	AD-A061 361 BOEING VERTOL CO PHILADELPHIA PA INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFI-ETC(U) SEP 78 P F SHERIDAN UNCLASSIFIED USARTL-TR-78-23B-VOL-26 NL													
		1 of 3 ADGEI 361								Energy Provine				
Maccourt	All Sold	Contraction of the second seco												
1 W TITLE														
10 1111 W								-Tenel	-inaui			PANGEDAS		
9.1111	10.mai													
		*50001												
11111 6.								5000		- innei	Thomas .		-	
														/

A 061360 TR-78-238 -VOL USARTL JINTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFIGURATION, YOLUME II-G, Harmonic Analyses of Airframe Surface Pressure Data, Runs 23-33, Forward Section 10) Philip F. Sheridan Boeing Vertol Company P.O. Box 16858 C Philadelphia, Pa. 19142 211p./ Sep 78 Final Repert, Mar Feb 78 5) DAAJØ2-77-C-ØØ20 Approved for public release; distribution unlimited. (6)16262209AH76 NOV 17 1978 ISGISUUS **Prepared** for APPLIED TECHNOLOGY LABORATORY U. S. ARMY RESEARCH AND TECHNOLOGY LABORATORIES (AVRADCOM) Fort Eustis, Va. 23604 78 11 13 060 403 682 mt

### APPLIED TECHNOLOGY LABORATORY POSITION STATEMENT

In 1975 a wind tunnel test program was conducted in the Boeing-Vertol 20-foot V/STOL Wind Tunnel on a 1/5th-scale UTTAS model to investigate and find solutions for several aerodynamic problems encountered during the UTTAS flight-testing. Specifically, these tests focused upon (a) the structure of the hub/rotor wake in the vicinity of the empennage, (b) the formulation of the ground vortex and its relation to hub loads and fuselage loads during transition, and (c) the occurrence of vibratory air pressures from the blade passing over the fuselage. Only portions of the above-mentioned wind tunnel test data were reduced and analyzed in addressing the flight-test problems of the UTTAS aircraft.

Under Contract DAAJ02-77-C-0020, Boeing-Vertol completed analyses on the data to understand more completely the aerodynamic interactions that are involved and to formulate instructions for the guidance of designers in these respects. The results of these studies are applicable to all existing and future single-rotor/tail rotor helicopters. The data have been segregated according to aerodynamic interactions and associated phenomena/problem areas. From this body of knowledge, a generalized set of design guidelines meaningful to the single-rotor helicopter design concept formulation were developed and are included in these reports.

Mr. Robert P. Smith of the Aeronautical Technology Division, Aeromechanics Technical Area, served as project engineer for this effort.

The findings in this report are not to be y other authorized documents. When Government drawings, specification lefinitely related Government procurem or any obligation whatsoever; and the upplied the sold drawings, specification menner licensing the holder or any other se, or sell any patented invention that	DISCLAIMERS a construed as an official Department of the Army position unless so designated bus, or other data are used for any purpose other than in connection with a sent operation, the United States Government thereby incurs no responsibility fact that the Government may have formulated, furnished, or in any way a, or other data is not to be regarded by implication or otherwise as in any are person or corporation, or conveying any rights or permission, to menufacture, may in any way be related thereto.
ade names cited in this report do not rdware or software.	constitute en official endorsement or approval of the use of such commercial
	DISPOSITION INSTRUCTIONS
secret this report when no longer nee	ded. Do not return it to the originator.
Reine Graften D' tuch Section () and Silly () Contraction	
C 13059710N AVAILABILITY DODED Dist. AVAIL DNI, V SPECIAL	
ALL	81.1.88

