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AN EXPERIMENTAL STUDY OF HELICOPTER
ROTOR IMPULSIVE NOISE

By

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June 1971

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U. S. ARMY AIR MOBILITY RESEARCH AND DEVELOPMENT LABORATORY
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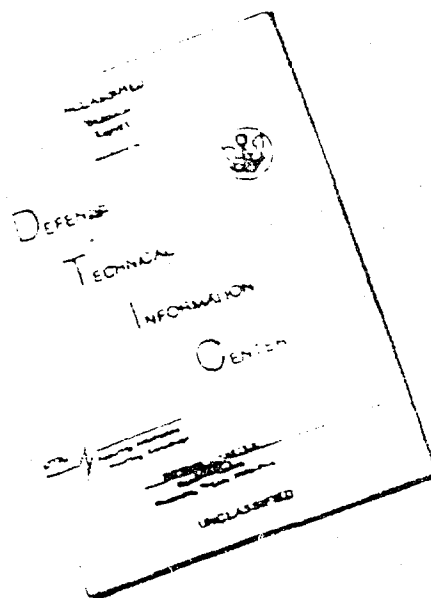


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This contract was initiated (1) to acquire simultaneously CH-53A helicopter noise and rotor airloads data for impulsive and nonimpulsive flight conditions and (2) to correlate these data with noise and airload prediction methods. More specifically, knowing the airloads and the associated noise levels, an acoustic analysis developed under a previous contract was modified with the hope of being able to predict the occurrence of impulsive rotor noise. A marked improvement in the ability to make acoustic predictions during the design of a new helicopter was expected.

From this and earlier studies, the consensus is that impulsive rotor noise is not severe amplitude-modulated broadband noise, but ordered rotational noise rich in higher harmonic content. Consequently, the ability to predict the occurrence of impulsive rotor noise requires considerable knowledge of the high-frequency airload content. Existing rotor airloads analyses are adequate for investigations of rotor and fuselage dynamics, but they are sorely lacking in defining the higher harmonics of airloads necessary for detailed acoustic analyses. However, before this study was initiated, it was believed that knowledge of the chordal airload distribution could compensate for the lack of high-frequency airloads data. Results of this study do show that knowing the chordal airload distribution enhances prediction accuracy of the lower harmonics of rotational noise. However, knowing the chordal airload distribution, the analysis remains incapable of predicting the higher rotational noise harmonics characteristic of impulsive rotor noise. Consequently, it would appear reasonable to conclude that, with or without the airloads known, this analysis cannot predict the occurrence of impulsive rotor noise. However, an analysis such as the one reported herein does have the potential for predicting the occurrence of impulsive rotor noise; but to succeed, major advances in modeling the rotor wake and accounting for rotor blade/vortex wake interactions and compressibility effects are needed. Solutions to these needs cannot be anticipated in the near future.

This program was conducted under the technical direction of Mr. Joseph H. McGarvey of the Reliability and Maintainability Division of this Directorate.

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AN EXPERIMENTAL STUDY OF HELICOPTER
ROTOR IMPULSIVE NOISE

Final Report

By

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Prepared by

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EUSTIS DIRECTORATE
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Fort Eustis, Virginia

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ABSTRACT

Results of a study of helicopter rotor impulsive noise (RIN) are presented in this report. Rotor noise, together with rotor blade dynamic and pressure data, was measured during hover and cruise of a CH-53A helicopter for use in a correlation study of calculated and measured noise. In addition, the rotor rotational noise analysis described in U. S. Army Aviation Materiel Laboratories (USAAVLABS) Technical Report 70-1B was modified to reduce computation time and to include blade flapping and coning motions. The inclusion of these motions, however, is shown to have little effect on the predicted noise.

Correlation of calculated and measured noise harmonic amplitudes is generally within 5 dB through the third harmonic at distances less than 1000 feet in front of the helicopter. Waveform correlation of calculated and measured time histories of acoustic pressure is good. RIN is identified as being primarily a rotational noise phenomenon, ordered at the blade passage frequency and its harmonics, rather than amplitude modulated broadband noise. Hover RIN is shown to be due to vortex interference (blade/wake interaction RIN), while cruise RIN is shown to be due to the combination of acoustic effects of a high subsonic tip Mach number on wave propagation and blade drag, and is herein referred to as advancing blade RIN.

FOREWORD

The work reported herein was performed by Sikorsky Aircraft, Division of United Aircraft Corporation, under contract DAAJ02-69-C-0025, Task 1F162204A14235, for the Eustis Directorate, US Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia. Portions of the data collection and analysis tasks were performed by H. R. Mull and Associates, Wilton, Connecticut. The work was carried out under the technical cognizance of Mr. Joseph McGarvey of the Eustis Directorate, USAAMRDL staff. Sikorsky Aircraft personnel directly associated with the project included Mr. W. E. Bausch, Mr. C. L. Munch, Mr. R. G. Schlegel and Mr. J. J. DeFelice. H. R. Mull and Associates personnel directly involved included Mr. H. R. Mull, Mr. J. Dunmore, and Mr. A. Smardin.

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LIST OF SYMBOLS

(Applies to Body of Report Only)

A	Amplitude of pressure pulse
B	Number of rotor blades
C	Radial force component
C_m	Sound pressure amplitude of m^{th} sound harmonic
D	In-plane (drag) force component
dB	decibel, referenced to 0.0002 microbar
$J_n(Z)$	Bessel function of the first kind, order n , argument Z
L	Any force component (thrust, in-plane, radial)
M	Rotational tip Mach number
M_a	Advancing tip Mach number ($M + M_F$)
M_F	Flight Mach number
M_r	Component of flight Mach number in direction of observer
P	Period of pressure pulse
R	Rotor radius
SPL	Sound pressure level, decibels
T	Rotor thrust force component
V	Forward translational velocity
V_t	Tip speed of blade
a_o	Speed of sound
$a_{oT,oD,oC}$	Steady Fourier components of thrust, in-plane, and radial force components
$a_{\lambda T,\lambda D,\lambda C}$	Fourier cosine components of thrust, in-plane, and radial forces
$b_{\lambda T,\lambda D,\lambda C}$	Fourier sine components of thrust, in-plane, and radial forces
i	Imaginary number $\sqrt{-1}$

k	Airloading harmonics decay power law exponent
m	Sound harmonic number
r	Distance from hub to observer
x, y	Field point coordinates of observer
λ	Airloading harmonic number
Ω	Rotor rotational speed, radians/second
ψ	Azimuth angle in rotor disk measured from tail of aircraft

1.0 INTRODUCTION

Over the past several years, noise generated by all types of aircraft has become a source of increasing concern in military as well as civil applications. The civil operator is concerned with community acceptance (or tolerance) of the vehicle so that it may be used near or in population centers; the military operator is concerned with the aural detectability of the vehicle in an effort to improve its survivability and combat effectiveness.

The helicopter, because of its unique operational capabilities and the requirements placed upon it, is a prime candidate for noise studies. The past few years have seen the initiation and completion of many helicopter noise studies, both theoretical and experimental, to identify and quantify the mechanisms by which the noise is generated, propagated, and received and to find the means to reduce it.

The helicopter generates noise of both mechanical and aerodynamic origin. Mechanical noise, such as that due to the gearboxes, bearings, hydraulic systems, etc., is in most cases important only at locations near the helicopter. Of the aerodynamic sources, such as the main and tail rotors and the engine compressors, main rotor generated impulsive noise (when it occurs) can be by far the most predominant noise, exceeding even piston engine exhaust noise (as has been shown recently by Cox and Lynn, Reference 1). While the other aerodynamic sources of helicopter noise (rotor rotational noise, rotor vortex noise, turbine engine compressor noise, etc.) have been studied in quite some detail during the past few years, rotor impulsive noise has been generally referred to as a unique and separate phenomenon and has been largely ignored until very recently. The study reported herein seeks to experimentally identify the mechanism(s) which produce(s) rotor impulsive noise (RIN), to determine whether this noise is primarily rotational noise or amplitude modulated broadband noise, and to determine whether present theory can accurately predict this type of noise.

The study has been broken down into three phases: (1) flight test, (2) data reduction, and (3) analysis and correlation. During the flight test phase simultaneous measurements of rotor blade airloads and motions, aircraft operating parameters, and external noise on the ground were made on a CH-53A helicopter for hover and several forward cruise speeds. In addition, internally mounted directional microphones were placed against the windows on opposite sides of the cabin to determine the azimuthal locations of the rotor blades at the instant impulsive noise was generated.

The data reduction phase involved reducing the measured aerodynamic and acoustic data into useful forms. Rotor blade differential pressures were reduced to harmonics of 1 per rev for use in the noise prediction program and to time history pressure plots for correlation with the predicted external time histories and internal noise data. A real-time, narrow bandwidth spectrum analyzer reduced the measured external noise into amplitude-vs-frequency plots at specified intervals along the flight path for cruise and averaged spectra at several hover positions. External

noise was also reduced to octave band time histories during flyover and to octave band spectra at twelve azimuth locations in hover.

During the analysis and correlation phase, the measured aerodynamic and acoustic data were used to determine the locations in the rotor disk where impulsive rotor noise is generated during hover and cruise flight.

In addition, modifications were made to the rotational noise prediction program to include the effects of rigid body blade flapping and rotor shaft tilt, and to produce a time history of acoustic pressure at specific field points (Appendix I). This program was then used to predict the radiated noise using measured airloads as well as airloads predicted by the classical helicoidal wake analysis for correlation with noise measured at the ground station.

2.0 ROTOR IMPULSIVE NOISE (RIN) GENERATION

RIN, when it occurs, is the most significant and annoying of all helicopter noise sources. RIN (or "blade slap", "thump", "crack", "pop", etc., depending upon its intensity and pulse shape) can be observed on both single- and multiple-rotor helicopters, depending primarily upon the flight conditions and aircraft configuration. Because of the unique character and low fundamental frequency (fundamental blade passage frequency) of RIN, machines experiencing it can usually be detected at greater distances than similar, nonimpulsive noise-generating helicopters. Furthermore, helicopters exhibiting RIN are more annoying than those without this type of noise (Reference 5).

Several investigators (References 1 through 3) have postulated that the observed character of impulsive noise from rotors is due to severe amplitude modulation of broadband noise. While this phenomenon can be observed during RIN conditions, it is highly unlikely that it is the sole cause of the impulsive type waveforms which are observed by the ear to be impulsive noise.

RIN, occurring at the fundamental rotor blade passage frequency, is primarily a harmonic phenomenon, and its origin appears to be ordered rotational noise rather than random broadband noise. A Fourier analysis of periodic impulsive noise produces a frequency spectrum with very high harmonic content and relatively little amplitude decay with frequency. This has recently been demonstrated analytically by Lowson and Ollerhead (Reference 4) and Leverton (Reference 5), and experimentally by King and Schlegel (Reference 6). King and Schlegel found that during nonimpulsive noise conditions, blade airloading harmonics decay approximately as $1/\lambda^{1.4}$ to $1/\lambda^{1.6}$ while during impulsive noise conditions the airloads decay about as $1/\lambda^{0.6}$ (λ = airload harmonic order). The increased high frequency airloading harmonic levels for the impulsive noise case result in increased high frequency sound harmonic levels, yielding the observed "slap". Furthermore, the phasing of the sound harmonics is important in determining the impulsive nature of the observed sound; for example, a harmonic spectrum with harmonics phase shifted by, say, 90 degrees with respect to the fundamental, may be more impulsive than one with all harmonics in phase. In a recent paper, Sadler and Loewy (Reference 7) indicate that the high frequency content of RIN may be primarily associated with vortex (broadband) noise. This, too, appears to be highly unlikely since vortex noise is random in amplitude, frequency, and phase. Consequently, it does not contain the necessary harmonic content and phase coherence necessary to define an impulsive sound.

Classically, there have been three main mechanisms for the generation of RIN postulated in the literature. These are summarized by Leverton (Reference 5) as the following:

1. Fluctuating forces due to blade/vortex intersection.
2. Fluctuating forces resulting from stalling and unstalling of the blade.
3. Local shock wave formation on portions of the blade.

The literature is in general agreement that the first is the primary source on tandem-rotor machines and in some cases on single-rotor machines. The second mechanism, that due to stall effects, is generally losing support as a probable slap mechanism. Leverton discusses the reasons in some detail in Reference 5. To summarize, it is believed that the stall process is relatively slow and does not produce the sharp changes in loading necessary to produce RIN. This is illustrated in Figure 1 (from Reference 5) where the stall duration is compared with a typical impulse duration on the basis of azimuthal movement. The impulse location in the disk of Figure 1 is purely arbitrary. The third RIN mechanism, that of local shock formation due to high advancing tip Mach numbers, is quite a complex subject. However, as pointed out by Ollerhead and Lowson (Reference 8), these shocks cannot propagate to an observer unless the blade actually exceeds sonic velocity. This does not appear to be a primary mechanism of RIN generation.

The only mechanism remaining to explain the occurrence of RIN is blade/vortex interaction. This mechanism does not, however, explain the occurrence of RIN on single-rotor helicopters during high speed flight where the observed "slap" is very intense as the helicopter approaches, but rapidly decreases as the helicopter passes overhead and retreats. There must then be another mechanism which is responsible for this type of RIN. Ollerhead and Lowson (Reference 8) indicate that this phenomenon can be explained as an acoustic effect due to increased tip speeds, and Arndt and Borgman (Reference 12) show that compressibility effects may also contribute. Thus, it appears there are two types of impulsive noise, defined according to the mechanisms by which they are generated:

1. Blade/Wake Interaction RIN
2. Advancing Blade RIN

Before discussing these two types, a review of rotational noise theory is presented.

2.1 REVIEW OF THEORY

2.1.1 Rotational Noise

Several investigators (References 2, 4, 9, and 17 through 20) have developed theoretical methods for the prediction of rotor rotational noise. The basic assumptions made vary from one to another, but all should accurately predict the noise, presuming sufficient input data are available. Most of these methods involve an open-form iterative computer solution. However, Lowson and Ollerhead made several additional simplifying assumptions which allowed them to develop a closed-form solution for far-field rotational noise in terms of Bessel functions (Reference 4). For the purposes of examining RIN, this solution is the least cumbersome and provides the necessary insight to the problem.

Ollerhead and Lowson present the theoretical result for the sound pressure amplitude of the m^{th} sound harmonic due to the steady and fluctuating

forces as the relation

$$\begin{aligned}
 c_m = \sum_{\lambda=0}^{\infty} \frac{i^{[mB-\lambda]}}{4\pi} \left\{ \frac{mB\Omega x}{a_0 r^2} \left\{ i a_{\lambda T} \left(J_{mB-\lambda} + [-1]^{\lambda} J_{mB+\lambda} \right) - b_{\lambda T} \left(J_{mB-\lambda} - [-1]^{\lambda} J_{mB+\lambda} \right) \right\} \right. \\
 - \left\{ \frac{i a_{\lambda D}}{R r} \left((mB-\lambda) J_{mB-\lambda} + [-1]^{\lambda} (mB+\lambda) J_{mB+\lambda} \right) \right. \\
 - \left. \frac{b_{\lambda D}}{R r} \left((mB-\lambda) J_{mB-\lambda} - [-1]^{\lambda} (mB+\lambda) J_{mB+\lambda} \right) \right\} + \frac{mB\Omega y}{a_0 r^2} \left\{ a_{\lambda C} \left(J_{mB-\lambda} + [-1]^{\lambda} J_{mB+\lambda} \right) \right. \\
 \left. \left. + b_{\lambda C} \left(J_{mB-\lambda} - [-1]^{\lambda} J_{mB+\lambda} \right) \right\} \right\} \quad (1)
 \end{aligned}$$

where the argument of Bessel functions is $mB\Omega y/r$.

The force components (i.e., $a_{\lambda T}$, $a_{\lambda D}$, $a_{\lambda C}$, $b_{\lambda T}$, $b_{\lambda D}$, $b_{\lambda C}$) are defined by the Fourier summations:

$$\begin{aligned}
 \text{Thrust} \quad T[\psi] &= a_{0T} + \sum_{\lambda=1}^{\infty} a_{\lambda T} \cos \lambda \psi + b_{\lambda T} \sin \lambda \psi \\
 \text{Drag} \quad D[\psi] &= a_{0D} + \sum_{\lambda=1}^{\infty} a_{\lambda D} \cos \lambda \psi + b_{\lambda D} \sin \lambda \psi \\
 \text{Radial Components} \quad C[\psi] &= a_{0C} + \sum_{\lambda=1}^{\infty} a_{\lambda C} \cos \lambda \psi + b_{\lambda C} \sin \lambda \psi
 \end{aligned}$$

The important fact to note is that all loading harmonics contribute to the noise radiated in each sound harmonic. Thus, it may be expected that increased high frequency airloading harmonics will cause increased levels of all sound harmonics. Lowson and Ollerhead (Reference 4) have shown that loading harmonics of order λ are significant radiators into the m^{th} sound harmonic in the range

$$mB[1-M] < \lambda < mB[1+M]$$

Thus, increased high-frequency airloads can be expected to increase the higher sound harmonics more than the lower ones.

The effects of forward speed on the sound field can be accounted for by replacing the term r in Equation 1 by $r(1-M_r)$ where M_r is the component of hub translation Mach number in the direction of the observer (see References 4 and 8). It must be remembered when making this transformation that both r and M_r refer to the 'retarded' position of the helicopter; that is, the actual position of the helicopter when the sound was generated. This substitution also enters the argument of the Bessel function term and can be expected to influence the directivity characteristics of the radiated sound.

2.1.2 Impulse Characteristics

At this point it is necessary to examine the effects of harmonic amplitude and phase on the overall waveform. An impulsive waveform consists of many harmonically related frequencies whose amplitudes decay very slowly with increasing harmonic frequency. This is illustrated in Figure 2 where an impulsive and a nonimpulsive waveform are compared. This figure was prepared by summing the first twenty harmonics assuming only a sine component for each harmonic. For the impulsive waveform, the amplitude of the harmonics dropped off at the rate of 3 dB per octave from the level of the fundamental; for the nonimpulsive waveform, the decay rate was 10 dB per octave. In order to emphasize the full potential impulsiveness of the waveforms selected, all harmonics were shifted 90° with respect to the fundamental. It is readily apparent that the harmonic amplitudes determine the impulsive or nonimpulsive character of the sound. A sharp impulse contains many high amplitude harmonics, while a nonimpulsive sound contains relatively few harmonics of significant amplitude.

Of equal importance in determining the impulsive or nonimpulsive character of a waveform is the relative phasing between the harmonics. This was shown subjectively by Fricke (Reference 10), who found that the detectability of a complex signal was a function of the relative phase between components. The effect of phase on the waveform can be seen in Figure 3. Here the more impulsive of the two signals is the impulsive waveform of Figure 3 (90° phase difference), and the less impulsive waveform is constructed by summing the same twenty harmonics but with all harmonics in phase with respect to the fundamental. The effect of phase on impulsiveness is apparent.

2.2 BLADE/WAKE INTERACTION RIN

Returning now to the two fundamental types of RIN introduced in Section 2.0, blade/wake interaction RIN occurs when a blade passes through or near a wake shed from a preceding blade or another blade in juxtaposition. It results from the rapid pressure fluctuations on the blade as it encounters the velocity variations in the shed wake (tip

vortex). Normally, single main rotor helicopters do not experience this form of blade slap except during conditions of low inflow (e.g., autorotative descent, low power descents, etc.) and certain transient maneuvers. Recently, however, Clark and Leiper (Reference 11) showed that for multi-bladed single rotors under high lift conditions in hover and some forward flight conditions, a shed tip vortex passes very close under the following blade. In fact, in the presence of flapping or certain wind conditions the vortex may actually pass through or over the following blade. Blade/wake interaction RIN occurs on tandem-rotor helicopters primarily when the shed tip vortices from one rotor pass through the other rotor; thus, in many flight regimes it is a constantly occurring phenomenon.

The effect of high harmonic airloading (resulting from the sharp pressure variations on the blade) on the radiated sound was discussed briefly in Section 2.1.1. The specific effect of increasing the amplitude of the high airloading harmonics may be demonstrated with the aid of the technique presented by Lowson and Ollerhead (Reference 4). They found that in many cases it was possible to present the airload harmonic amplitude drop-off as approximately an inverse power law. That is, the amplitude of the λ th airloading harmonic is related to the first harmonic of loading by the relation $L_\lambda = L_1 \lambda^{-k}$, where L is a force (thrust, drag, radial component) and k is a constant. Reference 4 indicates the value of k to be about 2.0 for smooth inflow cases and suggests a value of 1.0 for rough running cases, including blade slap. Reference 6 indicates that for severe RIN conditions (blade slap), k should be closer to 0.6 (or 1.1 when corrected for random loading effects, as discussed in Reference 4).

Figure 4 (from Reference 4) demonstrates the effect of the airloading decay laws on the sound harmonic amplitudes for the first twelve harmonics. For a smooth inflow case ($k = 2.5$), the harmonics drop off at about -9.5 dB per octave, a rate which will produce the nonimpulsive waveform of Figure 2. If, however, the "rough running" value of 1.1 suggested by King and Schlegel is used for k , the harmonics are of equal amplitude and produce the impulsive waveform of Figure 2. Thus, an airloading frequency spectrum containing significant harmonic components to very high frequencies due to blade/wake interaction will result in RIN.

Because of the way in which this type of RIN arises, namely, changing the airloading harmonic distribution, the directionality associated with it should not vary significantly from that expected for a similar non-slap case. This hypothesis can be seen by examining Equation 1. The detailed directionality is determined by the Bessel functions which do not depend upon the value of the loading harmonics. Only the amplitude terms are affected by loading. However, when going to the blade slap case, if the radial components change proportionally more or less than do the thrust and drag components, then gross changes in directionality may be expected.

2.3 ADVANCING BLADE RIN

This form of RIN was originally thought to be due to the formation of weak local shock waves on the advancing blade. As mentioned by Ollerhead and

Lowson (Reference 8) and discussed by Leverton (Reference 5), an observer can hear such a shock wave only if the blade speed is supersonic. If the blade speed is subsonic, the shock wave can not propagate to an observer's ear. However, the formation of local shocks can affect rotor noise levels by influencing the local blade airloading acting on the blade.

Advancing blade RIN as discussed in Reference 8 is basically an acoustic effect resulting from the coalescence of the harmonic wave fronts at high source translational speeds and, in fact, can be explained by the Lowson/Ollerhead theory (Equation 1). Figure 5 (from Reference 8) shows the effect of increasing tip Mach number on sound harmonic levels. As the tip Mach number approaches 1, the higher frequency harmonics increase in amplitude, producing exactly the same effect as the loading changes discussed in the preceding section. Furthermore, at tip speeds close to Mach 1, the fluctuating airloads become unimportant and the noise is controlled entirely by the steady loading.

The highly directional characteristic of advancing blade RIN observed when the helicopter flies directly overhead is also an acoustic effect which results from the forward speed correction made to Equation 1 in Section 2.1.1. Here the term $r(1-M_{\infty})$ which replaces r in the equation enters the argument of the Bessel functions, thus influencing the directivity characteristics. This effect can be seen in Figure 6, taken from Reference 4. As forward speed increases, the radiated sound becomes highly directional in the forward direction, particularly for the higher harmonics. This means that the RIN experienced by a helicopter at high speeds will be radiated preferentially forward with the maximum at about 15-20 degrees below the plane of the rotor. This effect was shown experimentally by Cox (Reference 16) in full-scale wind tunnel tests. Thus, while the acoustic effect of a high tip Mach number is at least partially responsible for the generation of the impulsive noise, the aircraft forward speed accounts for the highly directional character of this type of RIN.

The aerodynamic forces used in current acoustic theory to predict radiated rotational noise are the in-plane (induced drag) and normal (thrust) components of the blade section lift (Figure 7). The profile drag is ignored, since it is small compared to the other terms. When advancing tip speeds exceed a critical Mach number, the drag increases rapidly (Figure 8), a phenomenon known as drag divergence. This increased drag term may be a significant contributor to the radiated noise. In a recent paper, Arndt and Borgman (Reference 12) examined the effect of drag divergence on the radiated noise. Figure 9, taken from their paper, indicates that the effect of this term is to increase the levels of the higher harmonics of noise, the necessary condition for blade slap. While Arndt and Borgman indicate that the addition of this term to the Lowson/Ollerhead noise equation enhances correlation, they unfortunately do not show to what degree. For small angles of attack (such as near the tip), the lift term may be quite small and the drag terms will dominate the noise radiation. In this case the associated directivity will be that of a dipole with its maximum directivity in the plane of rotation, thus further contributing to the observed directivity of advancing blade RIN.

An additional factor which may contribute to the observed directivity and character of advancing blade RIN is thickness noise. While it is not significant for highly loaded rotors at low forward speeds, thickness noise can become a significant noise source at high forward speeds. Arndt and Borgman (Reference 12) crudely accounted for thickness noise by applying a forward speed correction to the theory developed by Diprose (Reference 21) for a static propeller. No attempt was made to correct for the nonuniform velocity field over the rotor disk. As Figure 10 (from Reference 12) demonstrates, thickness noise appears to be important only for the first few harmonics of noise; however, as tip speed increases, the levels of the higher harmonics increase quite rapidly. This effect, coupled with the associated directivity pattern, which is the same as for drag divergence generated noise, will tend to enhance the severity of the observed RIN.

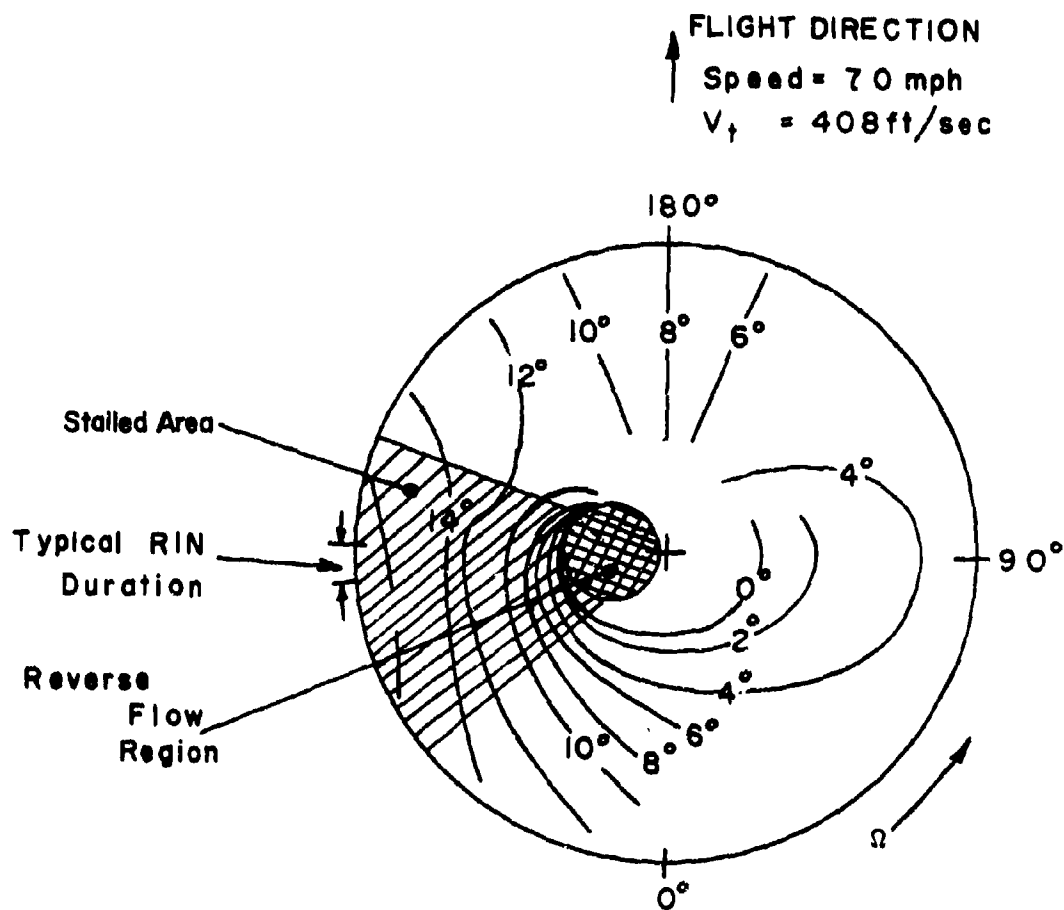


Figure 1. Comparison of RIN Duration With Blade Stall Duration for Single-Rotor Helicopter (Reference 5).

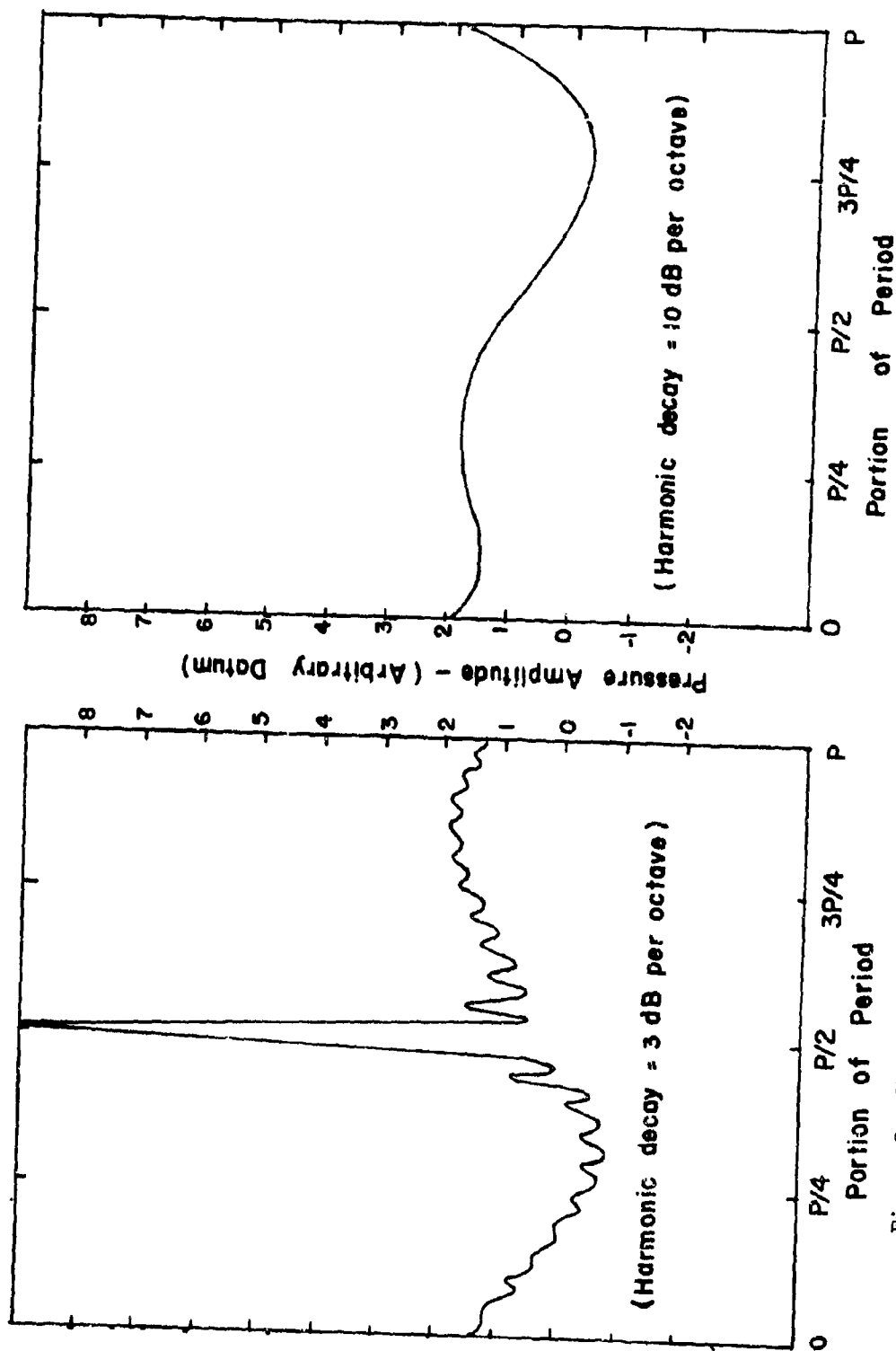


Figure 2. Waveforms Resulting From Summation of First Twenty Fourier Sine Harmonics With Varying Amplitude Decay Rates (Harmonics Shifted 90° With Respect to the Fundamental).

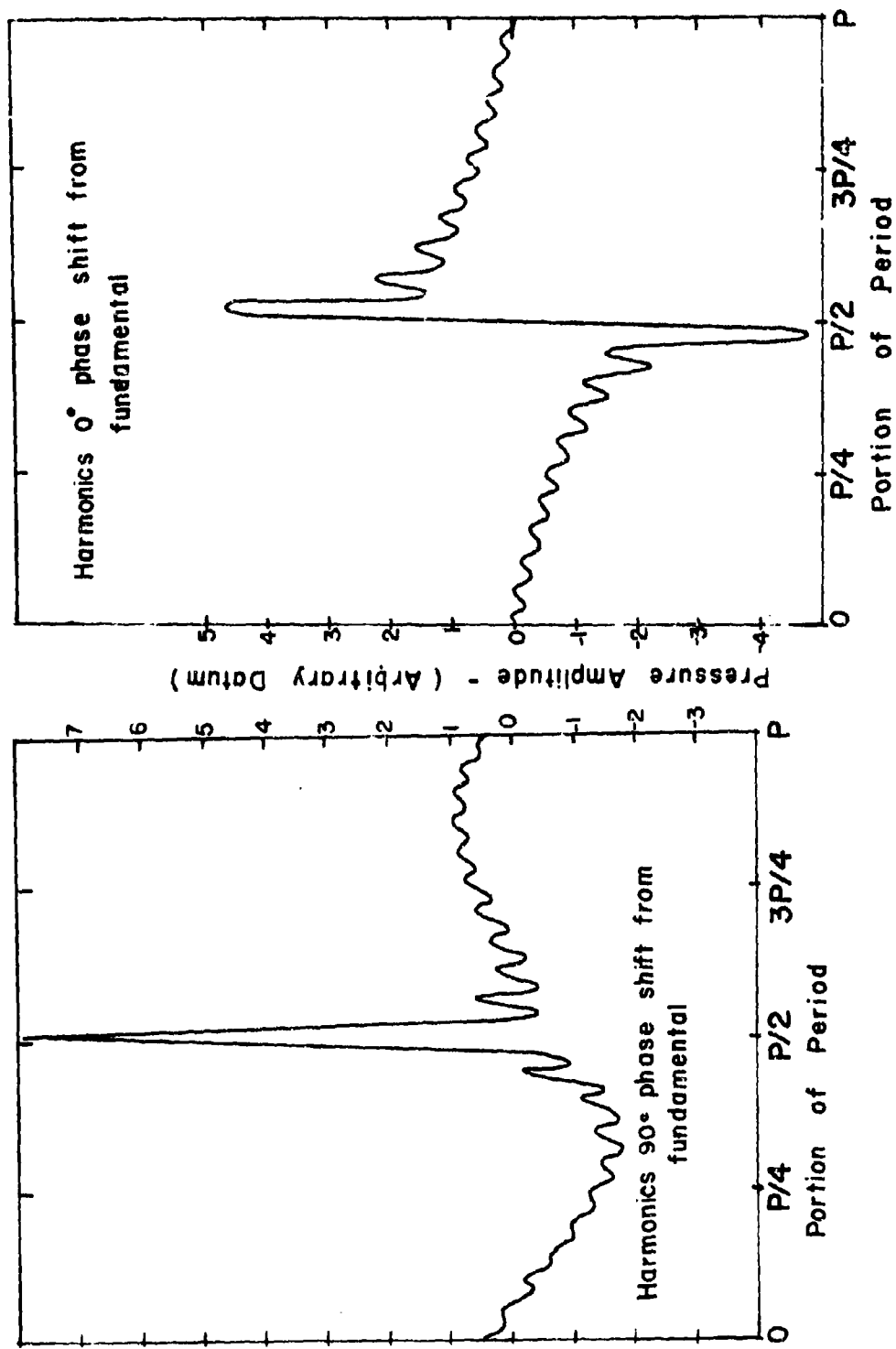


Figure 3. Effect of Harmonic Phase Difference on Pressure Waveform
(Harmonic Decay = -3dB per Octave).

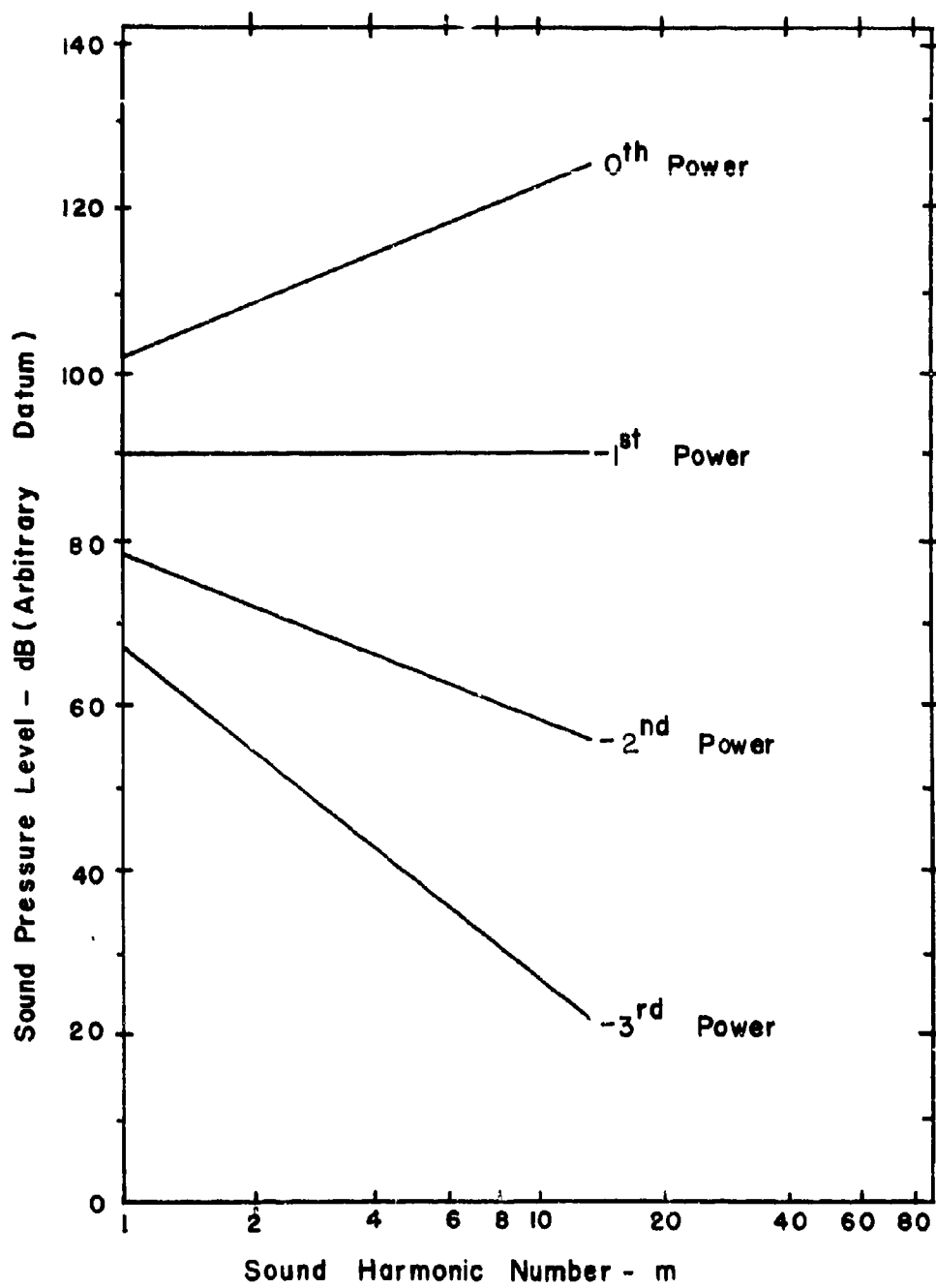


Figure 4. Effect of Airloading Harmonic Decay Power Law on Sound Harmonic Levels (Reference 4).

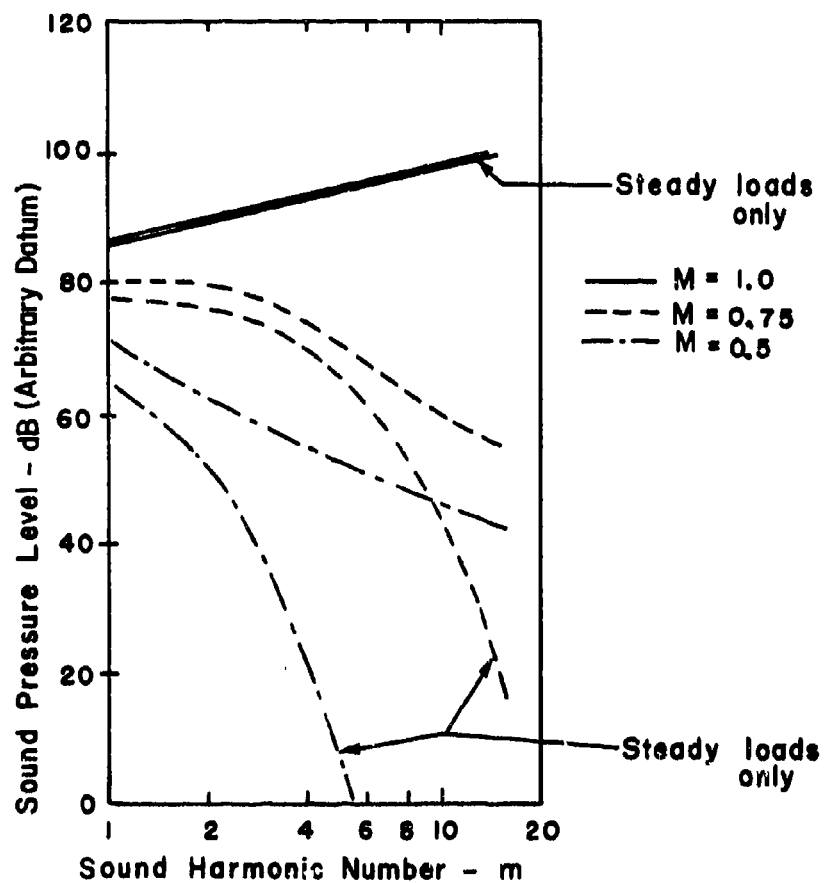
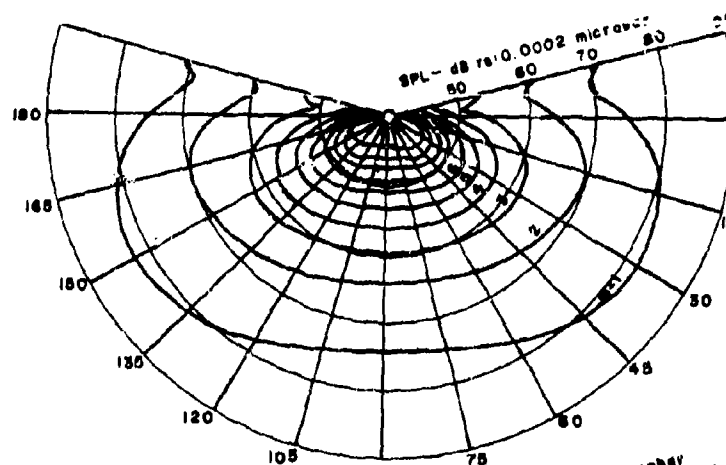


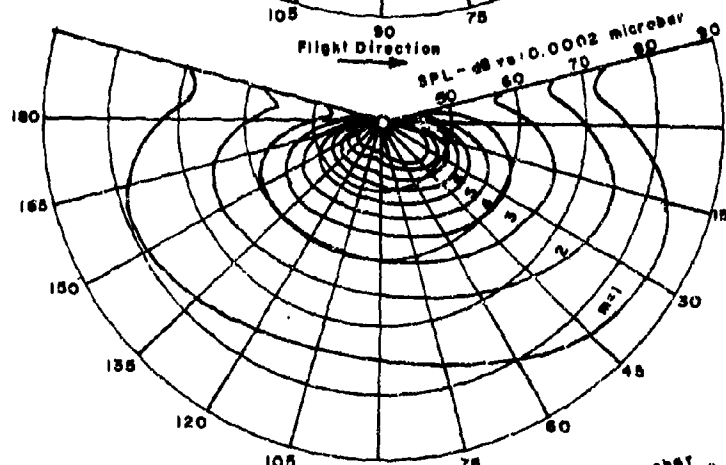
Figure 5. Effect of Rotational Tip Mach Number on Sound Harmonic Amplitude 10° Below Rotor Disk in Hover (Reference 8).

$M = 0.5$
 $B = 4$
 Thrust = 10,000 lb
 Dia. = 40 ft
 $r = 1000$ ft

a. Hover



b. Cruise Mach Number 0.125



c. Cruise Mach Number 0.25

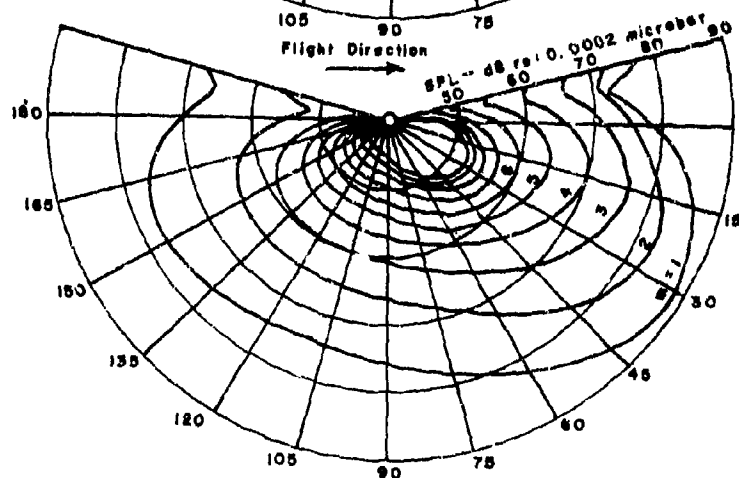


Figure 6. Effect of Forward Speed on Radiated Sound Directivity (Reference 4).

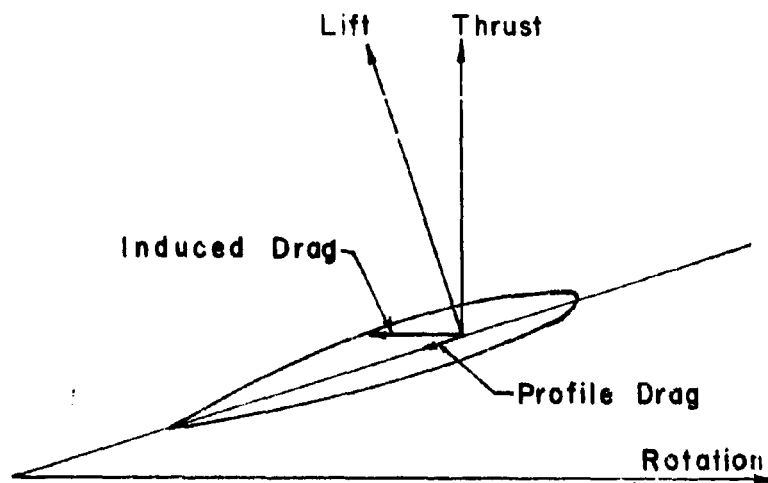


Figure 7. Force Components on Rotor Blade Section.

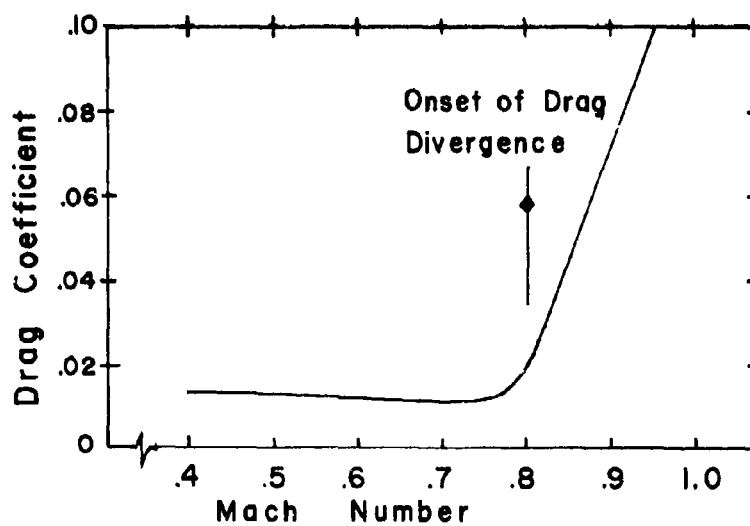


Figure 8. Airfoil Section Drag vs Mach Number for an NACA-0012-34 Airfoil at Zero Angle of Attack (Reference 12).

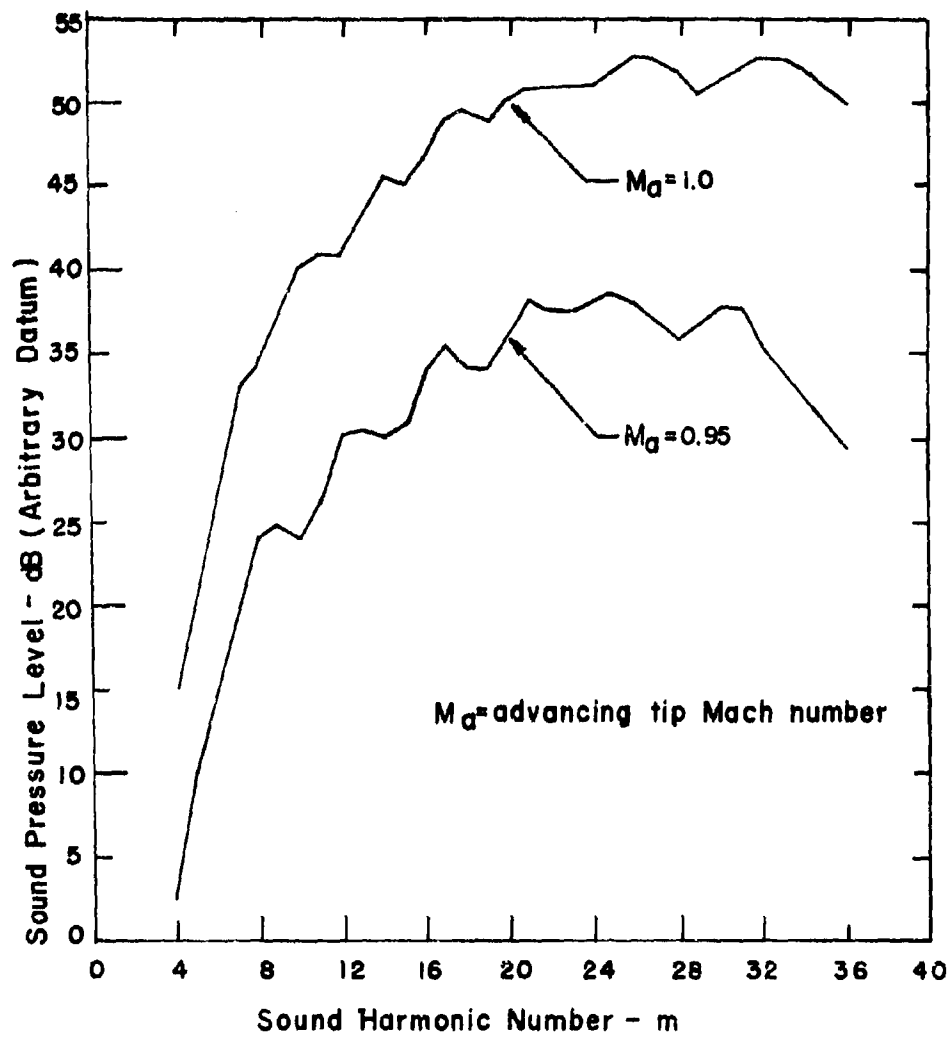


Figure 9. Calculated Harmonic Noise Spectra due to Drag Divergence Effects for a Two-Blade Rotor (Reference 12).

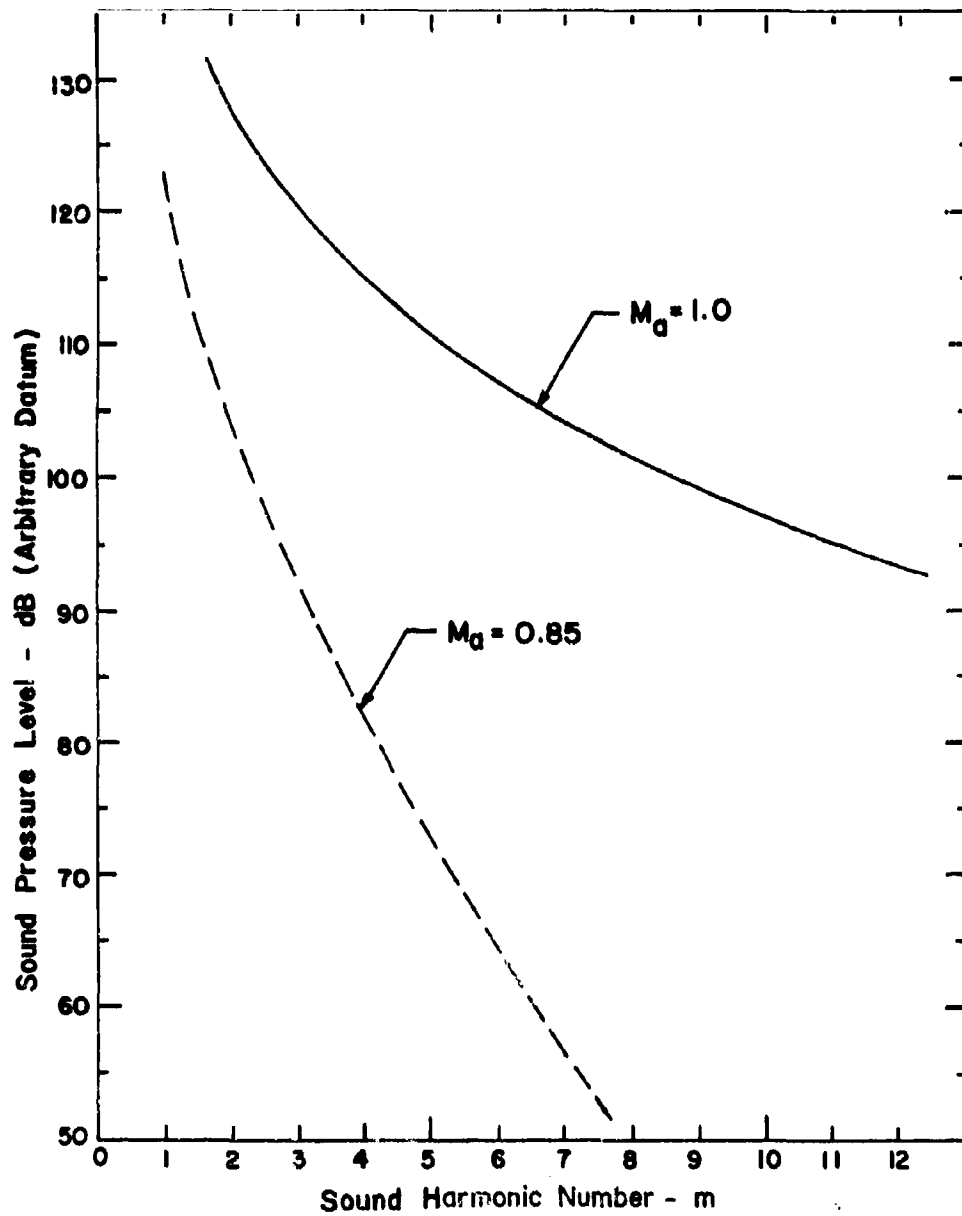


Figure 10. Harmonic Noise Spectra of Thickness Noise for a Two-Blade Hovering Rotor (Reference 12).

3.0 EXPERIMENTAL PROGRAM

The experimental phase of this study involved simultaneous measurement of rotor aerodynamics, rotor blade dynamics, and rotor noise on a CH-53A aircraft, as shown in Figure 11, during hover and forward flight conditions. These data were required for the prediction of impulsive and nonimpulsive rotor noise, for correlation of measured and predicted noise, and especially for the determination of how impulsive rotor noise is aerodynamically generated.

The blade pressure and dynamics instrumentation systems used in this contract were primarily the result of a rotor loads contract which was being run simultaneously. Since bandwidth limitations of the narrowband FM recording system restrict blade pressure measurements to 100 Hz or less, two portable direct record units were added to obtain high frequency pressure data at two chordwise stations (4.2% and 91% chord) near the tip of the blade (98% span). These data would determine whether the accuracy of calculated noise levels would be compromised by the frequency response limitations of the airborne data system. Appendix II discusses these high frequency pressure data.

Noise was measured at three locations inside the helicopter in the hope of locating where acoustic impulses originate in the rotor disk. These data were recorded on the FM system that recorded all rotor dynamics and aerodynamics in order to facilitate correlation of acoustic and aerodynamic data and to utilize the main rotor contactor information for correlation of the acoustic signal with main rotor position.

3.1 FLIGHT TEST

All data for this study were acquired during a flight test on October 15, 1969, at the Bridgeport Airport in Stratford, Connecticut. Noise data were recorded for a series of 14 flyovers and 13 hover orientations. One microphone was located on the centerline of the runway, and additional microphones were located 250 feet to each side of the center microphone perpendicular to the flight path (runway centerline) of the CH-53A helicopter. Forward flight data were recorded during unaccelerated flight from east to west and west to east at an altitude of 1000 feet at nominal airspeeds of 120 knots, 140 knots, and 170 knots. Hover data were recorded out of ground effect (OGE) at 13 helicopter headings at an altitude of 200 feet. Surface winds throughout the test were northerly from 3 to 8 knots. The mean temperature and relative humidity of the air were 50°F and 49%, respectively. Sea level barometric pressure was 30.12 in. Hg.

3.2 INSTRUMENTATION

3.2.1 Data Acquisition

Three data recording systems were used simultaneously during the flight test. An airborne FM multiplex system recorded aerodynamic pressures, blade pitch, blade flapping, blade azimuth angle, and internal noise. An

airborne direct-record system recorded differential pressure data from the fore and aft transducers at the 98% span station. A ground-based FM system recorded the acoustic data for the hover and forward flight test conditions.

3.2.1.1 Airborne FM

The heart of the FM multiplex recording system was an Ampex Model AF 200 recorder set for standard IRIG center frequencies and bandwidths operating at 15 inches per second (ips). Input signals to the recorder were pre-conditioned by voltage-controlled oscillators. The sensors that measured the aerodynamic and blade motion data were Sensotec (Division of Comtel Corp) pressure transducers and Baldwin-Lima-Hamilton angulators. Figure 12 presents a block diagram of the airborne FM system including the internal noise measurement system.

The microphones used to measure internal noise were housed in metal containers lined with 1-inch thick fiberglass to control reverberation inside the containers and vibration damping material covered the outer surfaces of the containers to prevent acoustic excitation of these surfaces. Each container was mounted in the center of a window as shown in Figure 13 to detect acoustic impulses coming through that window.

3.2.1.2 Airborne Direct

The differential pressures at 4.2% chord and 91% chord from the 98% span location were recorded on this system. In addition to the pressure transducers, the system consisted of two sound level meters and two Nagra portable tape recorders.

3.2.1.3 Ground FM

External helicopter noise was recorded at two locations on the ground with a Lockheed portable tape recorder operating at a tape speed of 15 inches per second. Three information channels were used, two to record noise data and a third to record a time code signal and comments. A fourth data channel had been set up, but the microphone that fed this channel malfunctioned during the flight test. Figure 14 shows the locations of the instrumentation along the helicopter's ground track.

The following procedure synchronized recording of data on the aircraft with recording on the ground and related data recorded on the ground with aircraft location along the flight path. The helicopter pilot radioed a "start" command as the aircraft passed over the end of the runway. This command started both the airborne data recording system and the time code generator on the ground. At this point, data records in the air and on the ground are synchronized, and the location of the aircraft is defined at one instant of time. For easterly flight, the "start" corresponds to a lateral distance of 1000 feet between the microphone array and the approaching helicopter. For westerly flight, this distance is 3700 feet.

3.2.2 Data Reduction

Rotor blade dynamic and aerodynamic data were converted from analog to digital form and then reduced to harmonics of rotor rotation. Data were sampled every 2.5 degrees of azimuth, giving 144 digitized data points for each data cycle from 0 degree to 357.5 degrees of azimuth inclusive. Thirty harmonics then were extracted from the data by performing a Fourier analysis of one typical data cycle for each flight condition. One cycle was used in order to preserve the high-frequency content of the data. This technique was necessary because slight differences between successive cycles cause the high-frequency components in a parameter's time history to be obscured when several consecutive cycles are averaged. The harmonic amplitudes were corrected for the attenuation characteristics of the 60 Hz low-pass filters that were used during the analog/digital conversion. Since all aerodynamic and blade motion data passed through identical filters, no phase corrections were required. A block diagram of the data reduction system is shown in Figure 15.

