205	34.022	34.409	552.350	463.350	3.53030
4	0.699259	0.895111	88.035	80.145	53.364	59.796	48.253	60.376	28.240	27.888	564.020	464.200	3.40400
5	0.899260	0.865111	85.238	82.394	55.748	60.670	47.421	60.921	24.568	23.783	570.150	464.650	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-4.883	0.450658	2505.500	2719.300	62.303	0.9280E-05	0.1122E 07
2	0.299259	0.955111	-6.656	0.483631	2505.200	2721.740	62.303	0.9280E-05	0.1108E 07
3	0.500741	0.924889	-6.926	0.484060	2508.700	2726.860	62.303	0.9280E-05	0.1082E 07
4	0.699259	0.895111	-6.933	0.484645	2504.500	2716.000	62.303	0.9280E-05	0.1054E 07
5	0.899260	0.865111	-7.241	0.486296	2509.000	2726.080	62.303	0.9280E-05	0.1029E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	28.040	0.396831	0.447181	0.644271	0.694088	0.335891	0.740304	134.551	77.065	0.09287
2	0.299259	0.955111	35.884	0.453063	0.391782	0.549344	0.713193	0.274943	0.635247	117.854	72.404	0.07355
3	0.500741	0.924889	38.009	0.504183	0.390429	0.536016	0.728390	0.267199	0.602271	117.775	64.116	0.07452
4	0.699259	0.895111	39.688	0.542584	0.431988	0.544208	0.793793	0.216618	0.592339	129.876	65.364	0.06264
5	0.899260	0.865111	43.483	0.565808	0.450249	0.532704	0.845213	0.167439	0.573166	135.853	66.030	0.04845

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIEB	ROTOR EFFB	HSVP FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.502580	0.421790	0.557436	0.756660	433.547	-0.061	-0.044	2506.580	98.433	98.433

TABLE XVI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 16

FLOW RATE # 6 2654. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.417	43.571	43.571	0.000	0.000	106.717	97.417	65.903	431.937	402.434	3.60880
2	0.299259	0.955111	93.850	47.148	47.148	0.000	0.000	105.028	93.850	63.326	436.267	401.721	3.65920
3	0.500741	0.924889	90.873	46.276	46.276	0.000	0.000	101.977	90.873	63.013	434.514	401.235	3.53030
4	0.699259	0.895111	87.972	46.668	46.668	0.000	0.000	99.584	87.972	62.055	434.701	400.855	3.40400
5	0.899260	0.865111	85.017	47.022	47.022	0.000	0.000	97.154	85.017	61.054	434.408	400.047	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.417	72.865	34.112	64.387	62.086	47.482	33.030	44.077	566.890	484.380	3.50460
2	0.299259	0.955111	93.850	70.523	41.309	57.158	54.144	55.251	36.692	41.613	555.440	478.150	3.65920
3	0.500741	0.924889	90.873	74.619	47.293	57.719	50.670	57.757	33.155	35.033	558.910	472.380	3.53030
4	0.699259	0.895111	87.972	80.781	52.420	61.463	49.540	58.742	26.510	26.826	574.170	472.760	3.40400
5	0.899260	0.865111	85.017	83.891	56.059	62.411	48.069	60.445	22.606	21.962	580.560	471.190	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-4.397	0.440606	2518.200	2665.750	62.300	0.9280E-05	0.1123E 07
2	0.299259	0.955111	-6.474	0.479828	2502.200	2643.230	62.300	0.9280E-05	0.1105E 07
3	0.500741	0.924889	-6.187	0.470982	2502.000	2650.260	62.300	0.9280E-05	0.1073E 07
4	0.699259	0.895111	-6.445	0.474845	2502.700	2657.290	62.300	0.9280E-05	0.1048E 07
5	0.899260	0.865111	-6.846	0.478482	2502.500	2653.570	62.300	0.9280E-05	0.1022E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	32.277	0.344947	0.444004	0.641411	0.692230	0.339019	0.772315	134.953	81.946	0.08770
2	0.299259	0.955111	37.513	0.420397	0.397117	0.555584	0.714775	0.277410	0.663929	119.173	76.429	0.07241
3	0.500741	0.924889	38.633	0.481334	0.414588	0.543323	0.763061	0.239008	0.624977	124.396	71.145	0.06616
4	0.699259	0.895111	38.626	0.533369	0.464564	0.559784	0.829899	0.185487	0.612064	139.469	71.905	0.05416
5	0.899260	0.865111	41.662	0.570443	0.486903	0.549412	0.886225	0.127914	0.580974	146.152	71.143	0.03751