REPORT D	OCUMENTATION PAGE	READ INSTRUCTIONS
1. REPORT NUMBER	2 GOVT ACCESSION N	D. 3. RECIPIENT'S CATALOG NUMBER
USARTI TR-78-23 B		
A. TITLE (and Subtitie) TAIT	ERACTIONAL AFRODYNAMICS OF THE	5. TYPE OF REPORT & PERIOD COVERE
STNCLE DOTOD HELTCO	TED CONFICUDATION	FINAL REPORT
Volume II Harmonic	Analucas of Atafmama Sumface	15 Mar 1977 - 13 Feb 197
Pressure Data, Sub-	Volume G. Runs 23-33. Forward	6. PERFORMING ORG. REPORT NUMBER
Section		
7. AUTHOR(4)		S. CONTRACT OR GRANT HUMBER(S)
Philip F. Sheridan		DAAJ02-77-C-0020
. PERFORMING ORGANIZATIO	N NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TAS
Boeing Vertol Compa	ny	62209A 11 262209AH76
P.O. Box 16858		00 189 EK
Philadelphia, Pa. 1	9142	
11. CONTROLLING OFFICE NA	ALE AND ADDRESS	12. REPORT DATE
Research & Technology 1	Aboratories (AVPADCOM)	13. NUMBER OF PAGES
Fort Rustie, Virgini	a 23604	211
14. MONITORING AGENCY NAM	E & ADDRESS(II dittorent from Controlling Office)	15. SECURITY CLASS. (of this report)
		Unclassified
		Unclassified
		SCHEDULE
Approved for public	release; distribution unlimite	ed.
Approved for public	(of this Report) release; distribution unlimite (of the obstract entered in Block 20, if different i	ed. rom Report)
16. DISTRIBUTION STATEMENT Approved for public 17. Distribution Statement 18. Supplementary notes	(of this Report) release; distribution unlimite (of the obstract entered in Black 20, 11 different i	ran Report)
Approved for public Approved for public 17. DISTRIBUTION STATEMENT 18. SUPPLEMENTARY NOTES Volume II of an etg Volume II is compri	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, if different i ht volume report. sed of nine sub-volumes (A thr	ough I}.
16. DISTRIBUTION STATEMENT Approved for public 17. DISTRIBUTION STATEMENT 18. SUMPLEMENTARY NOTES Volume II of an etg Volume II is compri 19. KEY WORDS (Continue on rev Rotor	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, If different i ht volume report. sed of nine sub-volumes (A thr error olds if naccosary and identify by block numb Aerodynamic Interaction	nugh I).
16. DISTRIBUTION STATEMENT Approved for public 17. DISTRIBUTION STATEMENT 18. SUMPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, If different i ht volume report. sed of nine sub-volumes (A thr reree olds If necessary and identify by block number Aerodynamic Interaction Flow Environment	nugh I).
16. DISTRIBUTION STATEMENT Approved for public 17. DISTRIBUTION STATEMENT 18. SUMPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash Flow	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, if different i ht volume report. sed of nine sub-volumes (A thr Aerodynamic Interaction Flow Environment Vibratory Pressures	rom Report) nugh I). */ Forward Crown
16. DISTRIBUTION STATEMENT Approved for public 17. DISTRIBUTION STATEMENT 18. SUPPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash Flow Interaction	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, if different i ht volume report. sed of nine sub-volumes (A thr Aerodynamic Interaction Flow Environment Vibratory Pressures Fuselage	nugh I).
16. DISTRIBUTION STATEMENT Approved for public 17. DISTRIBUTION STATEMENT 18. SUPPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev	(of this Report) release; distribution unlimite (of the obstract entered in Block 20, If different i ht volume report. sed of nine sub-volumes (A thr sed of nine sub-volumes (A thr Aerodynamic Interaction Flow Environment Vibratory Pressures Fuselage	ough I).
Approved for public Approved for public 17. DISTRIBUTION STATEMENT 18. SUPPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 35. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 36. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 36. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 36. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 26. ABSTRACT (Continue on rev Rotor Contain harmonic an pressure transducer ein the forward sect from 20 knots to 16	(of the Report) release; distribution unlimite (of the obstract entered in Block 20, if different is to obstract entered in Block 20, if different is ht volume report. sed of nine sub-volumes (A thr Aerodynamic Interaction Flow Environment Vibratory Pressures Fuselage mes able M messees and identify by block number of the nine sub-volumes of Vo alyses of the waveforms genera s, which covered the surface of b-volume covers the final elev pressure testing. The analyse ion of the model. Test condit 0 knots in level flight.	ough I). Forward Crown Forward Crown Jume II. These documents ted by each of the 53 f the model fuselage and en of the twenty-seven runs is encompass the transducers ions here involve speeds
Approved for public Approved for public 17. DISTRIBUTION STATEMENT 18. SUPPLEMENTARY NOTES Volume II of an eig Volume II is compri 19. KEY WORDS (Continue on rev Rotor Downwash Flow Interaction 34. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 35. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction 36. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction B. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction B. ABSTRACT (Continue on rev Rotor Downwash Flow Interaction B. ABSTRACT (Continue on rev Rotor B. ABSTRACT (Continue on rev Rotor B. ABSTRACT (Continue on rev Rotor B. ABSTRACT (Continue on rev Rotor DO 1 Jaco 75 1073 Rotor	(of this Report) release; distribution unlimite (of the abstract entered in Block 20, If different is (of the abstract entered in Block 20, If different is the volume report. sed of nine sub-volumes (A thr wrow olds if necessary and identify by block number Aerodynamic Interaction Flow Environment Vibratory Pressures Fuselage me add N mesonary and Neutify by block number of the nine sub-volumes of Vo alyses of the waveforms genera s, which covered the surface of b-volume covers the final elevy pressure testing. The analyse ion of the model. Test condit 0 knots in level flight.	ough I). "" Forward Crown "" Tume II. These documents ted by each of the 53 f the model fuselage and en of the twenty-seven runs is encompass the transducers ions here involve speeds UNCLASSIFIED