External noise data were processed into octaves and narrowband form as a function of time. Octave-band analysis involved charting the output of a General Radio Octave Band Analyzer. Narrowband analysis (2.5 Hz) was done with a Saicor Spectrum Analyzer and Saicor Digital Integrator terminating in a Midwestern Oscillograph to produce a 2.5 Hz bandwidth spectrum from 0 to 500 Hz every 0.20 second. Interpretation of the narrowband data was complicated by noise from the tail rotor since the third harmonic of main rotor rotational noise is separated by only 2 Hz from the first harmonic of tail rotor rotational noise. A typical narrowband spectrum is reproduced in Figure 16 to show both frequency content of the signature below 500 Hz and the problem of distinguishing main rotor noise from tail rotor noise.

3.2.3 Instrumentation Response and Calibration

The following section describes the pertinent response and calibration characteristics of each system used to acquire and analyze data. Aerodynamic parameters typically are within $\pm 2\%$ of transducer full scale, and acoustic levels typically are within ± 3.5 dB and ± 5.0 Hz.

3.2.3.1 Blade Pressure and Blade Motion Measurement System

Sensotec (formerly Scientific Advances) transducers, models SA-SA-M-7F and SA-SD-M-7F, were mounted on one main rotor blade to measure aerodynamic pressures acting on the surface of the blade. Table I contains the range of the transducers and the measurement/analysis system accuracy at each location on the blade. The system accuracy includes all components from transducers on the aircraft to final digital tape and is expressed as a percentage of transducer range. An airtight chamber was placed over each chordwise transducer array so that known pressures could be applied to obtain the response of each transducer. The transducer response measured this way determined values for the electronic R-cals that were made before and after each flight.

Blade pitch angle and flapping angle were measured with Baldwin-Lima-Hamilton angular position transducers, model 236. Pitch angle range was ± 60 degrees, flapping angle range was ± 30 degrees, and both were linear and temperature compensated over their entire range, giving a system accuracy of $\pm 2\%$ of full scale. Calibration was accomplished by mounting each angulator on an angular position table and recording the output voltage as a function of shaft rotation. Angulator response was determined for both clockwise and counterclockwise rotation of the input shaft to each angulator.

The azimuthal location of the instrumented rotor blade was measured photo-electrically. A metal disc with 72 equally spaced slots was attached to the main rotor shaft. Rotation of the shaft caused the disc to intercept a beam of light aimed at a light sensor, thereby producing 72 pulses per revolution. Accuracy of this signal is better than ± 1 degree.

3.2.3.2 Internal Noise Measurement System

The absolute amplitude of the rotor noise measured inside the helicopter was of secondary importance compared to the shape of the acoustic waveforms and the relative phasing among the three internal noise signals. An amplitude reference was supplied for each location, however, with a General Radio Calibrator, model 1562A, that applied a 114-dB signal (± 0.5 dB) at 1000 Hz ($\pm 3\%$) to each microphone.

3.2.3.3 External Noise Measurement System

Bruel and Kjaer microphones and amplifiers terminated in a Lockheed tape recorder model 417 operating at a tape speed of 15 ips were used to record external rotor noise. Type 4117 piezoelectric microphones were selected because of their good frequency response characteristics (± 3 dB from 3 Hz to 10,000 Hz). A Bruel and Kjaer charge amplifier, type 2624, was connected to the output of each microphone to permit the use of long connecting cables. This charge amplifier's response is ± 0.4 dB from 5 Hz to 10,000 Hz. A noise limit indicator, type 2211, was inserted between each charge amplifier and the tape recorder to insure that the level of the input signal to the tape recorder stayed within acceptable limits. Response of this instrument is ± 1.2 dB from 2 Hz to 35000 Hz, and tape recorder response is ± 2 dB from 0 Hz to 5000 Hz. The complete system was calibrated at 114 dB with a General Radio calibrator, type 1562A, at frequencies of 125 Hz, 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. Indication of elapsed time and compensation for flutter and wow were accomplished by connecting a Systron Donner time code generator to a separate track of the tape recorder. Amplitude accuracy of the total noise recording system is estimated to be ± 3 dB, while the worst possible accuracy, obtained by summing the deviations of each component, is ± 7 dB.

Rotational noise data were analyzed with a Saicor spectrum analyzer, model 31A, and a Saicor digital integrator, model 21A. These instruments were calibrated with built-in references and checked with peripheral equipment whose accuracy is traceable to the National Bureau of Standards. Accuracy of the noise analysis equipment is ± 0.2 dB and ± 2.5 Hz. Accuracy of the total acoustic measurement/analysis system is estimated to be ± 3.5 dB, ± 5.0 Hz.

TABLE I. PRESSURE TRANSDUCER LOCATION, RANGE, AND ACCURACY					
PERCENTAGE CHORDWISE	PERCENTAGE SPANWISE				
	40	75	85	95	98
	4.2	3-18 PSIA			± 10 PSID
		VIBRATORY $\pm 2\%$			
		STEADY $\pm 2\%$			
	15.8	3-18 PSIA			± 10 PSID
		VIBRATORY $\pm 2\%$			
		STEADY $\pm 2\%$			
	30.0	3-18 PSIA			± 10 PSID
		VIBRATORY $\pm 2\%$			
		STEADY $\pm 2\%$			
	60.0	± 2 PSID			
		VIBRATORY $\pm 2\%$			
		STEADY $\pm 3\%$			
	91.0	± 2 PSID			± 5 PSID
		VIBRATORY $\pm 2\%$			
		STEADY $\pm 3\%$			

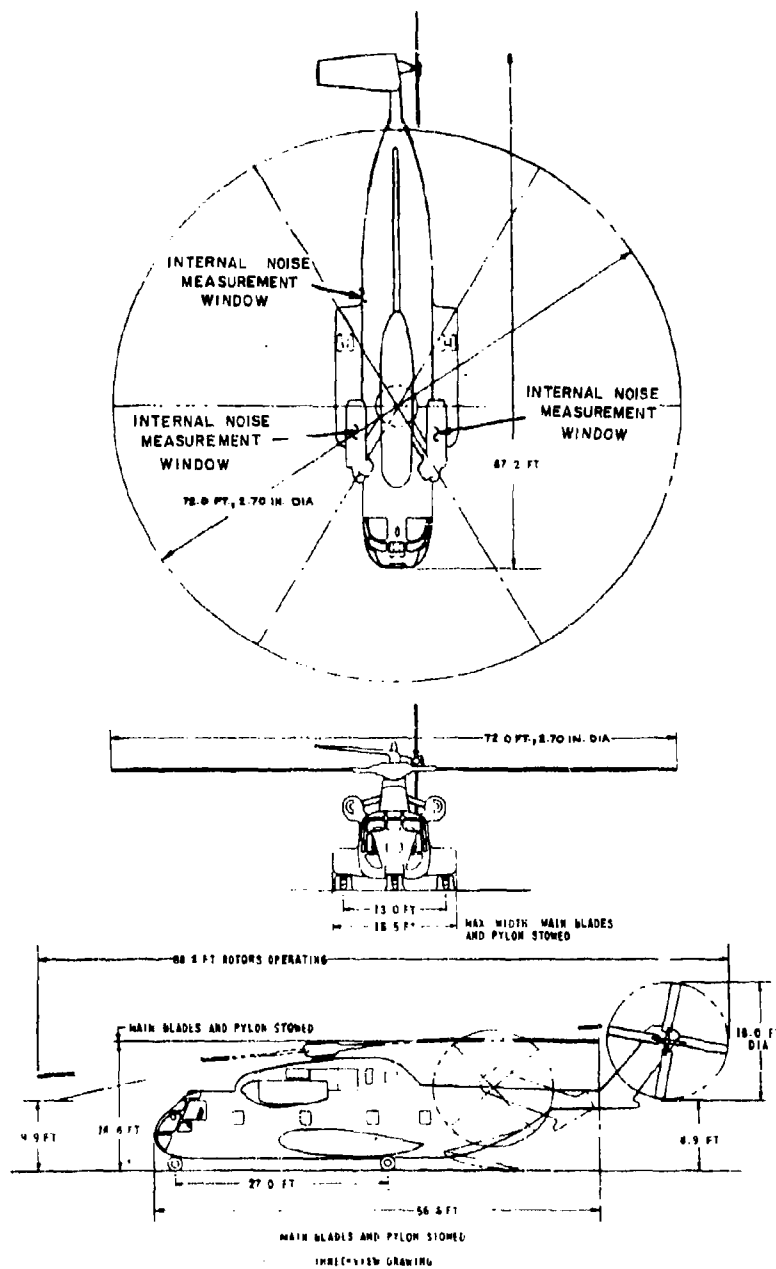


Figure 11. CH-53A General Arrangement.

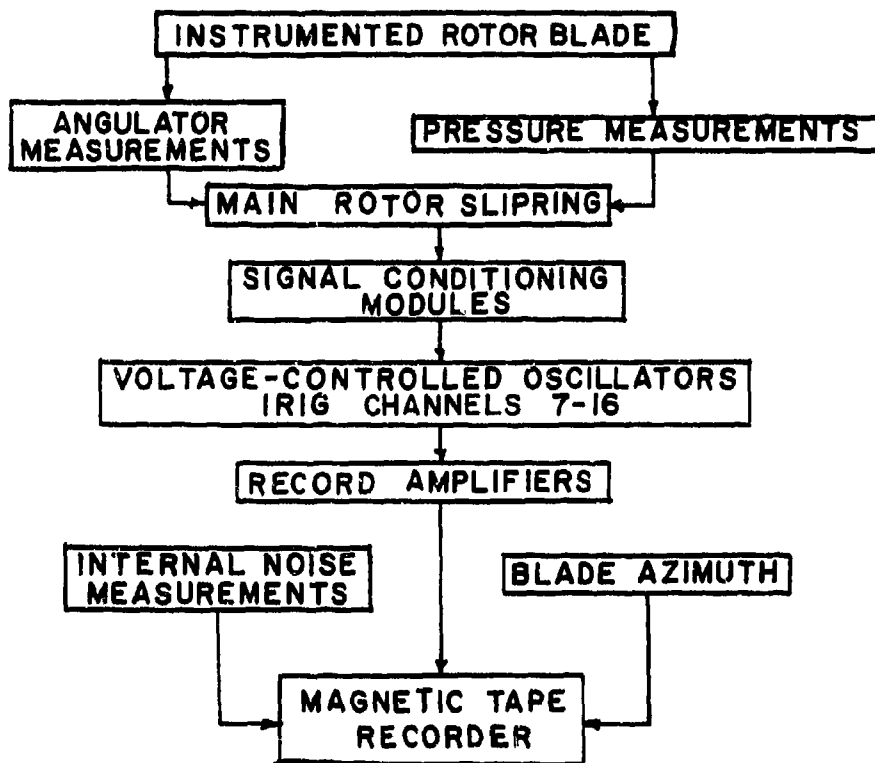


Figure 12. Airborne Data Acquisition System.

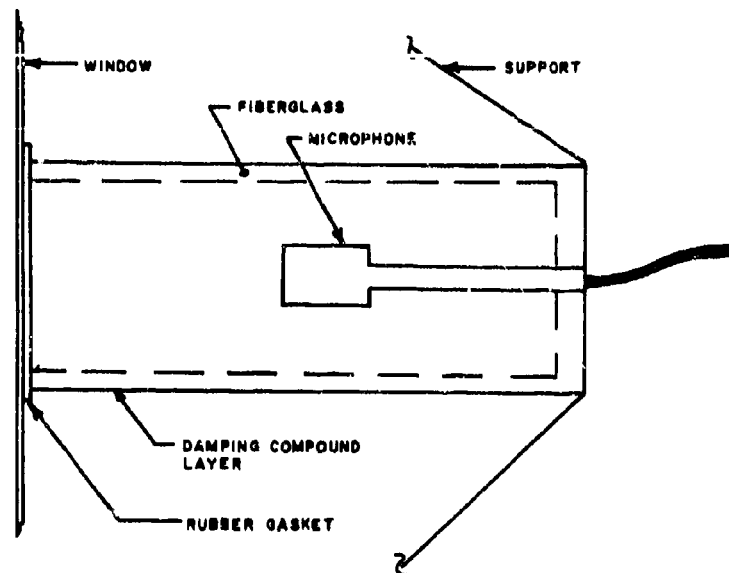


Figure 13. Internal Noise Microphone Installation.

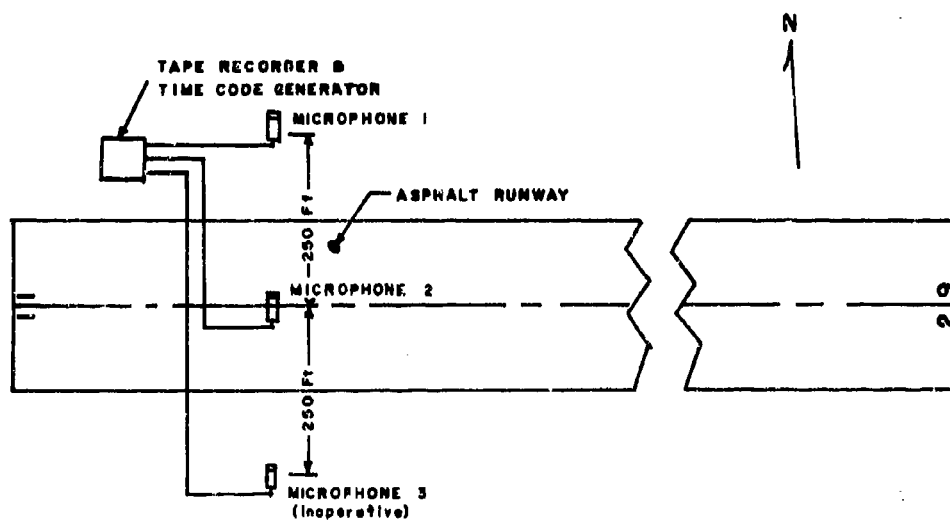


Figure 14. Ground-Based Data Acquisition System Layout.

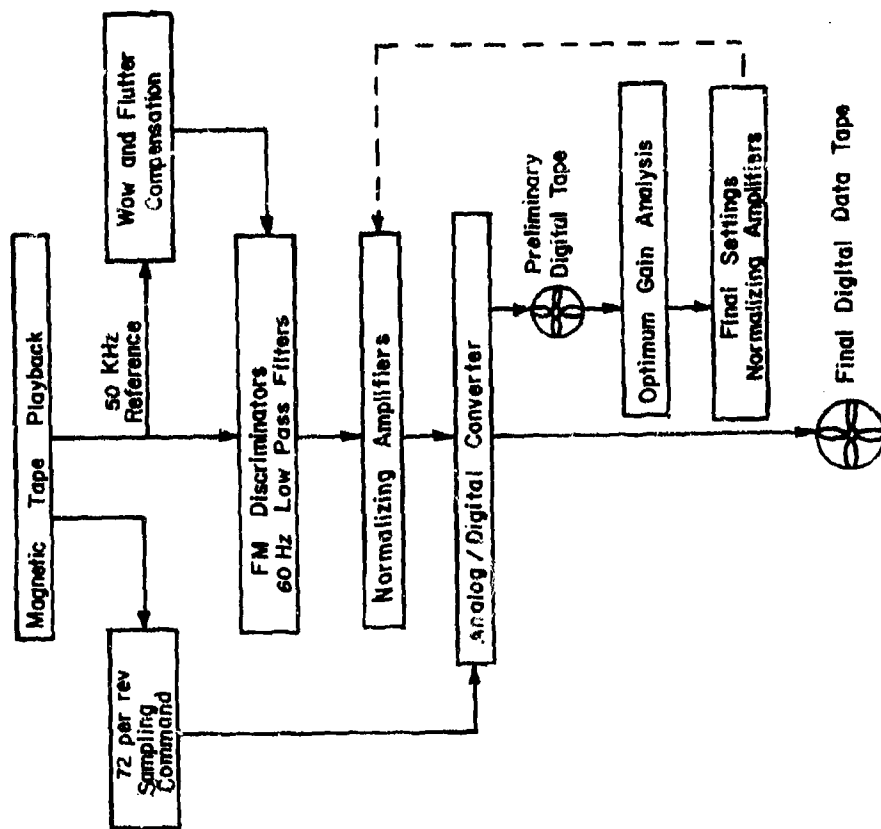


Figure 15. FM Data Reduction System

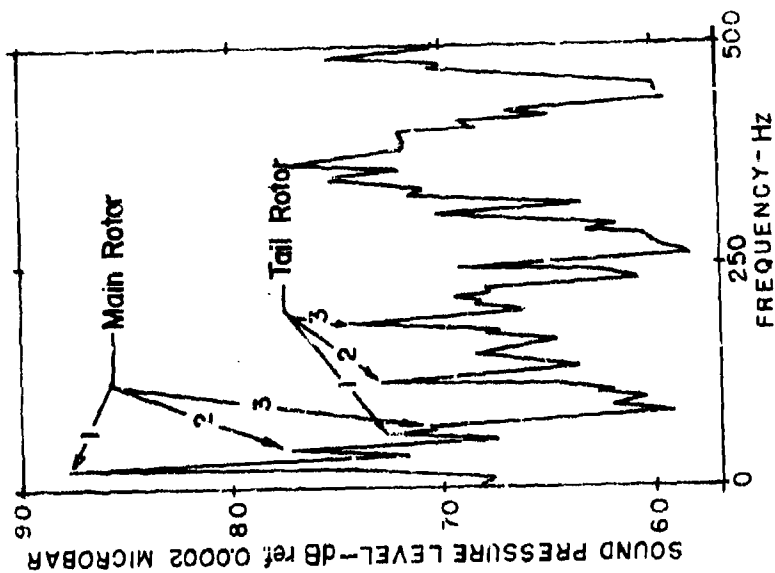


Figure 16. Typical Narrowband Spectrum of CH-53A Helicopter Noise, 170 Knots, 380-Foot Lateral Distance.

4.0 RESULTS

The present study seeks to define some of the characteristics of RIN and to determine how well these characteristics are predicted by the rotational noise analysis described in Reference 13. The present study also evaluates the ability to predict rotational noise levels from theoretical airload data. Section 4.1 describes the calculation procedures and correlation for rotational noise, and Section 4.2 investigates the aerodynamic noise generating mechanisms found in the CH-53A flight test data.

4.1 ROTATIONAL NOISE CORRELATION

The two qualities of rotational noise that determine the impulsiveness of the total rotor noise signature are harmonic amplitude fall-off and relative phasing among the noise harmonics. Comparison of measured and predicted root-mean-square sound pressure levels (SPL's) determined amplitude correlation, while comparison of measured and predicted time histories of acoustic pressure determined phase correlation. Predicted time histories are based on measured aerodynamic load data.

Time histories of acoustic pressure were not calculated from theoretical airloads. Experience has shown that currently available airload/blade response analyses predict amplitudes fairly well but predict phase behavior poorly even when variable inflow velocities for helical wake geometry are added to the calculations. Since the airload phasing can significantly affect calculated noise levels (Reference 4), it was decided that no new information would result from using theoretical airloads to calculate time histories of acoustic pressure.

4.1.1 Hover Noise

The most impulsive noise signature heard during the flight test occurred during hover out of ground effect. This RIN was caused by the main rotor blades cutting through wakes from tail rotor blades, a phenomenon which requires a quartering tail wind in order to occur during hover. Noise levels calculated from measured airloads reflect this blade/wake interaction, but levels calculated from theoretical hover airloads do not, since the airload prediction analysis considers only aerodynamics of the main rotor and does not simulate interactions of main rotor blades with tail rotor wakes.

4.1.1.1 Correlation Using Measured Hover Airloads

Calculated and measured SPL's agree fairly well through the fifth harmonic. In theory, 5 noise harmonics are all the analysis should calculate with confidence from 30 harmonics of airload for a 6-bladed rotor. Both calculated and measured noise levels changed radically with small changes in azimuthal position around the helicopter. Unfortunately, the azimuthal resolution of the measured noise data is insufficient to verify all the calculated variations around the hovering helicopter. To obtain this information, a circular array of microphones surrounding the helicopter would have been required. Since the instrumentation for such an approach was not available, hover noise data were recorded with one microphone on the runway centerline while the helicopter heading changed in 30-degree increments to achieve an

azimuthal traverse. The helicopter hovered 500 feet west of the microphone array at an altitude of 200 feet above the runway centerline. Some hover noise data also were recorded using the microphone 250 feet north of the runway centerline. The two microphones are roughly 26 degrees apart in terms of helicopter azimuth. Data from the sideline microphone has been corrected for the difference in distance caused by the right-triangle geometry setup of the hover test. Noise level changes due to directionality were ignored in this correction since the difference in elevation angle (angle between microphone, rotor hub, and horizontal) is approximately 2 degrees.

Plots of the azimuthal variation in calculated SPL are presented in Figures 17 through 19. The airload data used to generate Figure 17 do not correspond to RIN conditions, whereas the data for Figures 18 and 19 are associated with RIN. A measured SPL value is shown for each harmonic at the appropriate azimuth relative to the helicopter (zero azimuth is at the tail of the helicopter); it can be seen that predicted and measured levels generally agree within 10 dB, depending upon harmonic order and helicopter heading. The 5th harmonic in Figure 19 is an exception since the measured SPL is roughly 20 dB below the calculated SPL. A complete assessment of prediction accuracy - that is, SPL and directionality in vertical and horizontal planes - is beyond the scope of this study.

The calculated variation in SPL around the azimuth raised questions about the validity of the noise prediction computer program. Assuming that the airloads are fairly steady during RIN-free hover, the resultant rotational noise fundamental should radiate uniformly in all directions. A noise calculation using steady airloads resulted in a constant fundamental level around the azimuth. It is concluded that the computer program functions correctly, and that the calculated levels in Figure 17 vary azimuthally because of wind-induced asymmetric airloads. Cyclic changes in blade pitch are a secondary contributor to these calculated variations. For the hover conditions that produced moderate and pronounced RIN, the calculated variations are attributed to asymmetric loading due to wind effects and blade/wake interactions. The noise harmonic spectra shown in Figure 20 illustrate calculated and measured noise variations in a 26-degree azimuth increment. The calculated time history of acoustic pressure also can change radically with azimuth, as can be seen in Figure 21. Differences were observed in the two noise recordings taken for this helicopter heading, but the azimuthal spread was not sufficient to confirm the extremely impulsive signature calculated on the starboard side of the helicopter.

4.1.1.2 Correlation Using Theoretical Hover Airloads

In order to evaluate the ability to predict noise without airload information measured in flight, levels for 3 noise harmonics were calculated from theoretical rotor airloads. The results of this exercise confirm that accurate noise prediction is not presently possible for more than the fundamental using theoretical airloads. The theoretical airloads are restricted to too low a frequency range (typically 5 or 6 times the rotor hub rotational frequency), and the accuracy of the theoretical airload phasing tends to be unacceptable for acoustic prediction work. Existing rotor load analyses

of the prescribed wake/variable inflow/normal modes type used during this study are adequate for investigations of rotor and fuselage dynamics, but not for detailed acoustic studies.

Theoretical airloads were calculated using a variable inflow analysis to describe the air velocity distribution over the rotor disk for a given trim condition. The wake of each rotor blade is assumed to descend in the form of a helix from the rotor plane. The rotor trim condition is determined by a rotor blade dynamics analysis that uses the normal modes approach to calculate the loads on the blades and the response of the blades to the impressed loading. If inclusion of variable inflow changed the trim condition too much, the rotor was retrimmed with the variable inflow velocities included, new inflow velocities were calculated for the latest trim condition (control angles and blade motions), and the process was repeated until a converged answer was obtained.

Noise levels calculated from theoretical hover airloads are shown in Figure 22 along with noise levels measured for the RIN-free case. Slight azimuthal variations in the calculated fundamental SPL are caused by small higher-harmonic airloads. The variations shown for the calculated 2nd and 3rd harmonics have the same cause, but these variations are larger because the airload harmonics are more efficient acoustically for the higher noise harmonics. While the theoretical hover airload harmonics are sufficiently large to produce variations in the calculated noise fundamental, they are not large enough to give good agreement between calculated and measured noise harmonics above the fundamental.

4.1.2 Cruise Noise

Correlation between calculated and measured rotational noise levels during forward flight ranged from good to fair for the first three noise harmonics. Calculated fourth and fifth harmonic levels tended to be from 5 dB to 10 dB higher than measured within 1000 feet of the helicopter. At larger distances, measured levels tended to be higher than calculated. These results suggest that calculated directional characteristics place maximum radiation of the harmonics too far below the plane of the rotor. Including the effects of rigid-body blade coning and flapping motions on calculated directionality changed levels only by 1 to 2 dB on the average, and this difference tended to decrease calculated noise levels at large distances in front of the helicopter.

Calculated time histories of acoustic pressure reflected trends in measured data. During high-speed cruise at an altitude of 1000 feet, neither the calculated nor the measured time history sounded or looked impulsive at large distances ahead of the helicopter. As the helicopter drew closer, both measured and calculated time histories became more impulsive. Section 4.2 contains additional information on measured characteristics of high-speed RIN.

4.1.2.1 Correlation Using Measured Cruise Airloads

Measured and calculated harmonic noise levels are plotted against noise

origin location in Figures 23 through 25. Each point on the graph gives the noise harmonic level that originated at location, (X, Y, Z). These calculated SPL's include the effects of rotor shaft inclination and blade flapping and coning. Calculated SPL's are shown for lateral distances from 2000 feet to zero feet as the helicopter approaches. Measured SPL's are shown for lateral distances at which the first 5 noise harmonics are well defined. Consequently, the x-axis range of measured noise data varies from one flight condition to another. Since levels for port and starboard sides were obtained by passes in opposite directions at a given nominal airspeed, some acoustic differences between sides are from normal directivity associated with asymmetric airloads while some are from differences in airload amplitude and phase due to slight variations in aircraft trim and atmospheric turbulence between passes. Variations of calculated SPL with x-axis location reflect the effects of airload amplitude and phase on calculated directionality.

A major feature of the correlation presented in the figures is the consistently low calculated SPL at large distances ahead of the helicopter. Similar results were obtained in Reference 15, and an explanation offered at that time was that the orientation of the rotor system with respect to the ground should be included in the acoustic analysis. Consequently, the assumption of a flat rotor disk parallel to the ground was removed during the present study by adding shaft inclination and blade flapping and coning terms to the analysis (see Appendix I for analysis). As shown in Figure 26, the acoustic effect of these terms is small, even during high-speed cruise when forward shaft inclination and blade flapping are largest for a conventional (non-compound) helicopter. Reconsidering the problem in the light of these results, it appears that acoustic effects of forward flight must be included for improved correlation far in front of a rotor travelling at high speeds. These forward speed effects enter the problem both in the theory and in the airload data that are used with the theory. Theoretically, the helical motion of a point acoustic source attached to a blade must be coupled with relative translational Mach number effects. Helical source trajectories were beyond the scope of the present study, but simulation of relative translational Mach effects was accomplished using a coordinate transformation proposed by Lowson and Ollerhead in Reference 4. The X, Y, and Z coordinates of each observer location were multiplied by $(1-M_r)$, where M_r is the component of the hub translational Mach number in the direction of the observer. This transformation effectively reduces the propagation distance between noise source and observer to increase the calculated noise levels by the amounts shown in Figure 27. Results obtained by recalculating noise with modified observer coordinates match results obtained by scaling originally calculated levels by $20 \log_{10} (1/(1-M_r))$, thereby confirming that hub translational motion alone does not alter relative phasing among the acoustic sources that define the rotor as a noise generator. In terms of aerodynamic effects, profile drag forces increase rapidly with forward speed, thereby augmenting forward-radiated noise.

The effect on calculated SPL of simulating an impulsive chordwise distribution or airload also was investigated briefly. The section lift force (pounds per inch of span) was concentrated over 10% of the blade chord. This is the same as increasing differential pressure by a factor of 10 and decreasing the area upon which it acts by the same factor. For this investigation, the pressure amplitude was constant across the chord. When a blade with this modified chordwise loading passes over a point in the rotor disk, that point experiences a pressure pulse whose amplitude is 10 times normal and whose duration is 0.1 times normal; that is, the loading is more impulsive. As can be seen in Figure 28, the more impulsive load changes calculated noise levels by only 1 to 2 dB. This result is not surprising since results of Reference 15 suggest that the lower harmonics of rotational noise are relatively insensitive to changes in chordwise distribution if high-frequency airload data are used in acoustic calculations.

Variations in correlation between different flight conditions are attributed to the effects of wind gusts and turbulence on both aerodynamic and noise data. Although the surface wind velocity was below 10 mph for most of the data acquisition period, the pilots reported considerable turbulence and wind gusts at the 1000-foot flight altitude. These unsteady conditions are believed to be the main cause of the time variations in measured noise over short time intervals as well as the cause of variations in measured rotor aerodynamic data.

Some aspects of the correlation between measured and calculated time histories of acoustic pressure are shown in Figure 29. At distances over 2000 feet, neither the measured nor the calculated time history appears impulsive (Figure 29a). As distances decrease to between 500 and 1000 feet, both signatures become more impulsive on the advancing blade side of the flight path (Figure 29b). Typical measured and calculated time histories for 140-knot flight are shown in Figure 29c, where the shape of the acoustic waveform is consistent with the subjective observation that RIN was not heard during flybys at 140 knots.

4.1.2.2 Correlation Using Theoretical Cruise Airloads

The same analytical techniques that were used to predict hover airloads were used to predict cruise airloads. Iterations between inflow and rotor response analyses were continued until the correct rotor lift and propulsive forces were obtained ($\pm 10\%$) with head moments less than 10,000 ft-lbs. Results presented in Figures 30 through 32 show again that correlation decreases rapidly with increasing noise harmonic order.

4.1.3 Conclusions of External Noise Correlation Study

The correlation study demonstrated that the open-form acoustic analysis can calculate certain qualities of rotational noise from measured airload data, such as the SPL of the first 3 noise harmonics at moderate distances from the helicopter and the qualitative differences in acoustic pressure waveforms with and without RIN. The study also demonstrated that inclusion of rotor orientation in the acoustic analysis does not significantly improve correlation. The authors currently believe that source motion effects

must be included in the acoustic analysis in order to improve correlation far in front of a high performance helicopter. In addition to including motion of the acoustic sources, it is particularly important to include the effects of compressible aerodynamics on the airload data that are used for noise calculations. Specifically, the aerodynamic forces in the plane of the rotor due to profile drag may strongly influence calculated acoustic directionality. The present analysis considers only induced drag effects on in-plane aerodynamic forces.

4.2 IMPULSIVE NOISE SOURCE LOCATION

Triangulation using the 3 microphones inside the cabin of the helicopter was employed to locate the position(s) in the disk responsible for the generation of impulsive noise. Successful use of this procedure relies on two basic requirements:

1. That impulses be observed at all three microphone stations.
2. That a given impulse be identified at all three microphone stations.

If either of these requirements is not met, the triangulation procedure will not be useable. Furthermore, a very accurate time base relating the three microphone signals must be used because variations of only 0.0001 second in time-of-arrival differences can cause errors of up to 10% in the location of the sources.

Examination of the microphone oscillograph pressure traces (Figure 33) revealed that for both hover and forward flight RIN, the first requirement was not met. In fact, in forward flight there was no discernible impulsiveness in any of the microphone signals, and in hover only the forward left side microphone (and to some extent the forward right microphone) showed impulsiveness. In both cases the aft right microphone was completely dominated by tail rotor rotational noise. Attempts to filter out these tail rotor components did not correct the situation, due primarily to the unavailability of a very narrow bandwidth, high attenuation band elimination filter.

These problems resulted in the use of an alternative method to locate the source areas. This method involved specifying the position of the rotor at the instant the impulse was generated and using the measured airloads to determine the blade responsible for the slap. However, since no impulse was discernible for the forward flight case, this method is applicable only to the hover case.

4.2.1 Hover

In hover, RIN conditions were encountered only for certain aircraft headings with respect to the wind. Continuous RIN was experienced only when the helicopter was on a compass heading of 270° (wind from heading 030°). At this heading the wind was sufficient to blow the tail rotor wake into

the main rotor disk, causing blade/vortex interaction RIN; thus, the impulse noise source area is expected to be in the quadrant 270° - 360° (re: helicopter azimuth; 0° - 360° = tail). For other headings, RIN was not present, except at 210° and 240° where it was intermittent.

Examination of the noise recorded by the forward right and left interior mounted microphones (Figure 33) reveals that the intensity (severity) of the RIN is greatest at the left microphone, confirming that the RIN is indeed produced on the left side of the aircraft. Figure 34 shows that airloads near the tip (section load, pounds per inch of span) change in a smooth, gradual manner as the blade travels around the azimuth, except for the region from about 270° to 360° azimuth where the blade experiences rapid fluctuations in lift (loading) due to interaction with the tail rotor's shed wake. It is this rapid lift fluctuation that generates the high-amplitude, high-frequency airloading harmonics which, in turn, are responsible for the generation of RIN. Figure 34 also shows the azimuthal loading distribution for the no-RIN hover. There are no rapid changes in lift to increase the high-frequency airloads, and the general shape of the airload spectrum is quite different from the RIN case.

The harmonics of airloading are derived by performing a Fourier analysis of the waveforms shown in Figure 34 where the period is equal to one revolution. The pulse shape for the RIN case approximates a rectangular pulse with some modification due to the vortex intersections, and the no-RIN case is a rectangular pulse with a slow rise time. A Fourier analysis of these pulses should yield a harmonic amplitude spectrum which resembles that of a rectangular pulse (Figure 35). Figure 36 shows this to be the case. This figure also shows the expected increased levels of the high frequency airloads for the RIN case.

No changes were detected in the chordwise distribution of differential pressure when the instrumented main rotor blade passed through wakes from the tail rotor, and no significant differences were observed during hover with and without RIN. Figure 37 shows a family of pressure distributions in 2.5-degree increments from an azimuth angle of 305° degrees through 325° degrees. These pressure profiles correspond to the section loading data for the RIN case shown in Figure 34. Pressure distributions for hover conditions with and without RIN are presented in Figure 38 to show that distribution shape is not influenced by RIN. The RIN condition corresponds to a helicopter magnetic heading of 270° degrees, while the RIN-free condition corresponds to a magnetic heading of 030° degrees.

Further indication of the location of the impulse generating area is given by determining the location of the rotor at the instant the RIN is generated. This location is found through use of the 1-per-rev contactor channel recorded on the same tape as the internal microphone data. Examination of the recorded data shown in Figure 33a revealed that for one revolution of the instrumented blade, six impulses were recorded by the microphones (each blade passing through the tail rotor wake). Figure 39 illustrates the range of rotor locations at time of impulse for three revolutions of the blades (eighteen impulses). This range is found to be from about 300° to 325° azimuth, which agrees with the pressure traces of Figure 34. It thus

seems reasonable to assume that the RIN observed on the CH-53A during hover is due to main rotor blade/tail rotor wake interactions which occur at azimuth $300^\circ - 325^\circ$. This RIN is observed at the two forward internal microphone stations, but is masked by tail rotor noise at the aft right microphone station.

4.2.2 Forward Flight

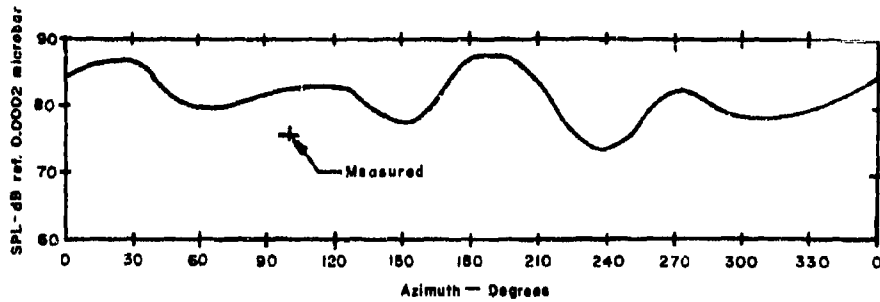
RIN was observed during forward flight only at high speed (170 kt). Observers on the ground noted that this form of RIN was highly directional and could be heard only during approach at large helicopter to observer distances where the angle of the observer below the rotor disk is small. As the helicopter approached and the angle became larger, the impulse could no longer be heard. Based on the directionality arguments presented in Section 2.3, this is not an unexpected observation. Simultaneous measurement of noise along the ground track and 250 feet to the side provided additional information on directional characteristics of forward-flight RIN. The acoustic signature directly ahead of the helicopter reached its maximum impulsiveness several seconds earlier than the signature 250 feet to the side of the flight path. The noise data exhibited mild RIN on the retreating blade side of the helicopter. Figure 40 illustrates the characteristics described above for the centerline microphone and advancing blade side microphone (flight from east to west). Note the impulsiveness of the centerline signal compared to the advancing blade side signal in Figure 40a, corresponding to a helicopter location over 2500 feet away. Figures 40b through 40d bring the helicopter nearly overhead. Figure 41 shows the two noise signals for flight from west to east, with 41a representing maximum impulsiveness on the retreating blade side of the aircraft. Comparison of the upper trace of this figure with that of Figure 40c shows the RIN on the retreating blade side to be less severe than on the advancing blade side. Figure 41b corresponds to the helicopter passing over the microphone array. For comparison, Figure 42 presents the most impulsive-looking signal recorded during 140-knot flight from east to west. Acoustic rise times are not short enough to produce RIN in this case.

Oscillograph traces of the noise recorded by the internal microphones (Figure 33b) showed no impulsiveness at the two forward stations. The aft microphone was completely dominated by tail rotor noise, and filtering the signal did not improve the situation. The fact that the impulse was not recorded by the internal microphones is to be expected, as can be shown by reference to Equation 1 (Section 2.1.1). The replacement of r by $r(1-M_r)$ to account for the effect of forward speed on the sound heard by a stationary observer reverts to simply r if the observer is moving with the helicopter. Thus, the acoustic effect of forward-flight RIN is not applicable to an observer on the helicopter. Some aerodynamic phenomenon, such as blade/wake interaction or compressibility-induced loading oscillations, must occur to cause RIN that can be detected inside the helicopter. Airload data do not show blade/wake interactions, so compressibility effects are left as the source of high-speed RIN that can be heard in the moving reference frame. Compressibility increases in-plane forces more than out-of-plane, which increases in-plane components of rotational noise. This will increase the first two or three rotational harmonics slightly inside the

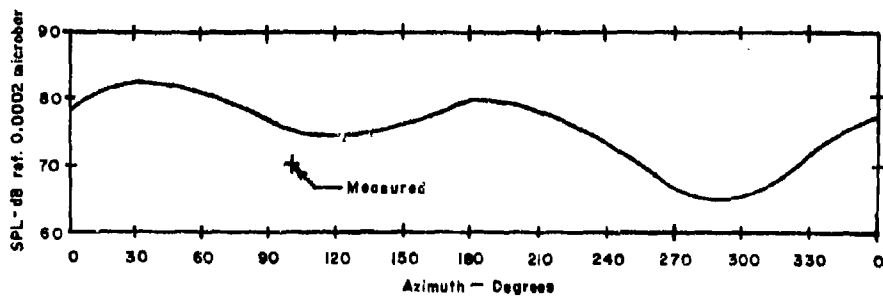
helicopter but will not be powerful enough to cause RIN to be heard inside the helicopter.

It was postulated in Section 2.3 that advancing blade RIN was primarily an acoustic effect of high tip Mach numbers rather than a result of high harmonic airloading. This can be seen by reference to Figure 43. The airloading variation with azimuth for the RIN and no-RIN cases is somewhat the same, except that the region of negative lift is of larger duration for the RIN case. However, there are no rapid changes in loading to cause increased high-frequency airloading harmonics. This can be seen more clearly in Figure 44, where the airloading harmonics have been plotted for the two cases. There is virtually no difference in the high-frequency airloads, and in fact, the amplitude decay with increasing harmonic frequency approaches λ^{-2} in both cases. Obviously, there are some differences in the harmonic content between the two cases, and this will cause differences in the character of the observed sound.

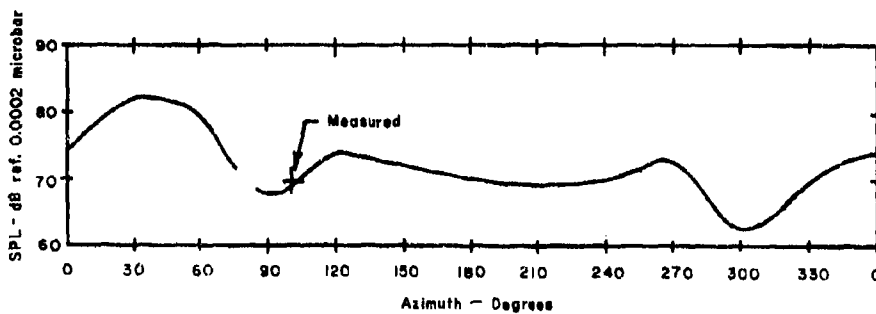
Based on the results of the measured airloading, and on the observed directionality of the radiated sound, it appears that for the CH-53A, advancing blade RIN is indeed a high tip Mach number acoustic effect rather than a result of increased-amplitude high-frequency airloads, as in the case of blade/wake interaction RIN. The observed directionality of the impulse confirms the theoretical explanation offered in Section 2.3. Compressibility effects, while enhancing the radiated slap, do not appear to be the primary cause of advancing blade slap. Compressibility generated noise is not highly directional, as shown in Section 2.3; however, the observed impulse is very directional in the plane of rotation. Since the advancing tip Mach number of 0.875 during 170-knot cruise is only slightly into drag divergence (Figure 8), the profile drag forces will not be predominant, and noise generated in this way will be a secondary, although possibly a significant, source.



a. Fundamental

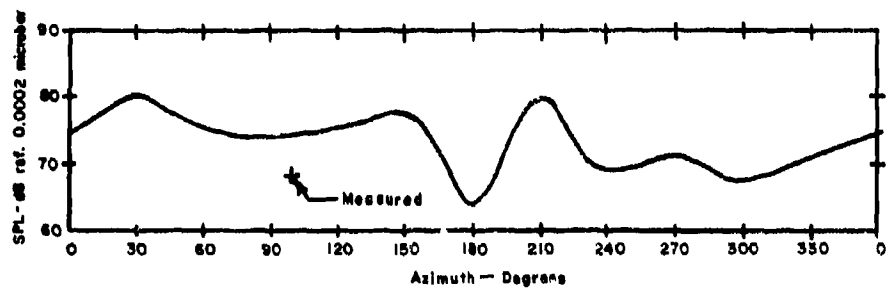


b. Second Harmonic

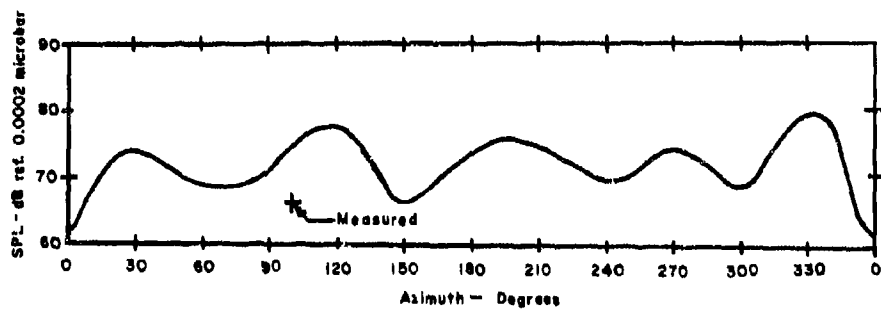


c. Third Harmonic

Figure 17. Calculated Hover Noise Variation,
Helicopter Heading 030 Degrees, No RIN.

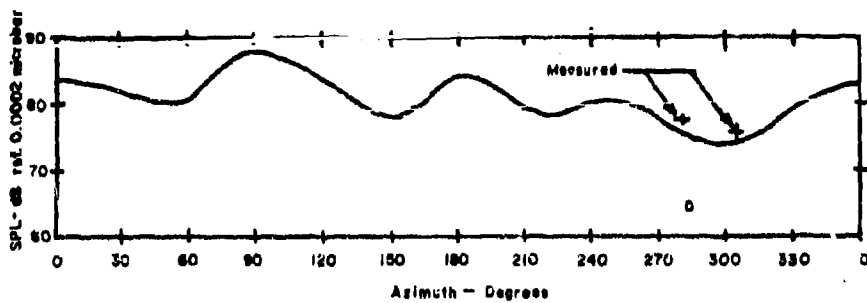


d. Fourth Harmonic

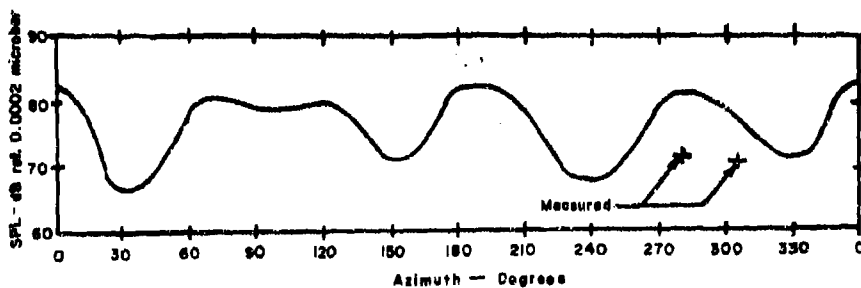


e. Fifth Harmonic

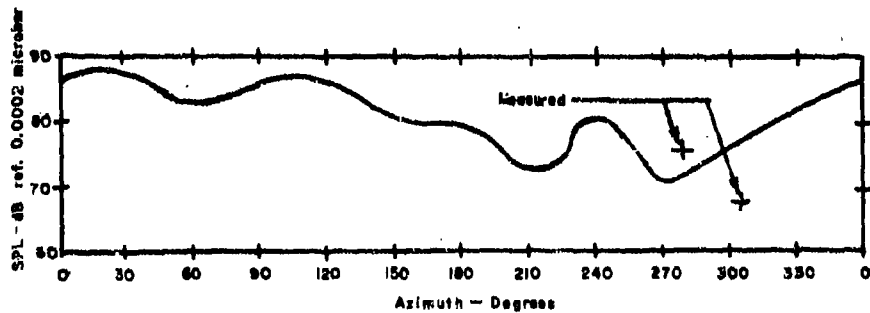
Figure 17. Concluded.



a. Fundamental

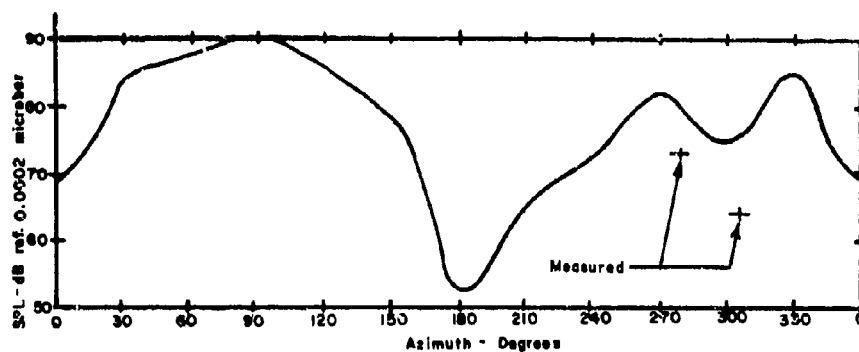


b. Second Harmonic

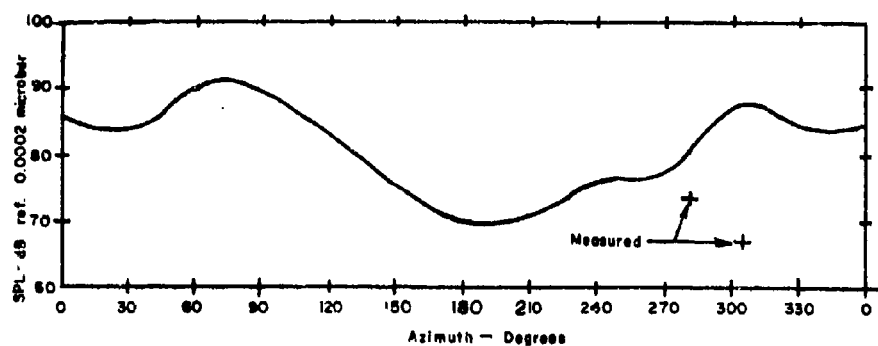


c. Third Harmonic

Figure 18. Calculated Hover-Noise Variation, Helicopter Heading 210 Degrees, Moderate RIN.

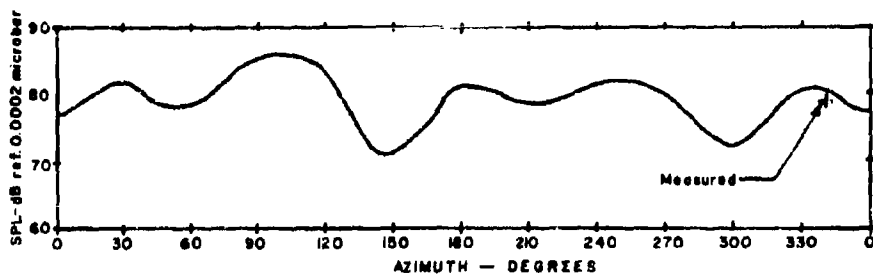


d. Fourth Harmonic

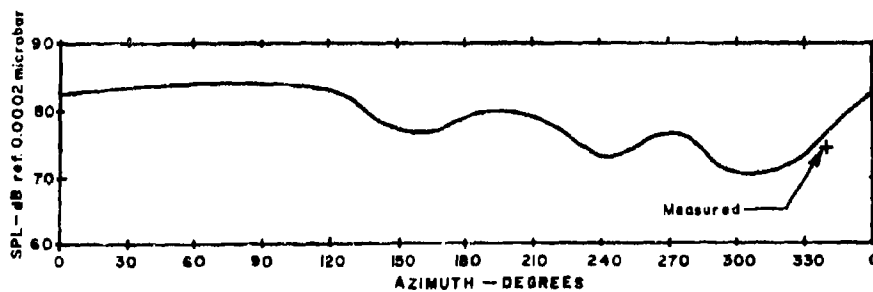


e. Fifth Harmonic

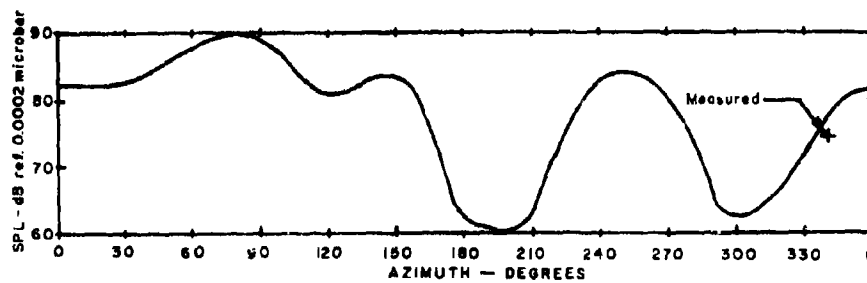
Figure 18. Concluded.



a. Fundamental

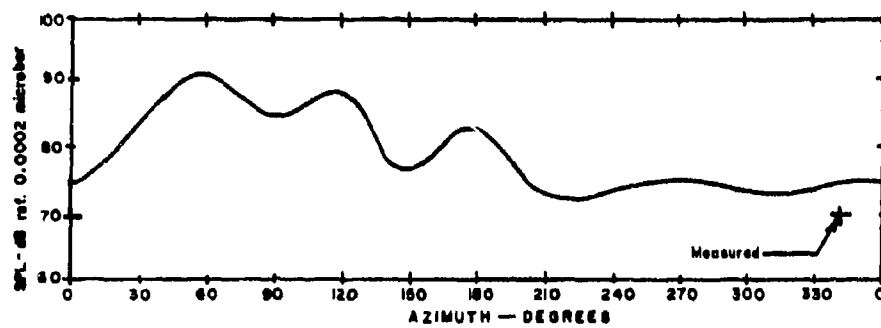


b. Second Harmonic

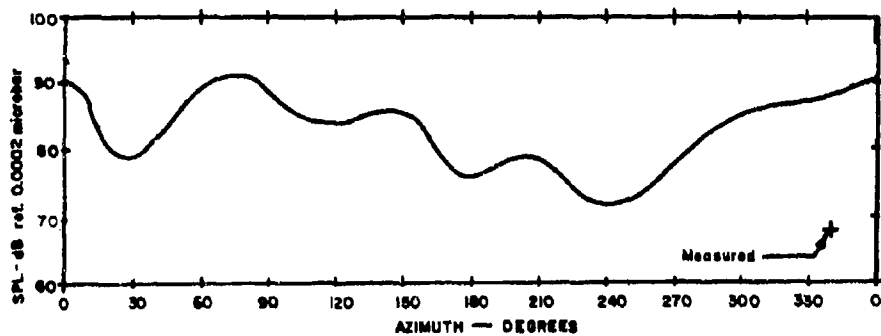


c. Third Harmonic

Figure 19. Calculated Hover Noise Variation,
Helicopter Heading 270 Degrees, Pronounced RIN.

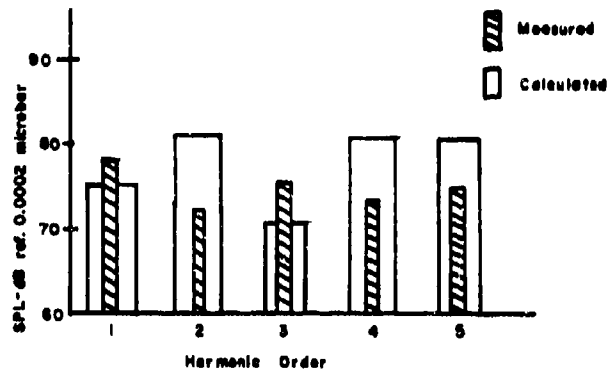


d. Fourth Harmonic

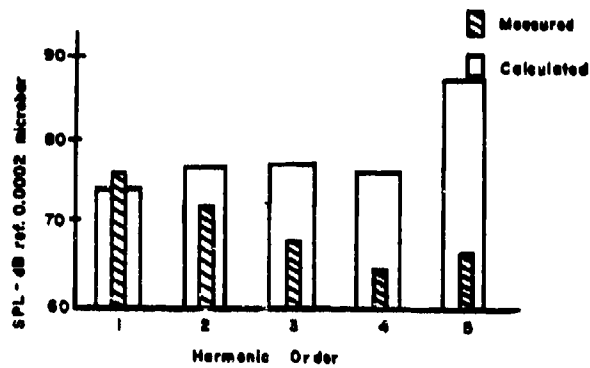


e. Fifth Harmonic

Figure 19. Concluded.



a. Azimuth Location 280 Degrees



b. Azimuth Location 306 Degrees

Figure 20. Measured and Calculated Rotational Noise Spectra at Two Locations During Hover, Helicopter Heading 210 Degrees.

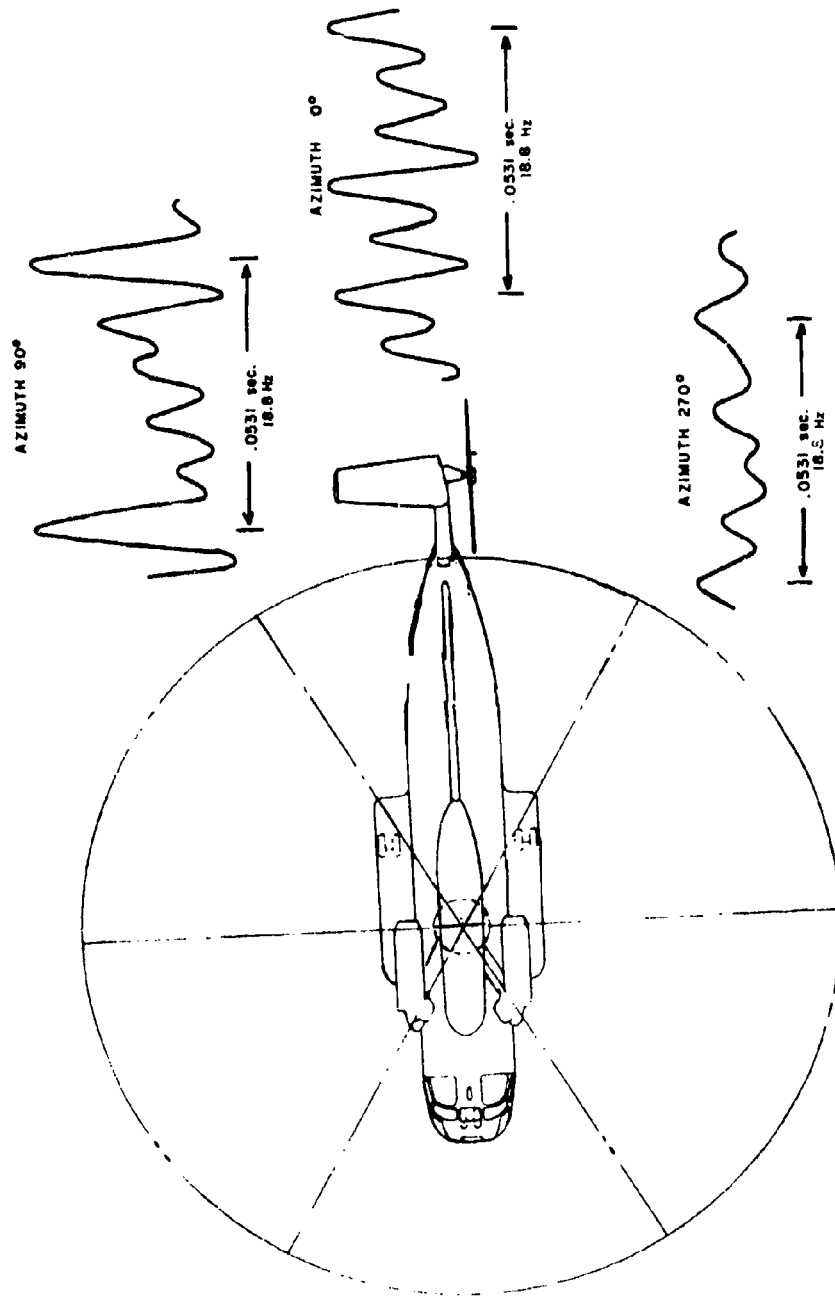
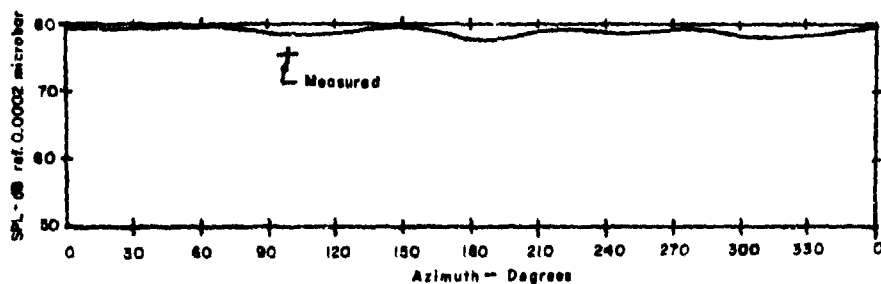
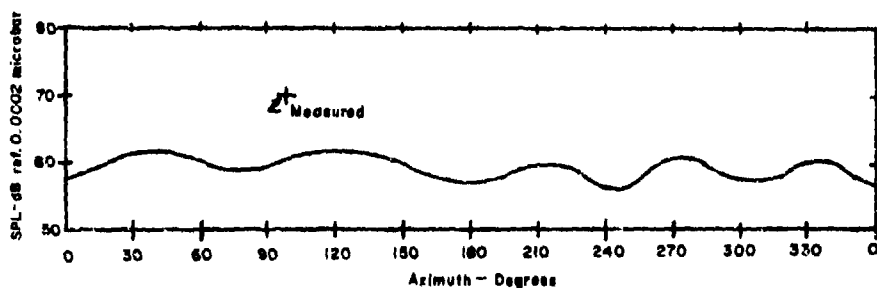


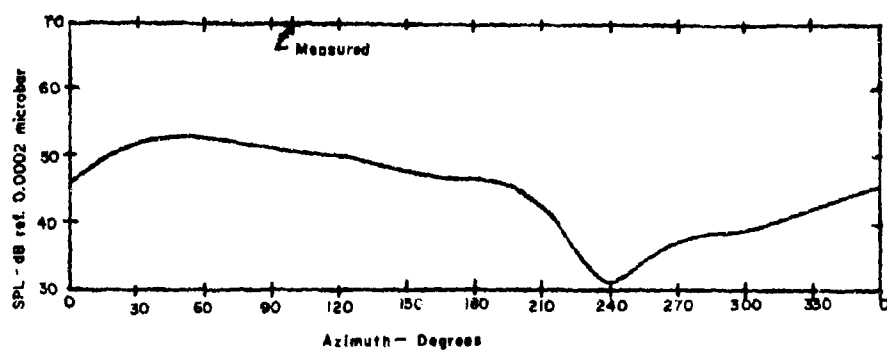
Figure 21. Calculated Time Histories of Acoustic Pressure at Several Azimuth Locations During Hover, Helicopter Heading 270 Degrees Magnetic, RIN Condition.



a. Fundamental

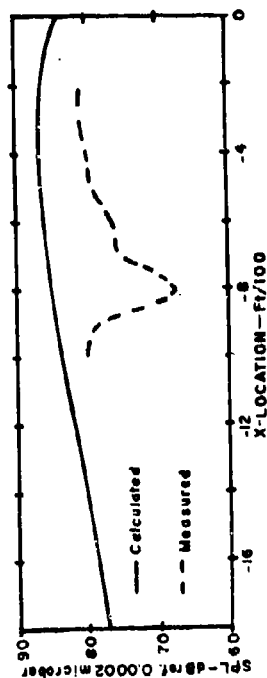


b. Second Harmonic

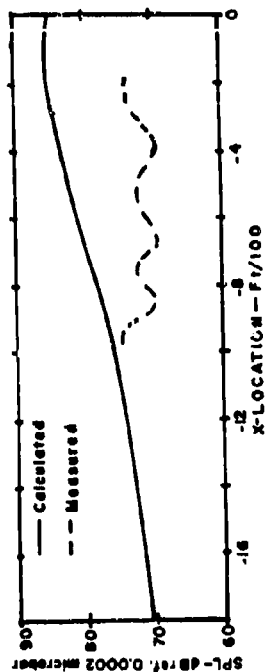


c. Third Harmonic

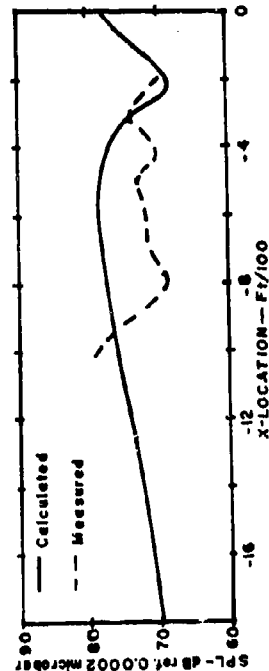
Figure 22. Calculated ~~no~~ Noise Variation Using Theoretical Airloads.