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1.	ROTOR PSIB	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.490240	0.443187	0.565466	0.783755	433.669	-0.056	-0.066	2505.520	98.391	98.391

FLOW RATE # 7 2575. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.030	42.118	42.118	0.000	0.000	105.777	97.030	66.536	432.536	404.968	3.60880
2	0.299259	0.955111	93.832	45.055	45.055	0.000	0.000	104.088	93.832	64.351	436.028	404.481	3.65920
3	0.500741	0.924889	91.117	44.856	44.856	0.000	0.000	101.559	91.117	63.790	435.107	403.839	3.53030
4	0.699259	0.895111	87.860	44.854	44.854	0.000	0.000	98.647	87.860	62.955	434.967	403.702	3.40400
5	0.899260	0.865111	85.296	45.690	45.690	0.000	0.000	96.762	85.296	61.824	434.910	402.468	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.030	70.363	30.782	63.272	64.057	45.685	33.758	47.640	565.420	488.480	3.50460
2	0.299259	0.955111	93.832	69.159	39.825	56.542	54.841	54.558	37.290	43.117	557.860	483.530	3.65920
3	0.500741	0.924889	91.117	74.313	46.066	58.311	51.691	56.554	32.805	35.456	564.580	478.760	3.53030
4	0.699259	0.895111	87.860	81.368	52.587	62.092	49.738	58.561	25.768	26.105	580.820	477.930	3.40400
5	0.899260	0.865111	85.296	85.344	56.625	63.852	48.433	60.549	21.443	20.741	589.210	476.020	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-3.764	0.427609	2508.200	2579.340	62.302	0.9280E-05	0.1113E 07
2	0.299259	0.955111	-5.449	0.458619	2501.700	2576.270	62.302	0.9280E-05	0.1095E 07
3	0.500741	0.924889	-5.410	0.455311	2508.700	2570.940	62.302	0.9280E-05	0.1069E 07
4	0.699259	0.895111	-5.545	0.456967	2499.500	2568.280	62.302	0.9280E-05	0.1038E 07
5	0.899260	0.865111	-6.076	0.463411	2510.700	2581.430	62.302	0.9280E-05	0.1018E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	35.840	0.312519	0.440691	0.632815	0.696397	0.333176	0.783484	132.884	83.512	0.08083
2	0.299259	0.955111	39.017	0.405380	0.406141	0.549701	0.736839	0.255772	0.665489	121.832	79.049	0.06518
3	0.500741	0.924889	39.056	0.467602	0.429208	0.547438	0.784031	0.222503	0.637252	129.473	74.921	0.06127
4	0.699259	0.895111	37.505	0.535753	0.487073	0.566236	0.860194	0.156752	0.612299	145.853	74.228	0.04605
5	0.899260	0.865111	40.441	0.574321	0.510695	0.560266	0.911521	0.102934	0.582914	154.300	73.552	0.03044

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.475640	0.458807	0.567056	0.809103	434.009	-0.061	-0.061	2505.759	98.401	98.401