#### PREFACE

The entire report describing the investigation of INTERACTIONAL AERODYNAMICS OF THE SINGLE-ROTOR HELICOPTER CONFIGURATION comprises eight numbered volumes bound as 33 separate documents. The complete list of these documents is as follows:

Volume I, Final Report

F

I

Volume II, Harmonic Analyses of Airframe Surface Pressure Data

- A Runs 7-14, Forward Section
- B Runs 7-14, Mid Section
- C Runs 7-14, Aft Section
- D Runs 15-22, Forward Section
- E Runs 15-22, Mid Section
  - Runs 15-22, Aft Section
- G Runs 23-33, Forward Section
- H Runs 23-33, Mid Section
  - Runs 23-33, Aft Section

Volume III, Flow Angle and Velocity Wake Profiles in Low-

Frequency Band

- A Basic Investigations and Hubcap Variations
- B Air Ejector Systems and Other Devices

Volume IV, One-Third Octave Band Spectrograms of Wake Split-Film Data

- A Buildup to Baseline
- **B** Basic Configuration Wake Explorations
- C Solid Hubcaps
- D Open Hubcaps
- E Air Ejectors
- F Air Ejectors With Hubcaps; Wings
- G Fairings and Surface Devices

Volume V, Harmonic Analyses of Hub Wake

Volume VI, One-Third Octave Band Spectrograms of Wake Single Film Data

- A Buildup to Baseline
- B Basic Configuration Wake Exploration
- C Hubcaps and Air Ejectors

Volume VII, Frequency Analyses of Wake Split-Film Data

- A Buildup to Baseline
- B Basic Configuration Wake Explorations
- C Solid Hubcaps



3

RECEDING PAGE

- D Open Hubcaps
- E Air Ejectors
- F Air Ejectors With Hubcaps; Wings
- G Fairings and Surface Devices

## Volume VIII, Frequency Analyses of Wake Single Film Data

- A Buildup to Baseline
- B Basic Configuration Wake Exploration
- C Hubcaps and Air Ejectors

# TABLE OF CONTENTS

INTRODUCTION	•	•	•	6
LIST OF TEST RUNS (TABLE 1)	•	•	•	8
UTTAS 1/4.85 - SCALE MODEL GEOMETRY AND SURFACE PRESSURE TRANSDUCER LOCATIONS				
(FIGURE 1)	•	•	•	11
PRESSURE TRANSDUCER LOCATIONS (TABLE 2).	•	•	9. 141	12
SURFACE PRESSURE HARMONIC ANALYSES	•	•		14

#### INTRODUCTION

Volume II summarizes the harmonic analyses of the airframe surface pressures measured at 53 locations on the fuselage, nacelles, and empennage of the model. These values are presented in nine volumes resulting from the following division of runs and pressures.

Volume	Runs	Pressure Section
II-A	7-14	Forward
II-B		Mid
II-C		Aft
II-D	15-22	Forward
II-E	1140	Mid
II-F	1 2 2 3 8 4 5 2 6 K	Aft
II-G	23-53	Forward
II-H		Mid
II-I		Aft

A computer printout sheet is provided for each pressure transducer for every run. The steady and ten harmonic components are given in pounds per square inch. The resultant and its phase angle are shown as well as the sine and cosine. A machine plotted time history with points every three degrees is offered for reference.

The parameters of any run may be found in the list of Test Runs, (Table 1), a copy of which appears in each volume.