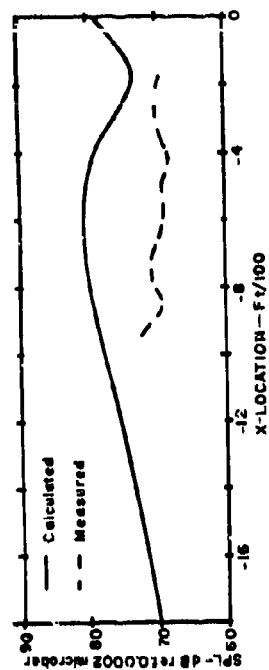
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

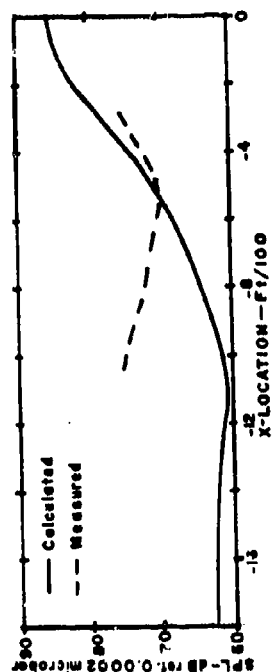


c. Second Harmonic, Starboard Side

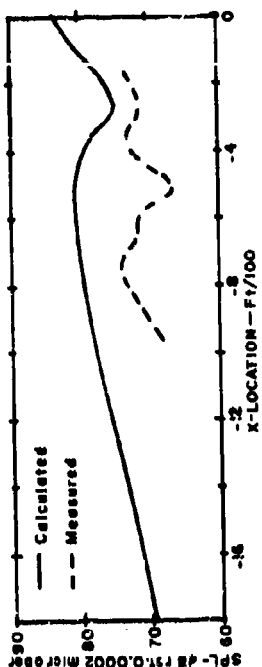


d. Second Harmonic, Port Side

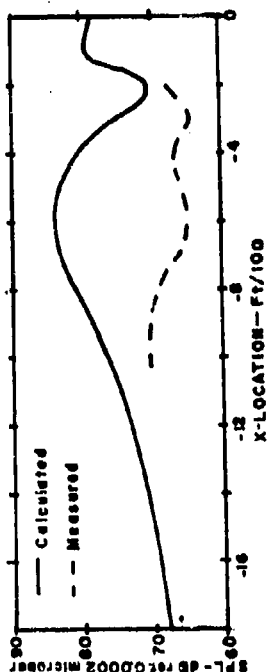
Figure 23. Rotational Noise Harmonic SPL-vs-Distance,
Measured Airloads, 120 kt.



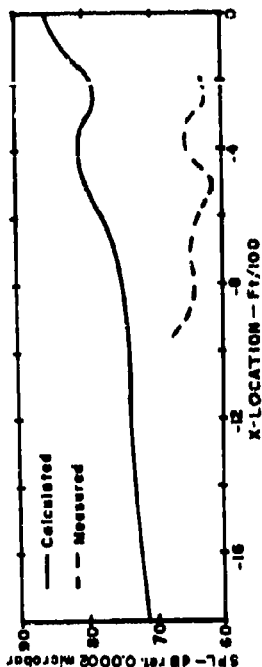
e. Third Harmonic, Starboard Side



f. Third Harmonic, Port Side

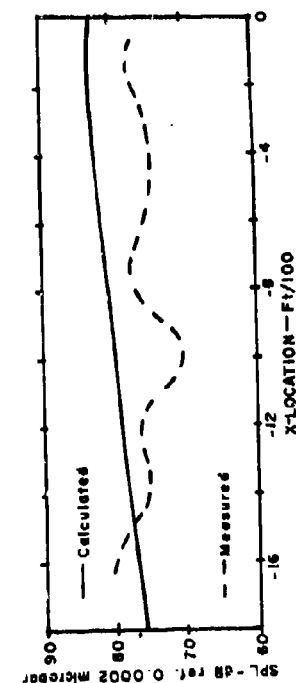


g. Fourth Harmonic, Starboard Side

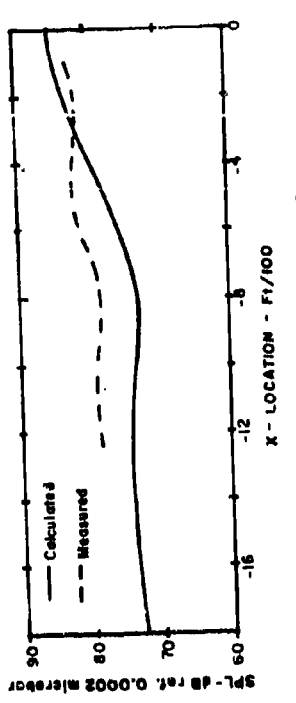


h. Fourth Harmonic, Port Side

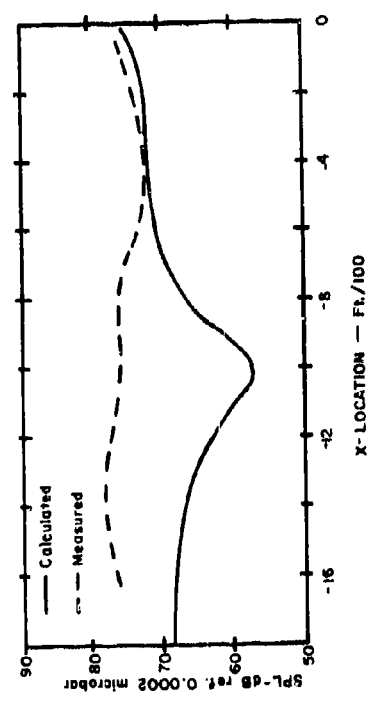
Figure 23. Concluded.



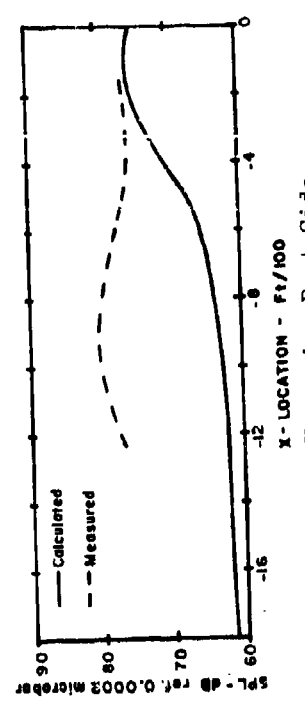
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

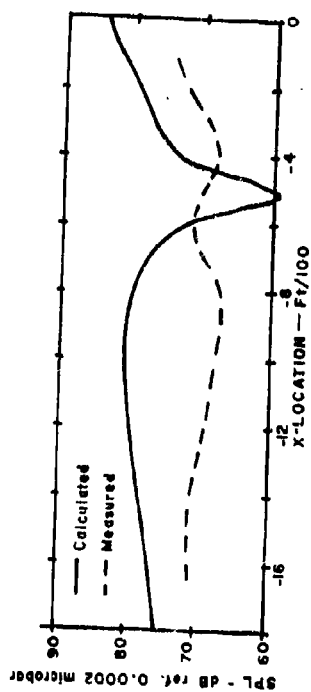


c. Second Harmonic, Starboard Side

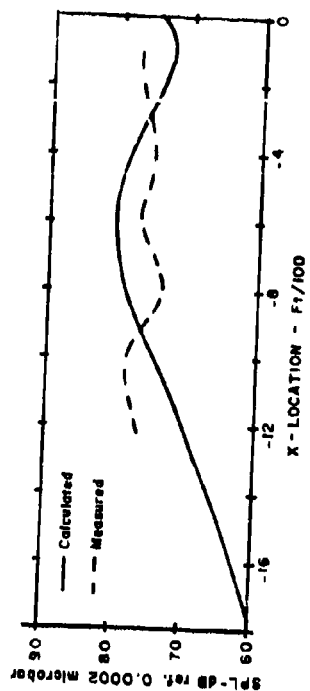


d. Second Harmonic, Port Side

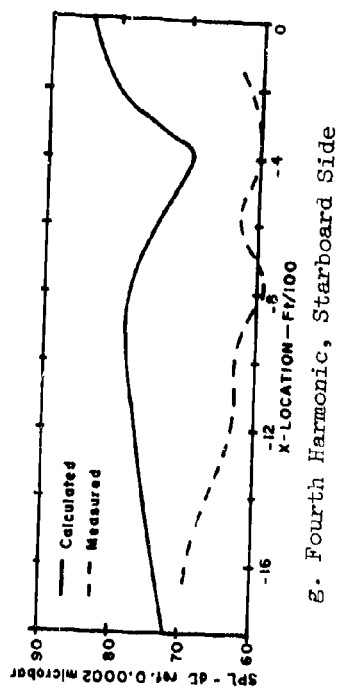
Figure 24. Rotational Noise Harmonic SPL-vs-Distance,
Measured Airloads, 140 kt.



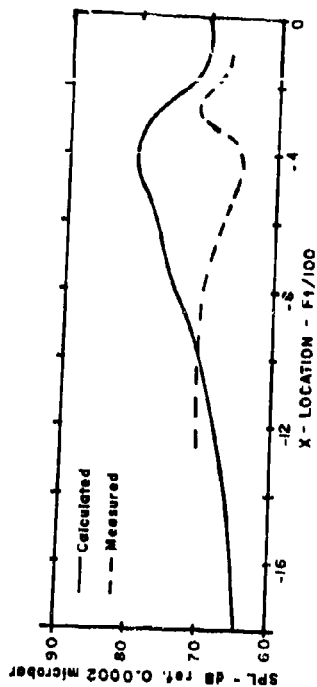
e. Third Harmonic, Starboard Side



f. Third Harmonic, Port Side

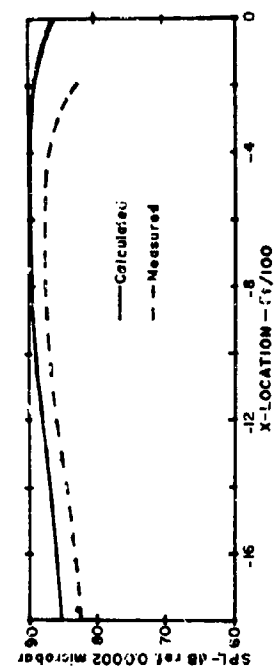


g. Fourth Harmonic, Starboard Side

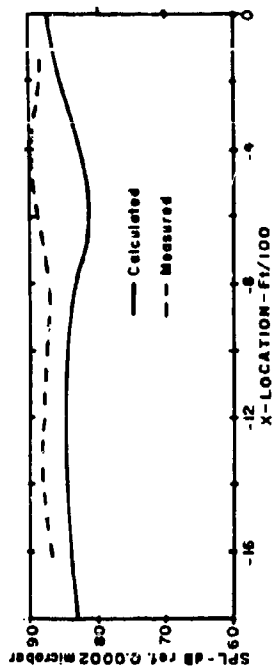


h. Fourth Harmonic, Port Side

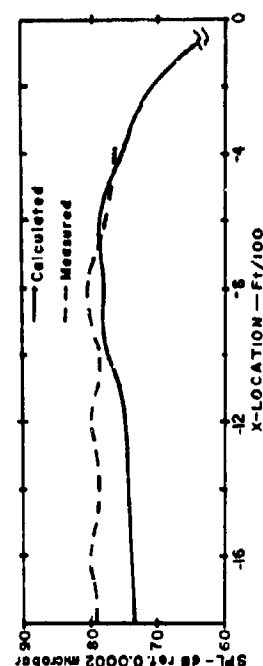
Figure 24. Concluded.



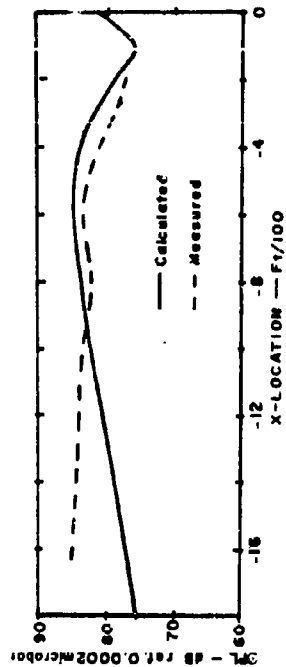
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

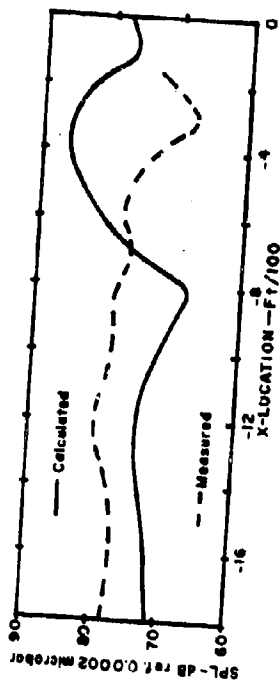


c. Second Harmonic, Starboard Side

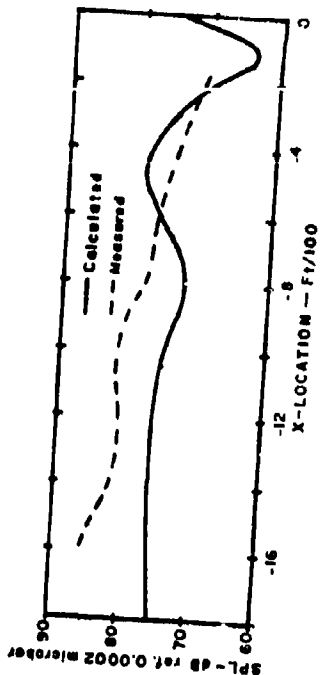


d. Second Harmonic, Port Side

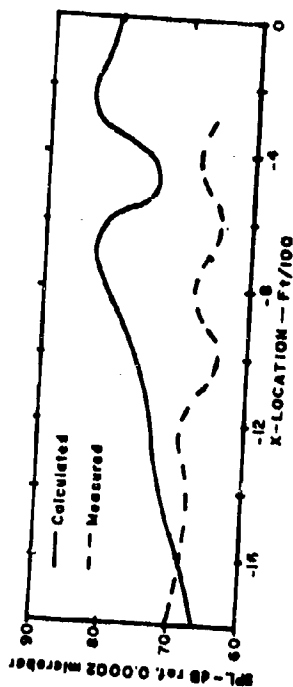
Figure 25. Rotational Noise Harmonic SPL-vs-Distance,
Measured Airloads, 170 kt.



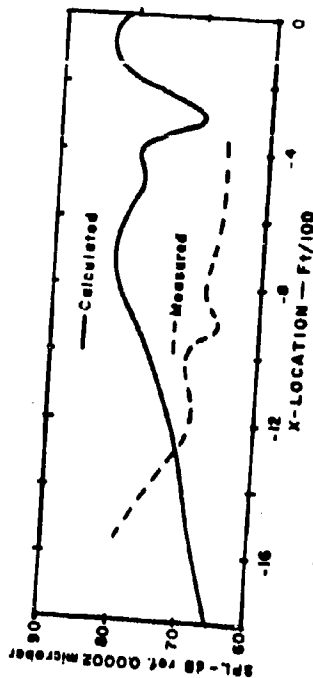
e. Third Harmonic, Starboard Side



f. Third Harmonic, Port Side

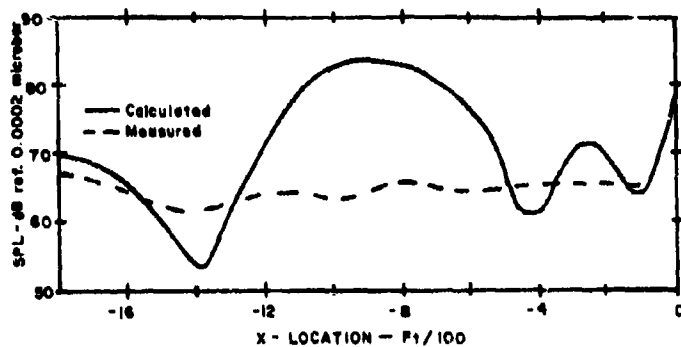


g. Fourth Harmonic, Starboard Side

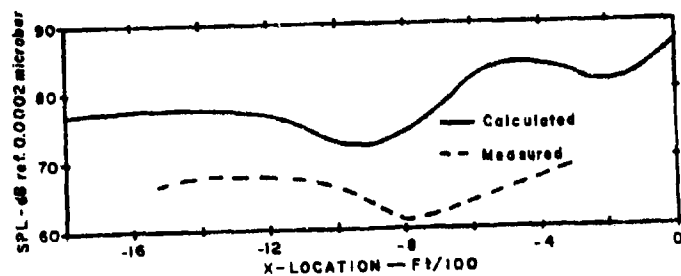


h. Fourth Harmonic, Port Side

Figure 25. Continued.

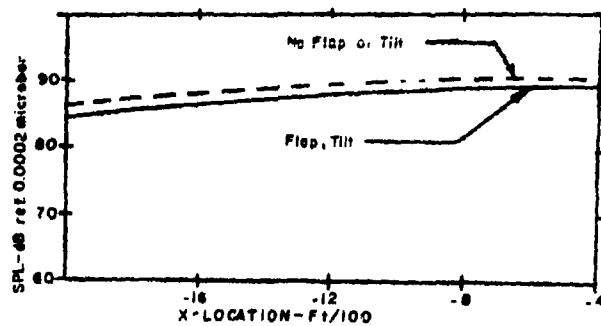


i. Fifth Harmonic, Starboard Side

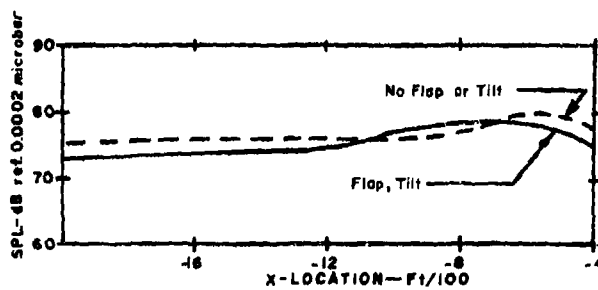


j. Fifth Harmonic, Port Side

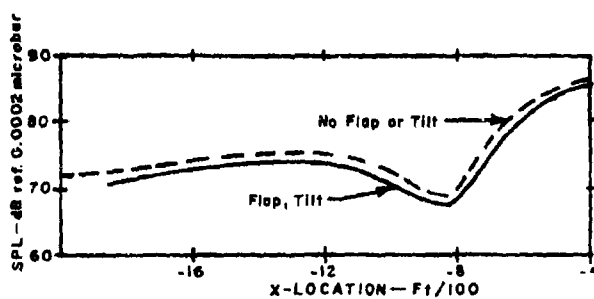
Figure 25. Concluded.



a. Fundamental

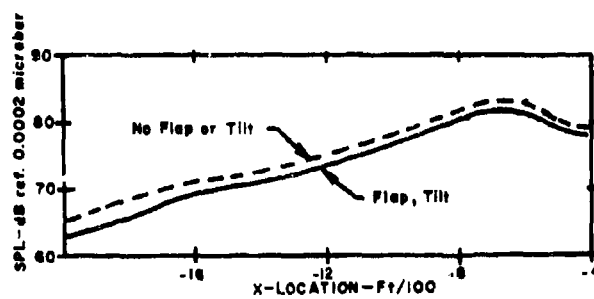


b. Second Harmonic

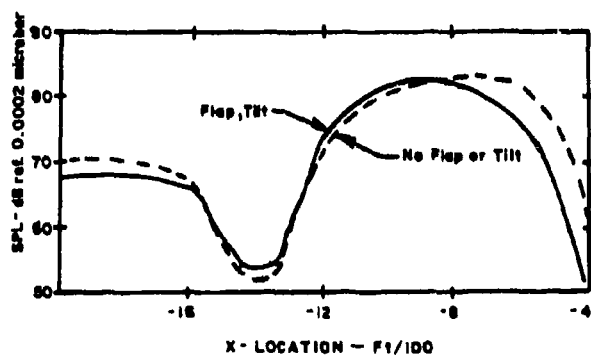


c. Third Harmonic

Figure 26. Effect of Shaft Inclination and Blade Flapping on Calculated Noise, Measured Airloads, 170 kt, Starboard Side.



d. Fourth Harmonic



e. Fifth Harmonic

Figure 26. Concluded.

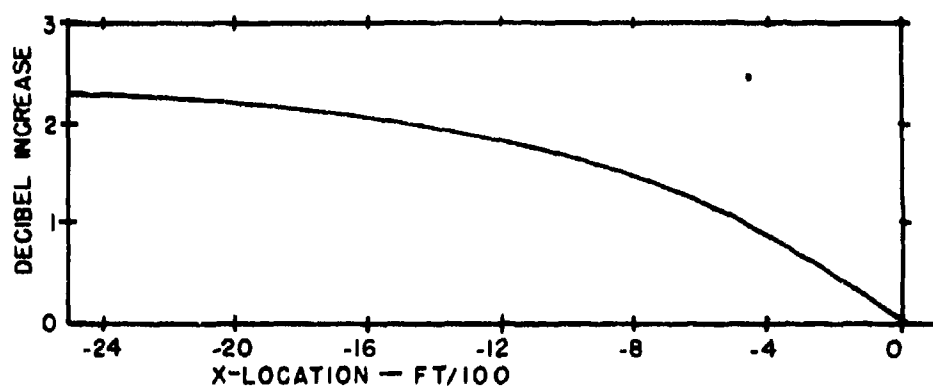


Figure 27. Effect of Simulated Translational Mach Number on Calculated Noise, 170 kt, Centerline.

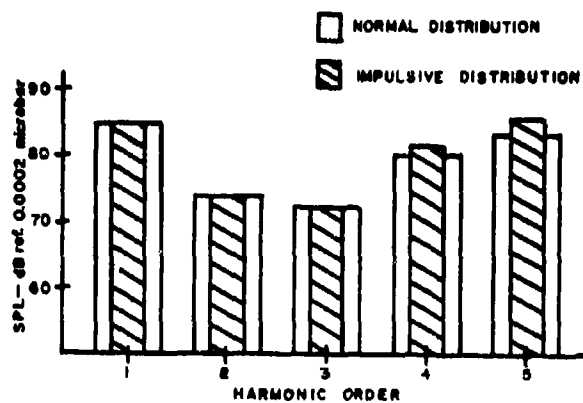


Figure 28. Effect of Simulated Impulsive Chordwise Loading Distribution.

 MEASURED

 CALCULATED

a. 170 kt, No RIN, Helicopter Over 2500 ft Away

 MEASURED

 CALCULATED

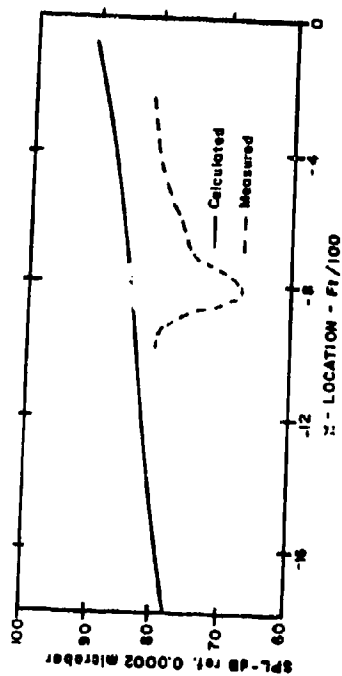
b. 170 kt, Maximum RIN, Helicopter 500 to 1000 ft Away

 MEASURED

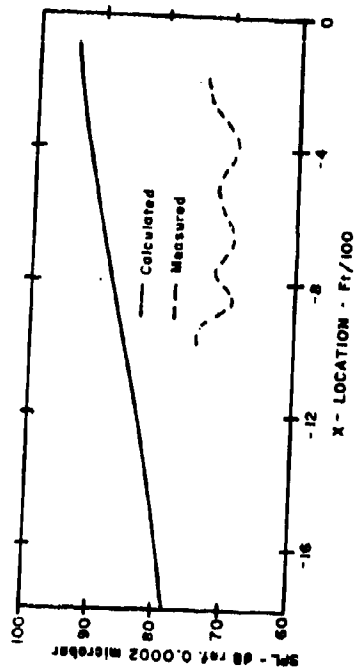
 CALCULATED

c. 140 kt, No RIN, Helicopter Approximately 500 ft Away

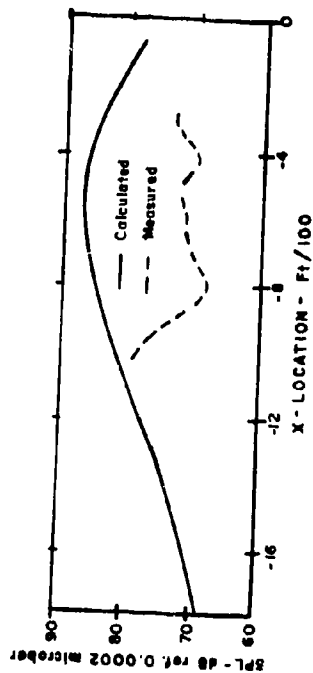
Figure 29. Measured and Calculated Time Histories of Acoustic Pressure on Starboard Side.



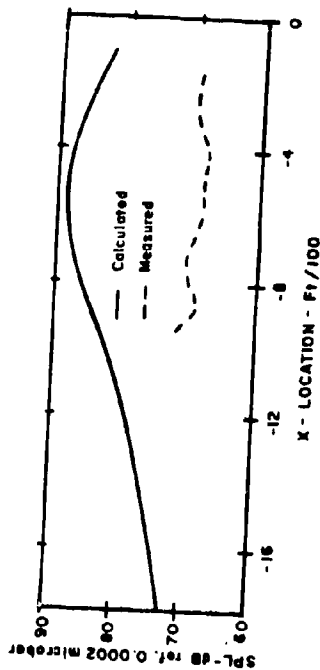
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

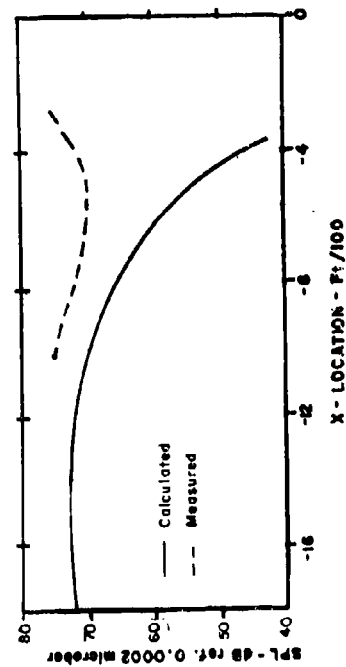


c. Second Harmonic, Starboard Side

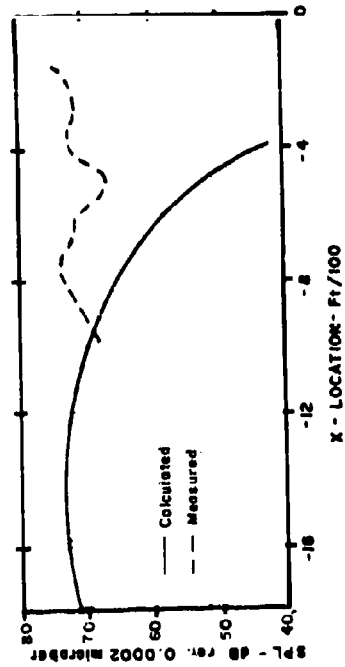


d. Second Harmonic, Port Side

Figure 30. Rotational Noise Harmonic SPL-vs-Distance, Theoretical Airloads, 120 kt.

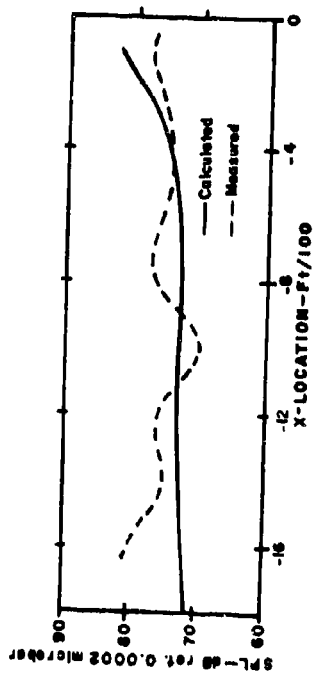


e. Third Harmonic, Starboard Side

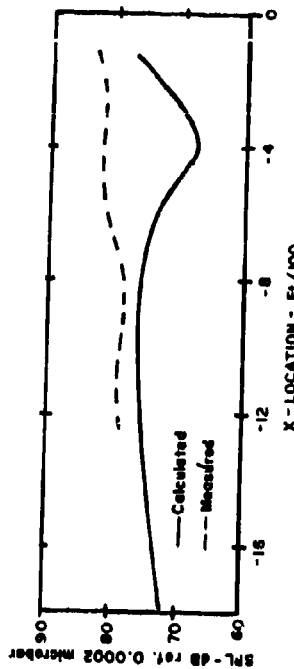


f. Third Harmonic, Port Side

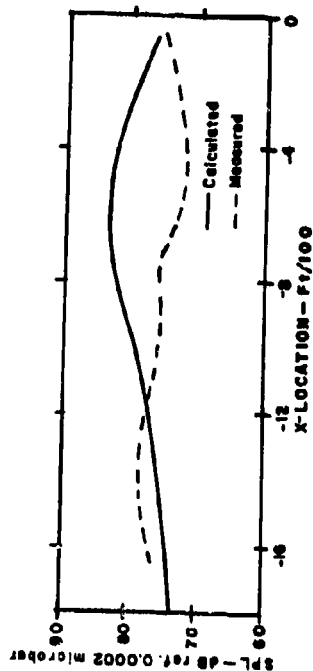
Figure 30. Concluded.



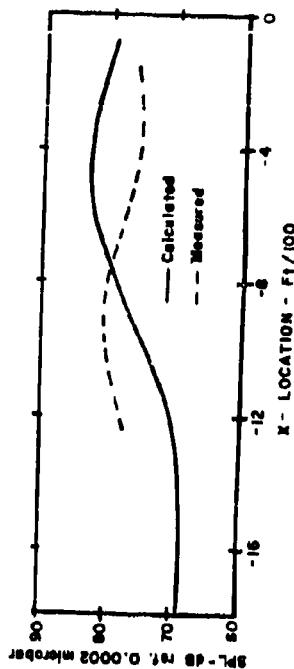
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

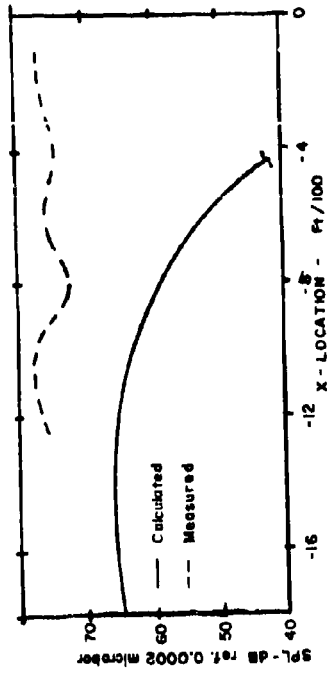


c. Second Harmonic, Starboard Side

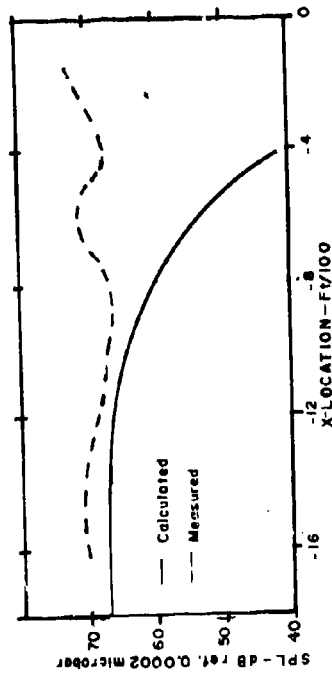


d. Second Harmonic, Port Side

Figure 31. Rotational Noise Harmonic SPL-vs-Distance, Theoretical Airloads, 140 kt.

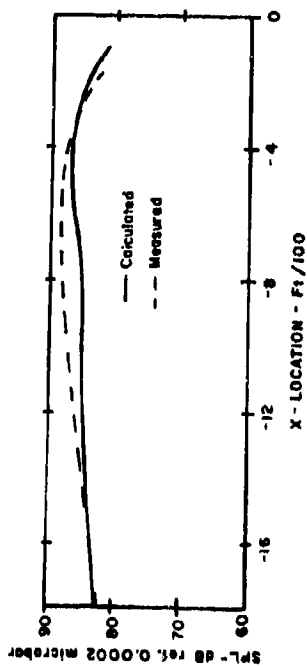


f. Third Harmonic, Port Side

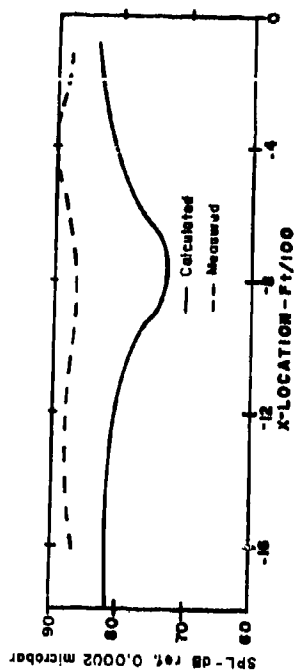


e. Third Harmonic, Starboard Side

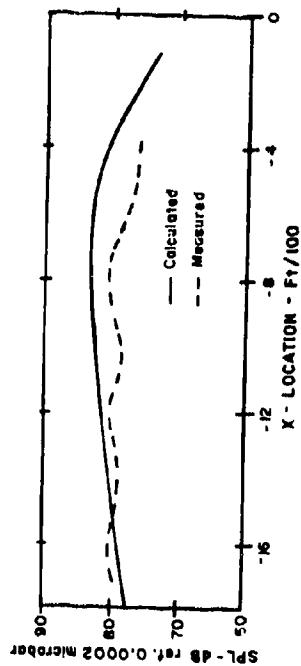
Figure 31. Concluded.



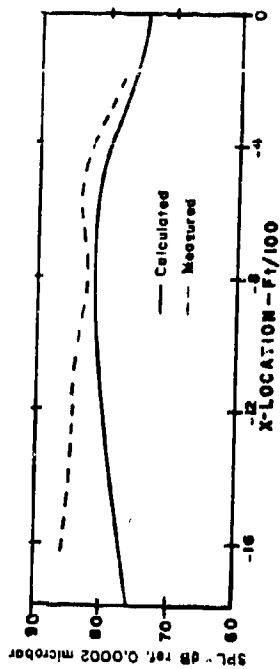
a. First Harmonic, Starboard Side



b. First Harmonic, Port Side

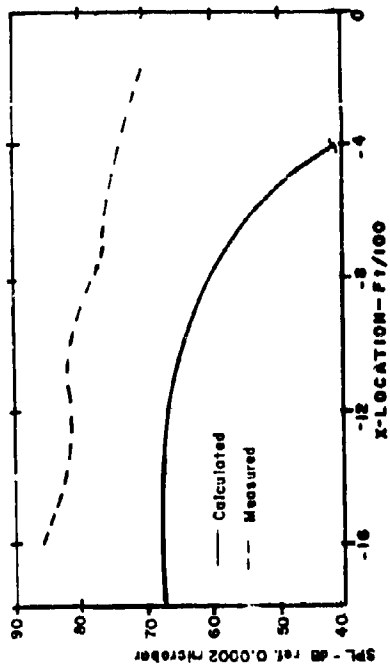


c. Second Harmonic, Starboard Side

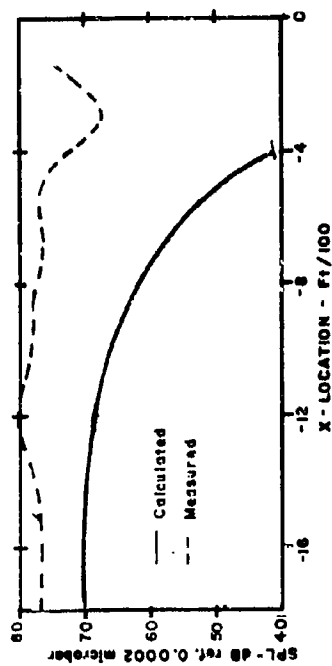


d. Second Harmonic, Port Side

Figure 32. Rotational Noise Harmonic SPL-vs-Distance, Theoretical Airloads, 170 kt.

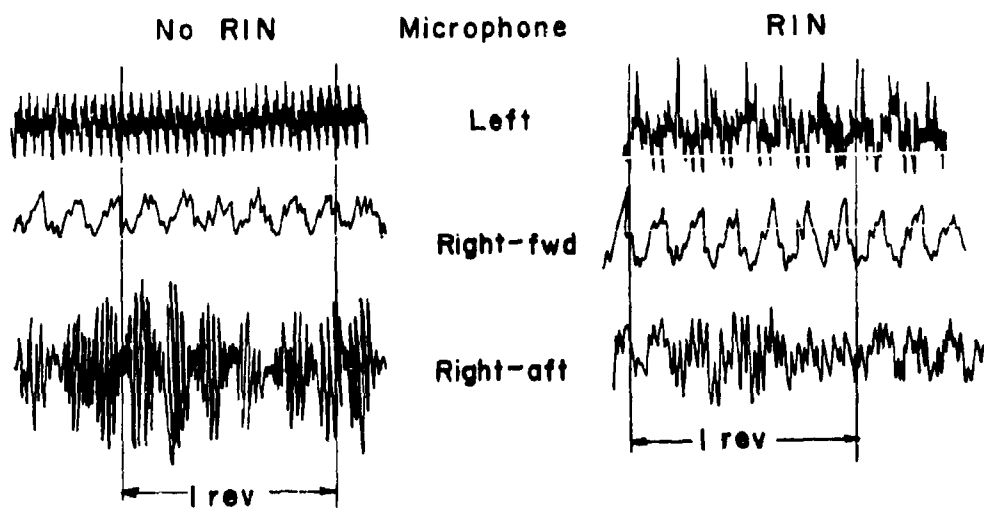


f. Third Harmonic, Port Side

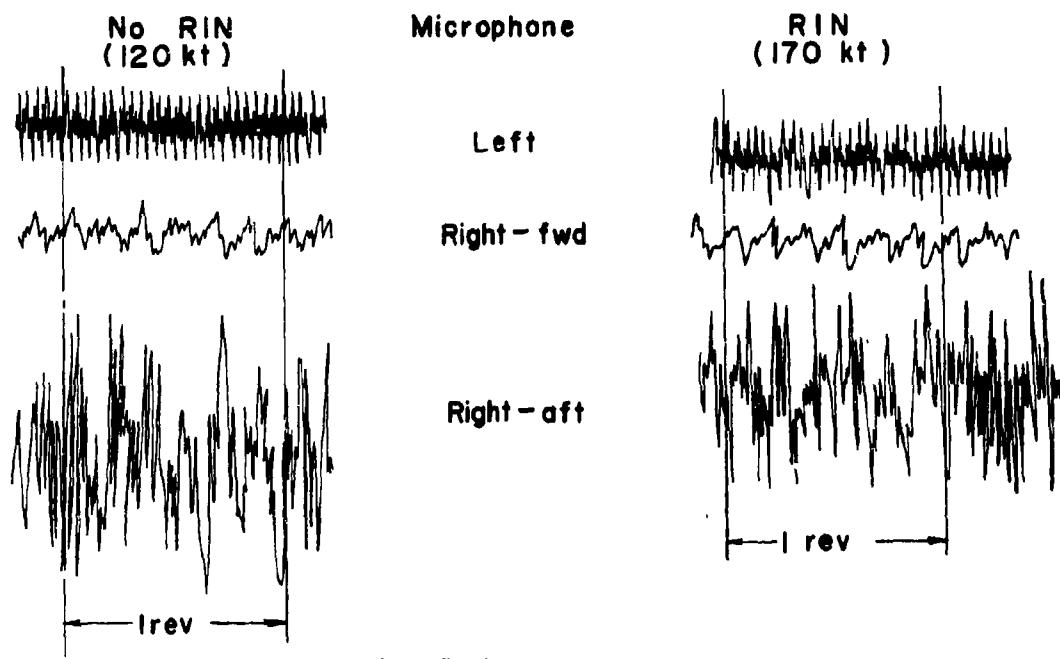


e. Third Harmonic, Starboard Side

Figure 32. Concluded.



a. Hover



b. Cruise

Figure 33. Sound Pressure Recorded by Internal Microphones.

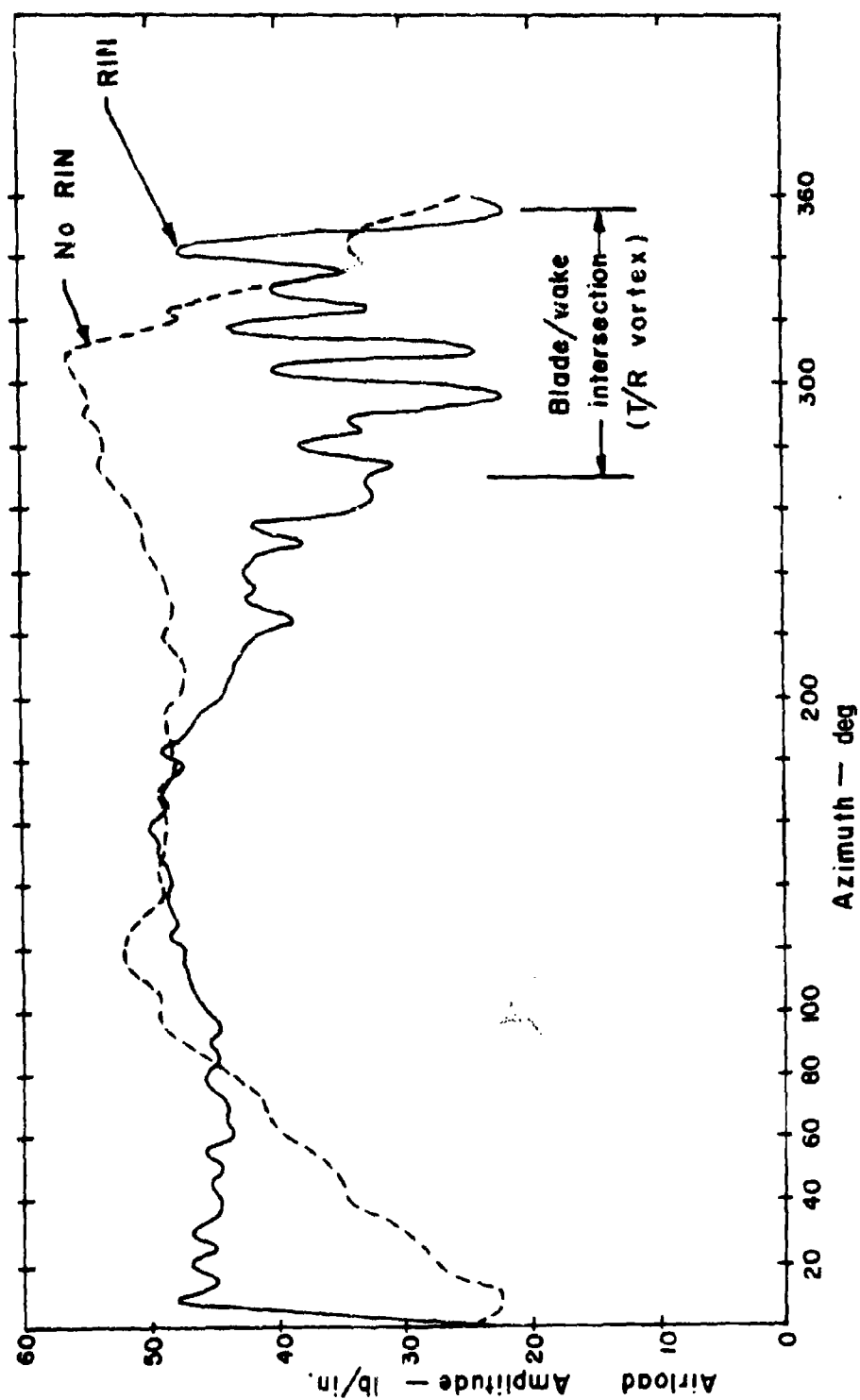


Figure 34. Blade section Airloading as a Function of Azimuth for
hover RIN and No-RIN Conditions (0.87 Span).

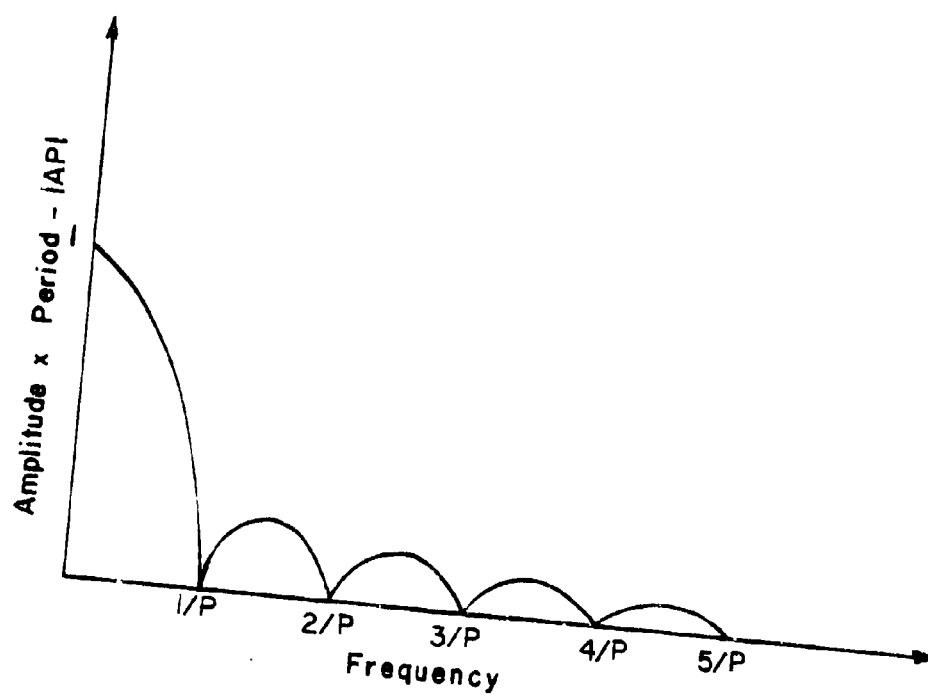
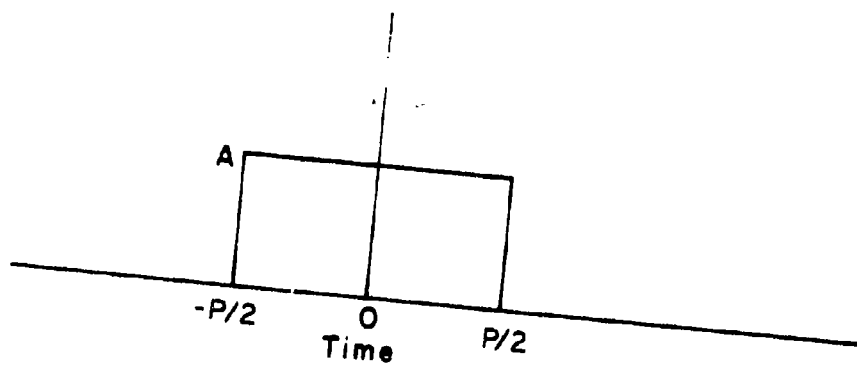


Figure 35. Harmonic Frequency Spectrum of a Rectangular Pulse.

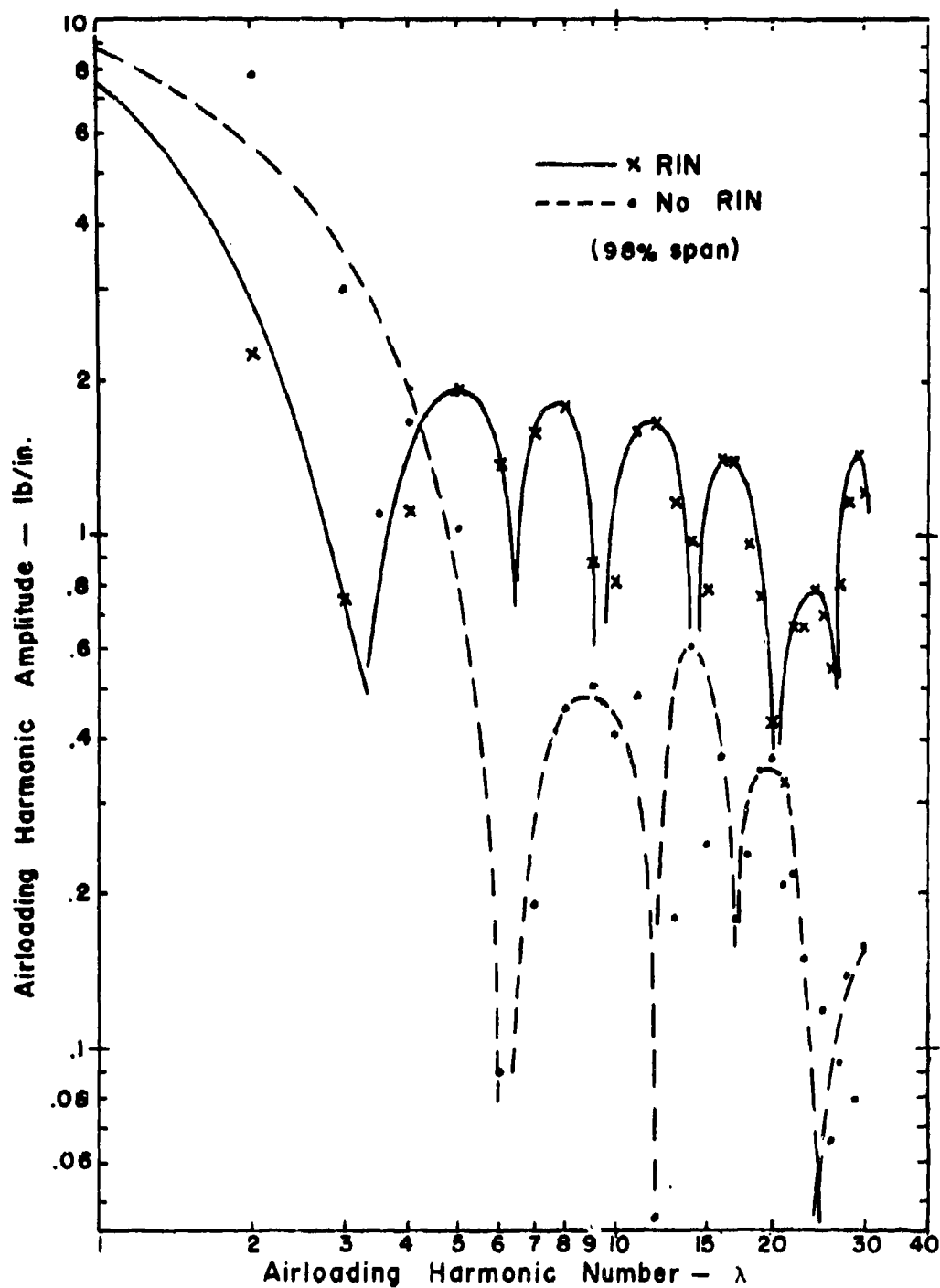


Figure 36. Airloading Harmonic Amplitude for Hover RIN and No-RIN Conditions.

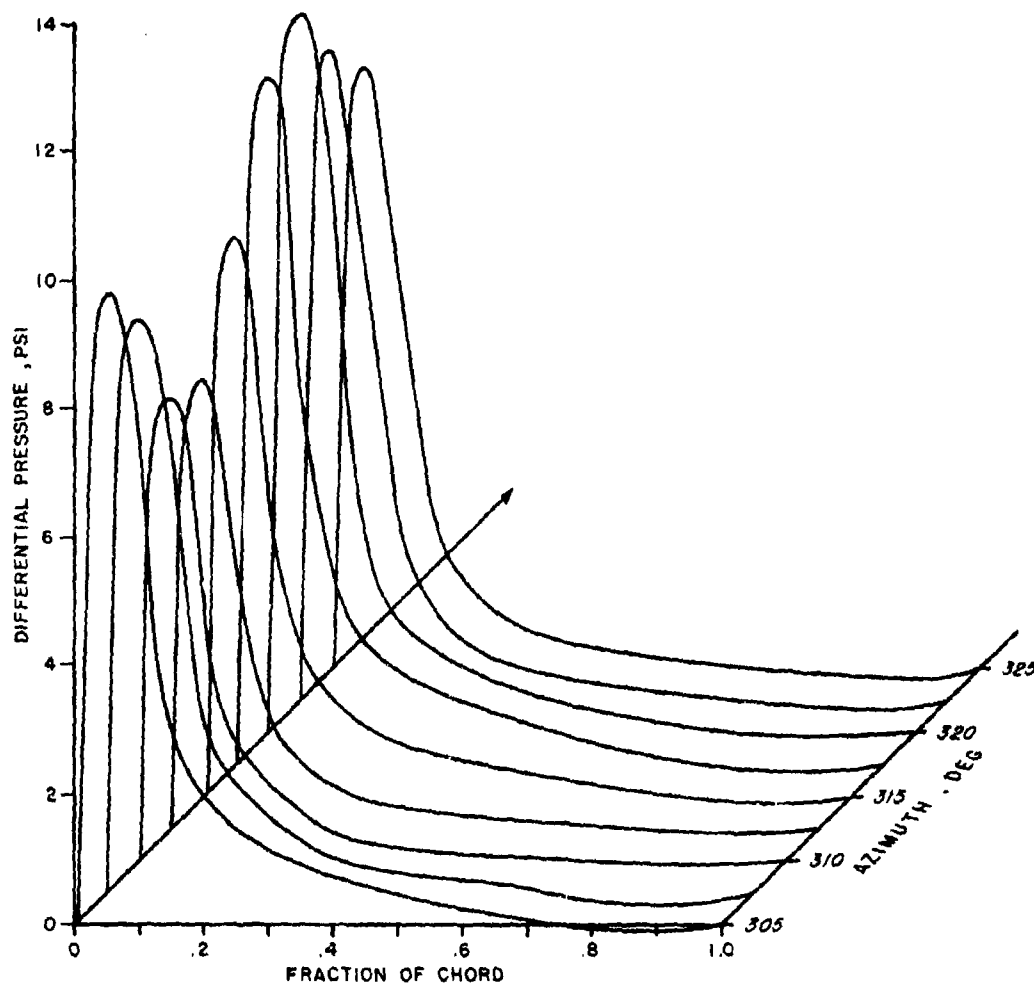
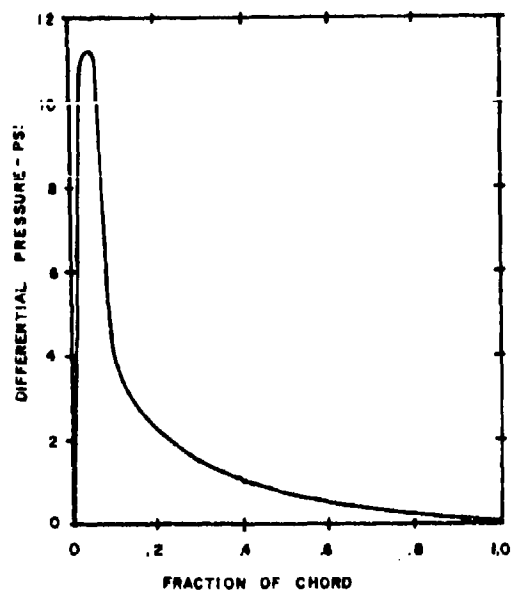
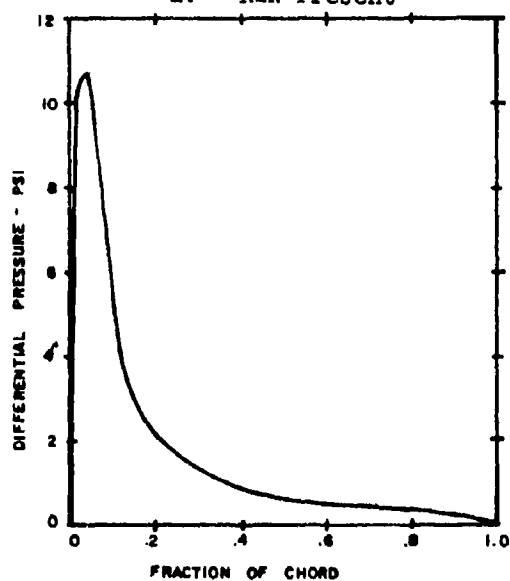


Figure 37. Chordwise Distribution of Differential Pressure as a Function of Azimuth, Hover RIN Condition.



a. RIN Present



b. RIN Not Present

Figure 38. Chordwise Pressure Distribution With and Without RIN, 98% Span, 160° Azimuth.