TABLE XVI. - Continued. BLADE-ELEMENT DATA FOR CONFIGURATION 16

FLOW RATE # 8 2504. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.069	40.920	40.920	0.000	0.000	105.342	97.069	67.142	432.938	406.916	3.60880
2	0.299259	0.955111	94.150	43.809	43.809	0.000	0.000	103.844	94.150	65.047	436.266	406.441	3.65920
3	0.500741	0.924889	90.826	43.688	43.688	0.000	0.000	100.787	90.826	64.312	435.274	405.613	3.53030
4	0.699259	0.895111	88.141	43.973	43.973	0.000	0.000	98.501	88.141	63.486	435.088	405.038	3.40400
5	0.899260	0.865111	85.058	44.269	44.269	0.000	0.000	95.888	85.058	62.505	435.089	404.634	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.069	68.865	25.939	63.793	67.873	42.191	33.275	52.063	568.280	494.580	3.50460
2	0.299259	0.955111	94.150	69.669	38.684	57.943	56.272	52.985	36.208	43.106	562.360	486.930	3.65920
3	0.500741	0.924889	90.826	73.073	44.596	57.886	52.389	55.442	32.940	36.451	569.410	486.430	3.53030
4	0.699259	0.895111	88.141	82.116	51.770	63.741	50.917	57.231	24.400	25.235	583.530	478.740	3.40400
5	0.899260	0.865111	85.058	86.038	56.599	64.801	48.865	60.115	20.257	19.692	595.050	480.010	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-3.158	0.415281	2509.200	2510.070	62.301	0.9280E-05	0.1109E 07
2	0.299259	0.955111	-4.753	0.444417	2510.200	2503.060	62.301	0.9280E-05	0.1093E 07
3	0.500741	0.924889	-4.888	0.444875	2500.700	2488.640	62.301	0.9280E-05	0.1061E 07
4	0.699259	0.895111	-5.014	0.446568	2507.500	2517.400	62.301	0.9280E-05	0.1037E 07
5	0.899260	0.865111	-5.395	0.450251	2503.700	2498.700	62.301	0.9280E-05	0.1009E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	40.263	0.263243	0.448484	0.637773	0.703204	0.331242	0.817540	135.342	87.664	0.07333
2	0.299259	0.955111	39.006	0.392429	0.417506	0.561414	0.743669	0.259353	0.684557	126.094	80.489	0.06610
3	0.500741	0.924889	40.051	0.454123	0.447515	0.545182	0.820853	0.185445	0.644071	134.136	80.817	0.05043
4	0.699259	0.895111	37.035	0.525744	0.492562	0.579423	0.850090	0.173610	0.630699	148.442	73.702	0.05138
5	0.899260	0.865111	39.392	0.575661	0.532396	0.570177	0.933738	0.079443	0.586770	159.961	75.376	0.02365

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

EHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.462310	0.473116	0.573656	0.824739	434.228	-0.060	-0.070	2506.259	98.421	98.421

FLOW RATE # 9 2451. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.061	40.333	40.333	0.000	0.000	105.108	97.061	67.435	433.725	408.444	3.60880
2	0.299259	0.955111	94.124	43.200	43.200	0.000	0.000	103.564	94.124	65.346	436.516	407.514	3.65920
3	0.500741	0.924889	91.164	42.931	42.931	0.000	0.000	100.767	91.164	64.783	435.630	406.987	3.53030
4	0.699259	0.895111	87.684	42.806	42.806	0.000	0.000	97.575	87.684	63.979	435.363	406.887	3.40400
5	0.899260	0.865111	84.769	43.103	43.103	0.000	0.000	95.098	84.769	63.048	435.330	406.458	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.061	67.981	22.842	64.029	70.366	40.161	33.032	55.335	566.820	495.000	3.50460
2	0.299259	0.955111	94.124	69.113	35.759	59.143	58.842	50.024	34.981	44.370	564.290	490.060	3.65920
3	0.500741	0.924889	91.164	75.101	45.054	60.085	53.136	54.734	31.079	34.598	573.310	485.660	3.53030
4	0.699259	0.895111	87.684	82.382	51.887	63.988	50.962	57.042	23.696	24.545	589.060	483.590	3.40400
5	0.899260	0.865111	84.769	87.031	57.473	65.355	48.672	60.663	19.414	18.665	601.230	483.520	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-2.865	0.409359	2509.000	2437.680	62.301	0.9280E-05	0.1106E 07
2	0.299259	0.955111	-4.454	0.438365	2509.500	2457.550	62.301	0.9280E-05	0.1090E 07
3	0.500741	0.924889	-4.417	0.435554	2510.000	2462.610	62.301	0.9280E-05	0.1061E 07
4	0.699259	0.895111	-4.521	0.436982	2494.500	2452.320	62.301	0.9280E-05	0.1027E 07
5	0.899260	0.865111	-4.852	0.439887	2495.200	2444.270	62.301	0.9280E-05	0.1001E 07