The designation (PS number) of the pressure sensors within each section are shown below.

Forward	Mid	Aft
Section	Section	Section
004.1	045.1	081.1
013.1	045.2	081.2
013.2	047.1	081.3
013.3	047.2	099.1
015.1	048.1	099.2
017.1	048.2	099.3
017.2	048.3	107.1
017.3	052.1	107.2
017.4	052.2	107.3
017.5	056.1	107.4
017.6	056.2	107.5
017.7	056.3	107.6
023.1	057.1	112.1
023.2	057.2	112.2
023.3	071.1	117.1
023.4	072.1	117.2
023.5	072.2	
026.1		
060.1	The second s	

The location of each transducer is shown in the scaled model drawing (Figure 1) and the listing of the transducer locations (Table 2).

The great majority of the pressure data points permitted usable harmonic analysis. Occasionally the computer program would skip a case with too many points beyond the valid voltage bandwidth of the measurement system. This is noted by the words "BANDEDGE" There are also a few cases where a very flat variation indicates an inoperative transducer.

TABLE 1

LIST OF TEST RUNS

DDFCCIIDFO MEASUREMENT OF VIBRATORY SURFACE

RUN         CONFIGURATION/CONDITION         VTUN         RFM         DISK         MODEL         HT         PAIL           NO.         T         K1/(a) Level flight baseline         60         1433/         8         2.2         6.5 $\approx$ Control           "         /(b) Max. gross weight level flit.         "         "         10         3.3         "	1	121		C. R. Same	and the second second	Star Hill &	din la set			and the second		Children and The			
RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MOEL         MA           NO.         CONFIGURATION/CONDITION         VTUN         RN         DISK         MOEL         MA           NO.         CONFIGURATION/CONDITION         VTUN         RN         DISK         MOEL         MA           NO.         CONFIGURATION/CONDITION         VTUN         RN         DISK         MOEL         MA           NO         MA         Loco         1433/         8         2.2         -6.5         -           "         "         "         "         "         "         "         "         MA           "         "         "         "         "         "         "         "         "         "           " <td></td> <td>TAIL</td> <td>ROTOR</td> <td>5</td> <td></td> <td>=</td> <td></td> <td>Off</td> <td></td> <td>=</td> <td></td> <td>=</td> <td>•</td> <td>=</td> <td></td>		TAIL	ROTOR	5		=		Off		=		=	•	=	
RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MORELSE           NO. $r$ NO         KNOTS         NEV         NO         NOTELSE           NO. $r$ $r$ $r$ $r$ $r$ $r$ 7 $K_1/(a)$ Level flight baseline $60$ $1433/$ $8$ $2.2$ $6.5$ 8 $r/(a)$ Repeat 7(a) $r$ $r$ $r$ $r$ $a$ $a$ 8 $r/(a)$ Repeat 7(a) $r$ $r$ $a$ $a$ $a$ 9 $r/(a)$ Repeat 7(a) $r$ $r$ $a$ $a$ $a$ 9 $r/(a)$ Repeat 7(a) $r$ $r$ $a$ $a$ $a$ 9 $r/(a)$ Repeat 7(a) $r$ $r$ $a$ $a$ $a$ 9 $r/(a)$ Repeat 10; T.P. 2/3,4/5 $r$ $r$ $r$ $a$ $a$ 10 $r/(a)$ Repeat 10; T.P. 2/3,4/5 $r$ $r$ $r$ $a$ $a$ $a$ $a$ <td>100</td> <td>MR HT.</td> <td>p/q</td> <td>8</td> <td>•</td> <td>=</td> <td></td> <td>•</td> <td></td> <td></td> <td></td> <td>=</td> <td></td> <td></td> <td>•</td>	100	MR HT.	p/q	8	•	=		•				=			•
RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MOG           NO.         RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MOG           NO.         RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MOG           NO.         RUN         CONFIGURATION/CONDITION         VTUN         RPM         DISK         MOG           7         K1/(a) Level flight baseline         60         1433/         8         2.2           8         * /(b) Repeat 7(a)         "         "         8         2.2           9         K2/Repeat high speed baseline with         "         1433/0         "         -3.5           10         */Max. climb at low speed         60         "         1433/0         "         -26.5           11         */(a) Repeat 10; T.P. 2,3,4,5         "         "         "         2.2           11         */(b) Repeat 10; T.P. 2,3,4,5         "         "         "         2.2           12         */(b) Repeat 7(b) with TR off         "         "         "         2.2           12         */(b) Rave GfW         T.P. 6,7,8,9         "         "		EL	•	-6.5		=	-2.0	-	-15	-15	-6.5	-6.5	-2.0	-2.0	