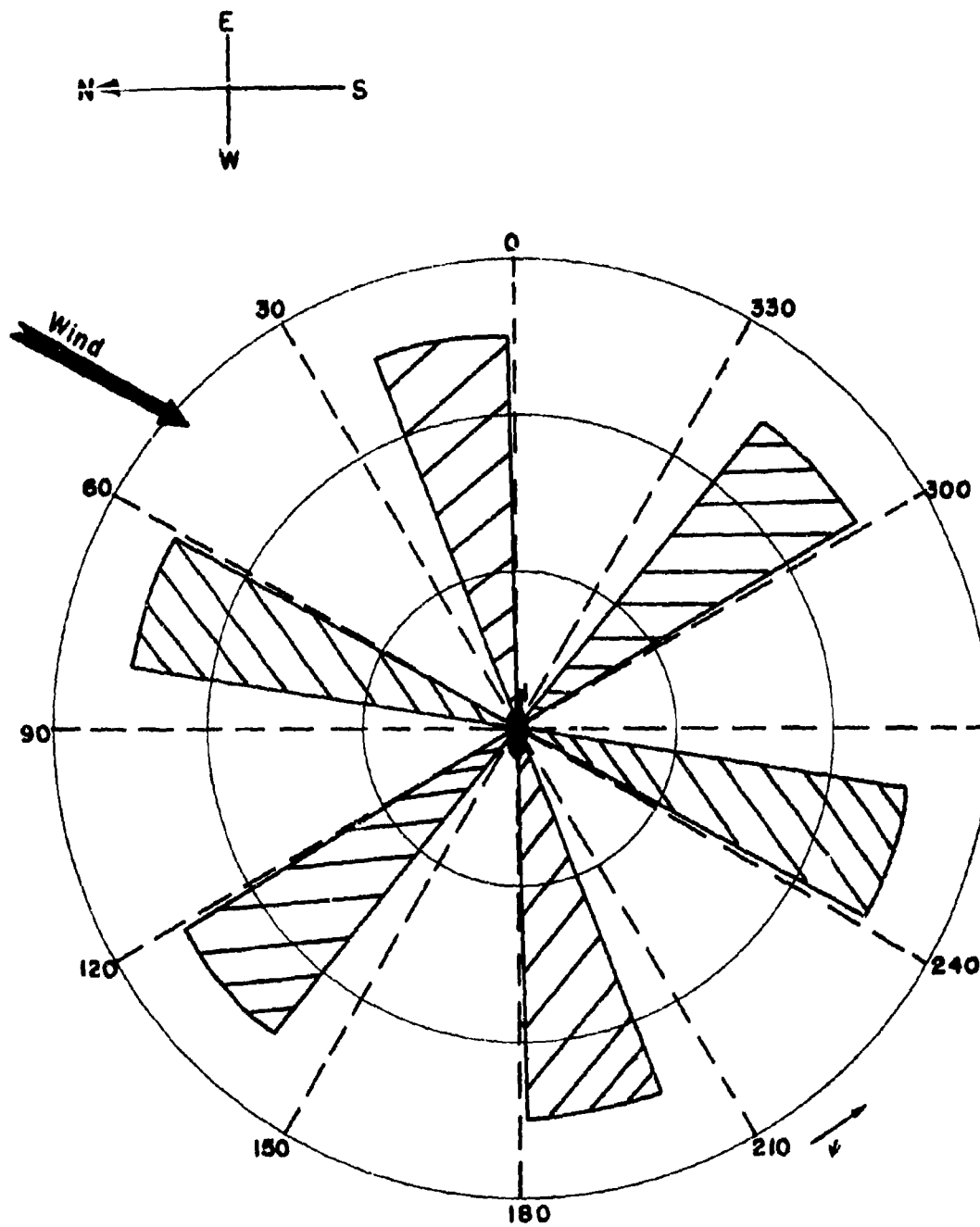
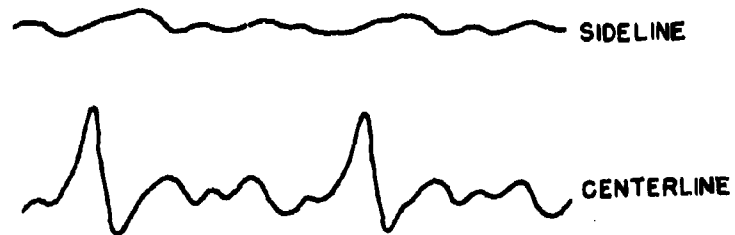


Figure 39. Range of Rotor Blade Locations at Instant of RIN Generation for OGE Hover.



a. Helicopter Over 2500 ft Away



b. Helicopter Approximately 1500 ft Away

Figure 40. Measured Time History of Acoustic Pressure, Advancing Blade Side, 170 kt.



c. Helicopter Approximately 600 ft Away

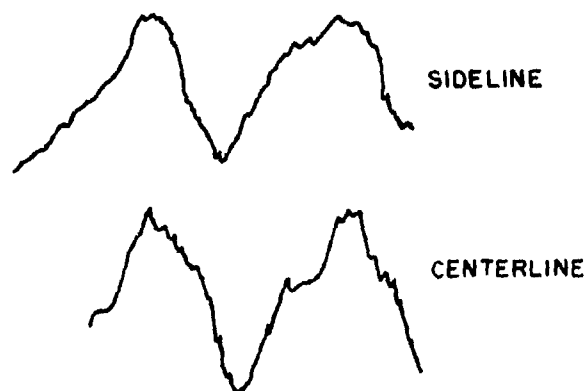


d. Helicopter Passing Over Microphones

Figure 40. Concluded.



a. Maximum Sideline Impulse, Helicopter
Approximately 600 ft Away



b. Helicopter Passing Over Microphones

Figure 41. Measured Time History of Acoustic Pressure,
Retreating Blade Side, 170 kt.



Figure 42. Measured Time History of Acoustic
Pressure, Advancing Blade Side, 140 kt.

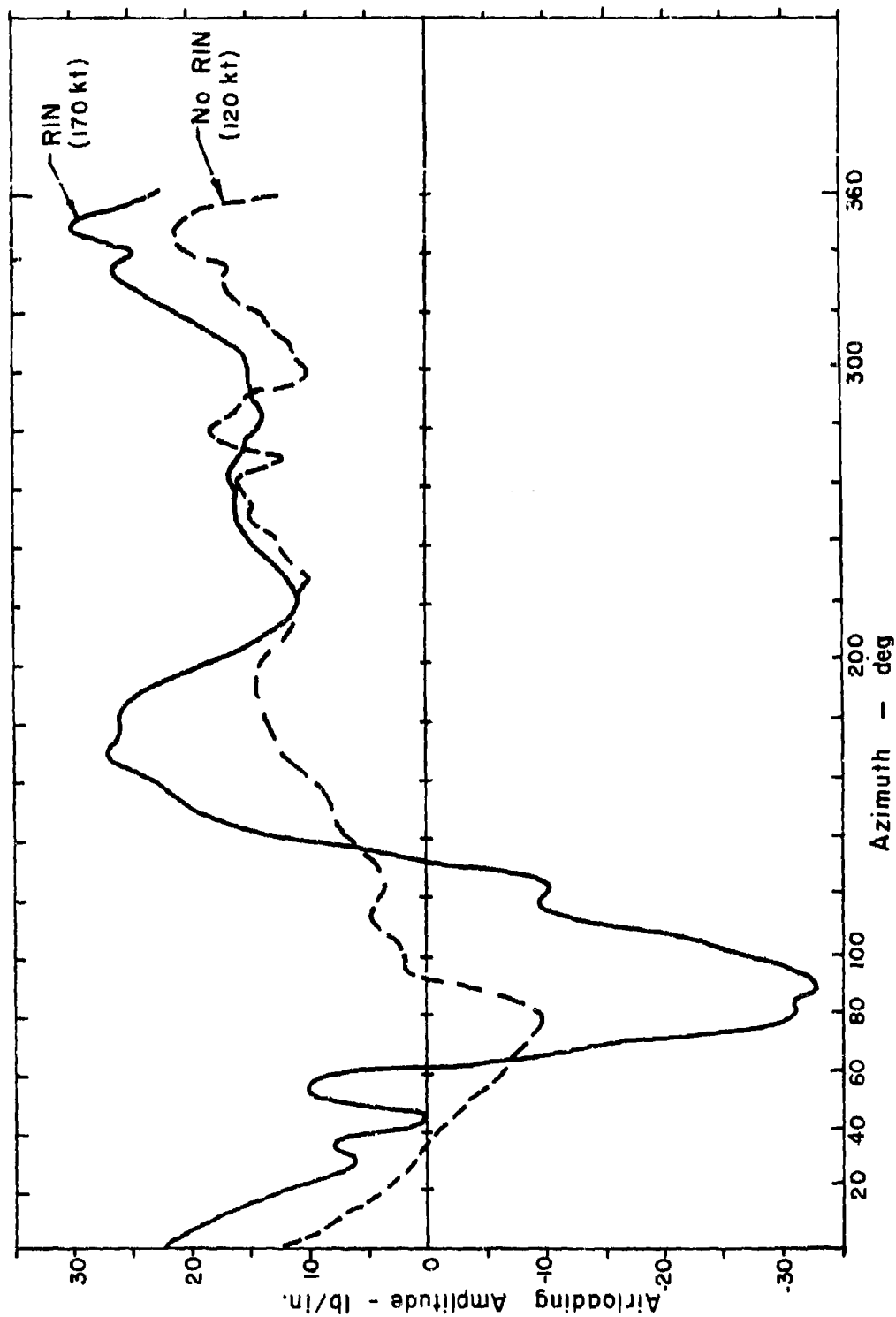


Figure 43. Blade Section Airloading as a Function of Azimuth for Cruise RIN and No-RIN Conditions (98% Span).

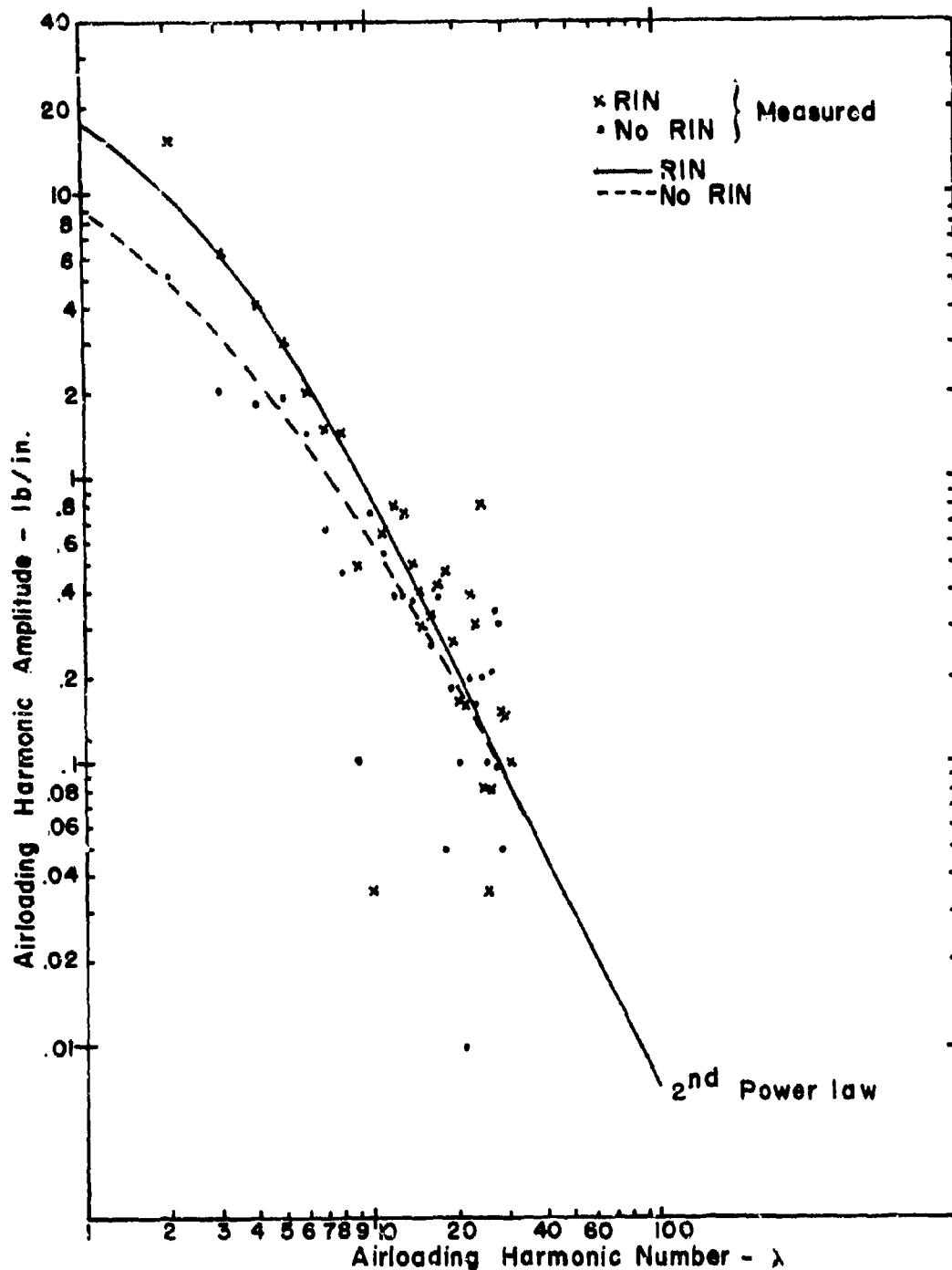


Figure 44. Airloading Harmonic Amplitude for Cruise RIN and No-RIN Conditions (98% Span).

5.0 CONCLUSIONS

Based on the results of this study of rotor impulsive noise (RIN) of a single rotor helicopter, it is concluded that:

1. RIN is characterized by an increase in SPL of the higher harmonics of rotational noise rather than increases in broadband noise amplitude and modulation. Rotor rotational noise harmonics up to the twenty-third (430 Hz) were measured during RIN conditions.
2. Cruise RIN and hover RIN of single-rotor helicopters appear to be generated by different aeroacoustic mechanisms. Cruise RIN results from the combination of acoustic effects of high subsonic tip Mach number and aerodynamic effects of drag divergence. Hover RIN results from high frequency oscillations in airloads commonly caused by blade/wake interactions.
3. Cruise RIN is highly directional, with maximum severity occurring directly ahead of the helicopter at small angles below the plane of the main rotor. The observed directionality of this RIN results from the directionality of drag divergence generated noise (maximum in the plane of the rotor) and the forward shift in directionality in the rotational noise lobes which occurs during high speed translation.
4. Aerodynamic shock effects do not appear to be a primary source of RIN for the helicopter studied.
5. The inclusion of blade flapping and coning in the acoustic analysis does not significantly improve correlation of measured and predicted noise levels.
6. Calculated time histories of acoustic pressure agree with trends in measured cruise data. Calculated and measured impulsiveness increases at 170 knots as the helicopter approaches the observer, while neither the calculated nor the measured waveform is impulsive at 140 knots.
7. Calculated noise harmonic levels correlate with measured data through the third harmonic at moderate distances from the helicopter. Correlation at large distances tends to be poor. Analytical omission of source motion and drag divergence effects seem to be the prime factors contributing to this inaccuracy. Atmospheric scattering of the noise may also be a contributing factor by causing shifts in the highly directional forward radiating patterns.

8. Theoretical airloads predicted from a Sikorsky-developed rotor loads and aeroelastic analysis (which uses a normal modes approach coupled with variable inflow) do not contain sufficient higher-harmonic amplitude and phase information to be useful for detailed acoustic predictions. These theoretical airloads give useful estimates only of the fundamental and the second harmonic of rotor rotational noise.
9. Limited ability of theoretical airload analyses to predict higher-harmonic amplitude and phase suggests that new empirical approaches are required to provide airload data for acoustic predictions.

6.0 RECOMMENDATIONS

Results from this study lead to the following recommendations for future research:

1. Modify the analysis used for the present study to incorporate the acoustic effects of profile drag and source motion. Evaluate improvement in correlation with noise data presented in this report and in Reference 15.
2. Develop a practical analysis for estimating rotor noise without measured airload data. This entails developing an empirical method for predicting airload spectrum shapes from measured rotor load data (such as H-34, NH-3A, CH-53A, and UH-1B data) and developing a computerized subroutine to construct an appropriate airload spectrum for the rotor geometry and flight condition of interest.
3. Improve the accuracy of broadband noise prediction by including the acoustic effects of vortex shedding, boundary layer turbulence, and oncoming vorticity in an acoustic analysis. Such an analysis should include the effects of blade tip geometry on shed vorticity and aerodynamic circulation. The study of basic generating mechanisms of rotor broadband noise currently supported by ARO-Durham under contract DAHCO4-69-C-0089 should be invaluable in the recommended study.

7.0 LITERATURE CITED

1. Cox, C.R., and Lynn, R. R., A STUDY OF THE ORIGIN AND MEANS OF REDUCING HELICOPTER NOISE, Bell Helicopter Company; USATCREC Technical Report 62-73, U. S. Army Transportation Research Command, Fort Eustis, Virginia, November 1962.
2. Schlegel, R.G., King, R. J., and Mull, H.R., HELICOPTER ROTOR NOISE GENERATION AND PROPAGATION, Sikorsky Aircraft; USAAVLABS Technical Report 66-4, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, October 1966, AD 645884.
3. Davidson, I. M., and Hargest, T.H., HELICOPTER NOISE, Jl. Royal Aero Soc., Vol. 69, May 1965.
4. Lowson, M.V., and Ollerhead, J.B., STUDIES OF HELICOPTER ROTOR NOISE, Wyle Laboratories; USSAVLABS Technical Report 68-60, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, January 1969, AD 684394.
5. Levertton, J.W., HELICOPTER NOISE - BLADE SLAP, PART 1: REVIEW AND THEORETICAL STUDY, University of Southampton; NASA Contractor Report 1221, National Aeronautics and Space Administration, Washington, D.C., October 1968.
6. King, R. J., and Schlegel, R.G., PREDICTION METHODS AND TRENDS FOR HELICOPTER ROTOR NOISE, Proc. Third CAL/AVLABS Symposium, 18-20 June 1969, Buffalo, New York.
7. Sadler, S.G., and Loewy, R.G., THE IMPORTANCE OF VORTEX SHEDDING EFFECTS ON HELICOPTER ROTOR NOISE WITH AND WITHOUT BLADE SLAP, Proc. Third CAL AVLABS Symposium, 18-20 June 1969, Buffalo, New York.
8. Ollerhead, J.B., and Lowson, M.V., PROBLEMS OF HELICOPTER NOISE ESTIMATION AND REDUCTION, AIAA Paper No. 69-195, AIAA AHS VTOL Research Design, and Operations Meeting, February 1969.
9. Loewy, R.G., and Sutton, L.R., A THEORY FOR PREDICTING THE ROTATIONAL NOISE OF LIFTING ROTORS IN FORWARD FLIGHT, INCLUDING A COMPARISON WITH EXPERIMENT, Rochester Applied Science Associates, Inc.; USAAVLABS Technical Report 65-82, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, January 1966, AD 629377.
10. Fricke, J.E., MONAURAL PHASE EFFECTS IN AUDITORY SIGNAL DETECTION, Jl. Acoust. Soc. Am., Vol. 43, No. 3, March 1968, pp. 439-443.
11. Clark D.R., and Leiper, A.C., THE FREE WAKE ANALYSIS. A METHOD FOR THE PREDICTION OF HELICOPTER ROTOR HOVERING PERFORMANCE, Jl. Am. Helicopter Soc., Vol. 25, No. 1, January 1970.

12. Arndt, R.E.A., and Borgman, D.C., NOISE RADIATION FROM HELICOPTER ROTORS OPERATING AT HIGH TIP MACH NUMBERS, presented at 16th Annual National forum of the Am. Helicopter Soc., Washington, D.C., June 1970, Amer. Helicopter Soc. Preprint No. 402.
13. Schlegel, R.G., and Bausch, W. E., HELICOPTER ROTOR ROTATIONAL NOISE PREDICTION AND CORRELATION. VOLUME II - DOCUMENTATION OF NOISE PREDICTION COMPUTER PROGRAM, Sikorsky Aircraft; USAAVLABS Technical Report 70-1B, U. S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, November 1970.
14. Gessow, A., and Meyers, G.C., AERODYNAMICS OF THE HELICOPTER, New York, Frederick Ungar Publishing Co., 1967.
15. Schlegel, R.G., and Bausch, W.E., HELICOPTER ROTOR ROTATIONAL NOISE PREDICTION AND CORRELATION. VOLUME I - ROTATIONAL NOISE PREDICTION AND CORRELATION UNDER NONUNIFORM INFLOW CONDITIONS, Sikorsky Aircraft; USAAVLABS Technical Report 70-1A, U.S. Army Aviation Materiel Laboratories, Fort Eustis, Virginia, November 1970.
16. Cox, C.R., ROTOR NOISE MEASUREMENTS IN WIND TUNNELS, Proc. Third CAL/AVLABS Symposium, 18-20 June 1969, Buffalo, New York
17. van de Vooren, A.I., and Zandbergen, P.J., NOISE FIELD OF A ROTATING PROPELLER IN FORWARD FLIGHT, AIAA J1., Vol. 1, No. 7, July 1963, pp. 1518-1526.
18. Wright, S.E., SOUND RADIATION FROM A LIFTING ROTOR GENERATED BY ASYMMETRIC DISK LOADING, J1. Sound Vib., Vol. 9, No. 2, 1969, pp. 223-240.
19. Wright, S.E., and Leverton, J.W., HELICOPTER ROTOR NOISE GENERATION, Proc. Third CAL/AVLABS Symposium, 18-20 June 1969, Buffalo, New York.
20. Sadler, S.G., and Loewy, R.G., A THEORY FOR PREDICTING THE ROTATIONAL AND VORTEX NOISE OF LIFTING ROTORS IN HOVER AND FORWARD FLIGHT, Rochester Applied Science Associates, Inc.; NASA Contractor Report 1333, National Aeronautics and Space Administration, Washington, D.C., May 1969.
21. Diprose, K. V., SOME PROPELLER NOISE CALCULATIONS SHOWING THE EFFECT OF THICKNESS AND PLANFORM, RAE Tech M.S. 19, 1955.

APPENDIX I

COMPUTER PROGRAM MODIFICATION

The computer program described in AVLABS Report 70-1B (Reference 13) was modified during the present study to reduce running time, to include rigid body blade flapping and rotor shaft inclination, and to obtain the time history of acoustic pressure at each location for which rotational noise levels are calculated. Modifications are described below.

I.1 RUNNING TIME

The computer program calculates rotational noise harmonic levels based on any arbitrary pressure distribution on the rotor blades. In order to relate the pressures on the blades to the noise heard by an observer, the pressure profile on a typical section of a blade at any given time is represented by a Fourier series whose coefficients are calculated by numerically integrating the pressure profile over the appropriate interval. Since the pressure profile changes as the blades move azimuthally, the Fourier series coefficients required for each noise harmonic must be calculated several hundred times to define the rotor system as a noise source. The calculation of these Fourier series accounts for 75% of the machine time used in the calculation of each noise harmonic.

These series coefficients are stored in the computer since they are not influenced by locations for which noise levels are calculated. In the original version, the coefficients were stored in the computer core and, consequently, were available only during the running of the program. If inspection of the computer output revealed that different observer locations were required to answer questions about the noise radiation patterns, it was necessary to re-run the program to reproduce the old Fourier series for the new observer locations. In the modified version, the series coefficients are stored on magnetic tape for each rotor operating condition. Machine time on subsequent runs is reduced from more than 150 seconds per noise harmonic to approximately 40 seconds by reading the coefficients from the tape. An input option, DRUM, has been added to specify that coefficients are to be read in from tape.

I.2 RIGID BODY FLAPPING

In the original noise prediction computer program, the rotor disk is represented by a flat plate that lies in a plane parallel to the ground. Directional characteristics of the rotor noise are caused solely by the distribution of aerodynamic forces over the rotor disk and by the pitch angle of the rotor blades as they rotate around the azimuth. Subsequent correlation work using this analysis indicated that correlation should be improved by removing the assumption of a horizontal, flat rotor disk in favor of a more realistic description of the rotor geometry and orientation relative to the ground.

The present study improved the mathematical model of the rotor system by adding rotor shaft fore/aft inclination and rigid-body blade flapping to the noise prediction equations. The sign conventions used are standard

for helicopters (Gessow and Meyers, Reference 14) with shaft inclination angle (θ) positive aft, and blade flapping angle (ϕ) positive above the plane perpendicular to the rotor shaft (Figure 45). These angles are used to define the x, y, and z components of the aerodynamic forces acting on the rotor blades. The effects of these angles on the distance between rotor and observer are neglected since this effect is small for normal helicopter operations.

The solution to the acoustic wave equation that is the foundation of the noise prediction analysis is given in Reference 15 as the relationship

$$P_m[x, y, z, t] = \frac{1}{4\pi} \int_0^b \int_0^R \int_0^{2\pi} \left\{ g_{mx} \frac{\partial}{\partial x} + g_{my} \frac{\partial}{\partial y} + g_{mz} \frac{\partial}{\partial z} \right\} \frac{1}{s} \cos \left\{ mn\Omega \left[t - \frac{\psi}{\Omega} - \frac{s}{c} \right] \right\} \\ + \left\{ h_{mx} \frac{\partial}{\partial x} + h_{my} \frac{\partial}{\partial y} + h_{mz} \frac{\partial}{\partial z} \right\} \frac{1}{s} \sin \left\{ mn\Omega \left[t - \frac{\psi}{\Omega} - \frac{s}{c} \right] \right\} \} db dr d\psi$$

where $P(x, y, z, t)$ is the m^{th} harmonic of acoustic pressure as a function of time t and observer location (x, y, z) and g_{mx} , g_{my} , g_{mz} , h_{mx} , h_{my} , h_{mz} are related to the components of the aerodynamic forces in the x, y, and z directions as defined in Reference 15.

The flapping motion of the blades introduces radial components of aerodynamic forces in the rotor disk. Fore/aft inclination of the rotor shaft merely changes the orientation of the rotor system relative to the ground. Since both feathering (pitch) and flapping motions are measured with respect to the rotor shaft, it is convenient to develop the analysis in a shaft axis coordinate system (Figure 45). Inclination of the rotor shaft from the vertical then can be accounted for by a simple transformation of coordinates.

Coordinate Convention:

Origin: Center of rotation
 x : $\perp$ shaft, + = aft ($\psi = 0^\circ$)
 y : $\perp$ shaft, + = starboard side ($\psi = 90^\circ$)
 z : Coincides with shaft axis, + = direction of positive rotor thrust
 β : Pitch angle on blade, + = leading edge up, function of radius and azimuth
 ϕ : flapping angle, + = above x-y plane, function of azimuth only (the blade is not permitted to bend or twist dynamically)
 ψ : Azimuth angle, normal helicopter (ccw from above, 0° on x-axis)

The g_{mx} , h_{mx} , etc., parameters may be treated as components along each axis

of the aerodynamic forces acting on the rotor blades. For this analysis, aerodynamic forces always are perpendicular to both the chord line and the feathering axis of the rotor blades. These forces are projected onto the z-axis directly and onto the x-y plane as radial and azimuthal components. If $\vec{F}$ is the aerodynamic force vector as shown in Figure 46, then the radial component, F_R , is $F_R = |\vec{F}| \cos\beta \sin\phi$; the azimuthal component, F_A , is $F_A = |\vec{F}| \sin\beta$; and the vertical component, F_Z , is $F_Z = |\vec{F}| \cos\beta \cos\phi$. x- and y-axis components of $\vec{F}$ are easily found from the azimuthal and radial components:

$$\begin{aligned} F_x &= F_A \sin\psi - F_R \cos\psi \\ F_y &= -\left(F_A \cos\psi + F_R \sin\psi\right) \\ F_z &= |\vec{F}| \cos\beta \cos\phi \end{aligned}$$

The above relationships translate into acoustic wave equation terminology as follows, where g_m is the magnitude of the unresolved aerodynamic force

$$\begin{aligned} g_{mx} &= g_m \left(\sin\beta \sin\psi - \cos\beta \sin\phi \cos\psi \right) \\ g_{my} &= -g_m \left(\sin\beta \cos\psi + \cos\beta \sin\phi \sin\psi \right) \\ g_{mz} &= g_m \cos\beta \cos\phi \end{aligned}$$

with analogous results for the h_m terms.

1.3 INCLINATION OF ROTOR SHAFT

The preceding equations are valid in the shaft-axis coordinate system, but this reference frame is not convenient for application to the noise prediction computer program. Consequently, the equations have been transformed from the shaft axis coordinate system to a more convenient system with the x-y plane parallel to the ground and z normal to the x-y plane (positive above this plane). By considering only fore/aft shaft inclination, the transformation consists of simple rotation about the y-axis. Using primed symbols for the shaft-axis system and unprimed for the transformed coordinates, the result is

$$\begin{aligned} x &= x' \cos\theta + z' \sin\theta \\ y &= y' \\ z &= z' \cos\theta - x' \sin\theta \end{aligned}$$

Consequently,

$$g_{mx} = g'_{mx} \cos \theta + g'_{mz} \sin \theta$$

$$g_{my} = g'_{my}$$

$$g_{mz} = g'_{mz} \cos \theta - g'_{mx} \sin \theta$$

so that the final result for g_m (or h_m) with the addition of flapping and longitudinal shaft tilt is

$$g_{mx} = g_m \left\{ \cos \theta \left(\sin \beta \sin \psi - \cos \beta \sin \phi \cos \psi \right) + \sin \theta \cos \beta \cos \phi \right\}$$

$$g_{my} = g_m \left\{ -\cos \beta \sin \phi \sin \psi - \sin \beta \cos \psi \right\}$$

$$g_{mz} = g_m \left\{ \cos \theta \cos \beta \cos \phi + \sin \theta \left(\cos \beta \sin \phi \cos \psi - \sin \beta \sin \psi \right) \right\}$$

The flapping and shaft tilt terms from g_m and h_m propagate through the analysis and ultimately influence only one basic term in the equations. That term, q_1 , accounts for direction and distance from the rotor system to an observer location.

$$\begin{aligned} q_1 = & [x - r \cos \psi] \left\{ \cos \theta [\sin \beta \sin \psi - \cos \beta \sin \phi \cos \psi + \sin \theta \cos \beta \cos \phi] \right\} \\ & - [y - r \sin \psi] \left\{ \cos \beta \sin \phi \sin \psi + \sin \beta \cos \psi \right\} \\ & + z \left\{ \cos \theta \cos \beta \cos \phi + \sin \theta [\cos \beta \sin \phi \cos \psi - \sin \beta \sin \psi] \right\} \end{aligned}$$

I.4 ACOUSTIC PRESSURE TIME HISTORY

In previous correlation studies of rotor rotational noise (References 2 and 15), the root-mean-square sound pressure level (SPL) in decibels was the critical parameter. The present study has included the time history of acoustic pressure to determine how well the analysis predicts both amplitude and phase of the noise harmonics. The addition of the time history to the computer program was straightforward since the required acoustic parameters, u_m and v_m , are calculated for the rms SPL. The

acoustic pressure of the m^{th} harmonic as a function of time is given as

$$p_m[t] = u_m \cos m\omega t + v_m \sin m\omega t$$

where ω is the blade passage frequency. The total acoustic pressure, $P(t)$, can be constructed from

$$P[t] = \sum_{m=1}^{\infty} u_m \cos m\omega t + v_m \sin m\omega t$$

The computer program now divides the blade passage period into 40 segments to define the time history of acoustic pressure.

1.5 USE OF ROTATIONAL NOISE PREDICTION COMPUTER PROGRAM

The program calculates the root-mean-square (SPL) of up to 10 harmonics of rotor rotational noise at as many as 20 observer locations relative to the rotor system. The time history of acoustic pressure also is calculated.

Calculated noise levels can be based on different chordwise distributions of airloading. Flight test aerodynamic data are used whenever possible, so the chordwise distribution is arbitrary and reflects the effects of stall, compressibility, reversed flow, and blade wake interactions. Use of an arbitrary distribution without flight data requires the user to fabricate pressures that give the desired distribution.

Subroutine E386RN is provided to calculate noise levels based on a hypothetical constant airload across the blade chord. This subroutine is much faster and less complicated than the calculation procedure for an arbitrary chordwise distribution of load. The time history of acoustic pressure is not calculated when subroutine E386RN is used alone.

1.5.1 Hardware Requirements

The program was written in FORTRAN V specifically for use on the Univac 1108 system operated by the United Aircraft Research Laboratories (UARL). The program uses direct access input/output FH-332 drums, units 28 through 30, to manipulate data. One tape drive unit, number 14, is required to store or recall the Fourier series coefficients discussed in Section I.1. If the noise prediction program is to be run on a different computer, an analyst must go over the source deck to make the input/output calls compatible with available hardware. Without using overlay techniques, the program uses approximately 50,000 decimal words of storage.

1.5.2 Software Requirements

The program uses two software packages that are uniquely suited to the UARL system. One package, called NTRAN, was used in the original version of the noise prediction program. This routine allows the 1108 computer to proceed with calculations while parameters are being read into core or written out onto a storage file. While this feature is standard for the

1108, different computer installations may have a different name or call argument for the routine than the UARL system. All calls to NTRAN occur in the part of the program called E676. The other software package that is tailored to UARL's system is called Drum Data Transfer (DDT). This routine was added during the present study to expedite storage and retrieval of the coefficients discussed in Section I.1. The remainder of the present section describes where DDT is used in the program and outlines the requirements that a substitute storage/retrieval routine must satisfy.

Coefficients named GMAR and HMAR are calculated for each noise harmonic and are a function of the aerodynamic loading on the rotor blades. For each noise harmonic, there are 720 values of GMAR and 720 values of HMAR (144 azimuthal locations per spanwise location times 5 spanwise locations). Since the program is designed to calculate as many as 10 harmonics of noise, the storage system must accommodate 14,400 coefficients. Storage format should be conducive to retrieving all of the coefficients for a given noise harmonic at the start of the major loop on noise harmonics in E676.

The statements in the noise prediction computer program that involve DDT operations are identified below by the sequence numbers that are punched in the last 8 columns of each card. Comment cards precede each DDT operation to explain its purpose. The first 4 characters, L76M, label the cards as part of the main program E676. In the program version presented in Appendix V, statements for DDT operations have been changed to comment cards by placing a "C" in column 1. The relevant cards are: L76M0910, L76M2750, L76M3600 through L76M3640, L76M4020, L76M4890, L76M4900, L76M4920, and L76M4930.

Note that cards L76M2750, L76M4890, and L76M4900 use DDT when the DRUM input mode is not used. The computer program can be used without developing a substitute for DDT by deleting these 3 cards and using the CARD input mode. Section I.5.4 defines input parameters and illustrates proper placement on punched cards.

I.5.3 Data Requirements

Input data describe rotor geometry and flight condition, observer location relative to the rotor system, and aerodynamic loads acting on the rotor blades. These data are read from cards for each run or are built into the program in the block data subroutine BLODAT. Section I.5.6 discusses some features of this subroutine that might affect use of the program for a rotor system other than the CH-53A rotor that was used for this study. Output data normally consists of:

1. A display of input values including differential pressure as a function of azimuth for each chordwise and spanwise location on the blade.
2. A listing of Fourier series coefficients (Section I.1) as a function of azimuth for each span location and each noise harmonic.

3. A listing of the oscillatory components of acoustic pressure used in the final equation of section I.4.
4. A listing of SPL as a function of observer location for each noise harmonic.

I.5.4 Input Parameters and Format

The programming names of input parameters and their appropriate units are indicated in this section. Placement of these parameters on punched cards is illustrated in Figure 47. Figure 48 shows actual values in a complete sample data set for the CARD input mode. Numerical values of the input parameters must contain a decimal point unless an integer is specified.

BB	Maximum blade thickness; inches.
AA	Blade chord length; inches, assumed constant along the blade span.
BLADEL	Blade length (radius); inches, measured from center of rotation.
GAMA	Blade twist rate (linear); degrees per inch, positive value for normal negative twist from root to tip.
RO	Blade radial location where twist starts; inches, normally taken to be reference radius for blade pitch angle.
CC	Speed of sound in air; inches per second.
OMEG	Rotational speed of rotor; revolutions per minute.
DPSI	Azimuth angle increment for calculations; degrees, can be 1.25 degrees or multiple of 2.50 degrees.
NBLADE	Number of rotor blades; integer.
MLIMDP	Number of harmonics of blade pressure to be input, not greater than 30; integer.
MLIMRN	Highest noise harmonic order to be calculated, not greater than 10; integer.
LSPAN	Number of interpolated equidistant radial stations used in noise calculations, equals 10 or 20 only; integer.
IREELS	Number of input data tapes (not greater than 5), normally left equal to 1; integer.
TCOP	Option to read aerodynamic data from punched cards (CARD), or magnetic tape or fastran drum (DRUM); alphanumeric.
PUNCH	Option to punch aerodynamic pressure harmonics on cards, normally left N; alphanumeric.
INTERM	Option for intermediate output, left N; alphanumeric.
IDD	Option for intermediate output, left blank or 0 (zero); integer.
RR(IN)	Instrumented radial stations in terms of decimal fraction of span for IN = 1 (closest to root) to IN = 5 (closest to blade tip).
XA(IN,JN)	Instrumented chordwise in terms of decimal fraction of chord at chord locations JN = 1 (closest to leading edge) to JN = 5 (closest to trailing edge) for each span IN.

TIME Time interval over which acoustic pressure is calculated, normally equals period of blade passage frequency (seconds per cycle); seconds.

THETA Fore-aft inclination of main rotor shaft from Z-axis, negative for forward inclination; degrees, autogyro sign convention.

E3860P Option to calculate noise based on constant chordwise load distribution, Y for yes or N for no; alphanumeric.

OPRONO Option to calculate noise based on arbitrary chordwise distribution of airload, equals Y for yes or N for no.

Note: E3860P and OPRONO must not be Y simultaneously since OPRONO results will be meaningless due to an equivalencing of certain variables.

NFT Number of observer locations at which noise levels are to be calculated, not greater than 20; integer.

Note: The parameters ANG, NHH, KEY 1, KEY 2, and KEY 3 are required only if E3860P equals Y, in which case OPRONO must equal N.

ANG Azimuthal increment used to calculate noise with E386RN; degrees, must satisfy $(360/\text{ANG}) = \text{even integer number}$, and ANG not less than 0.5 degree.

NHH Number of section load harmonics to be calculated from input pressure harmonics, normally equal to or less than MLIMDP; integer.

KEY 1 } Options for intermediate print-
KEY 2 } out from E386RN, left equal
KEY 3 } to zero; integer.

Note: Observer locations are specified in spherical coordinates (CAPRF, THETAF, ALFAF) when E3860P equals Y and in rectangular coordinates (XFP, YFP, ZFP) when OPRONO equals Y. Origin of both systems is the rotor hub.

CAPRF Line-of-sight distance from rotor hub to observer; feet.

THETAF Azimuthal location of observer relative to rotor; degrees, normal helicopter azimuth convention.

ALFAF Elevation angle of observer relative to rotor plane; degrees, negative for observer below rotor plane.

XFP X-axis location of observer (parallel to THETAF equal zero); inches from rotor hub, positive along THETAF = 0.0° and negative along THETAF = 180.0° (ahead of helicopter).

YFP Y-axis location of observer; inches, positive along THETAF = 90° .

ZFP Z-axis location of observer; inches, positive along ALFAF = 90° (thrust axis of hovering rotor).

IBURST Number of the data set being processed, significant only when TCCP equals TAPE; integer.

Note: The following parameters are not required if the DRUM input mode is used.

BO Steady component of blade pitch angle; degrees.

B1C First harmonic cosine component of blade pitch angle; degrees, defined for a positive series.
 B1S First harmonic sine component of blade pitch angle; degrees, defined for a positive series.
 FO Steady component of blade flapping angle (also called coning angle); degrees, positive for flapping up.
 F1C First harmonic cosine component of oscillatory flapping; degrees, defined for a positive series.
 F1S First harmonic sine component of oscillatory flapping; degrees, defined for a positive series.
 CN(K,JN,IN) Cosine component of kth harmonic of differential pressure at chord JN and span IN; pounds per square inch, defined for positive series.
 SN(K,JN,IN) Sine component of kth harmonic of differential pressure; as above.
 K Order of harmonic of differential pressure, between 1 (steady) and 31 (30th oscillatory component); integer.
 JN Location along blade chord between 1 (closest to leading edge) and 5 (closest to trailing edge); integer.
 IN Location along blade span between 1 (closest to root) and 5 (closest to tip); integer.

During normal operation, the first run for a given operating condition will use aerodynamic pressure data on punched cards. This is indicated by placing the word CARD in the space allotted to variable TCOP. By saving the Fourier coefficients that describe the chordwise distribution of differential pressure, subsequent runs for the same flight condition will require relatively few data cards. To use coefficients from a previous run, the word DRUM is placed in the TCOP location, and the appropriate data are read in via unit 14. Figure 49 shows sample data for the DRUM input mode where data are read from the 4th file of tape "G" (unit 14).

1.5.5 Output Data

Figure 50 contains a typical computer output from rotational noise prediction program E676. Values of differential pressure are printed every 2.5 degrees of azimuth from 0° through 357.5°. These listings are read line-by-line from left to right. Fourier coefficients are listed after the differential pressures with cosine coefficients followed by sine coefficients for each span location (blade station) and each noise harmonic. The first line of cosine coefficients is indented 3 spaces, as is the first line of sine coefficients. These listings are read the same way as the differential pressure listings. Oscillatory components of acoustic pressure are listed next for each observer location, followed by the time history of acoustic pressure at each observer location (field point). These acoustic pressures are read line-by-line from left to right. The 1st value is the acoustic pressure at some arbitrary time $t = 0$, and the 41st value is the pressure at the time $t = T$ (the period of the blade passage frequency). The value at $t = T$ should nearly equal the value at $t = 0$ if the time interval, TIME, is equal to $(1/\text{blade passage frequency})$. Rotational noise levels as a function of field point for each noise harmonic are the last parameters to be printed out.

I.5.6 Changes to Subroutine BLODAT

Subroutine BLODAT contains numerical values that normally do not change from run to run. The program is designed to accept aerodynamic pressure data at 5 chord stations for each of 5 span stations, and the status of each of these locations is defined in BLODAT by parameters IRS(I) and NCHAN(I,J). If no data are available for a given chord or span location, changes are required to IRS(I) or NCHAN(I,J), or to both. Since the transducer at the 4th chord location of the 1st span location was inoperative during the present study, NCHAN(1,4) = 0 to indicate that no data would be input for that position. This also tells the program to use an averaged quadratic integration technique in all chordwise integrations at the 1st span location. For normal use, NCHAN(1,4) should be changed to 4. The proper format for these parameters is shown in the listing of the program (Appendix V).

I.5.7 Running Time and Page Requirements

Approximately 2.5 minutes of machine time should be allowed for each noise harmonic when the CARD input mode is used. This is reduced to approximately 0.6 minute per harmonic when the DRUM input mode is used. To be conservative, allow for 50 pages of output.

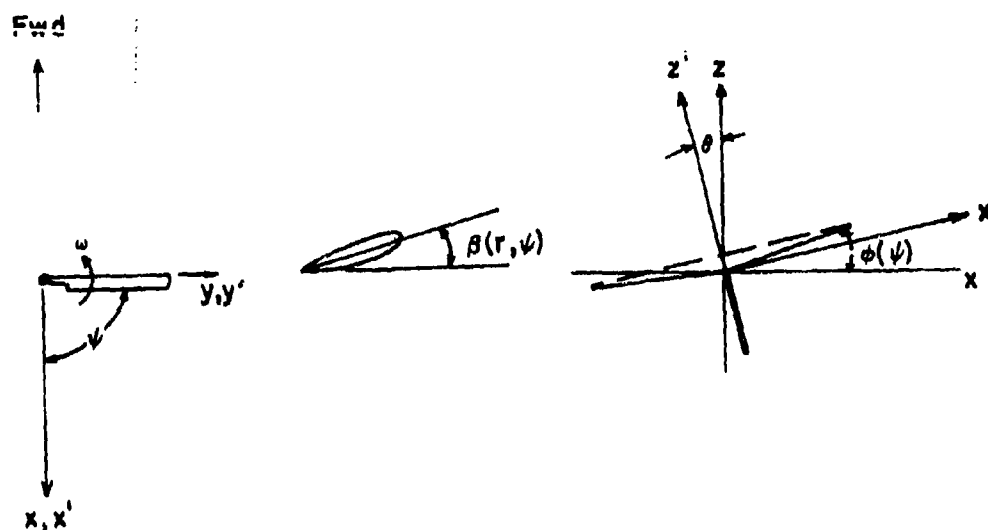


Figure 45. Coordinate Systems for Rotor Noise Calculation.

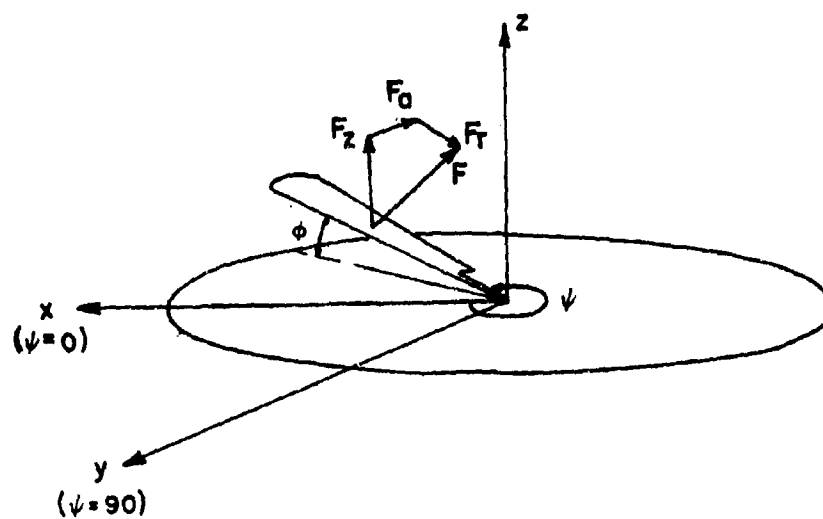


Figure 46. Resolution of Aerodynamic Forces.

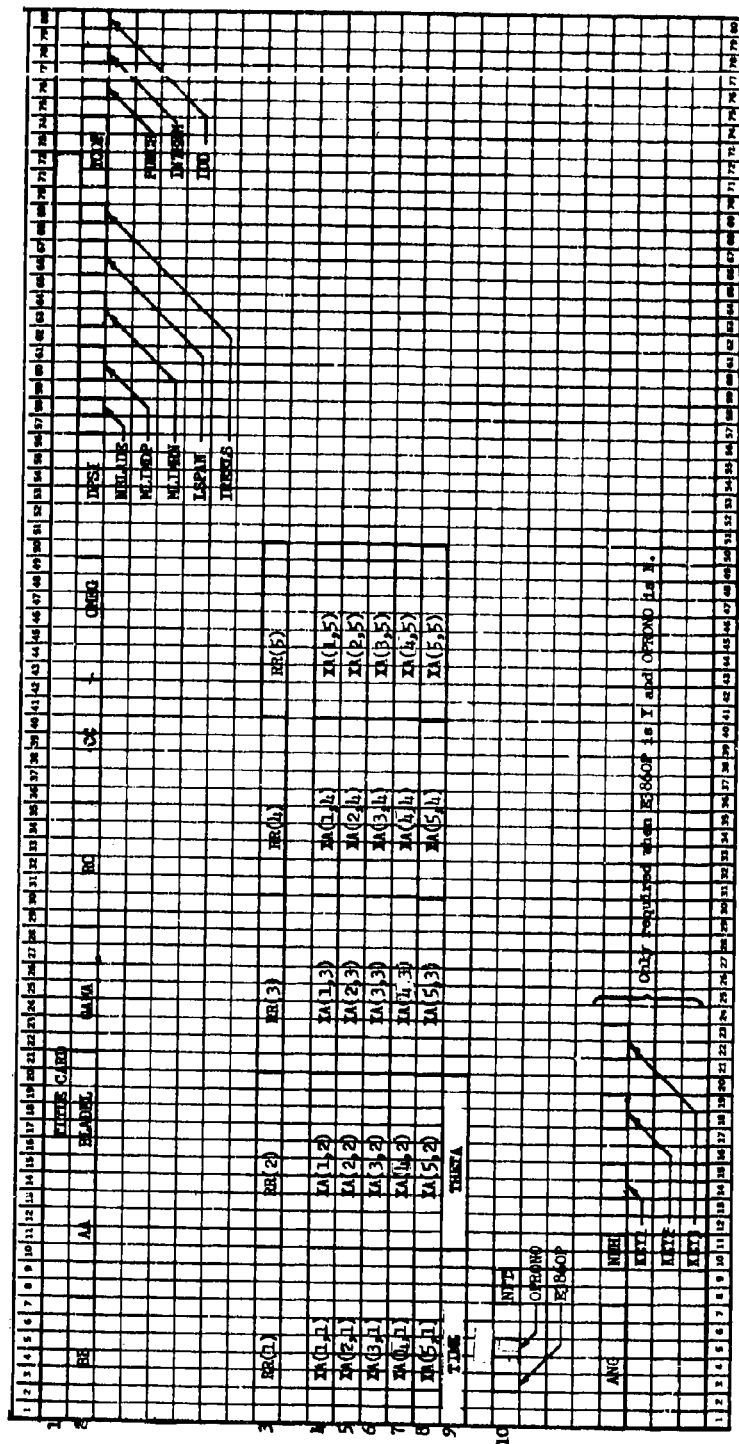


Figure 47. Placement of Parameters on Cards.

[illegible]

```

Q PUN E676WJ441167609005000050      (633) BAUSCH, W 3 STATION 1111
QF ASG 11
QF ASG 5
QF ASG G=9362SY
Q XOT CWR
  TRS
  THF NOISE
  PER G.G.O
Q XOT AF676
E676 SAMPLE DECK SFT-IN 20AUGUST70 TCOP = CARD
2.86 26.0 433.4 .0131 118.0 13270.188. 2.5 6 8 5 20 1 CARD N N
.4 .75 .85 .95 .98
.042 .158 .3 .6 .91
.042 .158 .3 .6 .91
.042 .158 .3 .6 .91
.042 .158 .3 .6 .91
.042 .158 .3 .6 .91
.0531 0.0
N Y 2
538.52 0. -30. 5596. 0. -3231.
538.52 0. -5. 6438. 0. -563.
BURST NO. = 7 *** ROTOR NOISE PUNCHED OUTPUT ***
BLADE PITCH HARMONICS
1.3133+01 1.2684+00 1.4096+00 (COLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY)
ROTOR FLAPPING ANGLE HARMONICS
3.4965+00-9.2093-01 0.0000 (POSITIVE TAIL HIGH -- DEGREES)
DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
(MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY).
SPAN 1 CHORD 1 STEADY= 1.3215+00
COSINE COEFFICIENTS
1.7893-01 8.6379-02-9.1522-02 5.4074-02-1.4760-02 1.3739-02-3.2843-03 6.8900-03
SINE COEFFICIENTS
2.5822-01 1.2173-01-7.8300-02 1.6145-02-2.9130-02 2.6313-02-8.1456-03 1.4022-02
SPAN 1 CHORD 2 STEADY= 5.2611-01
COSINE COEFFICIENTS
6.3769-02 2.6989-02-2.6319-02 2.2534-02-1.1330-02 2.8705-03-8.5509-04 4.2238-03
SINE COEFFICIENTS
1.0326-01 4.1014-02-2.4542-02 7.6643-03-4.6196-03 8.0601-03 7.9350-03 7.4742-03
SPAN 1 CHORD 3 STEADY= 2.7584-01
COSINE COEFFICIENTS
5.3880-02 2.8974-02-2.9560-02 9.6782-03-6.2573-03 3.0603-03 1.4864-03 3.5357-03
SINE COEFFICIENTS
7.3465-02 3.2867-02-1.2936-02 5.3314-03-6.4602-03 6.6668-03-7.8706-04 3.6909-03
SPAN 1 CHORD 4 STEADY= 0.0000
COSINE COEFFICIENTS
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SINE COEFFICIENTS
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
SPAN 1 CHORD 5 STEADY= -5.6346-02
COSINE COEFFICIENTS
-0.4211-03-4.8721-03 3.1423-03-3.3696-04-2.9359-05 4.4270-04-2.7112-04-9.1695-04
SINE COEFFICIENTS
-8.4587-04-4.6024-03 8.6588-05-1.6911-03 2.1953-03-3.2855-04 1.5774-04-2.6268-04
SPAN 2 CHORD 1 STEADY= 3.5155+00
COSINE COEFFICIENTS
6.2205-01-5.0632-02 1.4603-02 3.2436-02-6.0388-02 2.5522-02-1.7416-03-5.5072-03
SINE COEFFICIENTS
6.4991-01 1.7020-01 3.8800-02 8.0048-02 3.4875-03 1.5879-02 1.3939-02-4.9721-04
SPAN 2 CHORD 2 STEADY= 1.4074+00
COSINE COEFFICIENTS

```

Figure 48. Sample of CARD Input Mode.

2.2125-01-1.4134-03 6.7889-03 2.1101-02-3.0036-02 1.3883-02-5.0205-03-1.6058-03
 SINE COEFFICIENTS
 2.4252-01 7.7975-02 1.6632-02 3.2862-02 1.3079-02 7.4412-03 7.4750-03 5.3284-03
 SPAN 2 CHORD 3 STEADY= 1.1239400
 COSINE COEFFICIENTS
 1.4021-01-2.5537-02 7.3251-04 1.2601-02-1.5888-02 6.8869-03 1.0343-04 2.9860-03
 SINE COEFFICIENTS
 1.4063-01 3.6232-02 7.2472-03 2.2703-02-3.6062-04 7.2413-03 3.5772-03-4.5975-04
 SPAN 2 CHORD 4 STEADY= 2.7872-01
 COSINE COEFFICIENTS
 8.4155-02 2.6385-03-2.0558-03 9.6918-03-8.3669-03 9.2523-04-7.9473-04-2.9648-03
 SINE COEFFICIENTS
 4.7117-02 2.0689-02 6.5795-03 5.4138-03 1.1244-02 4.4744-03 3.3201-03-6.1514-04
 SPAN 2 CHORD 5 STEADY= -1.6337-01
 COSINE COEFFICIENTS
 2.6125-02 3.8526-03-1.3509-03 3.7271-03-2.7216-03 6.2714-04 6.4998-04-1.5116-03
 SINE COEFFICIENTS
 -1.3585-02 4.4238-03-3.3623-03-1.4518-03 4.5007-03 2.1445-04 1.2701-03 4.2440-04
 SPAN 3 CHORD 1 STEADY= 4.5398400
 COSINE COEFFICIENTS
 9.1344-01 2.4672-02-9.5280-02-6.1585-02-1.5801-01 5.5662-03 9.4039-02 1.1364-01
 SINE COEFFICIENTS
 6.0212-01 1.0442-01 1.7576-02-4.8439-03 1.3575-01 7.2371-02 6.9967-02-6.1871-02
 SPAN 3 CHORD 2 STEADY= 5.1488-01
 COSINE COEFFICIENTS
 3.1920-01 3.6656-02-2.4089-02 3.2477-02-4.0168-02 3.1908-03 1.3488-02 9.5870-03
 SINE COEFFICIENTS
 6.9666-02 9.5417-02 9.9914-03 1.6957-02 2.9003-02-2.0850-03 3.1961-03-3.1983-03
 SPAN 3 CHORD 3 STEADY= -3.7077-01
 COSINE COEFFICIENTS
 9.4995-02 5.2003-02-2.9669-02 1.2778-02-1.2519-02 9.4363-04 5.9984-03-1.5821-03
 SINE COEFFICIENTS
 -2.2669-03 6.2634-02-2.6832-03 1.3001-02 2.2155-02 4.6875-03-4.3110-03-6.0489-03
 SPAN 3 CHORD 4 STEADY= 1.1764400
 COSINE COEFFICIENTS
 5.5060-03 1.5338-02-1.7025-02 1.1994-02-3.1227-04-1.0326-04 1.0875-03-8.7683-03
 SINE COEFFICIENTS
 -3.8908-02 2.8985-02-2.4007-04 1.0648-02 6.8600-03 8.6288-04-9.1648-03-7.1324-05
 SPAN 3 CHORD 5 STEADY= 2.0242-01
 COSINE COEFFICIENTS
 3.1762-03 4.9851-03-2.5603-03 5.8589-03 2.8196-03-4.5628-04-2.1767-04-5.9044-03
 SINE COEFFICIENTS
 -2.3438-02 9.5578-03 9.9387-04 3.4870-03 9.5972-04 7.8844-04-6.8262-03 9.5167-04
 SPAN 4 CHORD 1 STEADY= 9.5341400
 COSINE COEFFICIENTS
 -1.3684400-8.4312-01-1.9837-01-2.4799-01-1.9390-01 7.3388-02 4.8595-02 5.4914-03
 SINE COEFFICIENTS
 -7.3405-01-8.1310-01 9.9605-02 2.6595-01 4.6046-02 4.8517-04-8.7989-03-1.4977-01
 SPAN 4 CHORD 2 STEADY= 3.8796400
 COSINE COEFFICIENTS
 -1.1079400-3.8811-01-6.3380-02-1.2579-01-1.7367-01 1.2761-01 1.3918-01-4.6663-02
 SINE COEFFICIENTS
 -3.5022-01-6.0494-01 1.0944-01 1.7018-01 1.4051-01-6.0502-02 6.5529-02-8.6124-02
 SPAN 4 CHORD 3 STEADY= 1.7704400
 COSINE COEFFICIENTS
 -2.6249-01-1.9883-01-5.1591-02-7.2592-02-3.6821-02 4.2362-02 1.6471-02 1.0313-02
 SINE COEFFICIENTS
 -1.9704-01-2.0230-01-4.3912-02 1.1520-01 1.1838-02 1.8821-02 9.7173-03-6.5188-02
 SPAN 4 CHORD 4 STEADY= 4.3502-01
 COSINE COEFFICIENTS

Figure 48. Continued.

-4.8628-02-4.7619-02-1.2670-02-7.7182-03-1.3397-02 1.3703-02 1.8237-02 1.3705-03
 SINE COEFFICIENTS
 -0.6418-02-4.2627-02-2.2100-02 4.0290-02 1.2906-02 3.3707-04-7.7343-03-1.2327-02
 SPAN 4 CHORD 5 STEADY= -3.7936-01
 COSINE COEFFICIENTS
 -8.4917-03-8.8517-03 0.6144-05-9.2092-04 6.0998-03 9.5912-03 2.2058-03 1.9945-03
 SINE COEFFICIENTS
 -4.7729-02-1.7351-02 7.0737-03 1.9094-02 2.9334-03 4.6809-04-5.7162-03-3.8534-03
 SPAN 5 CHORD 1 STEADY= 9.8304+00
 COSINE COEFFICIENTS
 -1.6596+00-1.2404+00-6.6369-01-3.8059-01-1.1047-01-2.8423-02-5.4526-03 1.0968-02
 SINE COEFFICIENTS
 -6.8719-01-8.1859-01-1.1993-01 8.5975-02 3.3376-02 3.7700-02-4.4579-02-2.0696-02
 SPAN 5 CHORD 2 STEADY= 2.5259+00
 COSINE COEFFICIENTS
 -3.7722-01-2.8959-01-1.1734-01-7.2880-02-6.9081-02-7.7209-03 5.1103-03 2.5126-03
 SINE COEFFICIENTS
 -0.8361-02-2.0992-01-6.1597-02 2.7910-02 1.4647-02-3.3070-03 3.4487-03-3.0249-02
 SPAN 5 CHORD 3 STEADY= 1.2639+00
 COSINE COEFFICIENTS
 -2.4124-01-2.1881-01-8.3634-02-4.0030-02-4.7826-02 1.4367-02 1.9826-02 1.0908-02
 SINE COEFFICIENTS
 -1.5170-01-1.7806-01-4.8001-02 2.7917-02 1.3979-02-6.2101-03 2.4727-03-2.9592-02
 SPAN 5 CHORD 4 STEADY= 4.7708+01
 COSINE COEFFICIENTS
 -7.9225-02-7.4821-02-2.3488-02-1.1087-02-2.3349-02 5.1036-03 6.3273-03 8.4353-03
 SINE COEFFICIENTS
 -7.1022-02-6.8677-02-2.6652-02 7.5530-03 1.0709-03-3.9655-03 6.1016-03-8.4271-03
 SPAN 5 CHORD 5 STEADY= 1.8145-01
 COSINE COEFFICIENTS
 -7.0866-02-6.5144-02-1.4039-02-5.5659-03-8.1222-03 9.7118-03 1.1004-02 7.8894-03
 SINE COEFFICIENTS
 -7.9007-02-7.2525-02-1.2389-02 2.1950-02 3.9799-03-3.4117-03-2.4317-03-5.3973-03
 Q XQT CUR
 TEF 0
 TRI 0
 Q FIN

Figure 48. Concluded.

Q PIN E676W441167609002000050 (633) DAUSCH, W 3 STATION 111
 QF ASG 12
 QF ASG 5
 QF ASG 029362SN
 Q XQT CUR
 ERS
 TIME 110151
 DEF 0.000
 IN 0
 TRI 0
 Q XQT AC676
 E676 SAMPLE DECK SET-UP 20 AUGUST 70 TCON=DRUM
 2.86 26.0 433.0 0.0131 118.0 13270.188. 2.5 6 8 5 20 1 DRUM N N
 .4 .75 .85 .95 .98
 .042 .158 .3 .6 .91
 .042 .158 .3 .6 .91
 .042 .158 .3 .6 .91
 .042 .158 .3 .6 .91
 .042 .158 .3 .6 .91
 .0531 0.0
 N Y 2
 538.52 0. -30. 5596. 0. -3231.
 538.52 0. -5. 6438. 0. -563.
 Q FIN

Figure 49. Sample of DRUM Input Mode.

E676 SAMPLE DECK SET-UP 20AUGUST70 TROP = CARD

BLADE THICKNESS (IN) = .2860+01 ZERO TWIST BLADE STA. (IN) = .1180+03
 BLADE CHORD (IN) = .2600+02 SPEED OF SOUND (IN/SEC) = .1327+05
 BLADE LENGTH (IN) = .9334+03 ROTOR ROT. SPEED (RPM) = .1880+03
 BLADE TWIST RATE (DEG/IN) = .1310-01 AZIMUTH INCREMENT (DEG) = .2500+01
 NUMBER OF BLADES = 6 TAPE / CARD / DRUM OPTION = CARD
 NO. OF HARMONICS TO REPRESENT PRESSURE CYCLES = 8 PRESSURE HARMONIC PULCH OPTION = N
 NO. OF ROTOR NOISE HARMONICS = 2 PRESSURE HARMONIC PULCH OPTION = N
 NO. OF INTERPOLATED SPAN STATIONS = 20 INTERMEDIATE OUTPUT OPTION = N
 TOTAL NO. OF TAPE REELS = 1

COMBINED ROTOR SHAFT INCLINATION AND FUSELAGE PITCH ATTITUDE = .0000 DEGREES
 TOTAL TIME FOR ACOUSTIC PRESSURE COMPUTATIONS IS .5310-01 SECONDS
 OPTION TO USE PROGRAM E306 (THEORETICAL CONST. PRESSURE PULSE) = H
 OPTION TO USE ROTOR NOISE PROGRAM (MEASURED PRESSURE PULSE) = Y
 NO. OF FIELD POINTS = 2

E306 FIELD POINTS

FP	R (FT)	THETA (DEG)	ALPHA (DEG)	FP	X (IN)	Y (IN)	Z (IN)
1	.0000	.0000	.0000	1	.5596+08	.0000	7.3231+04
2	.0000	.0000	.0000	2	.5438+04	.0000	-.5639+02

Figure 50. Sample Output.