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	43.535	0.231837	0.441108	0.640177	0.689041	0.349852	0.837253	133.095	86.556	0.07165
2	0.299259	0.955111	40.270	0.362858	0.423305	0.573202	0.738492	0.271454	0.716345	127.774	82.546	0.06774
3	0.500741	0.924889	38.198	0.457090	0.455941	0.563797	0.808698	0.206397	0.658411	137.680	78.673	0.05744
4	0.699259	0.895111	36.345	0.529682	0.515328	0.584702	0.881352	0.139842	0.629969	153.697	76.703	0.04162
5	0.899260	0.865111	38.365	0.586537	0.555931	0.577014	0.963461	0.044767	0.579417	165.900	77.062	0.01341

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIE1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
-0.453060	0.487968	0.582237	0.838093	434.604	-0.059	-0.071	2503.640	98.318	98.318

TABLE XVI. - Concluded. BLADE-ELEMENT DATA FOR CONFIGURATION 16

FLOW RATE #10 2292. GALLONS PER MINUTE

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	U1 FPS	V1 FPS	VZ1 FPS	VTH1 FPS	BETA1 DEG	W1 FPS	WTH1 FPS	BETAP1 DEG	H1 FT	P1 FT	STRTUB1 SQ IN
1	0.099260	0.985111	97.146	38.588	38.588	0.000	0.000	104.530	97.146	68.336	434.803	411.662	3.60880
2	0.299259	0.955111	94.180	41.022	41.022	0.000	0.000	102.726	94.180	66.464	437.664	411.513	3.65920
3	0.500741	0.924889	90.681	40.252	40.252	0.000	0.000	99.213	90.681	66.064	437.068	411.889	3.53030
4	0.699259	0.895111	88.106	41.537	41.537	0.000	0.000	97.406	88.106	64.759	437.081	410.269	3.40400
5	0.899260	0.865111	85.340	40.949	40.949	0.000	0.000	94.655	85.340	64.367	435.902	409.844	3.23450

	PASS.HT.2 FROM TIP	R2/RT	U2 FPS	V2 FPS	VZ2 FPS	VTH2 FPS	BETA2 DEG	W2 FPS	WTH2 FPS	BETAP2 DEG	H2 FT	P2 FT	STRTUB2 SQ IN
1	0.099260	0.985111	97.146	71.375	22.205	67.833	71.874	86.774	29.313	52.855	580.160	500.990	3.50460
2	0.299259	0.955111	94.180	70.555	32.583	62.580	62.496	85.389	31.600	44.123	569.330	491.970	3.65920
3	0.500741	0.924889	90.681	76.891	43.165	63.632	55.849	90.940	27.048	32.072	580.370	488.490	3.53030
4	0.699259	0.895111	88.106	84.883	52.126	66.992	52.114	56.239	21.114	22.050	598.100	486.130	3.40400
5	0.899260	0.865111	85.340	87.811	55.920	67.704	50.445	58.635	17.636	17.504	606.730	486.900	3.19360

ROTOR BLADE ELEMENT PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

	PASS.HT.1 FROM TIP	R1/RT	INC DEG	PHI1	RPM	QV GPM	DENSITY LB/CU FT	VISK SQ FT/SEC	REC
1	0.099260	0.985111	-1.964	0.391306	2511.200	2302.740	62.300	0.9280E-05	0.1100E 07
2	0.299259	0.955111	-3.336	0.416012	2511.000	2280.020	62.300	0.9280E-05	0.1081E 07
3	0.500741	0.924889	-3.136	0.410546	2496.700	2259.820	62.300	0.9280E-05	0.1044E 07
4	0.699259	0.895111	-3.741	0.421992	2506.500	2312.670	62.300	0.9280E-05	0.1025E 07
5	0.899260	0.865111	-3.533	0.415106	2512.000	2304.320	62.300	0.9280E-05	0.9962E 06

	PASS.HT.2 FROM TIP	R2/RT	DEV DEG	PHI2	PSI	PSII	EFF	OMEGAB	D	DELTA H FT	DELTA P FT	(TH/C)A
1	0.099260	0.985111	41.055	0.225174	0.480904	0.677620	0.709696	0.350165	0.881860	145.357	89.328	0.07613
2	0.299259	0.955111	40.023	0.330433	0.435679	0.606158	0.718753	0.314162	0.770630	131.666	80.457	0.07873
3	0.500741	0.924889	35.672	0.440256	0.479629	0.600262	0.799031	0.235621	0.703390	143.302	76.601	0.06750
4	0.699259	0.895111	33.650	0.529572	0.534721	0.609219	0.877715	0.152147	0.647652	161.019	75.861	0.04614
5	0.899260	0.865111	37.204	0.566874	0.564813	0.593751	0.951262	0.062859	0.606721	170.828	77.056	0.01896