RUNCONFIGURATION/CONDITIONVTUNRPMDISKRUNCONFIGURATION/CONDITIONVTUNRNOTSRNATNO. $7$ K1/(a) Level flight baseline601433/8""/(b) Max. gross weight level fit.""10""/(b) Max. gross weight level fit.""8""/(b) Max. gross weight level fit.""8""/(b) Repeat 7(a)""8"/(b) Increase speed to maximum160"""9K2/Repeat high speed baseline with"1433/0""10"/(b) Repeat 7(a) with TR off,""""11"/(a) Repeat 7(a) with TR off,"""""12"/(b) Repeat 7(a) with TR off,""""1013""(a) Repeat 7(b) with TR off,"""""13"/(b) Repeat 7(b) with TR off,""""""13""""""""1012"""""""""""13K2+S1/Check lateral strakes""""""""""		MOD	• 5	2.2	3.3	2.2	-3.5		-26.5	-26.5	2.2	3.3	-2.0	-3.5	2
RUN       CONFIGURATION/CONDITION       VTUN       RPM         7       K1/(a) Level flight baseline       60       1433/         8       /(b) Max.gross weight level fit.       "       "         8       /(a) Repeat 7(a)       "       "       1433/0         9       K2/Repeat high speed baseline with       "       1433/0         10       "/Max. climb at low speed       60       "       "         11       "/(b) Increase speed to maximum       160       "       "         9       K2/Repeat high speed baseline with       "       1433/0       "         10       "/Max. climb at low speed       60       "       "       "         11       "/(b) Repeat 10; T.P. 2,3,4,5       "       "       "       "       "         12       "/(b) Repeat 7(a) with TR off,       "       <	CANUCCO	DISK	psf.	8	10	8		=			2	10	=	8	z
RUN       CONFIGURATION/CONDITION       VTUN         NO.       7       K1/(a) Level flight baseline       60         "       "/(b) Max. gross weight level flt.       "         "       "/(b) Max. gross weight level flt.       "         8       "/(a) Repeat 7(a)       "       "         8       "/(b) Increase speed to maximum       160         9       K2/Repeat high speed baseline with       "         10       "/(b) Repeat 10; T.P. 2,3,4,5       "         11       "/(b) Repeat 10; T.P. 2,3,4,5       "         12       "/(b) Repeat 10; T.P. 2,3,4,5       "         12       "/(b) Repeat 10; T.P. 2,3,4,5       "         13       K2+S_1/Check 100; with TR off       "         13       K2+S_1/Check longitudinal strakes       "	ALE FRE	RPM	MR/TR	1433/ 4500	=	-		1433/0		=	2	=	=	F	=
RUN       CONFIGURATION/CONDITION         NO.       7       K1/(a) Level flight baseline         "       /(b) Max. gross weight level fit.         "       /(b) Max. gross weight level fit.         "       /(b) Max. gross weight level fit.         "       /(b) Increase speed to maximum         9       K2/Repeat high speed baseline with         10       //max. climb at low speed         11       /(b) Repeat 10; T.P. 2,3,4,5         12       '/(b) Repeat 10; T.P. 2,3,4,5         13       K2+Speed 10; T.P. 2,3,4,5         13       K2+S1/Check 10; Mith TR off         13       K2+S1/Check lateral strakes	NOC INO	VTUN	KNOTS	60		-	160	=	60		=		160		=
RUN NO	INITIAL OF THE AND	CONFIGURATION/CONDITION		$K_{l}/(a)$ Level flight baseline	<pre>" /(b) Max. gross weight level flt. baseline</pre>	" /(a) Repeat 7(a)	" /(b) Increase speed to maximum	$K_2/Repeat$ high speed baseline with TR off	" /Max. climb at low speed	" /(a) Repeat 10; T.P. 2,3,4,5	" /(b) Repeat 7(a) with TR off, T.P. 6,7,8,9	" /(a) Repeat 7(b) with TR off	" /(b) Max. G.W. at max. speed with TR off	K2+S1/Check longitudinal strakes	K <sub>2</sub> +S <sub>2</sub> /Check lateral strakes
		RUN	NO.	2	:	80		6	10	11	-	12	:	13	14