DIFFERENTIAL PRESSURE CYCLES AT INSTRUMENTED BLADE STATIONS

SPAN STATION 1 CHORD STATION 1

1.5519+00	1.5603+00	1.5624+00	1.5939+00	1.6028+00	1.6093+00	1.6138+00	1.6176+00	1.6195+00	1.6222+00
1.6259+00	1.6312+00	1.6366+00	1.6488+00	1.6504+00	1.6584+00	1.6590+00	1.6603+00	1.6627+00	1.6641+00
1.6720+00	1.6787+00	1.6819+00	1.6871+00	1.6899+00	1.6934+00	1.6978+00	1.6986+00	1.7001+00	1.7016+00
1.7031+00	1.7050+00	1.7069+00	1.7088+00	1.7107+00	1.7126+00	1.7145+00	1.7164+00	1.7183+00	1.7202+00
1.7221+00	1.7240+00	1.7259+00	1.7278+00	1.7297+00	1.7316+00	1.7335+00	1.7354+00	1.7373+00	1.7392+00
1.7410+00	1.7429+00	1.7448+00	1.7467+00	1.7486+00	1.7505+00	1.7524+00	1.7543+00	1.7562+00	1.7581+00
1.7600+00	1.7619+00	1.7638+00	1.7657+00	1.7676+00	1.7695+00	1.7714+00	1.7733+00	1.7752+00	1.7771+00
1.7790+00	1.7809+00	1.7828+00	1.7847+00	1.7866+00	1.7885+00	1.7904+00	1.7923+00	1.7942+00	1.7961+00
1.7980+00	1.8000+00	1.8019+00	1.8038+00	1.8057+00	1.8076+00	1.8095+00	1.8114+00	1.8133+00	1.8152+00
1.8171+00	1.8190+00	1.8209+00	1.8228+00	1.8247+00	1.8266+00	1.8285+00	1.8304+00	1.8323+00	1.8342+00
1.8361+00	1.8380+00	1.8399+00	1.8418+00	1.8437+00	1.8456+00	1.8475+00	1.8494+00	1.8513+00	1.8532+00
1.8551+00	1.8570+00	1.8589+00	1.8608+00	1.8627+00	1.8646+00	1.8665+00	1.8684+00	1.8703+00	1.8722+00
1.8741+00	1.8760+00	1.8779+00	1.8798+00	1.8817+00	1.8836+00	1.8855+00	1.8874+00	1.8893+00	1.8912+00
1.8931+00	1.8950+00	1.8969+00	1.8988+00	1.9007+00	1.9026+00	1.9045+00	1.9064+00	1.9083+00	1.9102+00
1.9121+00	1.9140+00	1.9159+00	1.9178+00	1.9197+00	1.9216+00	1.9235+00	1.9254+00	1.9273+00	1.9292+00
1.9311+00	1.9330+00	1.9349+00	1.9368+00	1.9387+00	1.9406+00	1.9425+00	1.9444+00	1.9463+00	1.9482+00
1.9501+00	1.9520+00	1.9539+00	1.9558+00	1.9577+00	1.9596+00	1.9615+00	1.9634+00	1.9653+00	1.9672+00
1.9691+00	1.9710+00	1.9729+00	1.9748+00	1.9767+00	1.9786+00	1.9805+00	1.9824+00	1.9843+00	1.9862+00
1.9881+00	1.9900+00	1.9919+00	1.9938+00	1.9957+00	1.9976+00	1.9995+00	2.0014+00	2.0033+00	2.0052+00
2.0071+00	2.0090+00	2.0109+00	2.0128+00	2.0147+00	2.0166+00	2.0185+00	2.0204+00	2.0223+00	2.0242+00
2.0261+00	2.0280+00	2.0299+00	2.0318+00	2.0337+00	2.0356+00	2.0375+00	2.0394+00	2.0413+00	2.0432+00
2.0451+00	2.0470+00	2.0489+00	2.0508+00	2.0527+00	2.0546+00	2.0565+00	2.0584+00	2.0603+00	2.0622+00
2.0641+00	2.0660+00	2.0679+00	2.0698+00	2.0717+00	2.0736+00	2.0755+00	2.0774+00	2.0793+00	2.0812+00
2.0831+00	2.0850+00	2.0869+00	2.0888+00	2.0907+00	2.0926+00	2.0945+00	2.0964+00	2.0983+00	2.1002+00
2.1021+00	2.1040+00	2.1059+00	2.1078+00	2.1097+00	2.1116+00	2.1135+00	2.1154+00	2.1173+00	2.1192+00
2.1211+00	2.1230+00	2.1249+00	2.1268+00	2.1287+00	2.1306+00	2.1325+00	2.1344+00	2.1363+00	2.1382+00
2.1401+00	2.1420+00	2.1439+00	2.1458+00	2.1477+00	2.1496+00	2.1515+00	2.1534+00	2.1553+00	2.1572+00
2.1591+00	2.1610+00	2.1629+00	2.1648+00	2.1667+00	2.1686+00	2.1705+00	2.1724+00	2.1743+00	2.1762+00
2.1781+00	2.1800+00	2.1819+00	2.1838+00	2.1857+00	2.1876+00	2.1895+00	2.1914+00	2.1933+00	2.1952+00
2.1971+00	2.1990+00	2.2009+00	2.2028+00	2.2047+00	2.2066+00	2.2085+00	2.2104+00	2.2123+00	2.2142+00
2.2161+00	2.2180+00	2.2199+00	2.2218+00	2.2237+00	2.2256+00	2.2275+00	2.2294+00	2.2313+00	2.2332+00
2.2351+00	2.2370+00	2.2389+00	2.2408+00	2.2427+00	2.2446+00	2.2465+00	2.2484+00	2.2503+00	2.2522+00
2.2541+00	2.2560+00	2.2579+00	2.2598+00	2.2617+00	2.2636+00	2.2655+00	2.2674+00	2.2693+00	2.2712+00
2.2731+00	2.2750+00	2.2769+00	2.2788+00	2.2807+00	2.2826+00	2.2845+00	2.2864+00	2.2883+00	2.2902+00
2.2921+00	2.2940+00	2.2959+00	2.2978+00	2.2997+00	2.3016+00	2.3035+00	2.3054+00	2.3073+00	2.3092+00
2.3111+00	2.3130+00	2.3149+00	2.3168+00	2.3187+00	2.3206+00	2.3225+00	2.3244+00	2.3263+00	2.3282+00
2.3301+00	2.3320+00	2.3339+00	2.3358+00	2.3377+00	2.3396+00	2.3415+00	2.3434+00	2.3453+00	2.3472+00
2.3491+00	2.3510+00	2.3529+00	2.3548+00	2.3567+00	2.3586+00	2.3605+00	2.3624+00	2.3643+00	2.3662+00
2.3681+00	2.3700+00	2.3719+00	2.3738+00	2.3757+00	2.3776+00	2.3795+00	2.3814+00	2.3833+00	2.3852+00
2.3871+00	2.3890+00	2.3909+00	2.3928+00	2.3947+00	2.3966+00	2.3985+00	2.4004+00	2.4023+00	2.4042+00
2.4061+00	2.4080+00	2.4099+00	2.4118+00	2.4137+00	2.4156+00	2.4175+00	2.4194+00	2.4213+00	2.4232+00
2.4251+00	2.4270+00	2.4289+00	2.4308+00	2.4327+00	2.4346+00	2.4365+00	2.4384+00	2.4403+00	2.4422+00
2.4441+00	2.4460+00	2.4479+00	2.4498+00	2.4517+00	2.4536+00	2.4555+00	2.4574+00	2.4593+00	2.4612+00
2.4631+00	2.4650+00	2.4669+00	2.4688+00	2.4707+00	2.4726+00	2.4745+00	2.4764+00	2.4783+00	2.4802+00
2.4821+00	2.4840+00	2.4859+00	2.4878+00	2.4897+00	2.4916+00	2.4935+00	2.4954+00	2.4973+00	2.4992+00
2.5011+00	2.5030+00	2.5049+00	2.5068+00	2.5087+00	2.5106+00	2.5125+00	2.5144+00	2.5163+00	2.5182+00
2.5201+00	2.5220+00	2.5239+00	2.5258+00	2.5277+00	2.5296+00	2.5315+00	2.5334+00	2.5353+00	2.5372+00
2.5391+00	2.5410+00	2.5429+00	2.5448+00	2.5467+00	2.5486+00	2.5505+00	2.5524+00	2.5543+00	2.5562+00
2.5581+00	2.5600+00	2.5619+00	2.5638+00	2.5657+00	2.5676+00	2.5695+00	2.5714+00	2.5733+00	2.5752+00
2.5771+00	2.5790+00	2.5809+00	2.5828+00	2.5847+00	2.5866+00	2.5885+00	2.5904+00	2.5923+00	2.5942+00
2.5961+00	2.5980+00	2.5999+00	2.6018+00	2.6037+00	2.6056+00	2.6075+00	2.6094+00	2.6113+00	2.6132+00
2.6151+00	2.6170+00	2.6189+00	2.6208+00	2.6227+00	2.6246+00	2.6265+00	2.6284+00	2.6303+00	2.6322+00
2.6341+00	2.6360+00	2.6379+00	2.6398+00	2.6417+00	2.6436+00	2.6455+00	2.6474+00	2.6493+00	2.6512+00
2.6531+00	2.6550+00	2.6569+00	2.6588+00	2.6607+00	2.6626+00	2.6645+00	2.6664+00	2.6683+00	2.6702+00
2.6721+00	2.6740+00	2.6759+00	2.6778+00	2.6797+00	2.6816+00	2.6835+00	2.6854+00	2.6873+00	2.6892+00
2.6911+00	2.6930+00	2.6949+00	2.6968+00	2.6987+00	2.7006+00	2.7025+00	2.7044+00	2.7063+00	2.7082+00
2.7101+00	2.7120+00	2.7139+00	2.7158+00	2.7177+00	2.7196+00	2.7215+00	2.7234+00	2.7253+00	2.7272+00
2.7291+00	2.7310+00	2.7329+00	2.7348+00	2.7367+00	2.7386+00	2.7405+00	2.7424+00	2.7443+00	2.7462+00
2.7481+00	2.7500+00	2.7519+00	2.7538+00	2.7557+00	2.7576+00	2.7595+00	2.7614+00	2.7633+00	2.7652+00
2.7671+00	2.7690+00	2.7709+00	2.7728+00	2.7747+00	2.7766+00	2.7785+00	2.7804+00	2.7823+00	2.7842+00
2.7861+00	2.7880+00	2.7899+00	2.7918+00	2.7937+00	2.7956+00	2.7975+00	2.7994+00	2.8013+00	2.8032+00
2.8051+00	2.8070+00	2.8089+00	2.8108+00	2.8127+00	2.8146+00	2.8165+00	2.8184+00	2.8203+00	2.8222+00
2.8241+00	2.8260+00	2.8279+00	2.8298+00	2.8317+00	2.8336+00	2.8355+00	2.8374+00	2.8393+00	2.8412+00
2.8431+00	2.8450+00	2.8469+00	2.8488+00	2.8507+00	2.8526+00	2.8545+00	2.8564+00	2.8583+00	2.8602+00
2.8621+00	2.8640+00	2.8659+00	2.8678+00	2.8697+00	2.8716+00	2.8735+00	2.8754+00	2.8773+00	2.8792+00
2.8811+00	2.8830+00	2.8849+00	2.8868+00	2.8887+00	2.8906+00	2.8925+00	2.8944+00	2.8963+00	2.8982+00
2.9001+00	2.9020+00	2.9039+00	2.9058+00	2.9077+00	2.9096+00	2.9115+00	2.9134+00	2.9153+00	2.9172+00
2.9191+00	2.9210+00	2.9229+00	2.9248+00	2.9267+00	2.9286+00	2.9305+00	2.9324+00	2.9343+00	2.9362+00
2.9381+00	2.9400+00	2.9419+00	2.9438+00	2.9457+00	2.9476+00	2.9495+00	2.9514+00	2.9533+00	2.9552+00
2.9571+00	2.9590+00	2.9609+00	2.9628+00	2.9647+00	2.9666+00	2.9685+00	2.9704+00	2.9723+00	2.9742+00
2.9761+00	2.9780+00	2.9799+00	2.9818+00	2.9837+00	2.9856+00	2.9875+00	2.9894+00	2.9913+00	2.9932+00
2.9951+00	2.9970+00	2.9989+00	3.0008+00	3.0027+00	3.0046+00	3.0065+00	3.0084+00	3.0103+00	3.0122+00
3.0141+00	3.0160+00	3.0179+00	3.0198+00	3.0217+00	3.0236+00	3.0255+00	3.0274+00	3.0293+00	3.0312+00
3.0331+00	3.0350+00	3.0369+00	3.0388+00	3.0407+00	3.0426+00	3.0445+00	3.0464+00	3.0483+00	3.0502+00
3.0521+00	3.0540+00	3.0559+00	3.0578+00	3.0597+00	3.0616+00	3.0635+00	3.0654+00	3.0673+00	3.0692+00
3.0711+00	3.0730+00	3.0749+00	3.0768+00	3.0787+00	3.0806+00	3.0825+00	3.0844+00	3.0863+00	3.0882+00
3.0901+00	3.0920+00	3.0939+00	3.0958+00	3.0977+00	3.0996+00	3.1015+00	3.1034+00	3.1053+00	3.1072+00
3.1091+00	3.1110+00	3.1129+00	3.1148+00	3.1167+00	3.1186+00	3.1205+00	3.1224+00	3.1243+00	3.1262+00
3.1281+00	3.1300+00	3.1319+00	3.1338+00	3.1357+00	3.1376+00	3.1395+00	3.1414+00	3.1433+00	3.1452+00
3.1471+00	3.1490+00	3.1509+00	3.1528+00	3.1547+00	3.1566+00	3.1585+00	3.1604+00	3.1623+00	3.1642+00
3.1661+00	3.1680+00	3.1699+00	3.1718+00	3.1737+00	3.1756+00	3.1775+00	3.1794+00	3.1813+00	3.1832+00
3.1851+00	3.1870+00	3.1889+00	3.1908+00	3.1927+00	3.1946+00	3.1965+00	3.1984+00	3.2003+00	3.2022+00
3.2041+00	3.2060+00	3.2079+00	3.2098+00	3.2117+00	3.2136+00	3.2155+00	3.2174+00	3.2193+00	3.2212+00
3.2231+00	3.2250+00	3.2269+00	3.2288+00	3.2307+00	3.2326+00	3.2345+00	3.2364+00	3.2383+00	3.2402+00
3.2421+00	3.2440+00	3.2459+00	3.247						

SPAN STATION 4 CH ₂ NO STATION 3									
2.2403+00	2.222+00	2.1970+00	2.1923+00	2.1942+00	2.2035+00	2.2202+00	2.2439+00	2.2736+00	
2.3051+00	2.385+00	2.4242+00	2.4619+00	2.4971+00	2.5289+00	2.5563+00	2.5811+00	2.6016+00	
2.6183+00	2.634+00	2.6546+00	2.6767+00	2.6916+00	2.7111+00	2.7404+00	2.7600+00	2.7800+00	
2.8338+00	2.850+00	2.8691+00	2.8851+00	2.9011+00	2.9166+00	2.9316+00	2.9466+00	2.9616+00	
2.9830+00	2.999+00	3.0152+00	3.0312+00	3.0472+00	3.0632+00	3.0792+00	3.0952+00	3.1112+00	
3.1270+00	3.143+00	3.1590+00	3.1750+00	3.1910+00	3.2070+00	3.2230+00	3.2390+00	3.2550+00	
3.2710+00	3.287+00	3.3030+00	3.3190+00	3.3350+00	3.3510+00	3.3670+00	3.3830+00	3.3990+00	
3.4330+00	3.449+00	3.4650+00	3.4810+00	3.4970+00	3.5130+00	3.5290+00	3.5450+00	3.5610+00	
3.5910+00	3.607+00	3.6230+00	3.6390+00	3.6550+00	3.6710+00	3.6870+00	3.7030+00	3.7190+00	
3.7690+00	3.785+00	3.8010+00	3.8170+00	3.8330+00	3.8490+00	3.8650+00	3.8810+00	3.8970+00	
3.9470+00	3.963+00	3.9790+00	3.9950+00	4.0110+00	4.0270+00	4.0430+00	4.0590+00	4.0750+00	
4.1310+00	4.147+00	4.1630+00	4.1790+00	4.1950+00	4.2110+00	4.2270+00	4.2430+00	4.2590+00	
4.3050+00	4.321+00	4.3370+00	4.3530+00	4.3690+00	4.3850+00	4.4010+00	4.4170+00	4.4330+00	
4.4950+00	4.511+00	4.5270+00	4.5430+00	4.5590+00	4.5750+00	4.5910+00	4.6070+00	4.6230+00	
4.6850+00	4.701+00	4.7170+00	4.7330+00	4.7490+00	4.7650+00	4.7810+00	4.7970+00	4.8130+00	
4.8950+00	4.911+00	4.9270+00	4.9430+00	4.9590+00	4.9750+00	4.9910+00	5.0070+00	5.0230+00	
5.1050+00	5.121+00	5.1370+00	5.1530+00	5.1690+00	5.1850+00	5.2010+00	5.2170+00	5.2330+00	
5.3150+00	5.331+00	5.3470+00	5.3630+00	5.3790+00	5.3950+00	5.4110+00	5.4270+00	5.4430+00	
5.5450+00	5.561+00	5.5770+00	5.5930+00	5.6090+00	5.6250+00	5.6410+00	5.6570+00	5.6730+00	
5.7750+00	5.791+00	5.8070+00	5.8230+00	5.8390+00	5.8550+00	5.8710+00	5.8870+00	5.9030+00	
6.0250+00	6.041+00	6.0570+00	6.0730+00	6.0890+00	6.1050+00	6.1210+00	6.1370+00	6.1530+00	
6.2750+00	6.291+00	6.3070+00	6.3230+00	6.3390+00	6.3550+00	6.3710+00	6.3870+00	6.4030+00	
6.5450+00	6.561+00	6.5770+00	6.5930+00	6.6090+00	6.6250+00	6.6410+00	6.6570+00	6.6730+00	
6.8150+00	6.831+00	6.8470+00	6.8630+00	6.8790+00	6.8950+00	6.9110+00	6.9270+00	6.9430+00	
7.1150+00	7.131+00	7.1470+00	7.1630+00	7.1790+00	7.1950+00	7.2110+00	7.2270+00	7.2430+00	
7.4350+00	7.451+00	7.4670+00	7.4830+00	7.4990+00	7.5150+00	7.5310+00	7.5470+00	7.5630+00	
7.7750+00	7.791+00	7.8070+00	7.8230+00	7.8390+00	7.8550+00	7.8710+00	7.8870+00	7.9030+00	
8.1150+00	8.131+00	8.1470+00	8.1630+00	8.1790+00	8.1950+00	8.2110+00	8.2270+00	8.2430+00	
8.4550+00	8.471+00	8.4870+00	8.5030+00	8.5190+00	8.5350+00	8.5510+00	8.5670+00	8.5830+00	
8.8150+00	8.831+00	8.8470+00	8.8630+00	8.8790+00	8.8950+00	8.9110+00	8.9270+00	8.9430+00	
9.1950+00	9.211+00	9.2270+00	9.2430+00	9.2590+00	9.2750+00	9.2910+00	9.3070+00	9.3230+00	
9.6150+00	9.631+00	9.6470+00	9.6630+00	9.6790+00	9.6950+00	9.7110+00	9.7270+00	9.7430+00	
9.9750+00	9.991+00	10.0070+00	10.0230+00	10.0390+00	10.0550+00	10.0710+00	10.0870+00	10.1030+00	
10.3850+00	10.401+00	10.4170+00	10.4330+00	10.4490+00	10.4650+00	10.4810+00	10.4970+00	10.5130+00	
10.8150+00	10.831+00	10.8470+00	10.8630+00	10.8790+00	10.8950+00	10.9110+00	10.9270+00	10.9430+00	
11.2750+00	11.291+00	11.3070+00	11.3230+00	11.3390+00	11.3550+00	11.3710+00	11.3870+00	11.4030+00	
11.7750+00	11.791+00	11.8070+00	11.8230+00	11.8390+00	11.8550+00	11.8710+00	11.8870+00	11.9030+00	
12.2750+00	12.291+00	12.3070+00	12.3230+00	12.3390+00	12.3550+00	12.3710+00	12.3870+00	12.4030+00	
12.7750+00	12.791+00	12.8070+00	12.8230+00	12.8390+00	12.8550+00	12.8710+00	12.8870+00	12.9030+00	
13.2750+00	13.291+00	13.3070+00	13.3230+00	13.3390+00	13.3550+00	13.3710+00	13.3870+00	13.4030+00	
13.7750+00	13.791+00	13.8070+00	13.8230+00	13.8390+00	13.8550+00	13.8710+00	13.8870+00	13.9030+00	
14.2750+00	14.291+00	14.3070+00	14.3230+00	14.3390+00	14.3550+00	14.3710+00	14.3870+00	14.4030+00	
14.7750+00	14.791+00	14.8070+00	14.8230+00	14.8390+00	14.8550+00	14.8710+00	14.8870+00	14.9030+00	
15.2750+00	15.291+00	15.3070+00	15.3230+00	15.3390+00	15.3550+00	15.3710+00	15.3870+00	15.4030+00	
15.7750+00	15.791+00	15.8070+00	15.8230+00	15.8390+00	15.8550+00	15.8710+00	15.8870+00	15.9030+00	
16.2750+00	16.291+00	16.3070+00	16.3230+00	16.3390+00	16.3550+00	16.3710+00	16.3870+00	16.4030+00	
16.7750+00	16.791+00	16.8070+00	16.8230+00	16.8390+00	16.8550+00	16.8710+00	16.8870+00	16.9030+00	
17.2750+00	17.291+00	17.3070+00	17.3230+00	17.3390+00	17.3550+00	17.3710+00	17.3870+00	17.4030+00	
17.7750+00	17.791+00	17.8070+00	17.8230+00	17.8390+00	17.8550+00	17.8710+00	17.8870+00	17.9030+00	
18.2750+00	18.291+00	18.3070+00	18.3230+00	18.3390+00	18.3550+00	18.3710+00	18.3870+00	18.4030+00	
18.7750+00	18.791+00	18.8070+00	18.8230+00	18.8390+00	18.8550+00	18.8710+00	18.8870+00	18.9030+00	
19.2750+00	19.291+00	19.3070+00	19.3230+00	19.3390+00	19.3550+00	19.3710+00	19.3870+00	19.4030+00	
19.7750+00	19.791+00	19.8070+00	19.8230+00	19.8390+00	19.8550+00	19.8710+00	19.8870+00	19.9030+00	
20.2750+00	20.291+00	20.3070+00	20.3230+00	20.3390+00	20.3550+00	20.3710+00	20.3870+00	20.4030+00	
20.7750+00	20.791+00	20.8070+00	20.8230+00	20.8390+00	20.8550+00	20.8710+00	20.8870+00	20.9030+00	
21.2750+00	21.291+00	21.3070+00	21.3230+00	21.3390+00	21.3550+00	21.3710+00	21.3870+00	21.4030+00	
21.7750+00	21.791+00	21.8070+00	21.8230+00	21.8390+00	21.8550+00	21.8710+00	21.8870+00	21.9030+00	
22.2750+00	22.291+00	22.3070+00	22.3230+00	22.3390+00	22.3550+00	22.3710+00	22.3870+00	22.4030+00	
22.7750+00	22.791+00	22.8070+00	22.8230+00	22.8390+00	22.8550+00	22.8710+00	22.8870+00	22.9030+00	
23.2750+00	23.291+00	23.3070+00	23.3230+00	23.3390+00	23.3550+00	23.3710+00	23.3870+00	23.4030+00	
23.7750+00	23.791+00	23.8070+00	23.8230+00	23.8390+00	23.8550+00	23.8710+00	23.8870+00	23.9030+00	
24.2750+00	24.291+00	24.3070+00	24.3230+00	24.3390+00	24.3550+00	24.3710+00	24.3870+00	24.4030+00	
24.7750+00	24.791+00	24.8070+00	24.8230+00	24.8390+00	24.8550+00	24.8710+00	24.8870+00	24.9030+00	
25.2750+00	25.291+00	25.3070+00	25.3230+00	25.3390+00	25.3550+00	25.3710+00	25.3870+00	25.4030+00	
25.7750+00	25.791+00	25.8070+00	25.8230+00	25.8390+00	25.8550+00	25.8710+00	25.8870+00	25.9030+00	
26.2750+00	26.291+00	26.3070+00	26.3230+00	26.3390+00	26.3550+00	26.3710+00	26.3870+00	26.4030+00	
26.7750+00	26.791+00	26.8070+00	26.8230+00	26.8390+00	26.8550+00	26.8710+00	26.8870+00	26.9030+00	
27.2750+00	27.291+00	27.3070+00	27.3230+00	27.3390+00	27.3550+00	27.3710+00	27.3870+00	27.4030+00	
27.7750+00	27.791+00	27.8070+00	27.8230+00	27.8390+00	27.8550+00	27.8710+00	27.8870+00	27.9030+00	
28.2750+00	28.291+00	28.3070+00	28.3230+00	28.3390+00	28.3550+00	28.3710+00	28.3870+00	28.4030+00	
28.7750+00	28.791+00	28.8070+00	28.8230+00	28.8390+00	28.8550+00	28.8710+00	28.8870+00	28.9030+00	
29.2750+00	29.291+00	29.3070+00	29.3230+00	29.3390+00	29.3550+00	29.3710+00	29.3870+00	29.4030+00	
29.7750+00	29.791+00	29.8070+00	29.8230+00	29.8390+00	29.8550+00	29.8710+00	29.8870+00	29.9030+00	
30.2750+00	30.291+00	30.3070+00	30.3230+00	30.3390+00	30.3550+00	30.3710+00	30.3870+00	30.4030+00	
30.7750+00	30.791+00	30.8070+00	30.8230+00	30.8390+00	30.8550+00	30.8710+00	30.8870+00	30.9030+00	
31.2750+00	31.291+00	31.3070+00	31.3230+00	31.3390+00	31.3550+00	31.3710+00	31.3870+00	31.4030+00	
31.7750+00	31.791+00	31.8070+00	31.8230+00	31.8390+00	31.8550+00	31.8710+00	31.8870+00	31.9030+00	
32.2750+00	32.291+00	32.3070+00	32.3230+00	32.3390+00	32.3550+00	32.3710+00	32.3870+00	32.4030+00	
32.7750+00	32.791+00	32.8070+00	32.8230+00	32.8390+00	32.8550+00	32.8710+00	32.8870+00	32.9030+00	
33.2750+00	33.291+00	33.3070+00	33.3230+00	33.3390+00	33.3550+00	33.3710+00	33.3870+00	33.4030+00	
33.7750+00	33.791+00	33.8070+00	33.8230+00	33.8390+00	33.8550+00	33.8710+00	33.8870+00	33.9030+00	
34.2750+00	34.291+00	34.3070+00	34.3230+00	34.3390+00	34.3550+00	34.3710+00	34.3870+00	34.4030+00	
34.7750+00	34.791+00	34.8070+00	34.8230+00	34.8390+00	34.8550+00	34.8710+00	34.8870+00	34.9030+00	
35.2750+00	35.291+00	35.3070+00	35.3230+00	35.3390+00	35.3550+00	35.3710+00	35.3870+00	35.4030+00	
35.7750+00	35.791+00	35.8070+00	35.8230+00	35.8390+00	35.8550+00	35.8710+00	35.8870+00	35.9030+00	
36.2750+00	36.291+00	36.3070+00	36.3230+00	36.3390+00	36.3550+00	36.3710+00	36.3870+00	36.4030+00	
36.7750+00	36.791+00	36.8070+00	36.8230+00	36.8390+00	36.8550+00	36.8710+00	36.8870+00	36.9030+00	

TRAP VALUES FOR FIELD POINT 1
-5.641257-05 -1.90735-06

Figure 50. Continued.

UTRAP VALUES FOR FIELD POINT 1
 -2.921837-05 -2.310169-05
 UTRAP VALUES FOR FIELD POINT 2
 -5.002590-05 -4.133724-06
 UTRAP VALUES FOR FIELD POINT 2
 -1.230774-05 -1.255837-06

PRESSURES AT FIELD POINT 1
 -5.832056-05 -6.924993-05 -7.782530-05 -8.338473-05 -8.544820-05 -8.376291-05 -7.832924-05 -6.940456-05 -5.740518-05 -4.326477-05
 -2.758798-05 -1.136242-05 4.485752-06 1.914439-05 3.484825-05 4.218005-05 4.975313-05 5.453300-05 5.667713-05 5.653421-05
 5.459650-05 5.144408-05 4.765908-05 4.380079-05 4.030783-05 3.747337-05 3.541367-05 3.404073-05 3.317545-05 3.288811-05
 3.120682-05 2.913549-05 2.575972-05 2.064667-05 1.359171-05 4.557872-06 -6.242740-06 -1.854834-05 -3.166813-05 -4.492261-05
 -5.750003-05

PRESSURES AT FIELD POINT 2
 -5.415962-05 -5.565995-05 -5.547906-05 -5.363859-05 -5.024999-05 -4.540777-05 -3.937879-05 -3.238854-05 -2.470560-05 -1.660561-05
 -8.358716-06 -2.026120-07 7.640309-06 1.499701-05 2.173278-05 2.775282-05 3.299771-05 3.743620-05 4.105614-05 4.385722-05
 4.583854-05 4.659585-05 4.731536-05 4.7710-05 4.533700-05 4.297221-05 3.664869-05 3.535060-05 3.008618-05 2.389784-05
 1.685651-05 9.120068-06 8.352629-07 -7.769854-06 -1.643925-05 -2.465044-05 -3.282823-05 -3.996053-05 -4.601590-05 -5.075524-05
 -5.399515-05

ROTATIONAL NOISE PROGRAM E676				
HARMONIC = 1		FIELD POINT COORDINATES (IN)		
FIELD POINT	X	Y	Z	SOUND PRESSURE LEVEL DECIBELS
1	5.590403	0.0000	-3.2310+03	8.3801+01
2	6.4480403	0.0000	-5.65300+02	8.1982+01

HARMONIC = 2		FIELD POINT COORDINATES (IN)		
FIELD POINT	X	Y	Z	SOUND PRESSURE LEVEL DECIBELS
1	5.590403	0.0000	-3.2310+03	7.5074+01
2	6.4480403	0.0000	-5.65300+02	6.0452+01

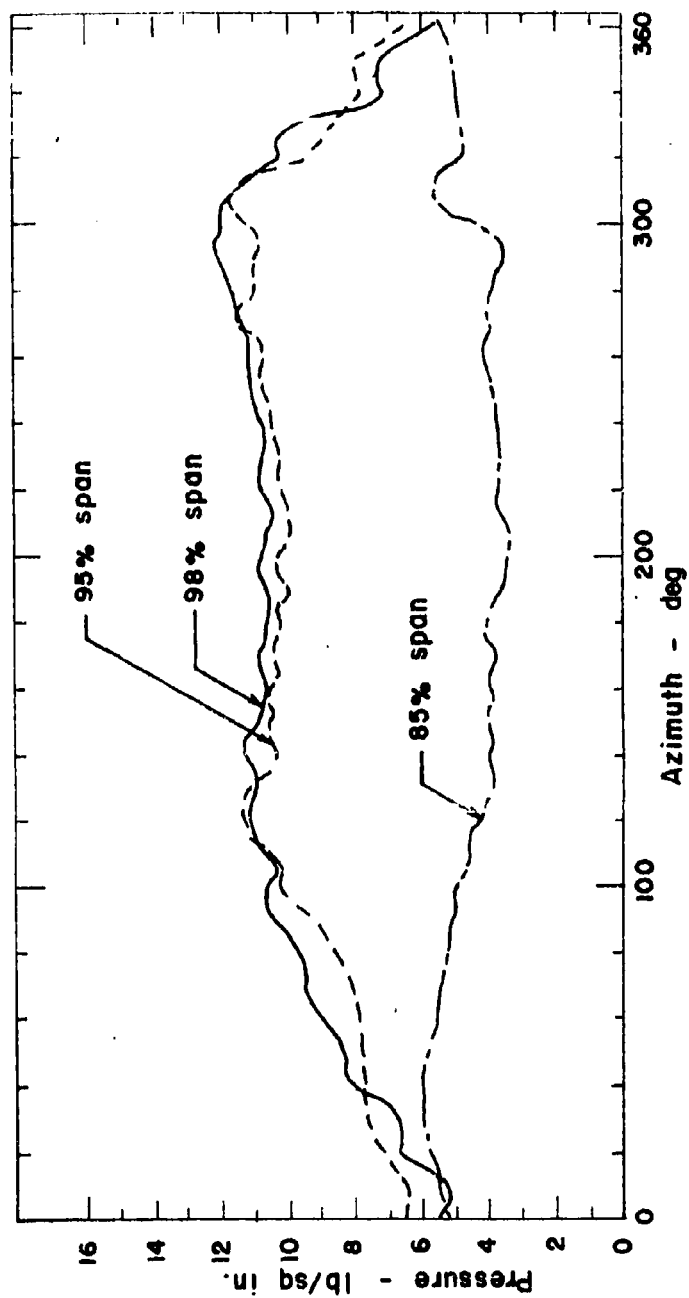
Figure 50. Concluded.

APPENDIX II
MEASURED AERODYNAMIC DATA

Figures 51 and 52 compare the azimuthal histories of differential pressure on a CH-53A main rotor blade for hover conditions with and without RIN. Pressures at 85% span do not show rapid fluctuations associated with blade/wake interaction RIN. However, pressures at 95% and 98% span do reflect the blade/wake interactions for the RIN condition. Traces for 75% and 40% span are not presented since they are as inactive as those at 85% span.

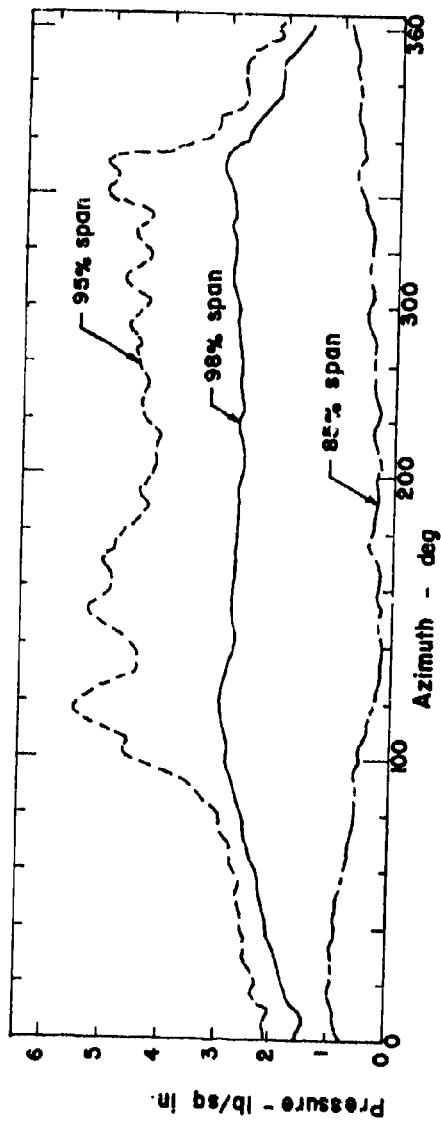
Measured aerodynamic data are presented in Tables II through X. These tables contain blade angulator and differential pressure data in harmonic form for a positive series ($A(\psi) = A_0 + A_1 \cos \psi + \beta_1 \sin \psi + \dots + A_n \cos n\psi + \beta_n \sin n\psi$). Angulator data are in units of degrees while differential pressure data are in units of pounds per square inch. Harmonics of pressure are read line-by-line from left to right for each spanwise and chordwise location. Note that the pressures for Span 1, Chord 4 (.4 span, .6 chord) are zero because of an inoperative transducer. Adverse effects of losing these data are negligible for the present study, because this inboard portion of the blade does not control the acoustic characteristics of the blade. Table XI contains trim parameters for each flight condition. Shaft inclination is referenced to vertical and is defined as positive for aft inclination (normal autogyro sign convention).

Differential pressure data recorded on the airborne direct system were analyzed to determine if more than 30 harmonics were present. Spectrum averaging with real-time analysis equipment revealed no more than 30 significant harmonics for the flight conditions of the present study. Since rotational noise levels were calculated from 30 loading harmonics, the present study made full use of the data's potential for rotational noise prediction.

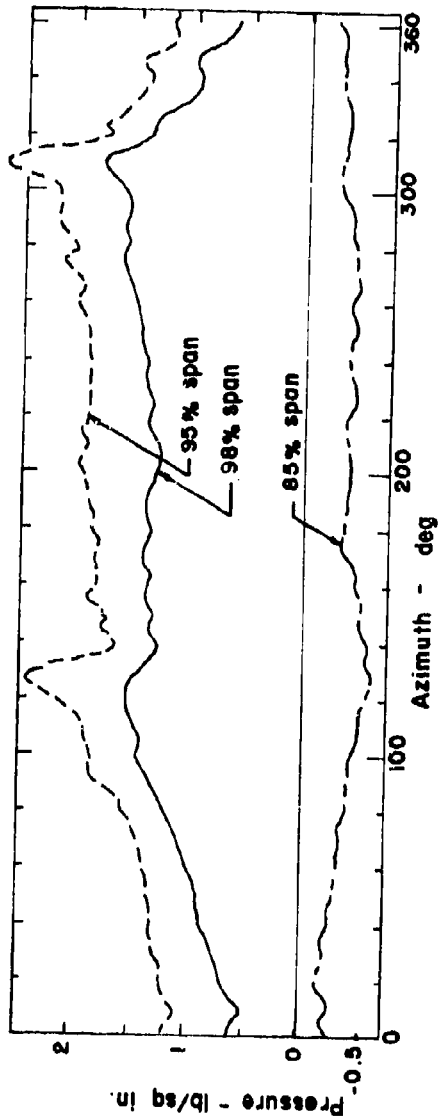


a. 4% Chord Station (Leading Edge)

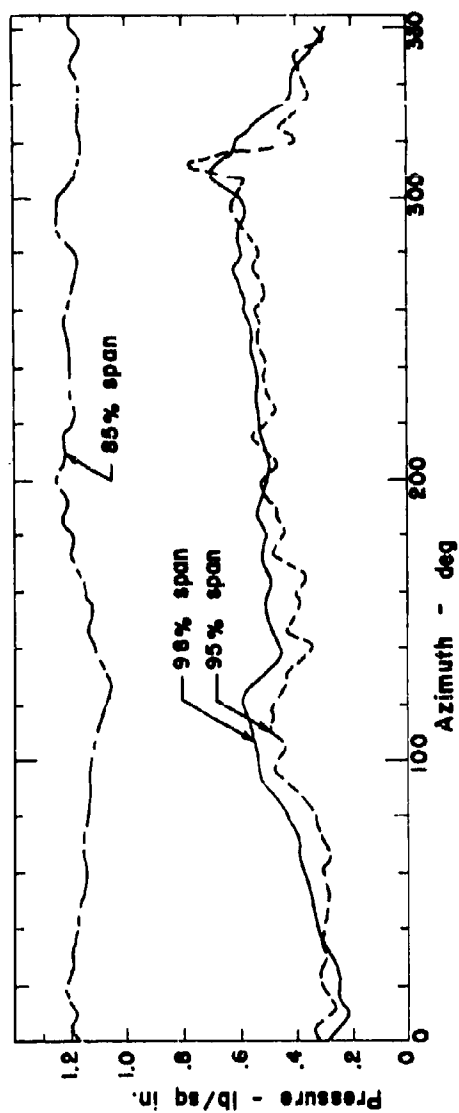
Figure 5L. Differential Blade Pressures - Hover Without RIN.



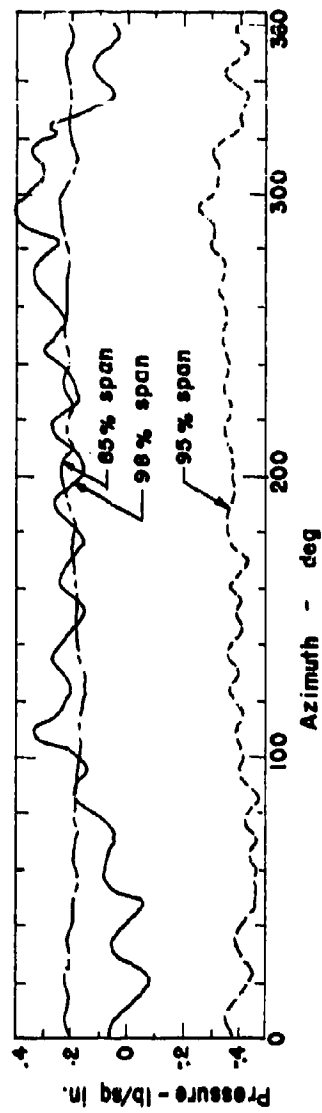
b. 15% Chord Station



c. 30% Chord Station
Figure 51. Continued.

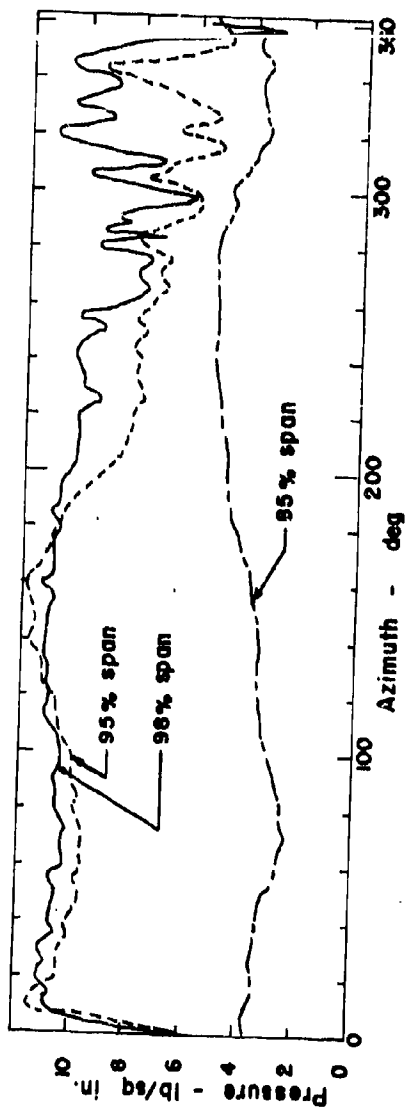


d. 60% Chord Station

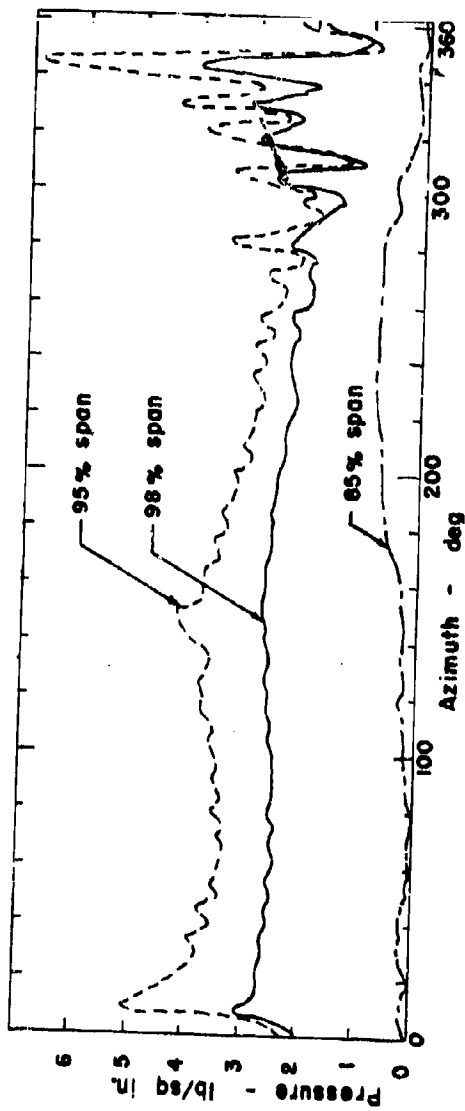


e. 91% Chord Station (Trailing Edge)

Figure 51. Concluded.

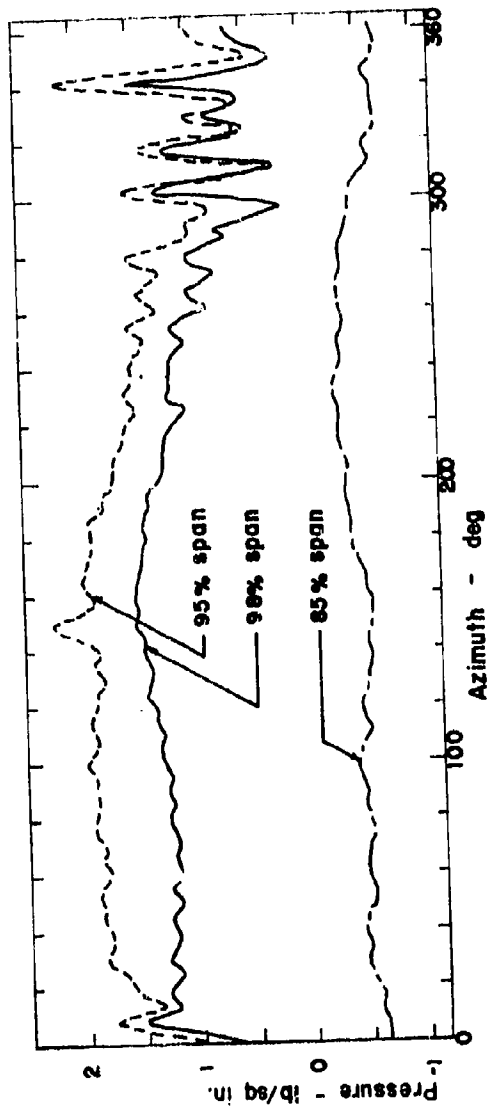


a. 4% Chord Station (Leading Edge)

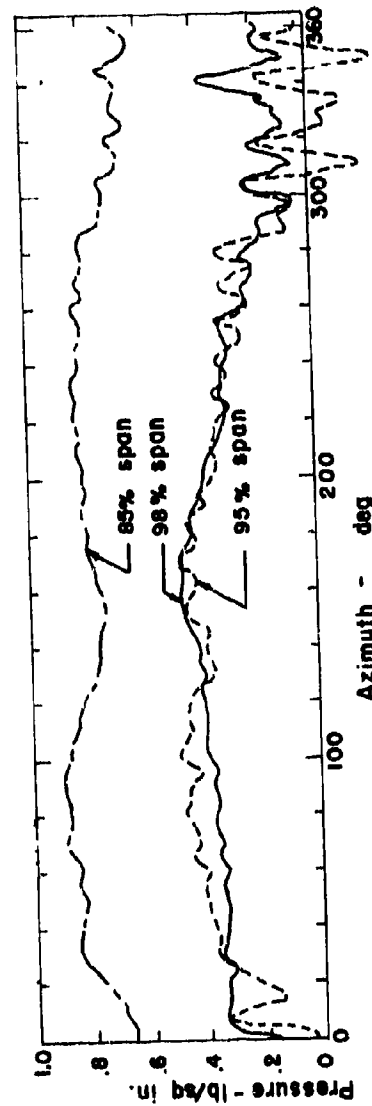


b. 15% Chord Station

Figure 52. Differential Blade Pressures - Hover With RIN.

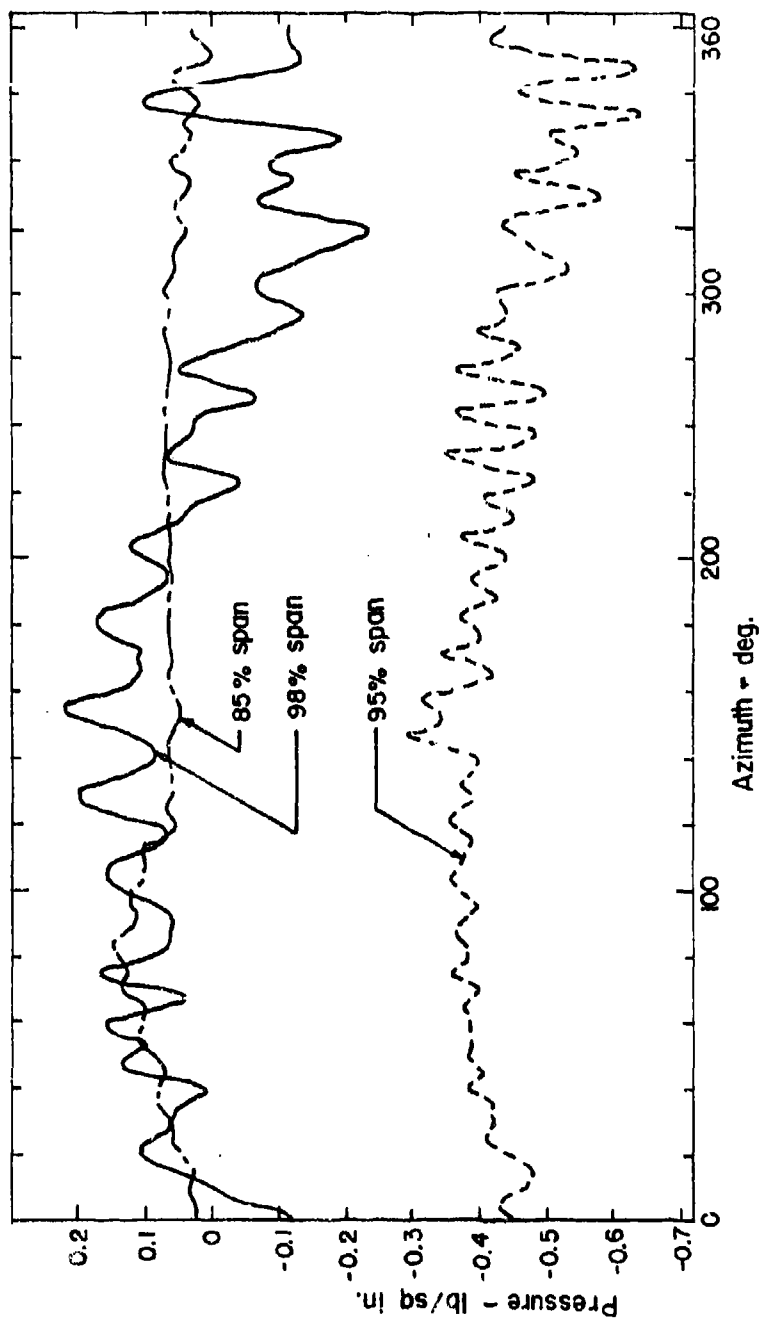


c. 30% Chord Station



d. 60% Chord Station

Figure 52. Continued.



e. 91% Chord Station (Trailing Edge)

Figure 52. Concluded.

TABLE II. AERODYNAMIC DATA - HOVER, NO SIN, 0300 HEADING

BURST NO. # 7 *** ROTOR NOISE PUNCHED OUTPUT ***

BLADE PITCH HARMONICS
 1.3133801 1.2684800 1.4096800 %COLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY
 ROTOR FLAPPING ANGLE HARMONICS
 3.4965800-9.2093-01 0.0000 %POSITIVE TAIL HIGH -- %SCREESH
 DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 %MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY# 1.3215800

COSINE COEFFICIENTS
 1.7893-01 8.6379-02-9.1522-02 5.4074-02-1.4760-02 1.3734-02-3.2843-03 6.8900-03
 -1.9970-03-3.4915-03 8.4930-04-1.1290-03-6.9497-03 3.9449-03-9.0343-04 4.3004-03
 4.3959-03 3.0881-04 9.1279-03-5.5478-03-4.8316-05 4.9040-03 3.4661-03-3.2388-03
 -1.5023-03-4.7401-03 4.2240-03-1.9447-03-2.2745-03-9.3488-03
 SINE COEFFICIENTS
 2.5822-01 1.2173-01-7.8300-02 1.6145-02-2.9130-02 2.6313-02-8.1456-03 1.4022-02
 4.4771-03 8.4027-03 9.5388-03 1.0633-02 5.3334-03 2.9976-03 2.5466-03 8.0187-03
 -3.6435-03 2.3755-03-5.3787-03-4.4364-03 3.3528-03 3.4018-03 6.9199-03 5.5968-03
 -1.0017-02 9.9794-05-1.6761-03 1.0711-02 1.4144-03 2.0408-03
 SPAN 1 CHORD 2 STEADY# 5.2611-01

COSINE COEFFICIENTS
 6.3769-02 2.6989-02-2.6319-02 2.2534-02-1.1330-02 2.8745-03-8.5509-04 4.2238-03
 3.1026-03 1.9779-03 3.8844-03-1.8980-03 2.1659-03-3.2059-04 3.5903-04-2.8702-03
 3.9076-04-5.7715-03-1.1922-02 4.5250-03 6.7258-03 1.7215-03 3.4697-03-2.3070-03
 2.7648-03-4.0455-03-4.0322-03-1.3050-03-8.7565-03 2.6422-02
 SINE COEFFICIENTS
 1.0326-01 8.1014-02-2.4542-02 7.6643-03-4.6196-03 8.0601-03 7.9350-03 7.4742-03
 -3.5750-03-2.0922-03-1.5032-04 2.7277-03-1.3113-03 2.4368-03 6.6702-05 4.5762-04
 9.8543-04-3.2046-03-4.5313-03 2.1323-03 1.8519-04 1.0419-03 2.1888-03-3.3102-03
 -4.5418-03 7.5371-03-4.1295-03-1.2611-03-5.6943-03 9.7307-03
 SPAN 1 CHORD 3 STEADY# 2.7584-01

COSINE COEFFICIENTS
 5.3880-02 2.8974-02-2.9560-02 9.6782-03-6.2573-03 3.0683-03 1.4864-03 3.5357-03
 -2.6590-03-4.1112-04 3.7660-03 1.8135-03-4.6702-04 9.3446-04 8.9288-04 3.0574-04
 1.1809-03 1.0868-03-7.3116-04-8.6081-04 1.6214-03 9.3902-04-1.5457-03 3.1568-03
 2.9810-04-1.9213-03 3.3486-03-3.8306-03 4.5115-04-3.0356-03
 SINE COEFFICIENTS
 7.3465-02 3.2867-02-1.2936-02 5.3314-03-6.4602-03 6.6668-03-7.8706-04 3.6909-03
 1.5718-03 3.2335-03 2.2136-03 2.8958-04 1.9336-03-1.3150-03-7.5293-04 7.0550-04
 -1.6301-03 1.3701-03-5.9663-03 3.8544-03 2.8686-03 2.3121-03 1.0317-03 2.3985-03
 -6.7346-04-2.8555-05 1.8868-03 1.8076-03-6.0112-04-5.8683-04
 SPAN 1 CHORD 4 STEADY# 0.0000

COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SPAN 1 CHORD 5 STEADY# -5.6346-02

COSINE COEFFICIENTS
 -9.4211-03-8.8721-03 3.1423-03-3.3696-04-2.9359-05 4.4270-04-2.7112-04-9.1695-04
 2.6618-04 3.1085-04 3.8000-04 1.8462-04-2.0502-04 6.7544-04 8.3109-04 5.1657-05
 7.5813-04-1.6474-04 7.6090-04-3.0417-04 2.1672-04-1.2764-04-4.5281-04 8.5785-04
 -1.8368-05 3.2837-04-7.3904-04-4.1605-04-7.0243-04-3.7858-04
 SINE COEFFICIENTS
 -8.4587-04-4.6024-03 8.6588-05-1.6911-03 2.1943-03-3.2855-04 1.5774-04-2.6268-04
 -8.8398-04 1.0617-04-2.8801-04 9.0521-04-2.2690-04-3.8574-05-6.9851-04 1.5426-04
 -7.2141-05 3.9775-04 1.1860-03-7.7125-04 4.8384-05-2.3706-05-6.4754-05-1.0166-03
 -6.9057-04-4.8320-04 1.0969-04-1.3911-04 3.3358-05 2.6347-06

TABLE II - Continued

SPAN 2 CHORD 1 STEADYH 3.515800

COSINE COEFFICIENTS

6.2205-01-5.0632-02 1.4693-02 3.2436-02-6.0388-02 2.5522-02-1.7416-03-5.5072-03
 1.1860-02-5.4898-03 1.8868-02 1.7013-03-7.0031-03 8.4396-03 9.0738-03 8.9960-03
 -4.0411-03 9.4131-04 1.1452-03 2.6997-03 5.8287-03-4.9967-03-5.5136-04-1.7133-03
 -2.1006-03-7.3604-03 2.2492-03 9.8086-04 2.3835-03 8.7400-03

SINE COEFFICIENTS

6.0991-01 1.7020-01 3.8480-02 8.0048-02 3.4875-03 1.5879-02 1.3939-02-4.9721-04
 1.6311-02 2.5767-02 8.5079-03 9.2934-03 1.9989-02 9.6852-03 1.4059-02-3.3363-03
 -2.1918-03 5.0861-03-8.8771-05-1.7950-04 2.1624-03 1.1886-02-8.9021-03 1.3144-02
 5.8140-03 1.3763-02 1.2142-02 6.0306-03-6.0559-03 5.8436-03

SPAN 2 CHORD 2 STEADYH 1.4074800

COSINE COEFFICIENTS

2.9125-01-1.4134-03 6.7889-03 2.1101-02-3.0086-02 1.3803-02-5.0205-03-1.6058-03
 2.7946-03-2.0997-03 7.8461-03 4.9558-03-5.5405-03 4.1930-03 4.0955-03 2.5070-03
 -6.9420-03-2.9400-03-1.0118-02 6.1578-03 4.7728-04-6.7487-04 2.1611-03-5.0470-03
 -1.3996-03 4.3807-04 4.5519-03-2.5978-04 3.1004-03 2.7604-03

SINE COEFFICIENTS

2.4252-01 7.7975-02 1.6632-02 3.2862-02 1.3079-02 7.4412-03 7.4750-03 5.3284-03
 5.5524-03 1.2052-02 1.4467-05 1.3798-03 1.0131-02-2.3284-03-1.9046-03 1.5630-03
 -3.8372-03-1.6881-03 6.2252-03 5.1712-04-1.6817-03-4.6572-04-2.4231-03 7.6010-03
 2.5987-03 4.7418-03-7.1681-04-2.7080-03 2.1766-03-1.8385-03

SPAN 2 CHORD 3 STEADYH 1.1239800

COSINE COEFFICIENTS

1.4021-01-2.5537-02 7.3251-04 1.2601-02-1.5888-02 6.8864-03 1.0343-04 2.9060-03
 3.7106-03-6.3201-04-3.2924-04 3.6240-04-3.2937-03 9.1033-04 3.8301-03-6.1639-04
 -3.1995-03 8.7501-04 4.1110-04 4.6413-03-1.1904-03 2.5720-03-7.0616-04-2.6867-03
 1.2705-03-1.1158-03 1.6909-03-1.7204-03-1.7354-03-3.6505-03

SINE COEFFICIENTS

1.4063-01 3.6232-02 7.2472-03 2.2703-02-3.6062-04 7.2413-03 3.5772-03-4.5975-04
 1.8374-03 5.7147-03-1.3828-03 4.9614-04 1.2891-03 1.0870-03-2.1114-03-5.3780-04
 1.2634-03-1.6645-03 1.5366-03-1.5986-03 8.5367-04 7.2630-04-3.3847-03 5.8619-03
 3.6215-03 3.6907-03 6.9162-04-1.6133-03 4.1089-04 1.5620-03

SPAN 2 CHORD 4 STEADYH 2.7872-01

COSINE COEFFICIENTS

8.4155-02 2.6385-03-2.0558-03 9.6918-03-8.3669-03 9.2523-04-7.9473-04-2.9648-03
 2.1314-03 7.2286-05 9.2409-04 7.9965-04-4.6974-04-1.9052-04 1.5216-03-3.9636-04
 5.1233-05-1.0101-03-3.6540-04-2.8228-04 1.5125-04 4.4250-04 8.4629-05-5.1707-04
 -6.2209-04-5.2277-04 2.1462-03-6.2797-04-1.0745-03 7.7548-05

SINE COEFFICIENTS

4.7117-02 2.0689-02 6.5795-03 5.4138-03 1.1244-02 4.4744-03 3.3201-03-6.1514-04
 -1.4586-04 4.0916-03 6.4142-04 2.3465-03 2.4332-03-2.6687-04-1.2663-03 2.1077-04
 6.9879-04 3.8897-04 9.3088-04-7.3644-04-1.0069-03-3.6329-04 6.1305-04 1.5469-03
 -6.7162-04 4.8457-04 9.6107-04 8.8164-04-1.4996-04 4.8214-04