AVERAGED PARAMETERS
1 INDICATES LEADING EDGE, 2 INDICATES TRAILING EDGE

PHIB1	ROTOR PSIE	ROTOR PSIIB	ROTOR EFFB	HSVB FT	FRC1	FRC2	RPMA	UT1A FPS	UT2A FPS
0.423020	0.507762	0.610396	0.831856	435.799	-0.041	-0.041	2507.479	98.463	98.468

REFERENCES

1. Crouse, James E.; and Sandercock, Donald M.: Design and Overall Performance of an Axial-Flow-Pump Rotor With a Blade Tip Diffusion Factor of 0.43. NASA TN D-2295, 1964.

2. Crouse, James E.; and Sandercock, Donald M.: Blade-Element Performance of 0.7 Hub-Tip Radius Ratio Axial-Flow-Pump Rotor With Tip Diffusion Factor of 0.43. NASA TN D-2481, 1964.

3. Miller, Max J.; and Crouse, James E.: Design and Overall Performance of an Axial-Flow Pump Rotor With a Blade-Tip Diffusion Factor of 0.66. NASA TN D-3024, 1965.

4. Miller, Max J.; and Sandercock, Donald M.: Blade Element Performance of Axial-Flow Pump Rotor With Blade Tip Diffusion Factor of 0.66. NASA TN D-3602, 1966.

5. Urasek, Donald C.: Design and Performance of a 0.9 Hub-Tip-Ratio Axial-Flow Pump Rotor With a Blade-Tip Diffusion Factor of 0.63. NASA TM X-2235, 1971.

6. Urasek, Donald C.: Design and Performance of an 0.8-Hub-Tip-Ratio Axial-Flow Pump Rotor with a Blade-Tip Diffusion Factor of 0.55. NASA TM X-2485, 1972.

7. Johnsen, Irving A.; and Bullock, Robert O.; eds.: Aerodynamic Design of Axial-Flow Compressors. NASA SP-36, 1965.

8. Kavanagh, P.; and Miller, M. J.: Axial-Flow Pump Design Digital Computer Program. Rep. ISU-ERI-AMES-66300, Iowa State Univ. (NASA CR-111574), Sept. 1970.

9. Crouse, James E.; Janetzke, David C.; and Schwirian, Richard E.: A Computer Program for Composing Compressor Blading from Simulated Circular-Arc Elements on Conical Surfaces. NASA TN D-5437, 1969.

10. Kavanagh, P.; Miller, M. J.; and Serovy, G. K.: Application of Blade-Element Design Methods to the Design of Highly Loaded Pump Stages. Trans IAHR 5th Symposium for Hydraulic Research, pt. 1, 1970.

11. Crouse, James E.; Montgomery, John C.; and Soltis, Richard F.: Investigation of the Performance of an Axial-Flow-Pump Stage Designed by the Blade-Element Theory - Design and Overall Performance. NASA TN D-591, 1961.

12. Ross, C. C.; and Banerian, Gordon: Some Aspects of High-Suction Specific-Speed Pump Inducers. Trans. ASME, vol. 78, no. 8, Nov. 1956, pp. 1715-1721.

13. Taylor, W. E.; Murrin, T. A.; and Colombo, R. M.: Systematic Two-Dimensional Cascade Tests. Vol. 1: Double Circular-Arc Hydrofoils. Rep. UARL-H 910254-50, United Aircraft Corp. NASA CR-72498), Dec. 19, 1969.

14. Miller, M. J.; Okiishi, T. H.; Kavanagh, P.; and Serovy, G. K.: Application of Blade-Element Techniques to Design and Performance Prediction Problems for Axial-Flow Turbomachinery. Rep. ISU-ERI-AMES-77900, Iowa State Univ., July 1970.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons. Also includes conference proceedings with either limited or unlimited distribution.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include final reports of major projects, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546