		TAIL.	ROTOR	Off			=					-		
		MR. HT.	þ/q	8			•				=	=		
		EL	•	-2.0		0	-2.0	1	-					
		MOM	a.	-3.5	:	21	-3.5			•	-	:		
	ESSURES	DISK	LDG. psf	8			=				=			
SI	<b>VFACE PR</b>	RPM	MR/TR	1433/0	•		н	=	=	-	=	100 <b>-</b>		
CONTINUED	TORY SUI	VTUN	KNOTS	160		60	160	=	=	=	:			
TABLE 1. ( LIST OF	MEASUREMENT OF VIBRA		CONF 140000/NOTION/ CONFITTON	K <sub>3</sub> /Effect of 45° tapered blade root cutout	K <sub>2</sub> +VG <sub>1</sub> /Effect of vortex generators on forward crown	K <sub>2</sub> /Autorotation	K <sub>2</sub> +S <sub>3</sub> /Effect of lower longitudinal strakes	$K_4/Rotor$ raised 2.5 inches	K4+S3/Lower strakes added to rais- ed rotor	K <sub>5</sub> /Rotor raised 5.0 inches	K <sub>5</sub> +S <sub>3</sub> /Lower strakes with rotor in highest position	$K_2/Autorotation$ at maximum speed	Active and a second sec	
		RUN	NO.	15	16	17	18	19	20	21	22	23		

	TAIL	ROTOR	Off	=	=	=	2			-	E	2	
	MR HT.	þ/d	8	=		=	=		:	=	=	2	
	SEL.	•	0	=	=	=	-6.5	-3.2	-2.3	-2.2	-2.1	-1.9	
	MOD	a a	5.3	5.0	4.4	3.5	2.2	0.2	-0.6	-1.6	-2.7	-3.5	
SSURES	DISK	psf.	8	=			-		=	=	=	=	
IS 'ACE PRE	RPM	MR/TR	1433/0	=	=		=	F	=	=	-	=	
CONTINUED TEST RUN	VTUN	KNOTS	20	30	40	50	60	80	100	120	140	160	
TABLE 1. LIST OF MEASUREMENT OF VIBRAT	COMPTCHIDATION / CONDITITION		K2/Level flight speed sweep	-					-		-		
	RUN	NO.	24	25	26	27	28	29	30	31	32	33	



TRANSDUCER DESIGNATION	MODEL	WATER	BUTT	LOCATION DESCRIPTION
PS004-1 -2	4.0	:	-1.2	Lower Surface Opper Surface
PS013-1 -2 -3	13.4 13.4 13.4	=	-5.3 -1.2 5.2	Forward Crown Forward Crown Forward Crown
PS015-1	13.4	-	-1.2	Lower Surface
PS017-1 -2 -3 -4 -5 -6 -7	16.6 16.6 16.6 16.6 16.6 16.6 16.6	24.2 33.4 - 33.4 24.2	-5.3 -1.2 5.2 -	Left Side Left Side Forward Crown Forward Crown Forward Crown Right Side Right Side
PS023-1 -2 -3 -4 -5	23.0 23.0 23.0 23.0 23.0 23.0	25.9	-5.3 -1.2 5.2	Left Side Forward Crown Forward Crown Forward Crown Right Side
P5026-1	26.0	-	-1.2	Under Surface
PS045-1 -2	45.4	:	-8.7	Top of Nacelle Top of Nacelle
PS047-1 -2	47.4	26.6	:	Left Side Right Side
PS048-1 -2 -3	48.6 48.6 48.6	=	-3.9 1.2 4.4	Aft Crown Aft Crown Aft Crown
PS052-1 -2	52.6 52.6	:	-8.7 8.7	Top of Nacelle Top Nacelle