SPAN 2 CHORD 5 STEADYH -1.6337-01

COSINE COEFFICIENTS

2.6125-02 3.8526-03-1.3509-03 3.7271-03-2.7216-03 6.2719-04 6.4998-04-1.5116-03
 1.6085-04 2.4534-04-1.1709-03 1.2073-03 8.1225-04 5.0774-04 1.1509-04 8.8855-05
 7.6715-04 1.3301-03 1.1530-03-4.4466-04-5.9289-04-9.0354-04 4.8799-06 1.4151-03
 3.8776-04 1.3138-04 1.4145-03 3.0636-04-5.7415-04-1.0304-04

SINE COEFFICIENTS

-1.3585-02 4.4238-03-3.3623-03-1.4518-03 4.5007-03 2.1445-04 1.2701-03 4.2440-04
 3.5165-04 1.9229-04 2.1429-04 1.0522-03 8.4828-04 1.9464-04 2.1339-05 4.8124-04
 4.7610-04 3.2276-04 3.1395-04-1.9230-03-3.4524-04 1.9437-04 1.0141-03 7.6594-04
 1.3039-04 2.5523-04-6.4601-04 3.8514-04-1.1134-03-1.1669-04

TABLE II - Continued

SPAN 3 CHORD 1 STEADY 4.539800
 COSINE COEFFICIENTS
 0.1344-01 2.4672-02-9.5280-02-6.1585-02-1.5801-01 5.5602-03 9.4039-02 1.1364-01
 -8.8008-02-8.4187-02-1.0871-01 5.4083-03 3.5277-02 5.6363-02 3.1177-02-1.9043-02
 -3.2661-02 5.0311-03-5.9469-03 8.5206-03-5.8866-03 5.6406-03-5.7473-03 2.2078-03
 1.2413-02 8.1592-03-1.4068-02-2.7078-02 1.3375-02-3.6504-03
 SINE COEFFICIENTS
 6.0212-01 1.9442-01 1.7576-02-4.8439-03 1.3575-01 7.2371-02 6.9967-02-6.1871-02
 -1.1948-01-1.6037-02 1.3864-02 8.4033-02 4.5553-02-9.9201-03-3.3030-02-2.5898-02
 6.4035-03 1.6180-02 2.1443-02-2.3009-03 8.4952-03 4.9311-03 7.0763-03 3.9102-03
 6.2789-03-7.0755-03 1.4883-02-2.2117-02 4.3998-02-9.5085-03
 SPAN 3 CHORD 2 STEADY 5.1488-01
 COSINE COEFFICIENTS
 3.1920-01 3.6656-02-2.4089-02 3.2477-02-4.0168-02 3.1908-03 1.3488-02 9.5870-03
 -1.6324-02-3.4432-03-3.2245-03 7.5349-03-2.9376-04 3.7356-03-3.6568-04-7.1000-03
 -3.0104-04 3.2427-03-8.8079-03 5.6712-03-3.0231-03 7.6622-03-2.1359-03-1.7513-03
 6.3915-03-4.0997-03 2.4094-03-2.3917-03 1.5254-03-2.8373-03
 SINE COEFFICIENTS
 6.9666-02 0.5417-02 9.9914-03 1.6957-02 2.9003-02-2.0850-03 3.1961-03-3.1983-03
 -7.5608-03 5.5986-03 5.1504-03 1.9627-03 1.2282-03-9.4510-03-7.3499-03-5.3253-03
 1.0441-02-8.2811-03 8.2889-03 3.2551-03 4.7143-03-2.1806-03 1.8540-03 8.0500-03
 4.7956-03-1.1204-02 9.3085-03-6.1570-03-9.8546-03-7.0809-03
 SPAN 3 CHORD 3 STEADY -3.7077-01
 COSINE COEFFICIENTS
 0.4995-02 5.2003-02-2.9669-02 1.2778-02-1.2519-02 9.4363-04 5.9984-03-1.5821-03
 -1.3751-02 2.7460-03-9.6099-03 3.0029-03 2.3433-03-7.1157-04 5.1523-03-4.7482-03
 -1.8145-03 3.7707-03 4.8344-03 1.5368-03-2.4066-04 6.8058-04-8.6469-04 2.6589-03
 8.2060-03-8.2631-03-1.5364-03-4.6039-04 4.0766-03-1.7138-04
 SINE COEFFICIENTS
 -2.2669-03 6.2634-02-2.6832-03 1.3001-02 2.2155-02 4.6875-03-4.3110-03-6.0489-03
 -8.8835-04-2.6791-03 7.1113-03 6.8703-04 4.5805-03-2.0644-03-2.1633-03 2.8066-04
 0.0530-03-3.8696-03 5.4391-04 3.5017-03 2.4168-03 3.1966-03 6.6476-03 6.1629-03
 5.6723-03-2.5686-03 4.2196-04 3.3113-03-4.0813-03 4.5622-03
 SPAN 3 CHORD 4 STEADY 1.1764800
 COSINE COEFFICIENTS
 5.5060-03 1.5338-02-1.7025-02 1.1994-02-3.1227-04-1.0326-04 1.0875-03-8.7683-03
 -5.5866-03 3.8759-03 2.8888-03 1.0275-04-2.5925-03-3.2028-03 5.4465-04-1.1663-03
 4.5118-04-2.3452-04-5.0419-04 3.2957-03-3.2744-04 6.5977-04 2.6995-03 9.0911-04
 5.0434-03-2.9738-03 1.5306-03-1.2794-03 2.0087-03-8.1781-04
 SINE COEFFICIENTS
 -3.8908-02 2.8985-02-2.4007-04 1.0648-02 6.8600-03 8.6288-04-9.1648-03-7.1324-05
 2.9426-03 2.9361-03 4.7852-03-5.6146-03 1.7945-03-2.8448-04-4.2911-04 1.0654-03
 1.8981-03-1.0507-04 1.6196-03 1.7150-03-1.1110-03 2.9154-03 5.4937-04 2.4146-03
 8.6896-03 5.9057-04 1.2109-03 1.0767-03-2.2987-04 6.3612-04
 SPAN 3 CHORD 5 STEADY 2.0242-01
 COSINE COEFFICIENTS
 3.1762-03 4.9851-03-2.5603-03 5.8589-03 2.8196-03-4.5628-04-2.1767-04-5.9044-03
 -6.3671-04 3.5209-04 3.9482-03-7.8798-04-6.8180-04-2.5325-03-8.7711-04 6.7480-04
 5.6727-04 2.5505-04 5.9795-04 6.5134-04-8.1177-04-4.7351-04 3.0004-03-1.1878-03
 1.5512-03-1.9229-03-1.4143-03 7.6162-04-1.1564-03 1.8107-03
 SINE COEFFICIENTS
 -2.3438-02 9.5578-03 9.9387-04 3.4870-03 9.5972-04 7.8844-04-6.8262-03 9.5167-04
 1.6053-03 2.9658-03 1.9493-03-4.6311-03 1.4959-03-4.4600-04 1.9675-03 9.7045-04
 1.7314-03-6.6614-03 1.7845-03 8.4139-06-2.0118-03 3.1844-03-1.9083-04 1.3417-03
 3.5526-04-2.1735-03 1.6984-03-3.8924-04 6.3088-04-7.8175-04

TABLE II - Continued

SPAN 4 CHORD 1 STEADY 9.5341800

COSINE COEFFICIENTS

-1.368400-8.4312-01-1.9837-01-2.4799-01-1.9390-01 7.3308-02 4.8505-02 5.4914-03
 -6.6775-03-1.4721-01-9.0591-02-9.1341-03 1.8089-03 5.0508-02-2.2830-03-3.1198-02
 -5.2273-02-3.0054-02-3.8927-02 2.2098-03 1.5133-02 1.5908-02-2.1017-02-2.2794-03
 2.5028-02 4.2023-05-9.7581-03-1.3757-02 1.6881-02 1.0201-02

SINE COEFFICIENTS

-7.3405-01-8.1310-01 9.9605-02 2.6595-01 4.6046-02 4.8517-04-8.7989-03-1.4977-01
 -1.6010-01-8.3455-02-5.0482-02 7.5381-02 1.4215-02-9.5309-02-1.0773-02-5.3507-02
 -2.5210-02-8.2992-03 6.2344-02 5.8983-02-2.9136-02 5.1984-03 3.8143-02 1.8088-02
 -2.7920-02 3.3486-02-1.0842-02 3.6688-02-2.8224-03 3.8402-02

SPAN 4 CHORD 2 STEADY 3.8796800

COSINE COEFFICIENTS

-1.107980-3.8811-01-6.3380-02-1.2579-01-1.7367-01 1.2701-01 1.3918-01-4.6663-02
 0.8304-03-5.3028-02-9.8897-02 2.0301-02-1.3747-02 4.3704-04 3.1276-02-2.2334-02
 -7.8128-03-6.2278-03-9.8328-03-2.7295-02 1.2925-02-3.8420-03 4.8009-03 6.4983-02
 0.5580-03-1.1926-02-3.5742-02-3.5270-03 1.4664-02 3.2219-03

SINE COEFFICIENTS

-3.5022-01-6.0494-01 1.0944-01 1.7018-01 1.4051-01-6.0502-02 6.5529-02-8.6124-02
 -1.4504-01 1.5102-02-1.9686-02 2.0229-02 7.3208-02-7.0087-02 3.4363-02-1.2989-02
 -2.7187-02-7.3026-03 3.1731-02 2.4635-03-1.0559-02 3.6535-02 3.3797-02-4.8835-03
 -4.1087-02 1.9825-03-8.5268-04 1.6166-02 2.3482-02 4.6819-02

SPAN 4 CHORD 3 STEADY 1.7704800

COSINE COEFFICIENTS

-2.6249-01-1.9883-01-5.1591-02-7.2592-02-3.6821-02 4.2362-02 1.6471-02 1.0313-02
 2.2379-02-6.7883-02-8.9710-03-1.4320-03-2.2842-02 2.8183-02 7.1747-03-1.3095-02
 -3.8257-03-2.8890-02-1.6426-02 2.2795-02 1.2125-02 1.7684-02 7.2674-03-1.1140-02
 7.3705-03-1.2288-02-4.9375-03 1.8689-02 1.6197-04 1.8488-02

SINE COEFFICIENTS

-1.9704-01-2.0230-01-4.3912-02 1.1520-01 1.1838-02 1.8821-02 9.7173-03-6.5188-02
 -1.3810-02-9.9860-03-3.1193-02 4.4519-02 1.1462-02-1.0973-02 5.3716-03-2.8734-02
 -1.2845-02 1.3334-02 3.0942-03 2.9604-02 1.8697-02-2.0232-02-3.1933-03 2.3911-03
 1.1915-03 9.1756-03 2.9021-03 1.0768-02 6.9495-03-1.1946-02

SPAN 4 CHORD 4 STEADY 4.3502-01

COSINE COEFFICIENTS

-4.8628-02-4.7619-02-1.2670-02-7.7182-03-1.3397-02 1.3703-02 1.8237-02 1.3705-03
 -2.1859-03-3.1607-03-9.6090-03 1.9575-03-3.3055-03 1.2500-03 1.1314-02-5.6686-04
 1.6763-03-1.0080-02-6.8390-03 1.0183-03-2.5432-03 1.2805-02 4.7617-03-3.2997-03
 3.3472-03-1.1393-02-1.7096-03-7.6077-03 7.5587-03 7.1984-03

SINE COEFFICIENTS

-0.6418-02-4.2627-02-2.2180-02 4.0290-02 1.2906-02 3.3787-04-7.7343-03-1.2327-02
 -0.5932-03-6.4330-03-6.8807-03 4.0859-03 9.2643-03-2.6250-03 3.8312-03-8.9611-03
 -5.0431-04-9.8795-03 1.0879-02 1.6004-02 1.1777-02 4.4553-03-2.1780-03-5.2995-03
 -2.7080-03-2.3385-03 5.2847-03 1.0200-02 2.0439-05 5.0925-03

SPAN 4 CHORD 5 STEADY -3.7936-01

COSINE COEFFICIENTS

-8.4917-03-8.8517-03 9.6144-05-9.2092-04 6.0998-03 9.5912-03 2.2058-03 1.9945-03
 -8.8767-04 3.4331-03 1.3717-03-2.5022-03-6.7829-03-2.8007-03-3.5518-03 1.2209-03
 -1.9448-03 8.3594-03 2.9051-04 6.1218-04-2.6776-03 4.4277-03 7.1966-03 2.0035-03
 -5.1467-03-3.7851-04 3.5406-03-1.9203-03-1.7568-03-4.5369-03

SINE COEFFICIENTS

-4.7729-02-1.7351-02 7.0737-03 1.7094-02 2.9334-03 4.6804-04-5.7162-03-3.8534-03
 -1.8753-03-5.0572-06 2.6993-03 7.7569-03 3.6277-03 1.0544-02 5.9268-03 4.2084-03
 -2.9645-03-2.7871-03 1.2635-03-5.7055-04 5.2044-03 1.7211-03-3.8385-03-1.6438-03
 -6.6820-04-7.5529-03 8.2384-05-5.7954-03 1.0034-03 2.0277-03

TABLE II - Concluded

SPAN 5 CHORD 1 STEADY 9.8304800

COSINE COEFFICIENTS

-1.6596400-1.2404800-6.6369-01-3.8059-01-1.1047-01-2.8423-02-5.4526-03 1.0968-02
 -3.8994-03-1.5860-02 1.7104-02-1.1093-02-2.7075-02-9.0516-02-2.1754-02-2.4752-02
 -4.1009-02-1.8956-02-1.3232-02 3.7125-03 1.2127-02 3.6404-02 2.6005-02 2.6624-03
 7.8025-03 2.4996-02-3.4414-02-1.7907-02-1.3129-02-1.0545-02

SINE COEFFICIENTS

-6.8719-01-8.1859-01-1.1993-01 8.5975-02 3.3376-02 3.7790-02-4.4579-02-2.0696-02
 -8.2308-03-4.8822-02-6.9061-02-6.5330-02-4.4534-02-2.0549-01-9.6744-02-5.9658-02
 -3.8119-02 1.2303-02 6.0929-02 8.1873-02 3.5231-02 1.2802-02 1.3826-02-1.1200-02
 -2.0696-02 9.6773-03-2.6531-02 5.9396-03 9.2508-03 2.5196-02

SPAN 5 CHORD 2 STEADY 2.5259800

COSINE COEFFICIENTS

-3.7722-01-2.8959-01-1.1734-01-7.2880-02-6.9081-02-7.7209-03 5.1103-03 2.5126-03
 6.3896-03-1.8722-02-1.9751-02-8.3092-03-1.4490-02-8.5917-03 1.2548-03-8.7066-03
 -2.2100-03-9.5015-03-9.9068-03 3.4556-03 8.6775-03 1.0221-02 6.5280-03 6.3178-03
 5.3227-03 4.2505-03-1.0978-03 2.0117-03 8.4952-04 4.4717-04

SINE COEFFICIENTS

-0.8361-02-2.0992-01-6.1597-02 2.7910-02 1.4647-02-3.3070-03 3.4487-03-3.0249-02
 -3.7474-02-2.3711-02-2.9421-02 1.3507-04-6.1121-03-1.4266-02-6.5356-04-8.0299-03
 -1.2949-03-1.2461-03 1.4980-02 1.3076-02 1.9412-03 3.9418-03-1.7798-03-3.6476-03
 -7.1338-03-8.1590-04 2.2453-04 5.6537-03 8.0248-03 1.5282-02

SPAN 5 CHORD 3 STEADY 1.2639800

COSINE COEFFICIENTS

-2.4124-01-2.1881-01-8.3634-02-4.0030-02-4.7826-02 1.4367-02 1.0826-02 1.0908-02
 0.3417-03-1.8416-02-1.7671-02 2.6224-04-6.0860-03-2.1235-03 9.0087-03-1.1013-02
 -4.5433-03-1.1041-02-1.3626-03 4.8760-03 6.2006-03 9.0849-03 7.2772-03-1.6576-03
 2.7372-03-1.8826-03-1.4716-03 4.7916-03 4.6726-03 3.6969-03

SINE COEFFICIENTS

-1.5170-01-1.7806-01-4.8001-02 2.7917-02 1.3979-02-6.2101-03 2.4727-03-2.9592-02
 -3.4499-02-1.4772-02-1.9321-02 1.0746-02 4.7960-03-1.0340-02-5.3674-03-1.1636-02
 -1.6140-03 5.1261-03 1.6911-02 1.0681-02-3.6546-04-1.2568-04-6.1935-04 5.0139-09
 -4.5858-03 1.8797-03 1.6431-03 8.8396-03 5.0994-03 5.4623-03

SPAN 5 CHORD 4 STEADY 4.7708-01

COSINE COEFFICIENTS

-7.9225-02-7.4821-02-2.3488-02-1.1087-02-2.3349-02 5.1036-03 6.3273-03 8.4353-03
 5.9461-03-6.6398-03-5.9131-03 1.6228-03-2.0853-03 8.8724-04 3.1532-03-3.8317-03
 -7.7469-04-4.4396-03 1.7617-03 4.1118-03 4.1378-03 3.7725-03 2.0608-03-9.7410-04
 2.3043-03-1.4790-03 1.4708-03 3.4300-04 1.1362-03 1.3324-03

SINE COEFFICIENTS

-7.1022-02-6.8677-02-2.6652-02 7.5530-03 1.0709-03-3.9655-03 6.1016-03-8.4271-03
 -1.2929-02-4.3641-03-8.7898-03 7.0681-03 2.6996-03-2.9661-03-2.0662-03-4.6562-03
 -5.2572-03 2.6007-03 4.9700-03 3.5243-03 1.2128-03-1.3730-03-1.7840-03 1.6872-03
 -1.3981-03-7.9569-04 3.2221-04 3.0294-03-3.5878-04 7.7917-05

SPAN 5 CHORD 5 STEADY 1.8145-01

COSINE COEFFICIENTS

-7.0866-02-6.5144-02-1.4039-02-5.5659-03-8.1222-03 9.7118-03 1.1004-02 7.8894-03
 2.4851-03 8.3311-03 8.5385-03 1.2029-03 1.5242-02-2.5901-02-8.9675-03-3.8741-03
 1.6540-03-6.4288-03-4.6925-03 3.3192-03 3.9116-03 2.5401-03 4.6753-05 1.2859-03
 3.4350-03 8.7009-04 1.4517-03-6.4478-04-1.2123-03 3.4983-03

SINE COEFFICIENTS

-7.9007-02-7.2525-02-1.2389-02 2.1958-02 3.9799-03-3.4117-03-2.4317-03-5.3973-03
 -8.3407-03-6.0708-03-4.8531-03-1.6882-03-1.5945-02 3.5526-02 1.0049-02-1.6938-03
 1.6474-04 3.5160-03-6.1722-04 3.3869-03 7.0822-03 1.0413-03-2.6955-03-6.0742-04
 -8.6310-04-9.0140-03 1.5820-03 4.6135-03 1.9016-03 4.6161-03

TABLE III. AERODYNAMIC DATA - HOVER, RIN, 210° HEADING

BURST NO. # 8 *** ROTOR NOISE PUNCHED OUTPUT ***

BLADE PITCH HARMONICS
 1.3149801-5.1298-01 1.5972800 NCOLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY
 ROTOR FLAPPING ANGLE HARMONICS
 1.6186800-1.8674800 0.0000 NPOSITIVE TAIL HINGE -- DEGREES

DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.

SPAN 1 CHORD 1 STEADY 1.2647800

COSINE COEFFICIENTS
 -6.3271-02 1.5366-01-2.3798-02 1.9142-02-6.4235-04 2.1418-02 2.9006-03 4.3904-03
 1.7620-03 7.6723-04 2.7176-03 7.1654-03-1.1713-02-7.1462-04-1.0302-02 5.7290-03
 -1.4834-03 3.7584-03 7.5091-03-1.1189-03 1.8806-04-3.6035-03-1.3170-02 3.8185-03
 -6.0449-03-4.6753-03-4.0406-03 4.3349-03-3.2237-03-6.9466-03

SINE COEFFICIENTS
 -6.7975-02 1.1582-01 1.6155-02 9.6492-03 9.3598-04 2.4391-02 6.8212-03 8.3991-03
 8.8698-03 3.8080-03 8.0825-03 1.0828-02-3.6018-03 4.7461-03 3.3214-03 2.4827-03
 -6.3148-03 2.3212-03 3.4229-03-3.2708-03 7.9586-04 1.3454-03-7.3544-03-9.2106-03
 -3.0386-03-5.0275-03 4.7932-03 2.8240-03 5.7599-03-4.1448-03

SPAN 1 CHORD 2 STEADY 5.1060-01

COSINE COEFFICIENTS
 -2.1787-02 4.9361-02-1.3132-02 1.0606-02 6.0639-03 1.1250-02 1.5358-03-1.0683-04
 6.5109-03-1.8269-03 1.3765-04 6.9291-04-3.4552-03-2.7963-04-3.3681-03 3.0101-03
 -7.5558-04 1.9744-03-1.9263-03 1.0037-04 7.0569-03 1.8911-03 3.9040-03-1.2772-03
 -3.8435-04-9.5977-04 2.4985-03-8.1280-03-5.8801-03 4.0514-03

SINE COEFFICIENTS
 -2.3541-02 4.0190-02 8.9051-04 6.4219-04 5.7319-03 8.5890-03 4.7969-03 5.7645-03
 1.7015-03 2.9611-03 4.0187-04 2.1719-03 1.5255-03 2.0816-03 4.6504-03 1.6018-03
 -2.9568-03-1.5157-03-6.5650-03 5.8280-03 5.9581-04-2.1374-04 1.6758-03-6.8024-04
 -3.6145-03-7.1126-03-1.8618-03 3.6644-03-2.4072-03 3.2561-03

SPAN 1 CHORD 3 STEADY 2.3039-01

COSINE COEFFICIENTS
 3.9569-03 3.4833-02-7.4390-03 9.5495-03-6.8038-03 6.7903-03 4.2903-03-8.8721-04
 -3.4871-03 3.0704-03 5.8936-03 1.0261-02-4.4525-03 4.2405-04-1.3115-03-4.0145-03
 -2.5574-03 5.5405-03-1.6810-04 2.2049-03-1.8030-03 5.8978-04 3.8212-03-2.7464-03
 -3.8807-04-4.7112-04-6.3374-03-1.7289-03-4.9188-03 1.9365-03

SINE COEFFICIENTS
 -1.8026-02 3.4091-02 1.5406-02 2.2868-03 3.8990-03 2.9831-04 3.8640-03 2.1162-03
 6.7870-04 3.0249-03-1.3121-03 7.6481-04 2.9948-03 2.8343-04 1.9835-03-1.1111-03
 -6.2693-04-2.0618-03-1.8063-03-2.2800-04 6.2882-04 4.0359-04 1.8732-03-6.6305-03
 -1.3897-03 3.7408-03 4.0968-03 3.2987-03 3.0029-04-5.3583-04

SPAN 1 CHORD 4 STEADY 0.0000

COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SPAN 1 CHORD 5 STEADY -3.0049-02

COSINE COEFFICIENTS
 5.9828-03-6.4795-03 1.2106-03 7.2676-04 1.7298-03 4.6916-05 3.7134-04-1.4315-04
 -4.2133-04 5.6123-04-6.9857-04-2.1011-03 7.2182-04 8.2735-04 9.5652-04 6.9424-04
 1.7673-03-1.7699-03-8.9845-04 3.9407-04 7.1498-04 5.1366-04-5.1396-04 1.5002-03
 3.6310-04 2.2840-03-2.0721-05-1.0779-04-5.6919-04-3.5682-04

SINE COEFFICIENTS
 -2.9976-03-2.7345-03-4.9350-03 1.5257-04 1.1329-03-9.9202-04 5.9322-04 2.1750-04
 7.5164-04-6.8477-04 5.8769-04-8.4726-04-1.7529-03 1.3102-04-5.4939-04 3.3300-04
 5.3858-04 1.2756-03 1.7809-03-9.1001-04 2.3246-04 7.6588-05-6.3374-04 1.7986-03
 -5.2556-05-1.4435-03-2.0153-03-1.6285-03-1.0511-03 2.7341-04

TABLE III - Continued

SPAN 2 CHORD 1 STEADY 3.1557400
 COSINE COEFFICIENTS
 -6.0432-01 6.5378-02 9.6619-02 1.2051-01-8.6912-03 6.1809-03 4.5970-02 1.0740-01
 6.5133-02 6.3285-02 4.6977-02-2.2366-02-3.0634-02-2.1811-02-1.2074-02-2.7465-02
 -1.9019-02 8.3302-03 4.8263-02 6.4165-02 6.1966-02 1.9755-02-3.8532-02-4.1872-02
 -1.8000-02-1.2138-02-4.8403-02-5.6375-03 4.5449-02 6.4245-02
 SINE COEFFICIENTS
 -3.1147-01 1.9749-01 1.3007-01 1.0749-01 1.0290-01 2.9404-02 5.2923-02 6.9593-02
 7.5040-03 8.5045-03-4.0499-02-6.4891-02-5.2857-02-2.3774-02-1.8771-02-2.7523-03
 2.2699-02 6.4261-02 5.1962-02 9.9979-03-3.6232-02-7.1359-02-5.6708-02-4.0063-03
 1.1965-02 2.3019-03 2.9952-02 5.2038-02 4.6977-02-1.0361-02
 SPAN 2 CHORD 2 STEADY 1.2420800
 COSINE COEFFICIENTS
 -2.9688-01 2.2162-02 5.4326-02 6.8796-02 5.8967-03 2.5945-03 2.1725-02 4.9006-02
 2.2770-02 1.8230-02 1.9796-02 1.0125-03-1.6452-02-1.7981-02-7.0519-03-1.9017-02
 -9.5399-03 1.4670-02 1.1905-02 2.7229-02 1.9316-02 6.6694-04-1.8130-02-1.6789-02
 6.8949-03-1.5713-02-1.2159-02 1.4596-02 2.7591-02 2.1538-02
 SINE COEFFICIENTS
 -1.1103-01 9.6526-02 5.4579-02 4.0758-02 3.4068-02 1.4822-02 2.2670-02 1.6158-02
 -2.5893-03-8.6142-03-1.1205-02-2.1416-02-1.3914-02-2.6909-03-6.0317-03 6.3848-03
 9.0211-03 2.4896-02 1.0860-02-9.3201-03-2.4301-02-2.7801-02-2.2639-02-3.8832-03
 4.4773-03-2.7975-03 1.5003-02 1.6177-02 3.1507-04-1.4701-02
 SPAN 2 CHORD 3 STEADY 1.0430800
 COSINE COEFFICIENTS
 -1.4331-01 3.2466-03 2.6389-02 3.9561-02-9.5510-04 8.1906-03 1.7911-02 2.4234-02
 9.3848-03 9.5470-03 1.1601-02 4.9699-04-7.0805-03-2.6373-03 1.7075-04-6.3756-03
 -5.1851-03 7.9365-03 8.6847-03 1.5030-02 6.1438-03-5.1859-03-1.3181-02-1.0405-02
 -5.5005-03-7.1186-04 5.1593-05 9.5756-03 1.2390-02 5.4115-03
 SINE COEFFICIENTS
 -6.8149-02 4.6958-02 2.0458-02 1.7331-02 1.9161-02 9.8082-03 8.9644-03 4.8526-03
 -2.3109-03 5.8140-03-9.1807-03-1.6390-02-4.6924-03-6.0459-04-3.3126-03-1.5029-03
 5.1611-03 9.5756-03 2.3312-03-5.2159-03-1.1476-02-1.2930-02-5.8177-03 1.1056-03
 4.7294-03 6.6884-03 6.3732-03 5.4411-03-1.1330-03-6.9694-03
 SPAN 2 CHORD 4 STEADY 2.0854-01
 COSINE COEFFICIENTS
 -8.2805-02 2.1139-02 2.4472-02 2.5180-02 7.8439-03 3.7468-03 2.0914-03 1.2098-02
 -1.8329-03-4.9836-04 3.9886-03 3.2809-03-7.4841-03-4.4422-03 1.4615-03-1.8726-03
 -7.0024-04 6.1951-03 1.9999-03 6.0500-04-1.3104-03-4.1757-03-3.6371-03-4.8886-03
 -7.0238-04 3.2332-03 4.0347-03 1.0154-03-1.0260-03-2.0070-03
 SINE COEFFICIENTS
 -8.6759-03 4.0215-02 1.6522-02 3.2601-03 1.6760-02-1.2167-03 9.7461-04-2.6032-03
 -3.4172-03 6.1326-03 2.8021-03-3.5061-03 5.3758-04 4.7844-03-8.7069-04 1.2789-03
 9.0836-04-3.3735-03-2.3045-03-3.2293-03-3.3185-03-3.5701-03-1.3816-03-2.6053-03
 3.7388-03 1.7221-03 1.0407-03-3.2553-03-1.8171-04-1.2848-03
 SPAN 2 CHORD 5 STEADY -1.7373-01
 COSINE COEFFICIENTS
 -2.9849-02 4.9327-03 5.1380-03 6.3509-03 2.8857-03 1.0807-03-1.7863-03 1.0247-03
 -2.7573-03-4.0863-03-1.4608-03 1.0106-03-1.8954-03-2.3643-03-1.9088-03-1.4083-03
 -1.4083-04 5.1061-03 3.2543-03-3.2554-03-3.0671-03-3.1204-03-1.9335-04-1.3266-03
 1.3023-03 7.6369-04 3.5292-03 6.7610-04 3.5904-04-3.2659-03
 SINE COEFFICIENTS
 1.3031-02 1.1137-02 4.4920-03-1.2502-03 3.0421-03-2.5363-03-1.9006-03-3.5707-03
 -2.7431-03 1.4676-03 3.7955-03-2.6112-04 6.7564-04 2.3361-03 9.1367-04 1.3211-03
 4.6693-04-4.2658-03-3.0528-03-1.9801-03-7.6793-04 7.3475-04 1.5424-03-9.1915-04
 1.4732-03 1.0880-03 1.5391-05-2.0337-03-2.2257-03 6.1778-04

TABLE 111 - Continued

SPAN 3 CHORD 1 STEADY 4.1991800

COSINE COEFFICIENTS

-0.1580-01-2.0433-01 3.4551-01 4.6275-01-1.3142-02-3.5954-01-1.2598-01 1.0159-01
 -1.3641-01-1.2202-01 1.5811-01 1.4193-01-9.6021-03-3.9774-03 7.2505-02 9.4394-02
 1.4752-01 1.1030-01 8.5376-03 5.6976-02 1.0981-01 2.2780-02-1.0697-01-1.6016-01
 -7.3138-02-1.7324-02-2.8502-02-8.2004-02-1.2302-01-8.7892-02

SINE COEFFICIENTS

-8.1974-01 1.8345-01 3.2030-01-1.5886-01-3.4188-01-1.6819-01 5.4953-02 3.1822-02
 7.6153-02 3.2147-01 2.4369-01 8.3325-03-1.4919-02 6.7174-02 7.2360-02 8.9527-02
 5.6776-02-4.1482-02-3.6621-03 5.5582-02-4.1511-02-1.6654-01-1.4265-01-4.7483-02
 4.6857-02-2.5095-02-7.1594-02-7.2688-02-6.1893-03 6.9352-02

SPAN 3 CHORD 2 STEADY 3.6573-01

COSINE COEFFICIENTS

-3.2430-01 1.6397-02 6.9283-02 3.8051-02-3.0686-02-6.9092-02-1.7758-02 2.5484-02
 -3.9342-02-2.1727-02 5.2016-02 4.3413-02 7.7074-03 1.5680-02 1.9280-02 1.4556-02
 3.0684-02 2.4022-02 8.7488-03 1.7367-02 2.7889-02-1.1265-02-4.3295-02-3.2657-02
 5.8352-03 4.7009-03-1.8784-02-3.5088-02-1.8150-02-1.4837-02

SINE COEFFICIENTS

-6.4595-02 1.4279-01 1.1383-01 6.1514-03-3.4080-02-1.9948-02-7.7462-03-1.3139-02
 0.3781-03 8.1883-02 3.5458-02 1.1610-02 5.8686-03 1.3120-03-1.8488-03 2.1381-02
 1.4394-02-1.7543-02-2.4562-02 3.0018-03-1.6856-02-3.2813-02-1.2521-02 3.4030-02
 4.2922-02-5.2281-03-5.8381-03 3.4666-03 1.8177-02 2.3179-02

SPAN 3 CHORD 3 STEADY -4.0018-01

COSINE COEFFICIENTS

-1.0782-01-1.8570-03 8.9802-03 7.2332-03-1.5093-02-4.6556-02-2.3168-02 8.1793-03
 -2.9525-02-7.1025-03 2.5327-02 2.7953-02 5.5150-03 9.3457-03 1.1379-02 1.0916-02
 1.9807-02 7.8309-03 1.0577-03 7.4527-03 1.5331-02-1.3137-02-2.7436-02-1.3626-02
 1.0046-02-5.7974-04-2.1791-02-2.1275-02-3.2249-04-1.0632-03

SINE COEFFICIENTS

-3.5829-03 1.2166-01 9.2377-02 6.7222-04-7.9642-03-1.6653-02-9.0665-03-2.0620-02
 6.2252-03 3.5475-02 1.7789-02 2.6031-03 5.1917-03 6.0054-04-7.3531-03 2.5527-03
 6.8851-03-4.0234-03-3.8469-03 8.7292-05-1.7609-02-1.6502-02-6.5461-04 3.1935-02
 1.5099-02-2.8720-03-8.1479-04 1.8574-02 2.0775-02 1.3814-02

SPAN 3 CHORD 4 STEADY 8.5786-01

COSINE COEFFICIENTS

-1.5770-02 6.4496-03-1.5248-02-1.4446-02-2.8034-03-3.9121-03-7.6607-03-3.7357-03
 -1.5199-02-6.4580-03 6.8966-03 1.4035-02 3.2885-03 5.7797-03 1.7411-03-2.2001-03
 -1.1700-04-2.6888-03 8.2266-04 3.1858-03 4.9670-04-5.1621-03-8.4129-03-1.4547-03
 8.8594-03 3.7607-03-6.5378-03 6.3317-04 1.0913-02 5.6450-03

SINE COEFFICIENTS

3.5503-02 5.9841-02 2.4812-02 1.4649-03 1.5504-02 6.8211-03-2.8931-03-1.4748-02
 -5.8968-03 2.9377-03-1.1389-03 6.4843-04 8.4922-03 4.7058-03-3.6292-03-3.5898-04
 2.0892-03-1.7047-03-4.8315-03-4.6179-03-6.0430-03 6.4950-04 8.7485-03 1.7217-02
 4.0626-03-6.5689-03 3.5113-04 1.1703-02 7.1326-03 2.1089-03

SPAN 3 CHORD 5 STEADY 7.6976-02

COSINE COEFFICIENTS

-0.4304-03 6.6213-03-5.9602-03-1.6223-03 7.5222-03 1.1258-04-8.4720-03-6.3688-03
 -3.9951-03 9.7301-04 4.9368-03 7.7317-03 2.9744-04 9.6218-04 3.3901-04-1.7625-03
 9.7535-03-3.4285-03-1.0426-03-8.2563-04-4.0519-03-4.1627-03-2.0371-03 3.1503-03
 2.0683-03 4.9178-03 1.3242-03 4.1463-03 4.0486-03 1.5131-03

SINE COEFFICIENTS

1.9178-02 1.0140-02-6.7500-03-2.0332-03 1.4432-02 1.3894-02 3.7452-03-7.4457-03
 -1.0512-02-7.3133-03-5.6339-03 3.0177-04 7.4695-03 7.4368-04-2.8715-03-2.1269-03
 -1.2855-04 1.4430-03-1.5211-03-5.5326-03 3.7338-04 4.1684-03 2.7179-03 5.0986-03
 -2.0828-03-3.2783-03 1.9913-03 4.2878-03 4.4103-03 9.7982-04

TABLE III - Continued

SPAN 4 CHORD 1 STEADY 0.1557800

COSINE COEFFICIENTS

8.3673-01-5.8406-01 2.6990-01 2.3069-01 2.1317-01 3.1326-01 7.7373-03 4.4229-02
 -3.1146-01-2.7154-01-1.9498-01-1.2855-02-1.5934-01-2.7142-03 7.0245-02-3.3795-02
 -3.5508-02-4.5375-02-1.5153-01 9.4888-02 1.2963-01-4.5549-02-1.2703-01 3.6804-02
 2.0198-01 4.6721-02-1.5185-01-2.2553-02 1.4025-02-1.4441-01

SINE COEFFICIENTS

1.5196400-6.5040-01 5.6420-01 5.3098-01 3.1304-01-1.6634-01-2.5070-01-1.7232-01
 -1.4183-01 1.0814-01 2.1519-01 4.5652-02 1.1578-01 1.8044-01-6.0483-02-5.1772-02
 -3.9416-02-1.1571-01 3.4024-02 1.0790-01-4.6614-02-1.2974-01-2.1229-02 1.6038-01
 -5.3972-03-2.5519-01-7.4533-02 2.6438-02-1.1106-01-2.6578-02

SPAN 4 CHORD 2 STEADY 3.3409800

COSINE COEFFICIENTS

4.1240-01-7.6599-02 1.5347-01 1.1755-01 4.9830-02 9.2946-02-6.8618-02-1.0911-01
 -1.9899-01-1.9591-01-1.4735-01-6.2476-02-1.1454-01-2.9008-02-2.8874-02-6.2518-02
 -3.1156-03-7.4801-03-5.9361-02 3.4450-02 3.9089-02-1.2419-02-5.2035-02-1.9472-03
 7.4843-02 1.7616-02-4.6100-02-7.9780-03-3.2450-02-4.1840-02

SINE COEFFICIENTS

4.4801-01-1.5411-01 1.9004-01 1.5209-01 1.2861-01-1.0402-01-6.1205-02-2.9415-02
 -2.0835-02 5.4545-02 1.6593-01 8.4618-02 9.1515-02 1.0114-01 8.9375-03 4.2362-02
 4.1312-02-6.0614-02 1.3596-02 3.6530-02-5.5046-02-7.3506-02-2.4362-02 3.9901-02
 -2.2227-02-1.0804-01-4.4879-02-2.5178-02-7.0282-02 1.7802-02

SPAN 4 CHORD 3 STEADY 1.7318800

COSINE COEFFICIENTS

1.4047-01-9.1700-02 2.5284-02 1.7300-02 3.4116-02 5.1952-02-8.5635-03-1.6263-02
 -5.5984-02-4.7289-02-2.8464-02 8.7838-03-1.7982-02 1.8483-02 7.1904-03-1.6800-02
 2.1212-02 1.4554-02-4.7444-02-7.3769-03 1.5218-02-1.0153-03-1.5812-02 1.5092-02
 3.7665-02-1.3299-02-1.9411-02 1.7071-02-8.0007-03-9.3165-03

SINE COEFFICIENTS

2.6453-01-6.6361-02 1.0989-01 6.1972-02 3.9806-02-4.0403-02-7.1185-03-5.4125-03
 -6.3001-03 1.6727-02 7.4339-02 3.5969-02 2.5920-02 1.9217-02-1.0772-02 1.6227-02
 1.5202-03-5.2643-02-1.9754-02 1.4085-02-1.5579-02-1.4824-02 2.5828-03 1.4977-02
 -2.4330-02-2.2850-02 2.3288-02 8.2909-03-5.1308-03 2.0914-02

SPAN 4 CHORD 4 STEADY 3.34-01

COSINE COEFFICIENTS

2.8826-02-2.9908-02-9.9324-03-9.8280-03 2.2682-02 1.5260-02 1.0494-04 1.0579-02
 -5.3990-03-9.6781-03-8.3166-03 8.2451-03 8.3519-03 1.0573-02-3.5718-03-1.3969-02
 0.8721-03 2.2071-02-1.1175-02-8.7916-03 1.4946-02 3.3207-03-1.7528-02 4.1396-03
 1.7798-02-6.4746-03-1.8366-02 1.6058-03-1.0886-03-3.4343-03

SINE COEFFICIENTS

8.2309-02-2.4141-02 1.4770-02 1.5771-02-3.5224-03-1.1022-02 5.5523-03-4.4959-04
 -3.3445-03 4.3547-03 2.8900-02 2.5847-02 1.5306-02 8.5821-03 4.7898-03 1.9686-02
 1.8880-02-3.0030-03 3.7769-03 9.4800-03 2.2451-03-8.5680-03-4.7796-03 7.1699-03
 -1.6628-03-1.2701-02-6.5155-03 2.7905-03-6.6780-03 4.0410-04

SPAN 4 CHORD 5 STEADY -4.1377-01

COSINE COEFFICIENTS

1.2440-02-1.2577-02-2.6790-03-7.6369-03 2.6838-03-4.6745-03 2.9262-03 2.2626-04
 1.6403-03 2.5258-03-5.1709-04-6.4062-04 9.8404-03 6.1756-03-9.9783-03 4.2872-03
 8.0766-03 6.1280-03-2.9670-03 3.4057-03 1.0880-02 1.4237-03-9.6147-03 2.7417-03
 2.6310-03-5.4443-03-2.2578-03-4.4965-03-1.3301-02 2.4562-03

SINE COEFFICIENTS

2.8875-02-1.4423-02-8.3499-03 1.7108-02-1.6359-03-2.3580-03 1.1205-02 7.3783-03
 3.8976-03-4.5946-03 5.7636-03 4.5276-03 1.1449-03-7.9393-03 7.0904-03 7.7025-03
 1.1927-03 3.8851-03 6.3806-03 6.7487-03 4.0538-03-3.7408-04-8.2303-03 1.4612-03
 0.0379-04 1.0504-04-5.5641-03 2.1603-03 2.6551-03 5.7811-03

TABLE III - Concluded

SPAN 5 CHORD 1 STEADYM 1.0140401
 COSINE COEFFICIENTS
 8.1270-01-3.5370-01 2.4003-01 2.5036-01-3.1692-02 2.4952-01-3.5342-01-4.4937-02
 -2.7319-01-3.6220-01-2.8402-01 1.2658-01-6.0639-02 4.4470-02-6.0244-02-1.0252-01
 -1.4074-02-3.9253-03-1.5175-01-3.9921-03-1.7202-02-2.0508-02-2.3080-01-1.4872-01
 2.0432-01 3.5410-02-8.7708-02 1.1638-01 3.5198-02-1.5819-01
 SINE COEFFICIENTS
 6.6957-01-6.3023-01 6.2842-01-2.7872-01 1.3366-01-3.4347-01-1.7288-01-1.2556-01
 -2.3129-01-3.9932-02 2.9022-01 8.0567-02 6.7052-02 2.5116-03-1.9218-01 2.6627-02
 -3.0270-02-8.8990-02-3.8876-02 6.2461-02-3.7976-02-6.6608-02-8.7667-02 2.6946-01
 1.2571-01-1.2968-01 2.9635-02 3.0079-02-1.8889-01 6.0941-03
 SPAN 5 CHORD 2 STEADYM 2.5385400
 COSINE COEFFICIENTS
 1.5803-01-7.3870-02 9.9888-02 6.8284-02 1.5492-02 7.0019-02-4.7606-02-2.1748-02
 -7.4740-02-6.8947-02-3.9431-02 1.3075-02-3.7381-02 2.6241-02 3.9248-03-3.0443-02
 -7.9848-03-4.2538-03-3.4262-02 5.1022-03-3.0950-03-1.0287-02-3.8107-02-9.4768-03
 5.1425-02-1.0871-02-2.7557-02 2.9741-02-8.9474-03-1.2226-02
 SINE COEFFICIENTS
 1.2599-01-1.2648-01 1.2680-01-1.7043-02 3.6776-02-7.6547-02-5.1485-02-2.7991-02
 -1.8366-02 2.5667-02 7.8913-02 1.2459-02 3.0507-02 3.7347-02-2.5686-02 2.9658-03
 4.3175-03-2.7577-02-6.9273-05 1.3829-02-9.6055-03-2.1131-02-9.3092-03 5.8727-02
 -2.5129-03-4.6704-02 1.3584-02-2.1486-04-4.1262-02 2.1977-02
 SPAN 5 CHORD 3 STEADYM 1.2635400
 COSINE COEFFICIENTS
 7.3466-02-7.0374-02 6.3303-02 4.6185-02 2.4770-02 6.7845-02-1.3275-03-7.8711-04
 -4.8294-02-4.4529-02-2.8239-02 3.7700-03-3.8129-02 9.7305-03-8.1173-05-3.0978-02
 -5.2614-03 3.8798-03-2.5313-02 1.2591-02 1.2101-02 3.2786-03-2.1399-02 1.0774-02
 3.4202-02-2.3749-02-2.6667-02 1.7965-02-1.0135-02-5.3685-03
 SINE COEFFICIENTS
 1.5251-01-1.2009-01 0.7390-02 2.8835-02 3.7487-02-4.5329-02-3.4307-02-3.2549-02
 -2.5132-02 6.8652-03 4.3240-02 4.0766-04 1.3471-02 2.8356-02-1.9328-02 5.9568-03
 1.5737-02-1.8055-02 1.3480-02 2.1090-02-6.1718-03-1.3105-02-4.0518-03 1.8661-02
 -2.6480-02-8.2246-02 1.4142-02 3.4376-03-2.1985-02 2.2550-02
 SPAN 5 CHORD 4 STEADYM 3.7704-01
 COSINE COEFFICIENTS
 1.4621-02-2.4624-02 2.1900-02 1.1867-02 8.7505-03 3.0769-02 1.0575-02 3.0434-03
 -1.0202-02-5.5399-03-5.0127-03-7.3016-05-1.3514-02 2.4298-03 2.4012-03-1.1622-02
 -3.5791-03 4.1703-03-5.2615-03 6.9210-03 5.7129-03 2.1700-03-2.0291-03 7.1668-03
 8.9510-03-7.4209-03-9.4767-03 4.5003-03-1.6163-03-1.0888-03
 SINE COEFFICIENTS
 6.8741-02-4.9530-02 2.6234-02 1.7611-02 1.4285-02-1.1065-02-1.2902-02-9.9176-03
 -5.0025-03 2.5469-03 1.1709-02-3.7950-03 2.3204-03 9.3883-03-5.5018-03 2.5214-03
 4.4152-03-9.1177-03 4.6128-03 8.2800-03-2.2532-03-3.6393-03-4.3014-03-5.1822-03
 -1.4782-02-1.4005-02 4.5181-03 2.9990-03-3.2509-03 7.5090-03
 SPAN 5 CHORD 5 STEADYM 8.5374-02
 COSINE COEFFICIENTS
 5.2951-02-1.1001-02 7.1416-03-6.1708-03-9.4801-03 1.6480-02 9.7270-03 1.3731-02
 8.2455-03-1.8087-03-2.1267-02-1.2361-02-1.3046-02-1.8234-02-2.3370-04-2.1166-03
 3.0837-03 5.0037-03-1.4226-02 4.2858-03 3.2564-03-1.8473-03-2.4293-03 2.3379-03
 1.3046-02 1.2941-02-5.2921-03-9.5100-03-1.5936-03-1.2265-02
 SINE COEFFICIENTS
 6.5530-02-5.5066-02 5.7374-03 4.5241-03-2.6133-03-7.7641-03-1.1234-02-1.2238-02
 -2.0758-02-2.0038-02-5.4267-03-5.8830-03-1.9541-02 5.0524-02 1.6466-03 2.8462-03
 3.7767-04-6.6161-03 5.5116-03 1.6024-02 5.3359-03-9.9931-04-8.6674-03-6.4790-03
 -7.7335-03-1.3028-02-9.8746-03 1.0012-02 7.0186-03 7.6939-03

TABLE IV. AERODYNAMIC DATA - HOVER, RIN, 270° HEADING

BURST NO. 9 *** ROTOR NOISE PULSED OUTPUT ***

BLADE PITCH HARMONICS
1.3162801-1.7935-03 4.1504-01 *COLLECTIVE LONGITUDINAL, LATERAL RESPECTIVELY*

ROTOR FLAPPING ANGLE HARMONICS
1.7319800-1.3847800 0.0000 *POSITIVE TAIL HIGH -- DECREASE*

DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
*MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.

SPAN 1 CHORD 1 STEADY 1.3391800

COSINE COEFFICIENTS
1.6842-01 1.7908-01-3.5315-02 2.8173-02 2.3828-03 1.5747-02-3.2480-03 1.2006-02
-6.9201-04 1.3176-02 2.1840-03 1.2291-02-6.2994-03-2.2842-03 5.5529-03-6.8462-03
-8.4238-04-5.0420-03-4.5405-03 5.0863-03 6.3481-04 1.2869-04 5.9835-03 4.1914-03
7.0458-04 4.7696-03-1.8723-03-1.3809-03 1.0794-02-3.1627-03

SINE COEFFICIENTS
-1.0774-01 1.2533-01 2.5883-02 3.0283-02 1.1103-03 3.3590-03 2.0545-03-1.6305-02
-3.2701-03-4.1357-03-3.3415-04 1.0375-02 1.1655-03 1.3834-03-2.5365-03 1.2223-03
0.9692-04 1.3464-03 2.7204-03-5.3835-03 2.8116-03-2.1243-03 5.4538-03 4.6632-03
-4.7221-03-1.7358-02-4.1309-03-1.4680-02-1.1529-02-1.0957-02

SPAN 1 CHORD 2 STEADY 5.2963-01

COSINE COEFFICIENTS
6.5183-02 6.2497-02-1.0866-02 1.5569-02 3.7416-03 1.2803-02 2.8519-03 4.7005-03
4.9648-03 3.8806-03 2.5518-03 3.1842-03-2.3467-03 5.8831-03 2.9942-03 7.0651-03
0.7411-03 3.1261-03 1.1215-02-4.7935-03 3.1659-03-1.7238-03 3.6137-03 2.9904-03
6.2268-04 5.5744-03 3.1856-04 4.4807-03 6.8716-03-1.3382-03

SINE COEFFICIENTS
-4.1635-02 4.5124-02 1.1334-03 5.1235-03 6.9334-03 6.3343-03 6.3573-03-4.0175-03
6.5418-03-4.2926-03-4.9978-04 1.5605-03 3.1924-03 3.4042-03 1.2453-04-2.1022-03
-1.0278-04-2.4990-03-8.0563-03-7.2549-04-3.8805-03 3.7382-03-6.5514-03 5.9456-04
-5.7738-03 3.9550-04 1.6530-03-7.9366-04 9.7936-05 8.6308-03

SPAN 1 CHORD 3 STEADY 2.8376-01

COSINE COEFFICIENTS
3.3210-02 5.0086-02-9.3304-03 7.7756-03-5.4065-03 6.7043-03-1.4983-03 1.0917-04
1.2784-03 3.8428-03-2.0919-04 6.5764-03 1.7223-03 1.5305-03 3.4672-03 2.6321-03
6.6373-04-3.1118-03 2.6301-03 1.8344-03 2.3464-03 1.6020-03 3.9973-03 1.1912-03
-4.3748-03-5.4227-04-2.1922-03-1.2280-03-1.9227-04-3.3436-03

SINE COEFFICIENTS
-3.0616-02 2.0031-02 1.2404-02-1.8955-04-3.7763-03 2.9879-03 3.8278-04-5.2959-03
-2.4786-04-2.7343-03-6.6459-04-6.3080-03 4.6086-03-2.6047-03 1.1879-05-1.8410-03
2.0149-04-1.5701-03 4.4580-03-3.0795-03-4.5819-03-3.5676-04 1.1841-03 1.4580-03
-1.3838-03 6.2202-04-1.5123-03-7.1171-04-2.2079-03 1.0266-03

SPAN 1 CHORD 4 STEADY 0.0000

COSINE COEFFICIENTS
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SINE COEFFICIENTS
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
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0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SPAN 1 CHORD 5 STEADY -2.7157-02

COSINE COEFFICIENTS
1.8794-03-6.2034-03 2.4910-03-5.7309-04 1.6969-03 2.1634-04 7.1328-04 9.1138-04
3.8050-04-6.3485-04 4.1897-05-1.2326-03-6.2899-04 1.1293-04 4.9786-04 4.7237-04
1.9680-05 1.4987-03-5.7762-04 7.3349-05-2.2365-04 2.3623-04-2.3995-04-1.8601-08
1.5844-03 8.2817-04 8.3523-04 1.3409-03-1.7806-04-4.3220-04

SINE COEFFICIENTS
1.9348-03-2.3587-03-1.2961-03-2.5200-04 1.6961-03 3.9584-04-1.1352-04 1.8030-03
8.4068-04 3.4002-04 3.9703-04 1.4278-03-1.1958-03-2.1222-04-2.2918-04 5.0728-04
2.6442-04-4.2189-04-9.2546-04 3.4865-04-4.3003-04 1.2678-03 2.2019-04 1.0739-08
-7.9604-04-8.8730-04-6.9859-06-3.4260-04-1.0216-03-1.6639-03

TABLE IV - Continued

SPAN 2 CHORD 1 STEADY 3,2561800

COSINE COEFFICIENTS

-2.6195-02 8.0566-02 3.8465-02 5.6249-02 7.8726-02-1.2002-02-1.2332-02-1.6883-02
 2.2656-03 2.3082-03 9.7369-04 6.2183-03-5.697-03 2.6398-03 1.6342-02 3.3699-04
 4.1323-03 1.7636-03 1.8751-03-4.4843-03-7.6846-03-4.4864-03-5.7316-03-5.9905-03
 -2.5590-03-6.7405-05-8.2191-03-1.4797-02-2.1517-02-1.1420-02

SINE COEFFICIENTS

-6.3450-01 1.7086-01 9.2658-02 1.0183-01 2.1776-02-3.2702-03-3.7421-03 1.7851-02
 -1.1219-03 1.3734-02 7.3057-03 2.4148-03-7.1798-03-6.4609-03-5.0405-04-1.2543-04
 -1.1970-02-2.2701-02-9.1097-03-9.2838-03 1.7900-03-3.7235-03-3.3249-03-5.6776-03
 -1.3751-02-1.1019-02-8.6526-03-1.1350-02-1.0347-02 1.9506-03

SPAN 2 CHORD 2 STEADY 1.2693800

COSINE COEFFICIENTS

-4.8750-02 3.4287-02 2.2895-02 2.6289-02-2.4423-02-6.8174-03-4.0348-03 2.3721-03
 -2.9188-03 8.2303-03 3.4610-04 1.4508-03-1.8291-04 1.0405-03 3.9079-03-8.1748-03
 -8.2847-03-5.7993-03-7.1038-03 4.0863-03 5.0607-04 4.1048-03 2.5819-03 3.0918-04
 1.9839-03 4.2255-03-4.1933-03-2.8798-03-7.9674-03-2.9200-03

SINE COEFFICIENTS

-2.7179-01 6.9954-02 4.1479-02 4.1469-02 2.2001-02-4.4597-03 2.1074-03 1.0134-02
 2.3286-03 5.1213-03 1.1271-04-4.4107-03-1.1333-03-5.6304-03-1.5437-03-5.9161-03
 3.1332-03-1.0027-02-3.5750-03-2.0628-03 1.4416-03-1.3282-03 2.7653-03 4.9278-03
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SPAN 2 CHORD 3 STEADY 1.0478800

COSINE COEFFICIENTS

-2.0367-02 1.1062-02 1.9063-02 1.5497-02-1.8905-02-1.9825-03-5.8708-03-6.9556-03
 3.3738-03 4.8633-03-8.6791-04-1.0168-03 3.9069-04 2.3976-03 1.8303-03-2.8230-03
 -4.3755-03-3.5636-03 1.8212-05-5.4817-04 7.1949-04-4.0145-04 2.5551-03-7.4207-06
 -1.3055-03 1.0391-03-3.3311-03 8.3712-04-6.3477-04 4.6841-04

SINE COEFFICIENTS

-1.2919-01 5.1023-02 2.0659-02 2.6308-02 8.2394-03-7.6041-03-1.0229-03 3.6919-03
 1.2307-03 8.9076-04-3.4287-03-2.8222-03 7.0954-04-4.4967-03-5.5940-03-3.5981-03
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 2.0789-03-2.6046-03 1.4323-04 1.0453-03-2.0407-03-4.3347-03

SPAN 2 CHORD 4 STEADY 2.2396-01

COSINE COEFFICIENTS

-3.4617-02 9.7481-03 3.6468-03 1.1163-02-2.9207-03-5.1566-03-4.1690-03 6.9874-04
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 -3.7180-03-3.3778-03-2.5591-03 1.1165-03 4.2077-05-1.0721-03 6.7509-04-8.4610-04
 -1.9912-03-3.4545-03-1.4642-04 5.8660-04 2.7592-03 3.1306-03

SINE COEFFICIENTS

-6.0153-02 2.4012-02 8.9261-03 1.4478-02 1.4226-02 7.0629-04 1.9482-03 5.1061-03
 7.2583-04-3.6246-04-1.3369-04 4.2040-04 1.6956-03 1.2487-03-1.2699-03 7.6353-04
 -3.6030-04-4.9988-04 1.2949-03 8.6286-04-1.4042-03-1.0072-03-5.9902-04 2.4425-03
 1.3756-03 2.9639-03 1.7051-03 4.1654-03 2.3288-03-3.2252-03

SPAN 2 CHORD 5 STEADY -1.6116-01

COSINE COEFFICIENTS

-2.2659-02 2.5924-03-3.5514-05 2.6237-03 8.4183-04-2.0539-03-1.3637-03 9.4403-04
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 -3.0767-03-1.8811-03 6.0385-04-1.9055-04-2.1852-04-4.9888-04 8.9262-05-3.0953-04
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SINE COEFFICIENTS

-1.6026-02 1.6514-03-4.0837-04 2.1208-03 5.5532-03 1.0592-03 5.3534-04 2.5056-03
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 6.3986-04 1.4777-03 2.1207-03-3.3149-04-9.1427-04-1.4963-03 1.3560-04 2.0680-03
 9.6467-04 2.3070-03 2.1580-03 2.2973-03 4.8202-06-3.0195-03

TABLE IV - Continued

SPAN 3 CHORD 1 STEADY 3.7626800

COSINE COEFFICIENTS

-4.2140-01-1.6558-02 1.2506-01 6.4239-02-3.4769-02 2.4057-02-6.3731-03 1.5331-02
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 7.2647-05 1.2205-02-2.9486-03-1.8692-02-2.4929-02-2.1527-02-8.7497-03 1.1472-03
 2.0388-03-3.2909-02-2.4275-02-1.8849-02 3.7591-03 1.9837-02

SINE COEFFICIENTS

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 -1.8301-02 1.4401-02 1.7617-02 3.8529-02-1.9226-02-2.5921-02-1.9675-02-1.4380-02
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SPAN 3 CHORD 2 STEADY 3.3146-01

COSINE COEFFICIENTS

-2.1888-01-5.0264-02 5.2682-03 1.7882-02-2.0651-02 6.8383-03-4.8721-03 3.5145-03
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 -8.4317-03 5.9353-03 6.1150-03-2.0287-03 3.2696-03-7.0669-03-3.6144-03 8.8753-04
 7.1454-03 6.1320-03 1.3376-03-1.7130-03 4.0424-03 1.1619-03

SINE COEFFICIENTS

-2.9814-01 7.7145-02 3.4331-02 4.8915-02-1.8029-02-2.1838-02-1.7281-02-2.8042-03
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 1.7197-02 9.9131-03 5.5513-03-1.9114-03-5.7420-03 1.4436-03 9.5463-04 4.3343-03
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SPAN 3 CHORD 3 STEADY -4.4979-01

COSINE COEFFICIENTS

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 2.8641-03 8.7755-03 2.7494-03-1.5923-03-7.3590-03-2.5182-03-2.9563-03 1.5963-03
 6.6154-03 2.1767-03 7.4627-03 4.9333-03 4.1267-03-6.5402-03

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-6.8109-02 8.3157-02 1.5324-02 2.6898-02-6.4314-03-1.7204-02-8.7530-03-4.3594-03
 -3.4567-03-5.0939-03 4.2684-03 7.8569-03 7.0368-03-6.0725-04-2.4121-03 6.5580-03
 8.5757-03 9.4218-03 9.2585-03-6.6195-03-2.4063-03 4.5978-03 2.5429-03-2.1029-03
 1.5153-03-4.5033-03-2.6445-03-3.0406-03-4.2355-03-9.1063-03

SPAN 3 CHORD 4 STEADY 7.9353-01

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SINE COEFFICIENTS

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 4.6334-03 5.5609-03 1.3309-03-6.4593-04 2.6695-04 2.4788-03 2.9238-03 6.2991-04
 1.0335-03-1.3731-03 4.2059-04-2.0933-03-8.2350-03-6.2518-03

SPAN 3 CHORD 5 STEADY 6.4519-02

COSINE COEFFICIENTS

-9.3133-03-2.4053-02-9.3614-03 3.7301-03-3.9428-04-4.0633-03-3.6451-03 4.5874-04
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 -8.1775-04 3.7212-04 2.0448-03 2.5213-03 6.1371-04 2.6314-04-1.5569-03-1.2911-03
 2.7018-03 4.1399-03 3.7660-03 1.2470-03 8.6298-04-8.0648-04

SINE COEFFICIENTS

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 1.1236-03 2.8907-03 9.5604-04 1.8101-03 1.6073-03 1.6682-03 2.1632-03-9.8397-04
 -1.6060-03 8.4104-04 1.3321-03-3.4968-03-3.1927-03-1.8345-03

TABLE IV - Continued

SPAN 4 CHORD 1 STEADY 9.0058800
 COSINE COEFFICIENTS
 -1.1492400 3.8078-01 1.7800-02 8.3182-02-1.6421-01-1.4946-01-3.0543-01-2.9599-01
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 -1.2408-01 2.1149-02 6.2863-02 7.2757-02-4.0358-02-8.3896-02-3.9773-02-2.3268-02
 2.8077-02 2.7723-02 6.2708-02 7.9086-02-5.1973-02-1.2174-01
 SINE COEFFICIENTS
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 1.3341-01 1.5562-01 1.6570-01 2.0415-01 2.0550-01 1.5552-01 2.2645-02 9.6219-02
 1.7040-01 1.3576-01 4.7977-02-7.0558-02-8.7145-02-7.3946-02-8.4334-03 1.1666-02
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 SPAN 4 CHORD 2 STEADY 3.2994800
 COSINE COEFFICIENTS
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 -7.1580-03 8.1608-02 1.1353-01 1.0836-01 3.3532-02 5.4116-02 9.006-02 1.3710-01
 1.5179-01 1.3342-01 1.2917-01 4.1765-02-7.0764-02-1.6589-01
 SINE COEFFICIENTS
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 COSINE COEFFICIENTS
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 SPAN 4 CHORD 5 STEADY -4.2792-01
 COSINE COEFFICIENTS
 -4.7019-02-1.3724-02-3.1574-03 3.4981-03 5.1660-03 2.1604-03 1.0941-02 5.5365-03
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TABLE IV - Concluded

SPAN 5 CHORD 1 STEADYN 9.9371800
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 2.4940-01 1.8664-01 1.3938-01 5.5215-02-2.3028-02 3.8770-02 1.7478-01 1.9501-01
 1.2535-01 5.1018-02-3.1513-02-1.6543-01-1.5418-01 1.1013-01
 SPAN 5 CHORD 2 STEADYN 2.4312800
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 8.0383-02 7.3765-02 6.7132-02 2.2106-02-4.6381-02-5.7716-02
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 4.4586-02 2.2026-02 3.6355-02 7.3436-02 6.6233-02 5.0544-02 3.8063-02 7.8334-02
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 SPAN 5 CHORD 3 STEADYN 1.1457800
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 -1.5772-03-8.1145-03-1.3218-02-7.5366-03-1.1116-03 2.2930-03-1.3621-03-3.5840-03
 5.0619-03 5.7118-03 6.5819-03 4.6171-03 6.5591-04-5.7831-03-4.5844-03-4.1745-04
 2.3818-03 6.0762-04-2.7882-03-1.0170-02-1.6714-02-1.0417-02
 SINE COEFFICIENTS
 8.9161-02 3.2622-02 2.4302-02-2.9534-03 7.2718-03 3.6063-03 3.1751-03 4.2036-03
 5.1663-04 4.3205-03 9.2968-03 1.4501-02 1.2372-02 9.0445-03 6.7347-03 9.2036-03
 7.0369-03 1.7710-03-2.6076-03-7.2529-03-9.4363-03-2.5980-03-1.1655-03 5.0617-03
 8.3535-05-4.5633-03-6.8534-03-8.1088-03 2.8944-03 1.3177-02
 SPAN 5 CHORD 5 STEADYN 2.9080-02
 COSINE COEFFICIENTS
 -7.5962-02 1.7043-02 1.5677-04-5.2604-03-1.3253-02-8.7536-03-9.4362-03-1.9447-02
 -1.4931-02-2.0200-02-1.3825-02-1.2621-02-1.5843-02 4.1064-02 3.2690-03 1.2713-03
 4.1836-03 7.8333-03 4.3685-03 4.2320-04-5.2100-03-5.7101-03-2.5326-03-2.1040-03
 3.7589-04-5.9612-03-2.2397-03 6.1892-03-3.1348-03 2.0977-03
 SINE COEFFICIENTS
 1.0193-01 2.7529-02 1.1419-02-1.3953-02-6.8675-03 5.9157-03 5.5643-03 6.5323-03
 0.1863-04 6.0095-04 3.3281-03 8.7541-03 5.3276-03 1.7684-02 2.7949-03-6.6509-03
 1.9094-03-3.3910-03-6.9624-03-2.5813-03-7.0699-03-8.7087-03-6.9721-03 7.6937-03
 7.4446-03 6.9831-03 1.3745-03-1.0284-02-6.9086-03 1.2807-03

TABLE V. AERODYNAMIC DATA - 120-KNOT, EAST-TO-WEST FLIGHT

BURST NO. # 22 *** ROTOR NOISE PITCHED OUTPUT ***
 BLADE PITCH HARMONICS
 1.2625801 3.5712800-5.1429800 %COLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY
 ROTOR FLAPPING ANGLE HARMONICS
 1.0390800 3.2634-01 0.0000 %POSITIVE TAIL HIGH -- DEGREES
 DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 %MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY 1.4568800
 COSINE COEFFICIENTS
 -7.4482-01 5.7765-01-1.7217-01-7.9422-02-4.2300-02 8.1176-03-2.0610-02-1.4874-02
 -4.8917-03-7.2146-03 6.8540-03 1.0963-04-4.5696-03 9.2308-03-3.1371-05 1.6227-03
 -6.7244-03 1.4672-03-1.3230-02 3.1987-03 3.1619-03-2.3544-03-7.2003-03-5.1666-03
 -7.6619-03-1.6835-02-1.5855-03-6.1061-03-1.1113-02 1.9844-03
 SINE COEFFICIENTS
 4.6525-01 7.8078-02 2.3710-01 5.5845-02-7.1875-02 2.8246-02-2.3821-02 5.7133-03
 -1.2296-02-5.7320-04-1.1370-02-5.2076-03 2.3773-03-9.3344-03 1.5070-03-3.9605-03
 3.1831-03 9.8516-03 7.0955-03 2.2616-03 6.9634-03 5.2881-03-7.0636-03 8.8973-03
 -1.1884-02-7.6464-03-8.6827-03-4.9929-03-1.9067-02-5.3780-03
 SPAN 1 CHORD 2 STEADY 5.4156-01
 COSINE COEFFICIENTS
 -2.4636-01 2.0155-01-4.9338-02-1.5852-02-1.9650-02 5.6638-03-2.7492-02-9.2798-03
 1.0997-03-2.5682-02-1.0031-02 2.1103-03-3.3353-03-1.7690-02 1.0430-02 3.0415-02
 -2.3046-03-1.0057-02 7.7924-03 3.4162-04-1.8156-02 2.6505-02-9.1599-03 2.0058-02
 -1.1976-02 1.5860-02 1.8897-03 9.1921-04 6.2731-03 1.2220-02
 SINE COEFFICIENTS
 2.5516-01-9.9657-03 9.1324-02 1.8870-02-5.8307-03 3.3587-02 4.6306-03-2.4508-03
 1.3630-02 1.1632-02-8.2042-03 4.1081-05-3.3960-03 5.2048-03 1.0476-02-1.4143-03
 -4.8729-02-1.1569-02 4.2906-04-2.5889-02-8.9785-03-2.3300-02 2.6361-03-2.6353-03
 -8.6197-03-2.1535-03-7.3608-03-5.9645-03-1.3473-03-5.7200-03
 SPAN 1 CHORD 3 STEADY 2.0702-01
 COSINE COEFFICIENTS
 -1.4976-01 1.5017-01-4.7000-02-1.9800-02-1.8586-02 1.0418-02-9.1389-03-2.0345-03
 -2.1773-03 1.6361-03-2.8154-03-2.2022-03-2.5311-03-9.7455-04 3.1904-04 1.4679-04
 -1.6788-03 5.8812-04-3.1973-03 2.4294-03-1.6418-04-3.3378-03-1.8380-03-2.8117-03
 -2.4129-04-2.5820-03 1.0302-03-5.4132-04 1.3102-04-2.1952-03
 SINE COEFFICIENTS
 1.1891-01-9.8714-03 3.9401-02 1.5518-02-1.4820-02 1.2132-02-6.9932-04 3.4399-03
 -3.6431-04 1.5494-03-2.4100-03-2.3941-03-5.5364-03 1.6479-03-1.3129-03 3.2366-03
 -1.4123-03-7.4724-04 2.1920-03-4.5327-03-1.7192-03-2.0403-03 1.7560-03-3.2223-03
 3.1668-04-3.4183-04-2.6214-03-3.0882-03-4.5381-03-5.2426-03
 SPAN 1 CHORD 4 STEADY 0.0000
 COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SPAN 1 CHORD 5 STEADY 1.8378-01
 COSINE COEFFICIENTS
 4.2233-03-2.7972-02-8.3308-04 5.1288-04 1.5295-03-1.5900-04 9.2070-04 4.0257-04
 9.4991-03-2.3272-04 3.4959-05 7.1013-04 5.8079-04 1.8464-04-4.2370-04-3.5136-05
 8.7300-05 8.1967-04 6.9089-04-4.4642-04-4.5523-04 5.1218-04 2.2215-04 3.1602-04
 -4.5999-04-1.4355-04-2.4600-04 4.1947-04 5.4477-05 1.2274-04
 SINE COEFFICIENTS
 4.3927-02 4.8164-03 4.8729-03-1.7127-03 2.3182-03-5.3802-04 1.6917-03-4.7524-04
 -4.8457-04-1.7800-03-1.7275-04 5.8059-04 6.9052-04 4.4626-04 5.5114-04-2.6664-04
 1.8028-04-6.0664-04-7.1408-04 7.9988-04 1.1400-04-1.4340-04 1.8722-04 1.3294-03
 -3.8967-05 1.6861-04-3.0716-04 1.3327-04 2.5797-04 9.8862-05

TABLE V - Continued

SPAN 2 CHORD 1 STEADY 4,2722400

COSINE COEFFICIENTS

-2.3649-01 1.5318400 1.5158-02 2.3440-01-2.5583-01 2.8601-01-2.2117-01 8.1035-02
 -6.0594-02 6.9470-02-8.6474-02 2.4340-02 9.6925-03-3.8683-02-5.5372-03-2.0649-02
 -2.0734-02-6.4705-02 3.1226-02-1.7829-02 9.8389-03-1.8134-02 2.8859-02-1.3211-02
 -2.2058-03 1.1020-02-3.6638-03-6.5718-03-1.3667-02 6.0206-03

SINE COEFFICIENTS

5.2138-02 4.4109-01-4.4853-02-1.6782-01-2.0936-01-3.1471-02-9.7771-02-4.2937-02
 7.1904-02-1.4118-01 4.1161-02-4.9886-02 3.1363-02-7.4788-02 4.5057-02-4.2731-02
 -1.9634-02-1.8077-02 9.8917-03-2.1562-02-2.2859-02 2.8224-02-3.2639-02-1.6496-03
 -1.3169-02 1.1753-02-2.8154-02 7.5791-03-1.0934-02 6.9944-04

SPAN 2 CHORD 2 STEADY 1.7564800

COSINE COEFFICIENTS

2.4430-02 6.3029-01 3.5406-02 5.5528-02-9.9657-02 9.8290-02-6.6809-02-5.4583-03
 4.8262-03 6.5483-03-1.8989-02 6.1269-04 1.2150-02-1.4224-02-2.9350-03-1.8880-03
 1.1128-03-1.0442-02 1.3955-02-1.3369-02-3.3570-03-4.7733-03 5.8630-04-5.0625-03
 -9.2579-03 1.7942-03-7.0164-03-7.5876-03-6.8897-03 5.4202-03

SINE COEFFICIENTS

-1.6657-01 1.6537-01 2.2208-02-9.3301-02-7.6919-02-1.7151-02-2.7948-02-1.8272-02
 2.3453-02-3.6943-02 2.2799-03 4.2177-03-5.4021-04-1.5144-02 4.8246-03-3.6005-03
 -1.8131-02 6.2545-03-2.0468-03-1.0135-03-3.6062-03 4.9982-03-6.3333-03-1.1087-03
 -1.9168-03 2.7236-04-1.0288-03 2.6163-03 1.7299-03-1.5207-02

SPAN 2 CHORD 3 STEADY 1.4598800

COSINE COEFFICIENTS

2.2511-02 3.6158-01 2.9670-02-8.1435-03-5.2049-02 6.4069-02-2.2885-02-3.0881-02
 6.0847-03 2.3359-02-6.0422-03-2.8202-02 4.8255-03 1.3468-02-3.5428-03-1.8616-02
 -3.3922-03 2.0576-02 2.0275-03-2.3411-02 3.7878-03 2.5415-02 1.0877-03-2.6266-02
 -3.1227-03 3.2343-02-4.4579-04-3.6554-02 3.3873-03 3.5356-02

SINE COEFFICIENTS

3.0172-02 6.1531-02 5.4186-02-5.7561-02-6.7475-02-9.0848-03 6.9631-03-3.5980-03
 -1.8405-02-1.8802-02 1.9977-02 5.7739-03-3.0787-02-1.4436-03 2.4975-02 9.7850-04
 -3.5249-02 1.6301-03 2.5442-02-7.9773-03-2.8837-02 2.1569-03 2.2229-02-4.3321-03
 -2.8145-02 2.6202-03 2.7854-02-3.4656-03-3.0225-02-4.7867-03

SPAN 2 CHORD 4 STEADY 2.8750-01

COSINE COEFFICIENTS

-1.5777-01 2.2544-01 4.6429-02 7.0774-03-2.3378-02 1.7624-02 2.0778-03-5.8018-03
 3.0637-03-1.1361-03-1.1694-03-1.9702-03 2.4146-03-2.8752-03-3.6467-03 1.7119-03
 8.1808-04-9.0785-04-4.4631-04 3.1964-03-2.3056-03-8.9511-04-1.0922-03 2.0212-03
 -2.4735-03-1.7343-03 7.9123-04 1.3782-03-3.5898-03-1.6883-03

SINE COEFFICIENTS

-1.9855-01-9.4690-03-1.0131-02-3.7702-02-7.7190-03-8.7350-03-1.0490-02 1.5194-03
 -3.1548-03-7.9898-03-5.2153-03 5.8143-03-5.5728-03-4.5214-04 6.7259-04 6.7203-04
 -6.8408-03-3.5542-03-1.7459-04 1.0072-03-2.4067-03-1.4061-04 1.5742-03-2.6067-03
 -2.3164-03 4.9780-04 1.2144-03-4.1108-03 4.5598-04 8.5182-04

SPAN 2 CHORD 5 STEADY -2.1236-01

COSINE COEFFICIENTS

-1.8048-02 5.7544-02 1.4526-02-2.9197-03-1.8478-03 2.1982-03 4.3128-03-3.1864-03
 2.7489-03-2.4809-03 2.1316-03-1.5358-03 1.7566-04 1.3953-03-1.9439-03 2.3691-03
 -3.2888-03 2.0995-03-2.8652-03 3.7502-03-4.6442-04 3.0487-05-1.7971-03 1.3268-04
 -6.3037-04-1.6462-03-6.3803-04 4.0261-04 1.1596-03-2.2121-03

SINE COEFFICIENTS

-2.0536-01-1.3468-03-6.9293-03-8.4404-03 3.2130-03-4.2153-03-3.7461-03 2.4358-03
 -2.5767-03-9.4456-04-2.7604-03 5.1314-03-6.5623-03 8.7684-04-1.2620-03 2.6795-03
 -2.6315-03-7.2211-04 9.4115-04 1.0325-03-1.0996-03-8.6236-04 2.9955-03-1.3021-03
 -8.4877-04-8.0294-04 2.7616-03-1.8390-03-1.2594-03 7.0885-04

TABLE V - Continued

SPAN 3 CHORD 1 STEADY 5.0278800
 COSINE COEFFICIENTS
 1.0424800 1.6650800 1.9028-01 2.1068-01-4.3720-02-1.3843-01 1.0831-01 1.3226-01
 -1.3109-01 7.4559-02 7.2098-02-6.4662-02 7.1090-02-4.1483-02-4.4403-02 8.2176-02
 -5.7059-02-1.6204-02 6.2011-02-4.4024-02 2.7830-02 2.1205-02-4.7924-02 3.7390-02
 -2.8163-02-3.7839-02 3.7416-02-3.5942-02-2.3428-02 1.9978-02
 SINE COEFFICIENTS
 -3.0113-01 2.6807-01 4.4775-01-5.8180-01-2.9404-01 1.2776-01-1.5443-01 1.6001-02
 -1.5213-02-5.8790-02 1.2276-01-8.9101-02-5.2156-02 1.0013-01-6.4027-02-4.3964-02
 2.6436-02-6.0526-02 2.8424-02-1.6258-02-5.9177-02 3.6733-02-3.9539-03-3.0193-02
 4.0370-02-3.0513-02 2.5586-03 1.2249-02-6.0649-02 9.3748-03
 SPAN 3 CHORD 2 STEADY 4.1445-01
 COSINE COEFFICIENTS
 5.4260-01 6.6204-01 9.3063-02-5.3235-03 1.4614-02-2.1057-02 2.2224-02 2.7817-02
 -4.3444-02 5.3779-03 3.2122-02-1.7330-02 1.1218-02-7.9375-03-1.3440-02 2.8506-02
 -1.7349-02-1.1185-02 1.9985-02-1.5819-02 3.3136-03-5.9482-03 2.9050-04 1.8759-02
 -2.5194-02 1.9804-03 1.6197-02-5.5710-04-1.1419-02-5.4071-03
 SINE COEFFICIENTS
 -1.0178800 2.3249-02 2.0564-01-2.3303-01-1.2795-01 6.5960-02-3.1235-02-1.7776-02
 2.2658-04-1.9850-02 2.1739-02-2.4181-02-1.6462-02 3.2430-02-1.7944-02-1.1781-02
 1.1839-02-2.2416-02 6.6177-04 3.0618-03-2.8102-03 4.5852-03-2.1083-02 8.0087-03
 8.0558-03-2.1393-02 2.5145-03 1.0046-02 5.7084-04-1.3029-02
 SPAN 3 CHORD 3 STEADY 1.3695800
 COSINE COEFFICIENTS
 6.8640-02 4.0684-01 8.6174-02-8.9687-03-3.5912-02 2.7245-02 1.6812-02-1.9448-02
 -1.7870-02 2.3730-02 1.5250-02-2.7392-02-2.3170-03 2.7432-02 6.7491-04-2.4072-02
 -5.4663-04 2.3328-02 7.4809-03-2.6180-02-6.8593-03 2.8880-02-1.2320-03-3.2040-02
 2.9541-03 2.9387-02-4.9411-03-3.0444-02-3.0846-03 3.0826-02
 SINE COEFFICIENTS
 -4.3772-01-5.4682-02 1.0577-01-1.1929-01-9.5043-02 2.6650-02 1.7434-02-1.9932-02
 -3.5260-02-2.7143-03 2.7159-02-1.0729-02-3.5108-02 6.0908-03 2.6802-02-1.0308-02
 -2.7446-02 1.9612-04 2.4146-02-3.2497-03-2.9976-02-5.1463-03 2.5999-02 1.4024-03
 -2.7361-02 4.3472-03 2.6702-02-4.5198-03-3.2309-02-5.9820-03
 SPAN 3 CHORD 4 STEADY -4.8522-01
 COSINE COEFFICIENTS
 -3.1555-02 1.6562-01 4.2202-02 1.5081-02-2.8691-02 6.7586-03 1.2966-02 1.2489-03
 -4.1574-03-4.3356-04 3.8774-03 1.7146-03-2.6127-03 8.1047-04 2.1286-03-3.7438-03
 -1.2850-03 1.3807-03 4.0549-04 1.1272-03-1.4030-03-9.4900-04 2.2790-03 7.2734-04
 -4.7602-03 6.3411-04-2.3064-03-1.5214-03 7.7795-05-1.3507-03
 SINE COEFFICIENTS
 -2.6761-01-4.0909-02 2.2303-02-4.5977-02-2.2532-02 5.6359-04 5.3325-04-7.7331-03
 -6.6103-03 2.7408-03-1.2037-03-3.0685-03-1.1404-03-1.7081-03 2.1310-03-1.9878-03
 -5.3704-03 6.6354-04-1.7894-03-1.3694-03-5.9406-04-1.4078-03-4.3264-04 7.2587-10
 -1.1409-03-5.5914-04 1.1059-03-1.4666-03-1.3175-03-9.7568-04
 SPAN 3 CHORD 5 STEADY -2.2523-01
 COSINE COEFFICIENTS
 -5.6236-03 3.7976-02 1.1218-02 4.4105-03-8.9230-03 2.5730-03 4.1095-03-2.3992-03
 -1.0679-03-2.0028-03 4.0642-04 1.6663-03-2.6063-03 4.8169-04 3.1926-03-2.5335-03
 4.6742-04-9.7663-04-8.4114-04 3.5605-03 2.2934-04-1.6814-03 3.2858-03-8.2625-04
 -8.3204-03 1.1109-03-1.3638-03-3.3676-04 1.7880-03-2.1325-03
 SINE COEFFICIENTS
 -1.4354-01-9.5747-03-8.3747-03-9.5525-03 2.4382-03-4.3180-04-1.3643-03-4.0234-03
 -1.3973-03 1.9441-03-3.5099-03-2.2320-04 1.1648-03-1.5222-03 1.7194-03-1.3587-04
 -2.6398-03 1.0870-03-9.9843-04-1.2343-03 1.1842-03-1.8439-03 3.7856-04 2.6035-03
 -2.9669-03-3.8299-04 1.0752-03-1.3046-03 3.5129-04-5.1664-04

TABLE V - Continued

SPAN 4 CHORD 1 STEADY 4.2219800

COSINE COEFFICIENTS

1.5395800 1.3025800 4.5019-01 3.2314-01-2.0864-01-4.2311-02 2.1454-02-9.1243-02
 3.3637-02 8.7441-02-4.0901-02-8.4593-02 4.1888-02 3.3758-02-4.3535-02-5.0351-02
 4.1671-02 2.4115-02-2.2737-02 3.6890-03 1.4419-02-1.5116-02-2.5145-02 1.2484-02
 1.4992-02-1.7823-02-1.2061-02 1.5942-03-3.3570-03-2.9734-02

SINE COEFFICIENTS

-1.4750800-4.0320-01-1.8623-02-1.6500-01-4.4765-01-1.7394-01 1.2043-01 5.0733-02
 -1.4596-01-6.0190-02 6.5443-02 1.1394-02-3.8037-02 1.7892-02 8.6268-03-4.6018-02
 -1.9743-02 2.7926-02-2.8598-02-4.4890-02-7.9898-03 3.4738-02-6.6040-03-3.0579-02
 2.1329-02 2.5153-03-2.4160-02-4.7104-03 9.1453-03-3.8068-03

SPAN 4 CHORD 2 STEADY 1.3534800

COSINE COEFFICIENTS

0.7141-01 3.9179-01 2.1280-01-7.6427-02-2.4871-01 1.0245-01 1.2633-01-9.7509-02
 9.4810-03 7.1545-02-4.8101-02-3.3708-02 3.9035-02 1.7594-02-2.1185-02-2.0148-02
 3.3545-02 4.3082-03-2.7864-02 2.0512-02 3.7025-03-1.8362-02-9.9363-04 7.8105-03
 -4.8898-03-1.7172-02 3.9590-03-1.0584-03-1.1472-02-1.2167-02

SINE COEFFICIENTS

-0.0772-01-1.7945-01 2.3104-01 5.0903-02-3.3207-01-2.2644-01 1.3692-01 8.7372-02
 -1.0873-01-1.5619-02 3.7619-02-2.8562-02-9.6808-03 6.2956-03-7.7632-03-3.0161-02
 -1.0490-02 3.3286-02-3.2465-02-3.5784-02 1.5881-02 7.4866-03-5.0605-03-8.2417-03
 1.6579-02-5.6543-03-1.1504-02 5.7042-03 4.8261-03-1.4736-04

SPAN 4 CHORD 3 STEADY 7.8889-01

COSINE COEFFICIENTS

3.6248-01 3.1924-01 1.5049-01 1.0468-01-1.6017-01-8.1154-02 1.1455-01 3.0603-02
 -5.9182-02 2.8653-02 3.5645-02-5.7182-02-4.5233-03 5.6288-02 6.7634-03-4.3613-02
 -2.6304-02 2.7047-02 1.8801-02-2.0775-02-2.8112-02 3.1986-02 3.1424-02-2.9086-02
 -2.4594-02 2.6488-02 1.9916-02-3.3294-02-1.2059-02 2.9702-02

SINE COEFFICIENTS

-5.8614-01-1.9595-01-2.0951-02 3.6030-02-8.2791-03-1.4133-01-6.7488-02 1.0612-01
 1.7874-02-7.9768-02 6.8581-03 3.8734-02-1.4104-02-1.1467-02 1.0631-03 1.0284-02
 5.5557-03-1.8175-02-1.2953-02 1.5164-02 5.8733-03-3.2380-02-1.2285-02 2.2755-02
 1.1507-02-2.4589-02-1.3842-02 1.6206-02 8.2495-03-9.5520-03

SPAN 4 CHORD 4 STEADY -9.4500-02

COSINE COEFFICIENTS

0.1175-02 1.3453-01 3.0133-02 1.4487-02-2.0257-02-1.6455-03-4.8325-04 6.3970-03
 2.8579-03-3.6149-03-1.3725-03 2.1989-03-5.6105-05 2.5287-03 3.0945-03-2.7916-03
 -4.4216-03-9.4980-03 2.9586-03 4.0436-03-2.2778-03-5.9428-04 1.2087-03 8.9990-04
 -1.3650-03-2.0076-03-1.0654-03-4.0664-03 3.4466-03 9.4887-04

SINE COEFFICIENTS

-4.3940-01-6.0715-02 3.2676-02-1.0340-02-3.4017-02-6.2035-03 3.5839-03 8.9499-03
 7.6510-04-1.3049-02-6.5094-03 5.3235-03 5.1398-03-1.0520-03-1.0021-03-1.9938-03
 2.3759-03-7.7407-05-2.3469-03 7.0212-04 2.0335-03-9.4988-04-1.3443-03 1.0391-04
 1.5854-03 5.0593-04-1.8310-03-2.2283-03-3.2088-03 2.0972-04

SPAN 4 CHORD 5 STEADY -5.2422-01

COSINE COEFFICIENTS

-5.5308-02 1.3909-02-1.9432-03 2.7499-03-2.0954-03 3.7724-03-1.8425-03 4.9534-03
 3.2417-03-4.2805-03-3.0168-04 5.3817-03 1.3319-03-1.7170-04 2.4519-03 2.0211-03
 -3.3441-03-2.2564-03 5.4989-03-2.7941-03-4.3480-03-3.0633-04-2.7898-03-8.3308-03
 4.5245-03 1.4307-02-6.1378-03-3.8744-03-1.7685-03 3.8547-04

SINE COEFFICIENTS

-1.8923-01-1.9514-02 1.3358-02-3.2211-03 1.4284-03 4.9905-03 7.1813-04 7.6518-05
 5.0195-03-1.7106-03-2.6179-03 2.5519-03 1.9689-03-3.3523-03-2.8841-03 5.7150-04
 -1.2006-03-3.1719-03 5.7323-03 4.4982-04-2.2730-03 1.2670-03-5.9358-04 5.6622-03
 7.3842-03 1.1565-03-2.0662-03 1.4282-04 3.0123-03 6.7332-03

TABLE V - Concluded

SPAN 5 CHORD 1 STEADY 4.0794800
 COSINE COEFFICIENTS
 1.6320800 1.0345800 5.5733-01 5.2797-01-8.1597-02-9.4733-02 9.6334-02-1.1048-03
 -7.7758-02 2.4794-03 1.9271-03-9.1527-02-1.4054-01-3.3881-02 4.8126-02-3.7017-02
 -1.0430-01-4.0029-02 4.2593-02 1.7934-02-4.1813-03-3.0990-03 2.7664-02-3.3953-07
 -3.8697-02-2.5103-02-1.2134-02-3.9232-02-4.1636-02-1.1361-02
 SINE COEFFICIENTS
 -0.7231-01-5.5587-01-2.7464-01-1.8629-01-3.8493-01-3.7006-01-1.5998-01 2.6769-02
 -1.2955-01-2.5171-01-8.7524-02 4.5626-02 4.1242-02-1.8058-01-6.5988-02 2.7126-02
 2.7822-02-4.1684-02-1.1683-02 4.1723-02-3.7507-02-4.2305-02-1.3078-02-1.3176-02
 -2.4700-02-4.9869-02-5.7453-02-6.2289-03-3.6548-02-1.6478-02
 SPAN 5 CHORD 2 STEADY 1.0785800
 COSINE COEFFICIENTS
 2.4566-02 2.0730-01 1.4726-01 2.1827-02-9.6305-02 2.5040-02 2.5082-02-2.9232-02
 1.9610-02 3.7238-02-3.3776-02-5.0026-02 1.7069-02 5.4532-02 6.0839-03-5.7406-02
 -1.2037-02 4.0516-02-2.7389-03-3.9892-02 1.0315-02 5.3264-02-1.1537-02-6.0441-02
 5.6521-03 6.4047-02-4.6132-03-6.5913-02 9.4463-03 6.1140-02
 SINE COEFFICIENTS
 -1.5764-01-2.4628-01-6.6378-02 3.4277-02-4.7703-02-8.3079-02-7.0114-02 2.8966-02
 7.3878-02-5.7424-04-8.0982-02-2.4167-02 6.5775-02 8.4083-03-5.8874-02-9.1064-04
 5.2164-02 2.4647-03-6.8990-02-1.3862-02 5.7362-02 1.0580-02-5.4039-02-1.0578-02
 5.6184-02 1.3510-03-6.3777-02-2.8340-03 7.2195-02 9.0538-03
 SPAN 5 CHORD 3 STEADY 1.6410-01
 COSINE COEFFICIENTS
 -2.6946-01 1.0556-01 4.8799-02 4.8932-02-7.3060-02-6.5782-03 2.0596-02-8.5573-03
 -1.2082-03 1.0108-02-3.1347-03-5.7847-03 4.4663-03-2.2928-03 2.7550-03-2.1232-04
 -5.2068-03-3.4002-03-3.5374-04 3.8460-03-4.4867-03 3.6618-03 5.1080-03-4.4754-03
 -9.1358-04 7.1126-03-4.4139-04-6.9210-03 3.4912-03-4.8381-04
 SINE COEFFICIENTS
 -5.0316-01-1.4849-01 3.6460-02 3.3007-02-5.6248-02-4.2807-02 1.1976-02 3.7488-02
 -4.0298-03-1.5871-02-7.8382-03-3.2948-03 9.3037-03 6.4567-03-8.9829-03-3.3997-03
 9.5132-04 3.0977-03 2.0947-03-5.0343-04-6.8336-03-7.4559-03 6.9313-03 2.0097-03
 -4.2458-03-1.8832-03-8.4219-04-1.8250-03-1.2632-03 3.8564-03
 SPAN 5 CHORD 4 STEADY -2.9532-01
 COSINE COEFFICIENTS
 -3.3002-01 1.6966-02-3.9320-03 9.5084-03-9.9660-03 2.8621-03-5.8104-03-4.3206-03
 6.2674-03 7.0514-04-1.4501-03-3.4289-03 2.5162-03 2.3951-03-2.1823-04-9.2692-04
 -4.0730-04 2.1082-03-5.8085-04-1.4226-03 1.7174-03-1.8213-03-4.1439-05-7.6532-04
 1.0753-03 2.2513-03 1.7290-04-1.4588-04 1.3390-03 6.3954-04
 SINE COEFFICIENTS
 -2.1927-01-4.3440-02 3.0464-02 6.8247-04-1.7934-02-1.0338-03-1.0402-03 5.4159-03
 5.1780-03 5.2981-04-4.3179-03-1.3176-03 1.2694-03 5.1522-03-1.8182-04-2.9745-03
 -2.1049-03 1.8236-03 4.0824-03-1.3017-03-8.6702-04-1.2061-03-1.4779-03-1.2055-04
 -3.7944-04 2.3827-04-1.3405-03 3.7605-04-1.2408-03 2.1761-03
 SPAN 5 CHORD 5 STEADY -5.4996-01
 COSINE COEFFICIENTS
 -1.2693-01-2.0660-02-8.0705-03 1.0484-02 6.3474-04 7.1189-03-5.5877-03-1.5001-03
 9.4024-03 1.4100-02 5.9984-03 7.4685-03 1.7111-02-4.4516-02-6.9642-03-1.0299-03
 -6.1952-04 5.4070-04-1.8118-03-1.7896-03-5.1630-04 4.9739-04-1.7209-03-2.3372-04
 -4.3905-04 4.0345-04-2.1098-03-4.8911-04 6.5655-05-1.6369-03
 SINE COEFFICIENTS
 -2.2250-01-1.5898-02 2.1463-02 1.7537-02-1.4998-02 1.2921-03-4.9869-03 4.2669-03
 5.2296-03 3.3989-03-5.4843-03-8.2889-03 1.3989-03 6.7004-03-1.7538-03-5.0530-04
 -3.1772-03 2.7021-03 1.2229-04 3.4489-03-1.6710-03 2.1866-04 4.9931-05-8.0991-04
 1.2330-03 3.1782-03-4.8867-04-3.0986-03 2.3357-03 2.6529-03

TABLE VI. AERODYNAMIC DATA - 120-KNOT, WEST-TO-EAST FLIGHT

BURST NO. # 13 *** ROTOR H-15C PUNCHED OUTPUT ***

BLADE PITCH HARMONICS
 1.1655401 3.8118800-4.4990800 %COLLECTIVE. LONGITUDINAL. LATERAL RESPECTIVELY
 ROTOR FLAPPING ANGLE HARMONICS
 1.8620800 2.3988-01 0.0000 %POSITIVE TAIL HIGH -- DEGREES
 DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY 1.7694800
 COSINE COEFFICIENTS
 -7.5170-01 5.4576-01-1.9337-01-1.8140-02-1.2594-02-3.4101-03-1.0181-02 1.1191-02
 -2.0304-02 8.7802-03-2.0313-02 1.9376-02-2.1629-02-3.8817-02-1.3646-02-2.5201-02
 -2.4527-02-1.4736-02-2.5566-02-1.6921-03 6.3747-04-2.7940-02 3.1563-03-9.6939-03
 -1.4280-02 1.2005-02-1.6829-02 4.7947-03-4.3391-04-1.0142-02
 SINE COEFFICIENTS
 5.1720-01 2.6738-01 1.5931-01-8.5007-03-8.5373-02 4.3346-02 1.9723-02 9.0404-04
 -2.0486-02 3.2938-02 3.8468-02 2.3150-02 2.6626-02 1.8542-02 1.8515-02 1.8530-02
 -2.2601-02 3.7740-03-1.4544-03-1.0460-02-9.8242-04-1.6166-02-4.4921-03 7.6054-03
 -1.6880-02-6.1982-03 9.7203-04-2.1845-02 7.9175-03-2.4267-02
 SPAN 1 CHORD 2 STEADY 6.3098-01
 COSINE COEFFICIENTS
 -2.4020-01 1.9289-01-4.1643-02-9.3803-04-2.4187-02-3.6638-04 3.2773-03 8.0028-04
 7.7740-04 1.0917-02 7.0730-04 1.1040-02-1.4191-02-1.0970-02-1.5448-02-1.1412-02
 -1.4545-02-7.7488-03 1.5106-02 2.6517-02 1.4778-02-2.6947-02 2.0740-02-9.6608-03
 -2.1464-02 2.2522-02-2.5430-02 2.2682-03 2.0372-03 3.8938-03
 SINE COEFFICIENTS
 2.8750-01 5.5752-02 7.1402-02 1.7626-02-2.4192-02 6.0528-03 3.5409-03 8.9071-03
 -1.4742-02 1.8746-02 1.0996-02 2.4904-02 7.9666-03 2.3586-03 5.6477-03-3.0392-03
 -9.1570-03-5.3121-03 5.7601-03-5.1451-02-4.0322-02 8.5404-04-9.2531-03-9.5195-04
 -1.0160-02 1.4442-02-1.5445-02 9.1168-03-1.4088-02 1.1957-03
 SPAN 1 CHORD 3 STEADY 3.3565-01
 COSINE COEFFICIENTS
 -1.5953-01 1.6216-01-4.1400-02-2.2474-02-7.1217-03 1.2323-02-5.7052-03-1.2307-02
 -6.7263-03 1.1647-02-4.9938-04-7.0179-03-1.4748-03 7.2055-03-4.0812-03-1.6262-02
 -7.0208-03 2.3711-03-7.9461-03-1.1492-02 1.7656-03 1.1476-02 1.4181-04-1.2794-02
 -4.4629-04 1.4294-02-3.0616-03-8.0629-03 4.7150-03 1.7202-02
 SINE COEFFICIENTS
 1.4188-01 2.9355-02 3.9311-02 6.8192-03-3.9528-02 1.6980-02 7.0551-03 1.1667-02
 -1.7890-02 1.1603-02 1.1039-02 3.9630-03-7.4319-03 2.7769-03 1.3150-02 1.3780-03
 -1.3611-02-1.5647-03 8.5243-03-3.9351-03-1.6648-02-3.5108-03 8.1001-03-4.7564-03
 -1.2959-02-1.0185-03 7.5402-03-3.9786-03-1.1777-02-2.6102-04
 SPAN 1 CHORD 4 STEADY 0.0000
 COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SPAN 1 CHORD 5 STEADY 8.5796-02
 COSINE COEFFICIENTS
 6.3679-03-3.0014-02-1.4572-03 3.3435-04 6.8510-04-1.3561-03 2.1095-04 7.1982-04
 8.1312-04 1.9492-04 6.2370-04-7.0713-04-8.9106-05-6.6626-04-2.5105-04 1.0089-03
 1.5769-03 8.7792-04 7.6464-04-7.5278-04-5.8657-04-1.5434-04 6.1898-04-1.9866-03
 -4.0516-04-1.3713-04 2.2986-04 2.6223-04-1.6214-03-3.4156-04
 SINE COEFFICIENTS
 2.7897-02-8.1992-04 1.5351-03-9.7345-04 1.8917-03-1.2602-03-3.4635-05-1.8352-03
 9.6371-04-1.6812-03 4.7364-04-1.0821-03 1.5935-04-1.0532-03 8.5260-04-9.8078-04
 -2.9040-04-3.9777-04-3.3435-04 1.6624-03 1.0366-03-5.7605-04-5.4119-06 9.3844-04
 8.5986-04 6.8951-04-1.1016-03 3.7871-05-3.1104-04-7.4104-04

TABLE VI - Continued

SPAN 2 CHORD 1 STEADYH 4,3369800

COSINE COEFFICIENTS

3.1971-02 1.2778400 1.8152-02 2.0998-01-1.4152-01 2.3464-01-1.6243-01 4.2499-02
 -1.1443-02 4.9020-02-9.5116-02 4.9124-02-2.3611-02 4.5343-03-3.0236-02-4.4193-03
 1.8607-02-5.4000-03-8.3990-03 1.8697-02 1.4655-02-4.3002-02 5.1082-03 3.0937-02
 -3.3112-02 3.6613-03 2.6416-02-2.2412-02-8.7200-03 2.2042-02

SINE COEFFICIENTS

2.9122-01 8.2917-01-1.2647-01-2.0071-01-1.4389-01 4.7232-02-1.5237-01 5.5325-02
 7.6180-02-6.4444-02-2.7330-02 3.8587-02 4.8149-03-7.5083-02 6.9719-02-2.8547-02
 -3.8408-02 2.9372-03 3.7969-02-3.4068-02 6.6259-03 3.4009-02-2.5070-02-1.0991-02
 2.0115-02-1.6927-02 8.5356-03 3.8836-03-2.5492-03 7.8574-03

SPAN 2 CHORD 2 STEADYH 1,7781800

COSINE COEFFICIENTS

1.1152-01 5.3741-01 3.4295-02 5.6679-02-5.1116-02 9.6608-02-6.3626-02 1.3644-02
 1.6266-02 4.2510-03-2.4152-02 7.6185-03-1.4163-03-4.9509-03 4.2733-03-2.6632-03
 1.5270-02 4.2269-03 6.7367-03-2.1888-03 1.0479-02-1.1903-02 5.7414-03 8.2134-03
 -4.4553-04-3.6114-03 5.3567-03-6.9034-04-1.5886-02 4.4130-03

SINE COEFFICIENTS

-3.3236-02 3.0270-01-2.6599-02-9.9732-02-6.3050-02 1.5423-02-4.1935-02 1.6489-03
 3.8250-02-2.5269-02-6.1523-03 1.3715-02 3.0279-03-2.2242-02 1.7617-02 4.3942-04
 -1.1435-02-3.8535-03 6.2118-03-9.3384-03-8.2163-04 4.5082-03-5.9924-03-1.0948-02
 7.7840-03 1.0668-03 5.5400-03 7.4888-03-4.1963-04-2.3107-04

SPAN 2 CHORD 3 STEADYH 1,4212800

COSINE COEFFICIENTS

7.3731-02 2.8196-01 1.7839-02 2.6598-02-2.8872-02 4.6280-02-1.9594-02-4.6127-03
 8.8809-03 8.6577-04-6.4897-03-3.4441-03 1.2193-03-2.0124-03-1.3506-03-1.1267-03
 4.6765-04-4.4043-04-2.6228-03 4.7920-03 1.7536-03-5.5452-03-4.3822-03 4.0152-03
 2.2755-03-3.3496-03 1.7567-03 7.8990-04-2.3201-03-1.4481-03

SINE COEFFICIENTS

1.1471-01 1.4698-01 3.1271-03-5.7119-02-3.8920-02-6.1768-04-6.1656-03 1.0122-03
 1.1292-02-3.7559-03-3.2692-03 1.7541-03 1.7847-03-2.8200-03-2.3786-03 9.9194-04
 -3.5016-04 8.3542-04 7.0164-04-1.5368-03-1.7970-03-5.0048-03 3.8131-03 2.3268-03
 -1.3726-04 6.7708-04 1.6535-03-3.5654-03 8.7553-04 1.5803-03

SPAN 2 CHORD 4 STEADYH 3,3088-01

COSINE COEFFICIENTS

-1.2912-01 2.1027-01 4.0753-02 1.6216-02-1.4254-02 1.9773-02-3.8320-05 4.2707-03
 3.1920-03 5.5747-04 3.2748-03-6.3172-03-8.4391-04 2.3443-03-8.8825-04-3.7812-03
 4.3955-04 3.1797-04-1.6360-03-1.3080-04 2.2508-03 1.1907-03 1.4440-04-7.0511-04
 -1.4327-04-9.4458-04-6.6669-04 2.3604-03-1.5813-03 5.2424-04

SINE COEFFICIENTS

-1.4707-01 3.2591-02-1.5018-02-3.2793-02-8.9613-03-2.0016-03-1.8730-03-2.9986-03
 1.4064-03-1.3956-03-4.5706-05 1.9180-03-1.4255-04 7.8103-04 3.1734-04 1.9517-04
 -1.0639-03-8.5334-04-1.6158-03 1.3332-03-1.0074-03-2.8231-04 3.2077-03-2.4423-04
 -4.0421-03 2.1967-03 2.9039-04-1.2905-03-1.2245-03 1.0155-03

SPAN 2 CHORD 5 STEADYH -1,8261-01

COSINE COEFFICIENTS

-1.0157-02 6.0845-02 1.3514-02-2.0794-03 3.2263-03 3.2181-03 2.4555-03 2.7304-03
 1.1535-03-1.3184-03 2.6684-03-1.8225-03-6.3885-04 1.1343-03 1.5786-03-1.6936-03
 -2.4161-03 1.1687-03-1.7009-03-2.2426-04 9.4610-04 2.3763-03-1.2171-03 1.7690-04
 -1.8600-03-5.8504-04 1.3804-03 4.8941-04-3.6066-03 3.5744-04

SINE COEFFICIENTS

-1.9732-01 2.6981-03 6.4492-05-9.0351-03-7.6550-04 2.8004-04-2.0594-03-6.0049-04
 -2.0468-04-3.9396-04 2.6800-04 2.1120-03-2.6579-03 9.3080-04 8.1560-04 1.6318-03
 -1.6955-03-9.6011-04-2.4909-04 7.4565-04-1.4359-03 1.3820-03 2.1315-03 3.0637-04
 -3.7379-04 3.0158-04-3.4333-04 8.3474-04-1.8071-03-8.1700-04

TABLE VI - Continued

SPAN 3 CHORD 1 STEADY 5.0507800

COSINE COEFFICIENTS

1.3825800 1.4887800 2.0795-01 3.3733-01-8.4563-02-7.5254-02 1.0298-01 9.5053-02
-1.0873-01 8.0426-03 1.6649-02 1.1028-02 1.9801-02-5.2045-02 7.1535-03 6.9338-02
-3.9317-02-8.3481-02 7.0216-03 3.5059-02 2.0833-02-5.0134-02 1.5528-02 7.4299-02
-4.2241-02-1.6495-02 4.0336-02-1.1366-02-1.6290-02 1.9028-02

SINE COEFFICIENTS

3.5130-02 7.6023-01 3.6147-01-4.1125-01-2.2360-01 1.6466-01-5.7856-03 1.1243-02
-4.4100-02 7.0492-02 9.6403-02-8.7833-02-2.6169-02 9.8243-02-1.3585-02-2.4986-02
-1.4871-02 1.0954-04 2.3095-02-2.5992-02-1.3153-02 3.1106-02-2.4709-02 1.7944-02
-7.6730-04-8.5543-02 3.0891-02 2.9048-02-3.5640-02-1.5040-02

SPAN 3 CHORD 2 STEADY 4.0409-01

COSINE COEFFICIENTS

6.8438-01 5.3477-01 9.5445-02 6.5512-02-4.6863-02 1.4313-02 7.6625-02-4.0569-03
-3.9311-02 1.5397-02-3.9268-03 3.1078-03 9.5746-03-3.4076-03-1.0546-02 1.6768-02
8.5805-03-1.3061-02-2.5410-04 1.2079-02-1.2601-03-1.1347-02-1.6089-03 1.3397-02
0.9328-03-1.9556-02 1.0915-02 1.2587-02-1.9495-02 6.0499-03

SINE COEFFICIENTS

-0.9359-01 2.0829-01 1.1949-01-1.3544-01-1.2517-01 3.4670-02 2.4287-02 4.5061-03
-4.7514-02 2.4927-02 3.6571-02-3.5545-02-2.0617-02 3.7014-02 1.1435-02-2.9137-02
3.4840-04 1.9700-02 1.6227-03-1.1384-02 1.8387-03 1.0095-02-5.1355-03-1.1267-02
8.5299-03-2.7107-03-1.0062-02 1.4591-02-8.3661-03-1.5835-02

SPAN 3 CHORD 3 STEADY -4.7725-01

COSINE COEFFICIENTS

1.6359-01 3.1865-01 6.7634-02 5.8930-02-4.6773-02 2.2593-02 2.8200-02 1.7343-03
-2.1223-02 2.9036-03 3.8672-03-7.5031-04-2.3782-03 7.4298-03-8.0009-05 1.1662-03
8.2075-04-2.6886-03-9.1634-04 6.5657-03-1.7947-03-2.8967-05-1.5389-03-1.5790-03
3.2173-03-5.6018-03-2.5344-03 5.5606-04-4.7637-03-7.0705-03

SINE COEFFICIENTS

-3.5439-01 6.7284-02 3.8961-02-8.3471-02-6.6631-02 1.8657-02 2.6183-02-1.9549-02
-2.9205-02 1.3423-02 2.2423-02-1.7500-02-2.0026-02 1.4430-02 9.2772-03-1.3679-02
-4.9926-03 8.4765-03 2.3426-03-2.8698-03-6.0585-03 1.0650-03 1.9672-03 1.8535-04
1.3506-03 6.0493-03 4.0716-03 6.3753-03-1.2420-03-3.9130-03

SPAN 3 CHORD 4 STEADY 8.5327-02

COSINE COEFFICIENTS

-2.7656-03 1.5432-01 4.2404-02 2.4767-02-2.7521-02 1.4746-02 1.2704-02 5.2493-03
-6.5127-03 8.4618-04 2.7522-03 1.5979-03-3.1963-03 4.3252-03 3.4195-03-1.9140-03
-2.0756-04 2.1873-03 2.6159-03-4.0909-04-2.4211-03-1.4815-03 7.1173-04 2.0608-03
-3.2567-04-2.7828-03 4.0690-04 9.1374-04-1.1366-03-1.9378-03

SINE COEFFICIENTS

-2.3629-01 8.8615-03 1.6114-02-3.3094-02-2.4174-02 3.2137-03 7.0870-03-5.5177-03
-6.6973-03 8.1160-03 4.8944-03-3.9296-03-3.5107-03 1.5184-03 3.9681-03-4.5451-03
-2.2527-03 3.1904-03 3.1383-03-2.2344-03-3.5350-03 4.9108-04 1.8946-03 6.2991-04
-5.8595-04 7.8155-04 2.2486-03 1.1114-03-3.0599-03 4.7690-04

SPAN 3 CHORD 5 STEADY -1.3263-01

COSINE COEFFICIENTS

-8.1742-04 3.9968-02 1.0075-02 2.3009-03-7.6032-03 5.1107-03 2.6942-03 2.6633-03
-1.0593-03-7.5843-05 3.0317-03 1.5458-03-3.2164-03 2.0615-03 2.3286-03-2.3404-04
3.5013-04 1.1926-03 2.4263-03 1.5200-03-1.7784-03-5.4583-04-7.1053-04 1.1878-03
2.2535-03-2.8043-03-1.8661-03 1.9203-03 1.4336-03-1.5174-03

SINE COEFFICIENTS

-1.3713-01-8.1253-04-2.7859-03-8.7348-03 5.0472-04 6.1089-04-2.1385-04-7.0121-03
-1.9903-03 1.1375-03-1.3745-03-9.6906-04-8.7485-04-8.6024-04 3.9617-04-2.5718-03
-2.0286-03 1.6314-03-5.2252-04 1.1781-03-7.0512-04-1.2377-03 3.2895-03 4.4722-04
-3.6548-04 2.2224-03 8.7697-05 1.7153-03 1.3401-04-9.9695-04

TABLE VI - Continued

SPAN 4 CHORD 1 STEADY 4.2952400

COSINE COEFFICIENTS

1.8536400 1.2335800 3.9149-01 4.2753-01-1.1638-01-7.8775-03 6.9343-03-9.3482-02
 7.5327-02 1.0116-01-1.0726-01-9.3537-02 1.0206-01 8.4530-02-6.6670-02-3.7490-02
 5.2527-02-8.9999-04-8.6916-03 4.7046-02 1.5341-02-5.9711-02 4.0849-03 6.4836-02
 -3.4622-03-4.8006-02 1.1086-02 1.5705-02-2.4635-02-7.3539-03

SINE COEFFICIENTS

-1.3172400 6.5611-02 1.6336-02-6.5811-02-3.9929-01-1.4301-01 1.7707-01 9.4212-02
 -1.3689-01-6.0306-02 6.7223-02-6.8443-03-4.4512-03 5.5608-02-6.1071-03-6.3466-02
 4.3396-02 7.0812-02-4.0524-02-5.5426-02 3.6465-02 3.1058-02-4.3465-02 6.0089-03
 2.3735-02-2.2832-02-2.4533-02 4.4709-02 1.2455-02-3.4263-02

SPAN 4 CHORD 2 STEADY 1.2251800

COSINE COEFFICIENTS

1.1089800 5.2594-01-1.0604-03 7.2270-02-1.0684-01 5.8568-02 1.2274-01-1.0872-01
 -2.7636-02 1.3152-01-4.9052-02-9.7978-02 7.2057-02 4.0398-02-3.9863-02 6.4594-03
 1.1057-02-6.5010-03 3.6015-03 2.4519-03-3.0932-03-1.2863-02 7.5564-03 1.2587-02
 7.7532-03-1.6340-02-1.3497-02 2.2080-02 2.6005-03-2.1014-02

SINE COEFFICIENTS

-7.8936-01 2.1314-01 1.5544-01-6.8080-02-2.3111-01-1.6550-01 1.2726-01 1.4484-01
 -1.4973-01-6.7204-02 1.0948-01-2.7839-02-3.6652-02 4.6162-02-2.8155-02-2.2272-02
 3.4743-02 1.5989-02-7.7223-03-1.7975-02 3.3888-03 3.3454-03-8.5269-03 1.5996-03
 5.8801-03 5.3757-03-1.7082-02 3.3400-03 2.0699-02-9.7273-04

SPAN 4 CHORD 3 STEADY 7.7701-01

COSINE COEFFICIENTS

4.7931-01 2.0347-01 6.3908-02 2.5102-01-6.9436-02-1.7348-01 6.5778-02 1.0836-01
 -2.9315-02-2.3238-02 1.8195-02-4.1148-02-3.3685-02 7.2172-02 4.9140-02-7.2268-02
 -5.8547-02 5.6758-02 4.4540-02-3.6368-02-3.0902-02 2.7915-02 1.9453-02-1.2721-02
 -1.0769-03 1.3716-02-5.6426-03-2.8800-04 1.2450-02-1.0966-03

SINE COEFFICIENTS

-4.9547-01-4.1105-04-9.6728-02-1.5278-02 6.9970-02-8.1615-02-1.1203-01 9.2733-02
 5.5419-02-7.3241-02-3.4181-04 4.7107-02-3.8135-02-5.2041-02 5.0253-02 5.3279-02
 -5.9834-02-3.7669-02 4.9806-02 2.8026-02-3.8056-02-2.0822-02 2.3625-02 9.7217-03
 -1.8103-02-5.5202-03 1.0336-02-4.2560-03 2.1469-03 1.6204-02

SPAN 4 CHORD 4 STEADY -2.2087-02

COSINE COEFFICIENTS

1.0859-01 1.3646-01 3.0952-02 3.0192-02-1.4019-02 2.1162-03-1.2077-03 7.3941-03
 4.7135-03-2.1719-03-1.3938-03-4.4921-04 1.1047-04 8.8703-03 6.5663-03-1.6713-03
 -3.1954-03-1.6708-03 2.0437-03 4.9662-03 1.3639-03-3.8855-03-2.1956-05 4.3195-03
 4.1150-03 2.7414-03 2.2242-04 5.0265-04 2.1049-03 2.1103-03

SINE COEFFICIENTS

-4.2102-01-1.7455-02 3.5328-02-1.2316-02-3.2147-02-1.0142-02 5.3367-03 1.4980-02
 -1.5251-03-1.5836-02-1.0944-03 3.9562-03 4.7768-03-2.7156-03-1.4131-03-3.1612-03
 -0.2878-04-1.6031-04-9.2841-04-3.5971-03-1.0976-03-2.0935-03-1.5038-03-8.3129-04
 4.8809-04 2.9100-04 4.8950-04 4.8653-03-1.8501-03 6.4888-04

SPAN 4 CHORD 5 STEADY -4.6603-01

COSINE COEFFICIENTS

-5.5083-02 1.9809-02 4.8924-03 1.5942-03-6.0462-03 2.0988-03-1.8528-04-1.0917-03
 5.4968-05-1.0932-03 1.2262-03-1.3988-03-8.3719-04-8.9749-05-3.3046-04-4.1880-03
 1.3230-03 7.1504-03-8.3628-04-9.8319-04 5.1404-03-2.0614-03-5.0099-03 1.4341-02
 1.0015-02-6.1898-03 5.8831-03 2.8552-03 1.7634-04 1.1440-03

SINE COEFFICIENTS

-1.8313-01-1.9897-02 1.5545-02-1.4822-03-4.5674-03 2.6134-03-1.4022-03 4.5563-04
 -6.5550-05-6.4057-04 2.4049-03 3.0640-03 1.7130-05-3.3681-03 6.5196-04 3.0163-03
 -4.5565-04 3.6142-04 5.8697-04-1.7254-03-5.4098-04 2.5244-03 3.1115-03 2.0554-08
 -4.3076-03-3.0440-03-4.2146-04 2.2482-03 3.9253-03 8.5428-04

TABLE VI - Concluded

SPAN 5 CHORD 1 STEADY 5.535800

COSINE COEFFICIENTS

1.770280 9.6457-01 4.3684-01 5.1700-01-8.6165-02-2.4677-02 1.5004-01-4.8647-02
 -7.6347-02 1.4419-01 1.3188-01-1.1365-01-1.3679-01 1.8044-01 1.3396-01-7.4896-02
 -1.1811-01 3.9097-02 7.8559-02-3.7032-02-5.9939-02 1.4020-02 1.0049-02-4.2602-02
 -5.9943-03 4.7380-02 1.5408-02-5.9892-02-1.4282-02 4.1469-02

SINE COEFFICIENTS

-8.4892-01-1.6435-02-9.0069-02 2.6235-02-2.5214-01-3.3542-01 7.3775-02 2.3425-01
 -8.0568-02-2.8843-01-2.8654-02 6.8463-02-6.5512-02-5.8847-02 1.1408-02 1.8582-02
 -0.8569-02-1.1167-01 4.6765-02 2.8489-02-1.1140-01-9.9674-02 3.5252-02 2.5035-02
 -4.7178-02-3.1878-02 2.9547-02-5.9813-03-4.8932-02 1.4649-02

SPAN 5 CHORD 2 STEADY 1.0080800

COSINE COEFFICIENTS

1.2178-01 1.2419-01 1.1673-01 1.3068-01-8.3871-02-2.8732-02 2.6044-02-1.8721-03
 2.1801-02 4.4887-03-1.3124-02-1.8110-02-9.1779-03 1.5274-02 4.0659-02 8.5122-03
 -3.8745-02-3.1559-02 1.6871-02 3.6405-02 8.6553-03-2.6279-02-1.2065-02 1.4952-02
 -1.3692-04-7.7852-03 4.8408-03 1.2397-02-1.0455-02-1.3265-02

SINE COEFFICIENTS

-1.6315-01-9.1100-02-4.3247-02 5.5817-02-7.4307-02-9.4477-02 7.1223-04 5.6727-02
 1.7233-02-2.4632-02-2.1311-02 4.0869-03 1.5696-02-1.5714-02-1.2315-02 1.8354-02
 1.6315-02-1.5021-02-2.2217-02 8.0433-04 1.3455-02 1.1234-03-1.7567-02 4.7419-03
 1.6258-02-1.1028-02-1.7076-02 7.4741-03 1.8364-02-3.5750-03

SPAN 5 CHORD 3 STEADY 1.7249-02

COSINE COEFFICIENTS

-1.0366-01 1.8006-01 1.1431-02 8.7741-02-2.9480-02-2.2487-02 2.6913-03 4.8785-03
 6.8663-03 7.3962-03-8.4026-03-1.0679-02 5.7514-03 2.2101-03 4.6348-03 2.3739-03
 -3.7847-03-1.4138-02 6.2791-03 8.6512-03 1.4459-03-3.2548-03-3.1093-03 1.6579-04
 3.5646-04 1.8438-03-1.0066-03-7.7171-05-6.3023-03-2.4030-03

SINE COEFFICIENTS

-7.7471-01-1.3476-02 2.2156-02 5.8632-03-3.8852-02-2.8488-02-1.2810-02 4.3435-02
 1.2978-02-2.0537-02-1.3935-02-5.6497-03 1.9071-02 7.7844-03-1.1537-02-1.2044-02
 7.1623-03 1.6741-03-3.5752-03 2.3236-03-5.3038-03-3.4431-03-6.6140-04 4.8006-03
 4.3300-04-1.3205-03-5.8378-03 4.5584-04 1.9017-03 1.6856-03

SPAN 5 CHORD 4 STEADY -1.4542-01

COSINE COEFFICIENTS

-3.0921-01 1.9918-02-1.7579-03 1.6344-02-4.7683-03 1.7596-03-1.1114-02-4.1561-03
 1.0336-02 2.0821-03-6.0677-03-5.3122-03 1.9346-03 8.8618-04 1.0530-03 7.1449-04
 1.4586-03-4.0434-03-3.7446-03 2.7397-03 4.9736-03-4.1642-05-3.4761-03-1.8090-03
 8.1934-04 1.2032-03 1.1563-03-2.2394-04-2.0891-03-1.1739-03

SINE COEFFICIENTS

-2.1462-01-2.5651-02 2.2966-02-5.1896-04-2.0851-02-1.8738-03-5.2562-03 7.8901-03
 8.8554-03 2.3363-03-5.7113-03-6.3453-03 3.5120-03 6.8024-03-1.7679-03-6.0399-03
 -1.2454-03 3.9690-03-1.0601-03-9.6680-04-3.8801-04 1.3775-03 3.9508-05-1.9283-03
 1.9142-03 6.7271-04-8.4929-04-3.0162-04 4.4893-04 1.2552-03

SPAN 5 CHORD 5 STEADY -3.9769-01

COSINE COEFFICIENTS

-1.2862-01-1.9108-02-4.2228-03 6.3179-03-2.6947-03-2.5637-03-1.6692-02-2.7261-04
 -2.9621-04-3.8906-03-1.9882-03-3.2191-03-1.2603-02 1.7977-02 7.3915-03 3.5082-03
 -3.5391-03-2.3979-03-4.2294-03 6.1334-03-3.0402-05-8.3412-04 1.9567-03-2.2209-03
 -2.7220-03 1.5626-03 3.3443-03-1.2406-03-6.7444-04-4.2403-04

SINE COEFFICIENTS

-2.0137-01-1.4110-02 1.8727-02 1.9274-02-6.1960-03-2.1404-03-1.0131-02 1.0137-02
 1.8058-02 4.4379-03-4.8086-03 6.5606-03 2.1006-02-3.4644-02-9.9011-03-5.6664-03
 -4.2575-03-6.9436-03-5.0682-03 4.6512-03-1.6667-03-4.4104-03-3.2754-03-2.6321-03
 -2.1823-03-4.1239-03-1.4507-03-2.8976-03-7.3468-03-3.3138-03

TABLE VII. AERODYNAMIC DATA - 140-KNOT, EAST-TO-WEST FLIGHT

BURST NO. # 16 *** ROTOR NOISE PUNCHED OUTPUT ***

BLADE PITCH HARMONICS

1.2660801 3.5189800-5.4378800 XCOLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY

ROTOR FLAPPING ANGLE HARMONICS

1.8056800-2.4824-01-7.6813-02 XPOSITIVE TAIL HINGE -- DECREASE

DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS

MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.