# PRESSURE TRANSDUCER LOCATIONS

TRANSDUCER DESIGNATION	MODEL STATION	WATER LINE	BUTT LINE	LOCATION DESCRIPTION
PS056-1 -2 -3	56.2 56.2 56.2	:	-3.9 1.2 4.4	Aft Crown Aft Crown Aft Crown
PS057-1 -2	57.4	27.0 27.0	:	Left Side Right Side
PS071-1	71.4	-	1.2	Top Surface
PS072-1 -2	71.6	28.9 28.9	:	Left Side Right Side
PS081-1 -2 -3	81.5 81.5 81.5	28.9	1.2	Left Side Top Surface Right Side
23089-1	89.4	-	1.2	Top Surface
PSC99-1 -2 -3	99.0 99.0 99.0	28.9	1.2	Left Side Top Surface Right Side
PS107-1 -2 -3 -4 -5 -6	109.5 109.5 109.5 109.5 109.5 109.5	38.7 38.7	-8.6 -8.6 - 8.6 8.6	Lower Surf Stab. Upper Surf Stab. Laft Side - Fin Right Side - Fin Upper Surf Stab. Lower Surf Stab.
PS112-1 -2	110.3 110.3	:	-15.9	Upper Surf Stab. Upper Surf Stab.
PS117-1 -2	117.0 117.0	47.7	-	Left Side - Fin Right Side - Fin

TABLE 2 (CONTINUED) PRESSURE TRANSDUCER LOCATIONS



UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES --- FWD SECTION

















#### UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION

![](_page_24_Figure_0.jpeg)

#### UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION

![](_page_25_Figure_0.jpeg)

![](_page_26_Figure_0.jpeg)

![](_page_27_Figure_0.jpeg)

![](_page_28_Figure_0.jpeg)

![](_page_29_Figure_0.jpeg)

![](_page_30_Figure_0.jpeg)

![](_page_31_Figure_0.jpeg)

![](_page_32_Figure_0.jpeg)

![](_page_33_Figure_0.jpeg)

![](_page_34_Figure_0.jpeg)

![](_page_35_Figure_0.jpeg)














## \*\*\* PS017.6 WAVEFORM \*\*\* \*\*\* CYCLE 0 \*\*\* \*\*\* DATA ANALYSIS \*\* ENTERED OUT OF RANGE BANDEDGE RUN TP CHAN 24 1 48 38 HARM 1 2 3 COS COEFF 0.36327E-02 0.26479E-02 0.99408E-03 PHASE 66.4 137.2 0.31022E 00 COEFF RES 9640E-02 9022E-02 0 03 45 6 18856 0 57 0 0 89 02 0 0 . 8 10 -0 71069E -03 0 .03 0. MAX= 0.34661E 00 MIN= 0.28995E 00 PEAK TC PEAK/2= 0.28329E-01 5.0000E-01 2.9999E-01 1.0000E-01 -1.0000E-01 -3.0000E-01 -5.0000E-01 60 120 180 240 300 ----360 ō AZIMUTH POSITION IN DEGREES

UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION



•








































































































AD-A061 361 BOEING VERTOL CO PHILADELPHIA PA INTERACTIONAL AERODYNAMICS OF THE SINGLE ROTOR HELICOPTER CONFI-ETC(U) SEP 78 P F SHERIDAN UNCLASSIFIED USARTL-TR-78-23B-VOL-26 NL													
	20F3 AD AD 61 361				Tenet	-Innai	Sinnel						
*****				Sanni Land		TRANK	-innai'						
	AND										TREAL		
		******											
				Same)				<b>1000</b>					
						<b>*10001</b>			5000		-10001	fine.	
													. /



## \*\*\* PS017.7 WAVEFORM \*\*\* CYCLE 0 \*\*\* \*\*\* DATA ANALYSIS \*\*\* ENTERED 38 OUT OF RANGE 38 BANDEDGE 0 RUN TP CHAN 27 38 38 0 0.57104E 00 1 COS COEFF 0.15285E-02 0.49420E-03 10 MAX= 0.58109E 00 PEAK TO PE MIN= 0.53175E 00 AK/2= 0.24672E-01 5.0000E-01 ------- [ ----- [ ------- ] ------- ] --2.99998-01 1.0000E-01 -1.0000E-01 -3.0000E-01 -5.0000E-01 60 180 240 300 120 ò 360 AZIMUTH POSITION IN DEGREES

UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION




















































HARMONIC ANALYSIS SKIPPED

































































































































UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION





# UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION



UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION





UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES --- FWD SECTION



### UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION







UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES----FWD SECTION



UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES---FWD SECTION











UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES --- FWD SECTION





















## UTTAS 1/5 TH SCALE MODEL FUSELAGE PRESSURES ---- FWD SECTION





UTTAS 1/5 TH SCALE NODEL FUSELAGE PRESSURES---FWD SECTION









10598-78