SPAN 1 CHORD 1 STEADY 1.5717800

COSINE COEFFICIENTS

-1.0399800 7.5633-01-3.7464-01-4.1783-02-1.0663-01 7.4181-02-7.3632-02 3.7777-02

-2.9714-02 3.2592-02-2.5193-02 6.1458-03-2.8729-02 5.9236-03-2.0129-02 1.3137-03

-1.2622-02 5.5308-03 2.4149-03 1.8297-03-1.6873-03 9.3427-03-3.5102-03-1.1375-03

-7.6830-03-3.4986-03-2.9614-03-8.7449-03-4.5212-03 7.9618-03

SINE COEFFICIENTS

5.7542-01-6.4823-03 3.0207-01 3.2483-02-6.8737-02 5.5352-02-6.7961-03 1.9779-02

-1.3582-02 8.1893-03-7.7728-03-1.0863-02-1.5824-02-2.0059-02-4.7943-03-2.1894-02

-5.9257-03-2.7471-02-1.3277-02-1.8856-02-2.2521-03-1.5816-02 6.5961-03-7.9315-03

4.3151-03 4.0253-04 6.0884-03 1.5587-02-7.5364-04-2.4154-03

SPAN 1 CHORD 2 STEADY 5.5893-01

COSINE COEFFICIENTS

-3.2250-01 2.4744-01-1.2910-01-1.4341-02-3.9860-02 1.0190-02-3.9342-02-7.7715-03

-1.3762-02 9.0389-03-4.0694-03-1.9648-02-1.4714-02 1.6614-02 1.3429-03-1.1911-02

-2.1694-02 2.4592-02 9.3097-03-5.3578-03 1.6177-02 3.2044-03-2.5141-03-4.1192-03

-5.1289-03-3.2618-03 3.1328-03-2.3456-02-2.2754-03-1.8139-03

SINE COEFFICIENTS

3.2079-01-2.3804-02 1.0925-01-1.5871-02-7.9892-03 2.1819-02-1.3650-03-1.5377-02

-1.7598-02-2.1815-02-8.7594-04-7.1410-03 0.563-02 2.3375-03 3.0391-03-1.2647-02

1.7237-02 3.8285-02 1.1167-02-1.9953-02 1.1079-02-1.3840-02 9.5293-03 1.3605-03

-1.7750-02 1.1535-02-1.5677-02 2.4617-02-2.3343-02 1.8343-03

SPAN 1 CHORD 3 STEADY 2.5193-01

COSINE COEFFICIENTS

-2.2264-01 1.8897-01-8.0707-02-2.4400-02-2.3587-02 1.5721-02-9.4920-03 8.8229-03

-4.2383-03 8.7480-04-6.2239-03-2.3416-03-5.2135-03-5.3529-04-2.7656-03-2.2199-03

-3.8170-03 4.9137-04-1.5779-03 1.0264-03-1.1525-03-4.2563-04-1.5525-03-3.2430-03

3.9779-04 4.6939-04 3.2734-03 2.4731-03 2.4884-03-3.6144-03

SINE COEFFICIENTS

1.5354-01-4.3676-02 5.2738-02 2.4771-03-1.5151-02 5.6092-03 4.8906-03 2.5545-03

-4.1595-03-1.1162-03-1.6245-03-3.3369-03-5.2894-03-3.1826-03-4.8466-03-5.7059-04

-4.2043-03-4.0674-03-7.2478-03-2.1026-04-4.6259-03-1.3689-03-2.3447-03 5.2117-04

-4.7201-04-2.2723-03 2.2204-03-4.1802-03 1.0681-04 1.4969-04

SPAN 1 CHORD 4 STEADY 0.0000

COSINE COEFFICIENTS

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SINE COEFFICIENTS

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

SPAN 1 CHORD 5 STEADY 1.1633-01

COSINE COEFFICIENTS

9.8842-03-3.6420-02 7.6790-04 3.6568-04-1.1146-03-1.3476-03-4.6976-04-1.1290-03

-1.0044-03-1.1146-03-4.6778-04 1.2949-04 1.3712-04-4.1319-04-4.9333-04 9.0107-04

7.2940-04 1.1502-03 9.7980-04-3.1639-04 1.3490-04-3.2772-04-7.3254-05 9.0275-05

-3.7497-04-4.9621-04 7.1931-04-3.0896-04 1.0414-03 4.8562-04

SINE COEFFICIENTS

4.9724-02 8.6151-03 3.9729-03-1.3977-03 1.6336-03-1.4067-03-3.8740-04-1.1129-04

3.1683-03-1.0183-03 5.8690-04 6.9741-04 1.8522-03 7.5696-04 1.9254-03-1.0231-03

1.6802-03 6.4488-04 2.5144-03-6.8592-04-5.3402-05 3.2903-05-6.0223-04 1.5642-04

-2.1190-04-1.2684-03-8.1897-05-7.4128-04-7.1469-04 1.0421-03

TABLE VII - Continued

SPAN 2 CHORD 1 STEADY= 4.5323+00

COSINE COEFFICIENTS

-1.7940-01 1.7619+00-3.7789-01 3.5856-01-2.3206-01 1.4205-01 5.2186-02-1.5252-01
 8.2101-02-1.1951-01 8.7269-02-9.2070-02-7.2593-03 1.9484-02-5.0856-02 4.2 22-02
 -6.1884-02 4.9378-02-2.7763-02-2.8632-02 2.0482-02-5.0281-02 1.9937-02-5.0475-02
 1.7240-02-5.8386-03-2.7221-02 1.8571-02-3.2158-02 2.1056-02

SINE COEFFICIENTS

3.8236-01 3.8532-01 2.4026-01-6.2043-01-3.4437-02-1.8838-01 1.1593-01-1.7658-01
 3.8184-02-1.2526-02-9.8332-02 5.4902-02-9.0934-03 6.0470-02-8.2695-02-5.2664-03
 2.8870-03-5.6567-02 3.9640-02-5.3495-02 2.7394-02-2.7976-02-1.7737-02 6.5670-03
 -4.7008-02 2.4239-02-4.0531-02 1.8312-02-1.6535-02-4.7951-03

SPAN 2 CHORD 2 STEADY= 1.8513+00

COSINE COEFFICIENTS

4.5741-02 7.1327-01-1.0328-01 1.0908-01-7.8798-02 4.9984-02 2.1732-02-6.5278-02
 2.0718-02-1.6030-02 9.3353-03-1.2599-02-1.7281-02 7.2092-03-1.5112-02-1.3006-03
 -5.1626-03 8.5096-04 3.4789-03-2.1151-02 1.2033-02-5.7802-03 4.0308-05-8.2477-03
 -1.7554-03 3.9107-03-1.6404-03-4.5673-03-6.1434-03-5.6874-03

SINE COEFFICIENTS

-4.2244-02 1.2124-01 1.0374-01-2.7166-01-3.4589-02-4.7420-02 3.6124-02-4.6882-02
 -9.5801-03 8.4860-03-3.7532-02 1.2442-02-1.2368-02 4.5665-03-1.6033-02-5.9656-03
 8.4553-03-2.4288-02 2.2579-02-1.2442-02-5.3551-03-6.0635-03-7.8602-03-2.1799-03
 -1.5682-02 1.5542-03 1.7302-03-1.9262-03 2.0578-03-7.4908-03

SPAN 2 CHORD 3 STEADY= 1.4711+00

COSINE COEFFICIENTS

2.4704-02 3.6126-01-4.4450-02 3.6962-02-4.1617-02 3.4132-02 1.4042-02-2.6245-02
 -5.8314-03-1.3758-03 1.0822-03-1.0352-02-6.1856-03 3.8450-03-4.8402-03-7.2371-03
 2.1947-05-0.9575-04-5.8525-03-6.8766-03 1.8852-03-3.1694-03-4.0915-03-2.3305-03
 -6.5034-03 1.1054-03-4.4736-03 1.8706-03-5.0403-03-9.1576-04

SINE COEFFICIENTS

1.5842-01 4.5420-02 7.1085-02-1.3907-01-3.1719-02-1.1048-02 3.0212-03-1.3924-02
 -1.3689-03-5.3495-03-1.3400-02 3.2802-03-9.3908-04-1.8944-03-5.4201-03-5.3817-03
 2.8228-03-1.9468-03-3.0780-03-2.7200-03 1.5915-04-5.9690-04-2.1446-03-1.4655-03
 -3.0303-03-6.6307-03-7.1154-03-1.8214-03-8.8891-04-2.1607-03

SPAN 2 CHORD 4 STEADY= 3.3822-01

COSINE COEFFICIENTS

-1.9818-01 2.6690-01 1.5157-02 1.3185-02-2.6935-02 1.7451-02 1.1716-02-4.0181-03
 -9.1603-03 4.5397-03 7.8183-04-3.6246-03-5.1278-03 1.4103-03 1.1162-03-6.7983-03
 3.0550-04-2.3217-03 1.3382-03-3.6719-03 7.9875-04 2.7478-04-2.5723-03-3.1964-03
 -4.1691-03-2.3562-04-2.2709-03-8.7881-04-2.6000-03-4.3432-04

SINE COEFFICIENTS

-1.9410-01-3.1865-02 7.1949-03-7.2241-02-8.4870-03-5.4846-03-9.8401-03-3.7830-03
 -4.8302-03-5.3166-03-4.4687-03-8.3279-04 2.5732-03-3.8840-03-3.4916-04-3.5617-03
 -5.7262-04-2.7812-04-3.7568-03-1.4458-03-1.0140-03 1.0643-03-1.4649-03-2.1168-03
 -2.8634-04-4.2956-03-3.4196-03-2.9870-03 1.5834-04-3.7106-03

SPAN 2 CHORD 5 STEADY= -2.1155-01

COSINE COEFFICIENTS

-2.9914-02 7.7471-02 9.5966-03-8.5501-04-6.0925-03 4.0236-03 1.9076-03 1.5176-03
 -4.3965-03 5.0761-03-9.5919-04 2.9989-04-1.5374-03 3.2433-04 2.9475-03-5.8954-03
 9.0923-04-1.2299-03 2.8499-03-2.3609-03-2.1797-03 2.3583-03 1.5863-04-4.8643-04
 -3.2080-03 1.5213-03 1.0327-03-2.0041-03-5.3994-04-1.5626-03

SINE COEFFICIENTS

-2.4154-01-4.5372-03-7.2578-03-1.2976-02-6.1165-04 7.4773-04-5.9536-03 1.4214-03
 -9.5814-04-4.2210-04-1.0184-04-3.2805-03 1.9857-03-4.0377-03 1.3338-03-4.8830-04
 -9.9125-04 1.9618-03-3.5592-03 2.8514-03-1.7683-03 8.1225-04-9.6392-04-6.8936-04
 1.2423-03-1.2970-03 1.7130-03-1.9580-03 1.5034-03-9.9697-04

TABLE VII - Continued

SPAN 3 CHORD 1 STEADY= 5.0899+00

COSINE COEFFICIENTS

1.4138+00 2.1062+00-9.6492-02 2.1610-01 1.3195-02-1.3131-01-4.7121-02 1.3861-01
 -6.6271-02-7.5611-02 6.7105-02-8.4713-02-2.5270-02 2.2284-02-1.0220-01-1.5459-02
 5.3233-02-8.8177-02 6.6572-03 3.4897-02-4.6769-02 2.4652-02 2.6807-03-4.8205-02
 1.3893-02 1.0124-02-4.9997-02 2.3050-02-1.3123-02-3.3012-02

SINE COEFFICIENTS

-2.8365-01 2.9484+01 5.5342-01-6.8690-01-3.0563-01 1.3176-01-1.1214-01-1.6008-02
 -6.5277-03-1.2223-01 2.8109-02 2.7001-02-1.2797-01 6.9192-03 3.6768-02-9.2376-02
 1.9832-02 2.4649+03-6.6605-02 4.3095-02 4.2520-06-4.3883-02 3.4607-02-1.2844-02
 -5.6925-02 2.9227-02-4.0928-02-3.3545-02 1.4907-02-3.3766-02

SPAN 3 CHORD 2 STEADY= 2.0644-01

COSINE COEFFICIENTS

7.3224-01 9.7440+01-4.1951-02-6.8101-02 2.3821-02-4.9558-02 3.5084-03 5.8280-02
 -4.5411-02-2.4172-02 1.8268-02-1.7607-03-1.7963-02 1.6821-03-1.7803-02-1.4357-02
 1.9847-02-2.2879-02 1.4638-02 5.1401-03-1.1363-02-7.2808-03-3.0931-03+8.1221-03
 -1.1249-02 1.6539-02-9.9994-03-1.9597-02 1.8293-03-9.8462-03

SINE COEFFICIENTS

-1.3782+00 9.4754-02 3.1306-01-2.8956-01-1.6408-01 3.1926-02-6.8949-02 1.3465-02
 -3.8350-03-2.8389-02 1.4671-03 1.0370-02-1.6497-02-1.5657-02 1.4066-02-2.5674-02
 -4.3110-03-7.8095-03-2.2010-02 9.5720-03 2.1865-03-7.1203-03-2.2406-03 5.1142-03
 -1.4254-02-1.1608-02 1.4152-02-1.0766-02-8.9969-03-5.0944-03

SPAN 3 CHORD 3 STEADY= -2.5086-01

COSINE COEFFICIENTS

1.0924-01 1.4247-01 6.1491-02 1.9672-01-9.7216-02-5.2597-02 2.4189-02-1.5102-02
 2.8157-02 4.0777-03-3.9904-02-1.0752-02 4.8054-03 9.6268-03 4.2944-03-1.7091-02
 -5.9611-03 2.3406-03 1.8043-02-1.0639-03-4.6159-03-3.2004-03-5.8965-03 1.0888-02
 2.9965-03-8.3086-03-1.0052-02-1.1824-03-2.2238-03 4.8815-03

SINE COEFFICIENTS

-5.5620-02-1.0047-01-1.7288-01-9.3416-02 2.9472-02-4.1383-02-2.3998-03-2.5882-02
 -4.4848-02 4.5212-02 1.6687-02-2.0263-02-1.9109-02-6.8838-03 2.2457-02 1.0627-03
 -1.7648-02-1.8207-02-1.6176-03 1.3676-02-2.6654-03-5.2164-03-1.1699-02-9.3563-03
 9.6920-03 1.5205-03-1.0473-02-4.3639-03-5.2852-03 1.8605-03

SPAN 3 CHORD 4 STEADY= -9.7465-02

COSINE COEFFICIENTS

-1.9503-02 2.2175-01 7.7990-03 1.5428-03-2.0499-02 5.6832-03 1.2824-02-3.2823-04
 -7.6758-03-4.7927-03-2.1867-03 2.2179-03-1.8914-03-3.7096-03 6.2222-04-1.4324-03
 -2.3804-03 2.9179-03-6.8540-04-2.8700-03 1.2895-03-1.4736-04-1.6370-03 1.2121-04
 -8.5362-04 8.0716-04-3.3382-04-1.5172-03-2.3777-03 1.2178-03

SINE COEFFICIENTS

-3.0872-01-4.5429-02 3.8436-02-7.0371-02-3.1469-02-8.3436-03 9.8034-04 1.2894-03
 -1.2553-02-2.0839-03 1.2114-03 6.5886-04 6.6393-05-1.3742-03 5.4131-04 1.2721-03
 -4.9538-03-3.0933-03 8.0487-04-6.9093-04-3.8331-03-3.4419-04-6.8970-04-4.1992-04
 -1.3585-03-2.7404-03-6.7157-04-7.3131-04-1.4734-03-2.2124-03

SPAN 3 CHORD 5 STEADY= -1.4115-01

COSINE COEFFICIENTS

-7.0444-03 5.4987-02 8.3275-03-5.6938-04-6.7115-03 2.5331-03 4.0079-03 6.6472-05
 -1.4771-03 1.4513-03-5.6299-04 3.6166-03 1.9017-03-1.7697-03 2.3289-03 6.0481-04
 -2.2325-03 2.0083-03-1.6198-03-7.7031-04 1.5405-03-9.5990-04-1.8487-03 3.3569-03
 -2.1493-04-9.6803-05 1.6276-03-1.1074-03-1.7796-03 1.9140-03

SINE COEFFICIENTS

-1.6845-01-1.5453-02-7.8643-03-1.4858-02-2.2990-03-4.3885-03-1.1468-03-1.1737-03
 -5.0913-03 1.4049-03 5.3881-04-1.2166-03 7.7595-04-2.5135-03-1.8020-03 2.8280-03
 -1.6393-03-3.3342-03 3.0618-03-3.5866-04-2.1033-03 6.9886-04-2.2744-03-9.8398-04
 2.5164-03-2.7198-03-2.1794-04 1.3682-04-2.1097-03-7.1681-04

TABLE VII - Continued

SPAN 4 CHORD 1 STEADY= 4.3236+00

COSINE COEFFICIENTS

1.9715+00 1.7273+00 1.4510-01 3.6523-01-1.8989-01-7.0262-02-5.0374-02-8.1551-02
 -1.3054-02 2.2191-02-2.7233-02-8.8619-02 3.8543-03 5.8714-02-5.2274-03-4.7682-02
 1.5209-02 2.4863-02-3.2421-02-3.1019-02 7.6739-03-1.2409-02-3.8463-02 1.0477-02
 2.2750-02-8.5650-03-2.8257-02 1.2685-02 5.6627-03-2.9764-02

SINE COEFFICIENTS

-1.7004+00-4.4107-01-1.6725-01-4.0294-01-3.8747-01-1.6028-01 3.3269-02 5.9933-02
 -1.0367-01-5.7492-02 2.4867-02 3.2600-02-3.3191-02-2.6417-04 1.0415-03-5.0303-02
 -2.5114-02 2.1249-02 1.0795-02-5.2152-02-2.5693-02 2.2832-02-1.0688-02-3.2052-02
 -1.8994-03 8.2123-03-2.4198-02-3.3753-02 8.7118-03-3.2610-03

SPAN 4 CHORD 2 STEADY= 1.2050+00

COSINE COEFFICIENTS

1.2423+00 7.6758-01-1.6780-01 1.1740-01-1.3123-01-9.3285-02 8.9736-02-4.3166-02
 4.7550-02 5.4762-02-5.6047-02-2.5415-02-2.8998-02 5.3950-02 6.4827-03-3.3707-02
 1.6422-02-8.3594-03-4.2393-03-5.1300-03 2.1730-02-1.3131-02-1.7508-02-5.2371-03
 7.1466-03 8.2349-03-7.0405-03 1.2010-02-6.0110-03-1.4993-02

SINE COEFFICIENTS

-9.7625-01 1.0403-01 1.2466-01-2.2126-01-7.3795-02-1.6345-01-4.6459-03 6.9424-02
 -9.3400-02 3.4776-02 6.3129-03 7.0378-03-2.1291-02-4.0789-02 2.4843-02-2.8320-02
 7.2172-03 4.7534-03-1.0973-02-2.2262-02-1.6288-02 2.3220-02-1.6970-02-1.0356-02
 -2.4989-02 2.3262-04-6.5719-03-2.9085-04 4.6294-03-5.2724-03

SPAN 4 CHORD 3 STEADY= 1.0717+00

COSINE COEFFICIENTS

4.4963-01 8.3456-02-2.3113-02 1.0889-01 1.7004-02 2.1714-02 1.1169-02 3.4136-02
 -1.0639-01-5.3970-02 8.4566-02-9.4600-03 7.3584-02 4.3102-02-8.7931-02-3.8947-02
 -5.7450-02 4.5283-02 1.1128-01-2.5284-02 2.1506-03-3.8745-02-5.0018-02 7.3130-03
 1.1933-02 6.1519-02 5.6549-04-3.3694-02-2.1095-02-1.3396-02

SINE COEFFICIENTS

-1.7907-01-1.7007-01-1.5906-01-1.5639-01-9.7307-02 2.1396-02 2.6342-02 9.0315-02
 4.3062-02-1.4499-01-3.7597-02 1.4058-02-2.7820-02 1.0284-01 2.3038-02-2.3830-02
 -3.2716-02-1.0252-01 3.1659-02 4.4045-02 4.6705-03 4.4070-02-3.0891-02-3.5992-02
 -3.3781-02 2.8668-04 5.4115-02 6.3574-03-9.3105-03-2.6533-02

SPAN 4 CHORD 4 STEADY= -9.9500-02

COSINE COEFFICIENTS

8.8545-02 2.5226-01 1.7002-02-2.6905-02-2.8211-02-3.2769-03 8.9155-03 5.1615-03
 7.9514-03-1.0162-02 2.5602-03 6.3093-03 1.0036-03-3.8267-03 5.4993-03 6.2450-05
 -7.3830-03 5.6090-04 6.7769-03-5.4648-03-1.8509-03-9.0334-04-5.1794-03-4.7395-03
 5.6189-03 7.6473-03-3.1342-03 3.5130-03 6.3448-03-3.7929-03

SINE COEFFICIENTS

-6.0061-01-6.4250-02 7.1578-02-9.5353-03-4.4522-02-1.0975-02-5.4469-03 8.4329-03
 3.6648-03-2.9450-03-1.2587-02 9.0692-03 1.1790-02-4.9902-03-4.9866-03-5.2253-04
 1.9772-03-1.0195-02 1.1108-02-4.2796-04-6.5972-03 2.0631-03 4.8269-03-2.1726-03
 -4.3462-03 1.2799-03 4.6337-04-5.8436-03 3.5874-03 2.1539-03

SPAN 4 CHORD 5 STEADY= -5.2357-01

COSINE COEFFICIENTS

-7.9665-02 2.8101-02 9.7941-03-3.3593-03-6.3725-03 1.4941-03 2.8592-03 8.4455-04
 1.1706-03 8.0555-04 2.0628-03 2.3176-03 1.6306-03 2.6175-04 2.1273-03 2.1280-03
 -1.1364-03 4.8706-03 6.4884-03 3.4328-03-2.6707-03 1.7490-03-1.6357-03 4.9562-03
 1.5034-03 1.4787-03-1.4458-04 5.0410-03-2.3900-03 5.5268-03

SINE COEFFICIENTS

-2.2812-01-3.0271-02 8.6824-03 9.6914-03-4.3660-03 1.0240-03 1.6224-03 2.3124-04
 1.4639-03 3.8227-03-3.3329-03 6.3064-03 4.7951-03-2.8931-03-7.5772-04 6.5209-03
 2.6779-05-2.1302-03-2.1474-03 4.2896-03-2.6924-03-6.7841-03 1.5857-03 6.7580-03
 -9.8096-03-3.3866-03 2.6719-03-2.6086-03-3.3305-03 1.6305-03

TABLE VII Concluded

SPAN 5 CHORD 1 STEADY= 3.8522+00

COSINE COEFFICIENTS

2.0919+00 1.5811+00 2.9130-01 5.0501-01-3.9004-02-1.3974-01-5.7719-02-9.3646-02
 -1.3519-01-9.8406-02-1.2932-02-3.3734-02-7.0961-02-3.9397-02 9.3866-02 4.2265-02
 -5.6323-02-1.2288-02 5.4187-02 2.1286-02-7.2295-02-5.3138-02-8.8187-03-7.2273-03
 -4.1520-02 2.5115-02 4.0744-02 5.4266-03-1.5099-02 1.1267-02

SINE COEFFICIENTS

-1.2370+00-5.8802-01-4.2915-01-6.2079-01-4.7978-01-3.6031-01-2.2704-01-2.8163-02
 -8.7805-02-1.6219-01-4.8759-02 1.1078-01 5.3981-02-1.5028-01-5.9752-02-2.5220-02
 -6.2986-02-1.3975-01-1.0505-01-3.4907-02-7.2623-02-8.8903-02-3.9709-02 1.9106-02
 -1.8672-02-5.4239-02-1.2458-02 9.1485-03-2.6611-02-4.6692-02

SPAN 5 CHORD 2 STEADY= 1.1609+00

COSINE COEFFICIENTS

2.2748-01 3.6384-01-3.2215-01-1.9117-01 1.6325-01 1.9713-01-3.1060-02-1.1201-02
 -3.0325-03-9.4680-02 2.4410-02 4.6282-03-9.4527-02 3.8611-02 1.3153-01 8.1431-03
 -6.4468-02-1.1217-02-1.3480-02-3.6093-02-1.2164-02 1.2793-02 4.2200-02 2.3797-02
 -1.3501-02-9.4418-03-9.2455-03-3.9680-02-2.1732-02 2.5066-02

SINE COEFFICIENTS

-2.4403-01 7.4926-02 1.7887-01-3.8162-01-3.4688-01 7.4007-02 1.1341-01 3.6621-02
 6.6840-02-2.7779-02-8.0613-02 5.9548-02-2.2783-02-1.2342-01 6.1039-03 9.4822-02
 1.7434-02-1.4412-02 1.4598-02-1.2096-02-4.8456-02-4.0312-02-1.0275-02 2.8816-02
 2.5462-02-7.7183-04 1.5776-02-3.3395-03-4.1172-02-3.2656-02

SPAN 5 CHORD 3 STEADY= 1.8184-01

COSINE COEFFICIENTS

-3.4178-01 2.2636-01-3.2560-02-1.4013-01 9.7603-02 1.7576-01-1.1957-01-6.8889-02
 -7.3469-02-1.2066-02 1.8852-01 4.9582-02-8.9640-02-7.5860-02-3.5698-02 6.7314-02
 7.3391-02-1.3246-02-5.0218-02-2.4489-02 1.2512-03 2.3562-02 4.1121-02-7.9562-03
 -4.6243-02-1.2566-02 1.2377-02 3.5705-02 1.0164-02-2.4814-02

SINE COEFFICIENTS

-5.1914-01-2.0836-01 1.7745-01-1.1459-01-2.3937-01 8.5470-01 1.3532-01-7.8029-04
 -1.3380-02-1.6750-01-4.9251-02 1.6154-01 7.4310-02-1.2855-02-8.5447-02-7.4803-02
 4.3211-02 7.4409-02 1.7776-02-3.1357-02-3.4416-02-2.6320-02 1.6348-02 5.1677-02
 3.7095-03-3.1554-02-2.8456-02-5.1743-03 3.6051-02 2.0984-02

SPAN 5 CHORD 4 STEADY= -1.9193-01

COSINE COEFFICIENTS

-3.9314-01 7.0409-02 2.5496-03 3.6392-03-2.7981-02 1.0094-03-7.9245-03-8.4421-04
 6.0007-03 7.7451-04-2.1974-04-1.0170-03-1.0344-03 4.1036-03 9.9115-04-1.7013-04
 -6.1498-04-8.2977-04-1.1422-04 3.4584-04 1.8544-03 1.4852-03-4.3563-03-6.9525-05
 -1.7413-03 2.0535-03-5.2038-04-1.1668-03 8.2218-05 1.5667-03

SINE COEFFICIENTS

-2.6216-01-7.5712-02 4.1631-02 6.0684-03-8.7412-03-5.8244-03-3.0011-03 7.3681-03
 4.7052-03 3.6956-03-5.8810-03-2.7051-03 1.5559-03 2.8091-03 2.6170-03-2.5764-03
 -1.4684-03-3.7160-05 1.1852-03 1.4538-03-2.0710-03 1.2430-03 6.3242-04 3.6152-04
 -1.8165-04-7.3682-04 9.6047-04-1.9318-03-7.8798-04 1.3296-03

SPAN 5 CHORD 5 STEADY= -4.3901-01

COSINE COEFFICIENTS

-1.6340-01-2.7109-03-7.3843-03 4.0004-03-1.0941-02 1.5422-02-2.6676-03-4.3488-03
 3.1469-03 7.5604-03 4.7359-03 2.9112-03 1.3975-02-2.4671-02-2.8420-03-3.4610-03
 -7.8810-04 3.3814-04-6.9932-03 6.8667-05 7.0719-03-8.3436-05-1.5762-03 2.3385-04
 3.0705-03-8.3413-04 2.2771-03 1.7025-03 3.0090-03 2.5441-03

SINE COEFFICIENTS

-2.4782-01-2.3698-02 2.4086-02 2.7757-02-7.9328-03-9.5922-03 5.2043-03 5.1507-03
 4.1839-03 5.6710-04-3.1119-03-1.6578-02-9.7995-03 4.0075-02 1.2444-02 1.9845-04
 3.3750-03 6.7822-03 2.3900-03-2.0297-03 7.9301-04 3.3486-03 4.8541-04 1.2148-03
 1.1255-03 1.3947-03-2.4436-04 3.8726-03 8.2530-04 4.5212-03

NOT REPRODUCIBLE

TABLE VIII. AERODYNAMIC DATA - 140-KNOT, WEST-TO-EAST FLIGHT

BURST NO. # 23 *** ROTOR WISE PURCHES OUTPUT ***
 BLADE PITCH HARMONICS
 1.2486801 3.1825800-5.4590800 %COLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY IN
 ROTOR PLANNING ANGLE HARMONICS
 1.6400800 2.4820-01 0.0000 %POSITIVE TAIL HIGH -- NEGATIVE
 DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 EMFASITING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY# 1.4340800
 COSINE COEFFICIENTS
 -0.7874-01 7.1484-02-3.0694-01-4.4989-02-1.3330-01 6.3231-02-8.6684-02 1.8630-02
 -5.3068-02 2.3941-02-4.3362-02-5.3878-03-3.3959-02-4.5084-04-2.4391-02-4.3592-03
 -2.5277-02 1.0213-03-2.7478-03 1.1614-02-5.1615-03 1.3713-02 1.0093-02-8.0250-03
 -2.1242-04 1.0761-03-2.4748-03-3.7920-03-4.2746-03-2.7860-03
 SINE COEFFICIENTS
 6.5338-01 6.2492-02 3.9053-01 1.1666-01-3.2466-02 6.2006-02 7.5729-03 3.6348-02
 2.5052-03 2.4870-02 3.0347-03 7.2457-03 4.0940-03-5.3440-03-9.9445-04-2.2815-02
 -1.4517-02-2.5601-02-3.7192-03-2.4937-02-9.1851-03-1.4884-02 5.9914-03-1.5357-02
 -3.6172-03-1.1585-02 7.71-03-2.5806-04-8.9636-03-1.3605-02
 SPAN 1 CHORD 2 STEADY# 5.4473-01
 COSINE COEFFICIENTS
 -3.0225-01 2.1700-01-1.1553-01-2.6728-02-5.5898-02 4.2305-03-4.6233-02-2.0659-03
 -2.0846-02 2.3386-03 1.7843-03-1.6328-02-8.5534-03 3.3427-02 1.6826-02-3.6135-02
 -1.4708-02 3.4336-02 2.4594-03 1.7907-02 8.7563-03 2.9711-03 1.8707-02-5.8819-03
 1.2566-02-8.0813-03 1.1289-02-1.4383-02-6.7143-03-2.2319-02
 SINE COEFFICIENTS
 3.5827-01 1.0530-02 1.5153-01 4.3532-02 1.7294-02 4.4564-02 2.6098-02 1.7979-02
 1.3407-02 7.3889-03 1.7632-02 1.2439-02-5.3140-03 3.3715-04-1.8562-02-1.3984-02
 4.7676-03 3.7285-03 2.0920-02-4.1993-03-1.3032-02-5.1518-03 7.4878-03-1.4612-02
 1.2383-02-1.0490-02 1.3237-02-1.3391-02-8.1526-03-8.5710-03
 SPAN 1 CHORD 3 STEADY# 1.7820-01
 COSINE COEFFICIENTS
 -1.9004-01 1.7851-01-6.6939-02-1.7249-02-3.0073-02 1.7213-02-1.5017-02 5.4770-03
 -8.9028-03 1.1538-03-4.8926-03-5.6285-03-3.9304-03-1.8216-03-3.7051-03-5.1657-03
 -2.2318-04-2.8435-03-1.4103-05 2.5970-03 4.3818-04 2.6348-03-6.7997-04 1.4290-03
 2.5287-03 3.1129-04 1.4623-04-3.0497-03-1.2532-03 1.0488-03
 SINE COEFFICIENTS
 1.0595-01-1.6215-02 8.4336-02 3.0863-02-1.1531-02 1.6131-02 7.2811-03 6.9570-03
 -1.6345-03 4.6558-03 2.4442-03 1.5022-03 2.0586-03-1.8445-03-1.6681-03-1.3205-03
 -8.3347-04-4.3646-03-2.7298-04-2.5428-03-2.0858-04-3.0436-03-3.4701-03-3.8967-03
 -3.3171-03 1.5185-05 7.7675-04 2.2507-03-1.5983-03 5.4818-04
 SPAN 1 CHORD 4 STEADY# 0.0000
 COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SPAN 1 CHORD 5 STEADY# 2.0679-01
 COSINE COEFFICIENTS
 8.4039-03-3.4984-02 2.5648-03-1.2759-03 1.9745-03-1.7336-03 4.0416-05-8.6213-04
 6.1971-04 8.6005-06 7.7133-04 6.7053-04 1.7617-04 8.4334-04-1.0271-04 8.6809-04
 -1.8759-04-1.7472-04-5.3840-04-1.1281-05-9.3874-04-2.3010-04 9.2592-04 9.0275-05
 8.9976-04 8.6660-04 1.5811-03 9.7413-04 7.1062-04-7.9322-04
 SINE COEFFICIENTS
 3.0284-02 7.3932-03 1.2710-03-3.2689-03-4.1976-04-1.4820-03-1.4269-04-1.1829-03
 1.1139-04-8.7763-04 3.5134-04 1.3716-04 1.0734-03 1.6310-04 4.8294-04-1.3103-03
 -2.2989-04-5.8366-04-7.7723-04 1.2986-03 1.2950-03 1.0889-03 1.3752-03 7.8203-04
 1.6209-03 5.5903-04-2.7793-04 1.7452-04 1.6796-04-8.2305-04

TABLE VIII - Continued

SPAN 2 CHORD 1 STEADY 4.1495800

COSINE COEFFICIENTS

2.0497-01 1.5885800-1.9094-01 2.4764-01-2.5134-01 1.9323-01 2.8384-02-9.7484-02
 5.7413-02-7.1897-02 7.8027-02-7.9187-02 2.2220-02 1.0234-02-3.2931-02 3.7803-02
 -5.5312-02 6.5381-02-3.5078-02 1.6665-02 1.4064-02-1.3261-02 2.4319-02-3.8681-02
 4.3270-02-7.0932-03 3.2563-03 6.3751-03-6.9985-03 3.3273-02

SINE COEFFICIENTS

4.5836-01 5.6924-01 3.6997-01-4.0758-01 4.0585-02-1.0826-01 1.4385-01-8.0024-02
 1.1718-01 2.9027-02-2.8150-02 7.1455-02-2.9803-02 8.8705-02-4.6938-02 5.5389-02
 1.6075-02-2.4777-02 4.0714-02-2.6319-02 4.8098-02-3.2531-02 2.8999-02 4.0067-03
 -1.6223-02 2.5976-02-1.2364-02 1.2877-02-1.8484-02 1.4018-02

SPAN 2 CHORD 2 STEADY 1.6678800

COSINE COEFFICIENTS

1.0782-01 6.6408-01-3.6098-02 7.2265-02-9.0166-02 8.0200-02 2.0279-02-4.6111-02
 2.3246-02-9.6724-03 1.0238-02-1.4213-02-6.0417-03 1.4123-02-1.4746-02 1.2418-02
 -2.1891-03 5.0931-03-2.0293-03-3.3419-03 1.1225-02-5.3649-03 5.6827-03-3.4853-03
 4.3398-03 2.2936-03-1.4198-03 7.0706-03-8.1818-04 3.8964-04

SINE COEFFICIENTS

-4.8381-02 2.0987-01 1.5258-01-1.7657-01 1.5114-03-2.5667-02 4.9398-02-1.6982-02
 3.1736-02 2.1651-02-1.3732-02 2.6868-02 2.3043-03 1.9549-02-1.4593-03 7.8296-03
 1.7407-02-5.6798-03 1.9369-02-4.9624-03 2.3779-03 4.4711-04-6.0600-03 8.2434-03
 -6.5607-03 4.9062-04 3.0995-04 2.5734-03 3.2855-04 3.2147-03

SPAN 2 CHORD 3 STEADY 1.4145800

COSINE COEFFICIENTS

1.0701-01 3.4474-01-5.9335-03 2.0535-02-5.4806-02 4.8337-02 1.2665-02-1.7619-02
 -2.7277-03-2.2539-04 5.7945-03-9.1742-03 1.0403-03 5.5817-03-4.3757-03 8.3118-04
 2.5289-03-1.0211-05-6.9980-03 1.1900-03 7.9408-03 1.9521-03-2.8921-03 1.8554-03
 -1.3962-03-1.9682-03-2.6614-03 3.7291-03 2.6643-03-7.0814-04

SINE COEFFICIENTS

1.5106-01 9.8864-02 1.0496-01-8.3167-02-1.7693-03-7.7899-03 1.3390-02 3.3000-04
 2.0397-02 6.0711-03-1.2474-03 1.2708-02 4.5386-03 2.3149-03 2.9261-04 6.4200-03
 7.8222-03-3.0478-03 4.4285-03-5.8666-04 1.8263-03 5.2003-03-4.3565-04 2.9310-03
 -4.5253-04-2.1487-03-7.5452-04-2.5031-03-9.9566-04 5.1405-03

SPAN 2 CHORD 4 STEADY 2.3909-01

COSINE COEFFICIENTS

-1.6427-01 2.5080-01 2.8126-02 1.1419-02-2.4656-02 2.1281-02 1.0006-02 7.5032-04
 -6.8432-03 1.9082-03 1.2563-03-1.8465-03-2.4350-03 2.4663-03-8.8062-04-4.7107-03
 2.6440-03 1.3220-03-1.8428-04-3.1407-03 1.6714-04 2.7063-03-5.5203-04 5.6405-04
 7.9377-04 1.8619-03-5.2085-04-6.0527-04 9.9270-04 4.7207-05

SINE COEFFICIENTS

-1.6144-01-7.3921-03 2.1577-02-4.2443-02 8.1691-03-2.8208-03-2.7250-03 2.8406-03
 7.1094-03 1.9637-04-1.3631-03 4.3469-03 7.6220-03-2.6334-04 2.5707-03 1.5491-04
 2.4742-03 2.2065-03 1.2993-03 8.5527-04-7.4683-04 8.6451-05-2.1226-03 3.0938-03
 2.1048-03-6.0585-04 9.7673-04 1.1129-03 1.9126-03-8.7971-04

SPAN 2 CHORD 5 STEADY -2.4270-01

COSINE COEFFICIENTS

-3.1236-02 7.4330-02 1.0086-02 8.5297-04-1.8428-03 3.7995-03 1.4632-03 2.0652-03
 -2.6638-03 2.8309-03 1.5405-04-2.0732-03 7.1869-04 8.0536-04 2.2192-03-4.2879-03
 2.3174-04 6.2183-04 1.9550-03-9.9506-04-1.7854-03 3.6607-03-5.7817-04 6.6335-04
 -9.4700-04-9.9614-04 2.2213-03-2.3120-03 1.4421-03 1.0282-04

SINE COEFFICIENTS

-2.2332-01-2.3622-03-3.5269-03-4.3183-03 4.0028-03-1.8676-04-4.5723-03 9.9386-04
 2.4172-03-1.2651-03 9.2622-04 4.2671-04 2.7231-03-1.5372-03 2.3551-03 1.5839-03
 -1.3254-03 4.8007-04-3.3068-03 3.4790-03-6.0879-04 3.3349-04 1.4111-03 5.3615-04
 2.6113-03-2.2404-04 3.5933-04-5.2649-04 6.9604-04 1.2827-03

TABLE VIII - Continued

SPAN 3 CHORD 1 STEADY 4.6217400

COSINE COEFFICIENTS

1.8001400 1.8397400 5.2699-02 1.8407-01-9.8673-02-5.5541-02-4.9690-02 1.0797-01
 -8.8533-02-7.2509-02 5.5413-02-2.4398-02-1.8795-02 3.0521-02-4.7627-02 5.4482-03
 4.8926-02-4.3333-02-1.3243-02 3.3535-02-2.7286-02 9.8975-03 1.4385-02-2.6289-02
 1.6515-02 1.8545-02-2.3604-02 2.3913-02 1.2209-02-1.9742-02

SINE COEFFICIENTS

-2.3579-01 6.2355-01 5.7155-01-4.6036-01-1.6935-01 1.6415-01-1.2249-02 2.1414-02
 4.6968-02-3.2980-02 7.7086-02 4.9025-02-5.8260-02 4.4282-02 4.6335-02-5.0285-02
 1.5685-02 1.2420-02-3.0809-02 3.5421-02 3.4757-03-3.3679-02 4.3713-02 8.3506-03
 -1.7953-02 3.9379-02-6.2427-03-1.7336-02 2.1563-02-1.1342-04

SPAN 3 CHORD 2 STEADY 1.0838-01

COSINE COEFFICIENTS

8.0775-01 8.1767-01 1.2930-02-6.9963-02-1.4689-02-7.5263-03-1.6896-02 5.4032-02
 -4.0292-02-2.7696-02 3.3123-02-1.9776-02-4.4662-03 6.9802-03-1.3682-02 6.7630-03
 -4.0312-03-9.1519-03-3.0938-03 1.3010-02-1.7911-03-1.1561-02 1.8676-02 1.5455-03
 -5.8165-03-6.2246-03-1.1717-03 1.3649-02 1.0530-03-1.3642-03

SINE COEFFICIENTS

-1.2593400 2.0895-01 2.7736-01-1.9121-01-1.1814-01 5.4737-02-1.8944-02 2.4026-03
 2.4537-02-1.4725-02 3.2957-02 1.7144-02-3.2413-02 2.1415-02 1.2547-02 2.2783-03
 1.4904-03 2.1233-03 8.1790-03-8.3939-03 1.1858-02-9.6313-03-1.0806-04 2.0674-02
 -7.0857-03 5.4526-03-1.3370-02 6.3376-03 1.2524-02-6.5848-04

SPAN 3 CHORD 3 STEADY 1.2898400

COSINE COEFFICIENTS

1.9775-01 4.0129-01 4.1139-03 2.4884-02-3.0772-02-2.9508-02 4.1375-03 3.6126-02
 -3.0390-02-3.1084-02 4.8011-03 1.3235-02-1.6099-03-1.1310-02 5.2304-03 5.5201-03
 -2.8674-03-9.7252-04-7.3075-03 2.6024-03 2.8005-03-7.6002-03 2.6116-03 2.4510-03
 6.7486-03-4.0983-03 5.2097-04 3.9748-03 4.0192-03-8.2915-04

SINE COEFFICIENTS

-4.4021-01 3.5334-02 8.2507-02-1.2981-01-1.8605-02 1.7512-02-2.3333-02 7.1384-03
 1.8282-02-2.4941-03-2.3395-03 1.5127-04 6.1738-03-1.9674-03 2.6927-03-1.2106-03
 -4.9300-03 3.8883-03 1.8530-03-3.5367-04-1.4084-03 2.6512-03 1.2755-03 2.9251-04
 -1.0932-03 4.3912-03-3.4162-04 1.3638-03-7.1986-04 4.9188-03

SPAN 3 CHORD 4 STEADY -5.9369-01

COSINE COEFFICIENTS

-3.1939-03 1.9091-01 2.6635-02 3.1220-03-2.5171-02 4.3134-03 1.0260-02 5.4775-03
 -8.2419-03-4.1849-03 8.3741-04 3.6287-03 1.7223-03-9.1471-04 5.4767-04-7.1306-05
 -1.9886-03 5.3397-04 1.8502-03-1.2542-04 1.2022-03-1.3874-03-2.6618-04 6.0613-04
 1.7432-03 1.6529-04-3.2711-05 3.7247-05-5.8346-04 1.7507-03

SINE COEFFICIENTS

-2.7166-01-2.0818-02 4.0086-02-4.0317-02-1.1121-02-4.0238-03 1.8875-03 4.6834-03
 -2.5574-03 2.5160-03 5.1430-03-3.6835-04 1.9382-04 2.0004-03 3.5421-03 2.6969-03
 -2.6285-03-2.2118-04 3.3515-03 1.1239-03-1.3359-03-5.3946-05 1.2818-04 1.6797-03
 -1.1155-03 1.1472-03 9.7940-04 2.4210-03-2.7984-04 1.0178-04

SPAN 3 CHORD 5 STEADY -2.2170-01

COSINE COEFFICIENTS

-8.8295-03 5.0322-02 9.2771-03-1.3756-04-4.4485-03 1.9364-03 2.4801-03-3.1585-04
 -9.0095-04 1.1061-03 2.5304-04 2.4574-03 2.2322-03-8.3511-04 2.5039-03 5.8304-04
 -2.4278-03 4.8725-04 2.2250-03-1.0059-03 1.5810-03-1.8073-03-1.7088-03 1.3428-03
 7.4764-04-1.1875-03 1.1193-03-4.6276-04-7.7219-04 1.8446-03

SINE COEFFICIENTS

-1.5570-01-1.1072-02-5.9127-03-9.8178-03 2.5236-03-2.8820-03-6.2447-04-2.2192-03
 -3.3562-03 1.5544-03 1.2720-03-2.3183-03 4.1513-04-5.2347-04-2.0933-05 3.2302-03
 -1.1894-03-1.0041-03 1.0442-03 1.5776-03-5.5618-04 1.2988-03 2.0637-04 1.0734-03
 5.2330-04-1.3243-03-1.2978-03 1.0245-03-1.5675-03 1.4037-05

TABLE VIII - Continued

SPAN 4 CHORD 1 STEADY 3.7895400

COSINE COEFFICIENTS

2.0476400 1.5019800 1.8422-01 3.2336-01-1.9702-01-7.0542-02-2.1020-02-4.0690-02
 -1.0936-02 1.7241-02-2.1046-02-5.4869-02 7.9125-03 6.4300-02 6.8571-03-4.3788-02
 1.6008-02 3.7613-02 4.6565-03-1.9309-02 1.0507-02 1.6009-02-1.1713-02-4.0824-03
 3.2483-02 6.9130-03-2.1894-02 9.9147-03 2.5404-02-4.8435-03

SINE COEFFICIENTS

-1.6729800-1.1049-01 6.3047-03-3.0514-01-2.1896-01-5.8845-02 6.3013-02 1.0773-01
 -6.6723-02-4.4623-02 6.8065-02 5.5311-02-1.0264-02 2.4901-03 1.7918-02-1.3609-03
 -7.7359-03 1.5439-02 2.0411-02-2.8174-02-1.4582-02 3.0603-02 9.0972-03-1.4258-02
 -5.2369-03 2.7654-02 7.6240-03-2.8823-02 5.2808-03 2.7005-02

SPAN 4 CHORD 2 STEADY 9.8028-01

COSINE COEFFICIENTS

1.3530400 7.8215-01-1.8164-01 6.5023-02-1.0137-01-7.1201-02 6.0045-02-1.3510-02
 7.1105-03 4.7708-02-3.4233-02-4.7332-02 6.4499-03 5.9972-02 4.1789-04-5.5356-02
 2.10164-02 1.4951-02-1.4779-02 1.0436-02-9.5479-03-2.4606-04-4.3784-03-2.4836-03
 8.9736-03 1.6963-03 1.1215-02-6.8452-03-3.8983-03 9.3964-04

SINE COEFFICIENTS

-1.1260800 3.1550-01 2.2570-01-2.2306-01-5.4271-02-9.7410-02-2.7053-03 8.7143-02
 -5.6545-02 3.8218-03 5.8280-02 4.2883-03-3.1031-02-1.6243-02 3.7705-02-4.8232-03
 -1.8516-02 2.6881-02-2.1177-03-9.4070-03-7.1900-04-1.6168-03 4.6313-03-1.0813-02
 -1.6807-03 1.8980-04 9.7946-03 2.1420-02-8.8502-03 1.4841-03

SPAN 4 CHORD 3 STEADY 8.4055-01

COSINE COEFFICIENTS

5.5892-01 7.6080-02-5.9357-02 2.2438-01-2.3654-02-1.8103-02 2.0309-02-5.6504-02
 -2.3723-02-1.9427-02 1.9630-02 9.8881-02-1.1632-03-5.1745-02-2.5610-02-4.5115-02
 2.98464-02 6.0755-02-5.7273-03 5.0553-03-4.1427-02-4.3826-02 4.0077-02 3.7977-02
 3.5962-03 1.2038-03-2.9210-02-6.2328-03 1.4205-02 1.2725-02

SINE COEFFICIENTS

-3.2608-01 3.1929-02-1.8825-01-1.4604-01 4.4392-02-9.5601-03 7.5014-02 6.4851-02
 -5.0713-02-3.8565-02-6.1764-02 3.4147-02 1.0315-01 4.1141-03-1.2149-02-3.4224-02
 -5.7165-02 2.3195-02 2.5554-02 2.6508-02 3.5528-02-4.9408-02-5.0322-02 1.5481-02
 2.2328-02 2.7914-02 5.5079-03-2.7301-02-1.1328-02-1.0362-02

SPAN 4 CHORD 4 STEADY -1.5639-01

COSINE COEFFICIENTS

8.4512-02 1.9730-01 3.7625-02-9.5393-03-3.0487-02 9.4723-04 6.2888-03 3.4871-03
 7.7535-03-4.6734-03-3.1819-03-3.3633-03 9.1013-03 5.4803-03-4.4425-03-2.9507-03
 -7.8875-04-3.0539-03 3.4600-03 4.4365-03-3.1403-03-6.4036-04 7.1387-04 1.3199-03
 -4.5696-03-1.3391-03 6.2033-03 4.7103-03-3.0054-03 6.1366-04

SINE COEFFICIENTS

-5.1966-01-4.5289-02 5.2622-02 3.0745-03-2.5181-02-9.8308-03 4.5428-03 8.4908-03
 2.2244-04 4.2285-04-1.7814-03 3.2938-03 1.7931-03-1.7009-03 1.2030-03-1.8337-03
 2.7959-03-3.0183-04-2.5036-03-5.1321-03 7.2513-03 2.2410-03 1.3647-03 2.0782-04
 1.2286-03-4.9634-03-1.1706-03 2.6976-03-1.1681-03-1.3475-03

SPAN 4 CHORD 5 STEADY -5.5243-01

COSINE COEFFICIENTS

-8.5499-02 2.1206-02 1.1180-02-2.9795-03-4.5067-03 3.0733-03 1.3211-03-7.6966-04
 1.0747-03-3.6383-03-1.8011-04-4.3083-04 3.1180-03 2.3006-03 4.3511-04-3.5361-04
 -8.4913-04-1.4498-03 5.6174-04-3.3064-03-7.1377-03-4.6901-03 3.9933-03 3.0580-03
 -5.9295-03-1.6693-03-1.1440-03-4.3379-03 3.5448-03 9.4749-03

SINE COEFFICIENTS

-2.0677401-2.8514-02 6.4653-03 7.9050-03-2.6037-03 8.9366-04-7.3615-04 4.1049-03
 1.9244-03-7.9017-04-3.5772-03 6.9699-04 1.0306-03-7.2722-03 2.5070-03 1.7779-04
 -2.1302403-6.6663-04-2.1447-03 1.7038-03-6.0347-03-2.4002-03 7.2012-03-9.1320-04
 -5.0709-03-8.2222-04 2.9074-03 2.2186-03 7.8190-03 6.4600-03

TABLE VIII - Concluded

NOT REPRODUCIBLE

SPAN 5 CHORD 1 STEADY 3.6497809

COSINE COEFFICIENTS

2.0277800 1.3024800 2.2681-01 4.1923-01-1.4887-02-6.7458-02 5.5693-02 5.7308-02
 -5.0617-02-2.8293-02 2.7680-02-3.6355-02-8.7881-02-4.1474-02 2.9569-02 7.2543-03
 -6.3235-02-3.5220-02 6.5149-02 7.4098-02 2.5441-02-5.2351-03 4.4104-02 7.2651-02
 -2.0348-03 1.2300-02 3.5950-02 2.6939-02-5.1836-03-1.6202-02

SINE COEFFICIENTS

-1.1566800-1.7720-01-1.1327-01-3.4714-01-2.1762-01-1.5729-01-9.1517-02 6.3307-02
 -4.7277-02-1.6186-01-6.2769-02 6.1147-02 6.5199-02-1.6143-01-7.3657-02 3.1757-02
 6.2352-02-2.6921-03-6.8240-03 4.6261-02 3.7016-02-1.1441-02-2.9357-02 3.6235-02
 1.0020-02-3.5744-02-2.1460-02 2.1073-02 3.0960-02-5.1907-02

SPAN 5 CHORD 2 STEADY 9.8433-01

COSINE COEFFICIENTS

2.3623-01 2.9755-01-1.6073-01-1.5638-01 6.7003-02 2.5128-01 2.4780-02-1.2809-01
 -6.3838-02-1.7025-02 1.7007-02 1.4478-02-3.7850-02 5.1604-02 1.1389-01-1.9770-02
 -1.1524-01-3.7847-02 3.0055-02 2.2345-02 2.0762-02 2.2722-02 1.4114-02-9.4769-03
 -3.1279-02-2.7929-02-5.3298-05 1.0649-02 2.9966-02 2.1511-02

SINE COEFFICIENTS

-2.9570-01 5.8596-02 1.5026-01-2.2683-01-3.1934-01 2.4044-02 2.2752-01 9.9327-02
 -4.5270-02-5.9971-02-4.1055-02 2.6997-02-7.0782-03-7.3913-02 3.0619-02 1.2202-01
 2.0746-02-6.8339-02-3.6912-02-1.7099-02-1.0608-02 8.0144-03 2.6565-02 3.1734-02
 8.9777-03-2.1968-02-3.1911-02-1.5742-02 2.7311-03 2.0707-02

SPAN 5 CHORD 3 STEADY 1.0086-01

COSINE COEFFICIENTS

-2.2339-01-9.3401-02-3.4034-02 1.3886-01 2.2747-02 9.8829-02-9.263-02-1.9725-01
 -4.5270-02-5.9971-02-4.1055-02 2.6997-02-7.0782-03-7.3913-02 3.0619-02 1.2202-01
 -5.7869-02-7.2646-02 9.4855-03 4.1854-02 3.3613-02-1.1978-02-3.5572-02-3.3151-03
 2.5644-02 5.8841-03-3.1287-03-5.8630-03-6.5022-03 1.8002-03

SINE COEFFICIENTS

-2.8288-01-6.1251-02-1.2936-01-7.7748-02-2.7768-02 7.6246-02 1.7263-01-4.5964-02
 -2.0363-01-4.2131-03 1.2435-01 7.5154-02-9.4281-03-1.0182-01-6.2724-02 7.5078-02
 8.0258-02-2.7045-02-5.9453-02-1.6459-02 2.1843-02 3.5444-02 2.2052-04-3.0432-02
 -8.1517-03 1.3568-02 5.5960-03 3.7144-03 9.3813-04-8.2746-03

SPAN 5 CHORD 4 STEADY -3.4329-01

COSINE COEFFICIENTS

-3.6187-01 2.1346-02 1.2440-02 2.6984-02-2.1395-02-1.2210-02-7.1884-03 1.9346-02
 4.4623-03-1.4888-02-2.6982-03 1.3933-02-1.0462-04-1.1564-02-2.6798-04 1.4995-02
 -4.6342-04-1.8820-02-5.6408-04 1.7653-02 8.8426-04-1.8906-02-2.5260-03 1.9900-02
 1.7415-04-2.0125-02-7.1857-04 1.0877-02 4.0044-05-2.3700-02

SINE COEFFICIENTS

-2.0043-01-4.7243-02 8.2482-03 1.4584-03 1.3432-02-4.7506-03-2.0488-02 1.0935-02
 2.0655-02 2.7275-03-2.0034-02-2.5219-03 1.8332-02 2.3406-03-1.4805-02-3.2807-03
 1.7100-02 4.8605-04-1.6557-02-2.0254-04 1.7365-02-1.1544-03-1.9522-02 1.4461-03
 2.0356-02 9.9128-04-2.1400-02 2.2587-04 2.1969-02-6.0722-04

SPAN 5 CHORD 5 STEADY -5.7754-01

COSINE COEFFICIENTS

-1.6072-01-1.1016-02 2.1280-03 4.3326-03-1.5985-03 5.4335-03-2.7068-03 1.0081-03
 7.5208-03 1.0360-02-1.3959-03 4.5645-03 1.9450-02-3.9934-02-2.2850-03-7.5476-03
 3.4811-03-6.3923-03-3.6775-03-1.5817-03-2.1451-05 2.3775-03-5.4076-03-3.3899-03
 5.9754-03-1.7975-03-1.7473-03-6.5757-03 2.2701-03-1.7754-03

SINE COEFFICIENTS

-2.1563-01-1.5051-02 1.9678-02 1.5776-02-7.4650-03-4.7539-03 2.6133-03 2.5928-03
 -2.6560-03-2.1273-03-2.8327-03-1.0653-02-6.9958-04 2.0171-02 7.9891-03 1.0255-03
 -0.5783-04 1.1313-02 5.2463-04 4.0573-05-1.7358-03-7.2305-04 5.7763-03-1.4173-03
 1.3313-03 4.3858-03-2.4426-04 2.0009-03 3.5849-04 9.3970-03

TABLE IX. AERODYNAMIC DATA - 170-KNOT, EAST-TO-WEST FLIGHT

BURST NO. # 24 *** ROTOR NOISE PULSED OUTPUT ***
 BLADE PITCH HARMONICS
 1.5546801 4.9134800-8.4462800 %COLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVE
 ROTOR FLAPPING ANGLE HARMONICS
 1.9927800 3.9739-01 0.0000 %POSITIVE TAIL HIGH -- DEGREES
 DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS
 MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY# 1.1983800
 COSINE COEFFICIENTS
 -1.0415800 1.2808800-7.7225-01-2.5942-01-1.4078-01 1.5667-01-9.2889-02 3.4479-04
 1.6256-02 1.0277-02 2.9061-03-3.0422-03-4.2291-03-1.3762-02-4.1117-03 8.5788-04
 -5.0536-03 5.0310-03 1.4332-02 1.8746-03 1.6661-03 6.0260-03 4.8956-03-6.3040-03
 -5.2236-03 4.9684-03-2.6515-03-2.3534-03 6.9054-03 1.3314-03
 SINE COEFFICIENTS
 2.6313-01 2.7256-01 7.4164-01-8.7592-02-2.0768-01 1.3183-02 2.5878-02-5.5683-02
 -2.6174-02-1.4816-02-2.9247-02-2.1113-03-7.7634-03 8.4036-03-2.4053-03 4.1907-03
 4.7974-04 6.0961-03 2.7657-03-7.6328-03-6.8676-03-1.1038-02-5.4443-03-5.6225-03
 -4.1854-03-4.6181-03 3.3433-03 6.9911-03 3.9864-03-5.1586-04
 SPAN 1 CHORD 2 STEADY# 4.6796-01
 COSINE COEFFICIENTS
 -3.4696-01 4.3822-01-2.5723-01-9.0981-02-3.8631-02 8.2267-02-1.5171-02 1.2184-02
 1.9120-02 5.1382-03 6.5025-03-8.2903-03-9.6184-03 5.0489-03-3.1380-03-3.4102-02
 -1.7709-02 5.0765-03-5.3043-03 2.0901-02-1.1406-02-2.4565-03-1.4235-02-8.0784-03
 -7.5605-03-1.1770-03 3.7395-03-1.6006-02 2.4025-03-3.4868-03
 SINE COEFFICIENTS
 2.0562-01 3.2633-02 2.5790-01-7.0077-02-8.5451-02 3.1167-03 2.8500-02-2.0355-02
 -1.4504-02-3.7135-03-1.8101-02-8.5968-03 5.9224-03-1.0937-02-3.9987-02 3.0814-03
 9.9306-03 4.0847-03-1.9643-03-6.8712-04-3.3972-03-4.8080-05-3.4930-03-1.2801-03
 -6.6481-03 1.2615-03 3.0860-02-1.5372-02 3.7652-03 1.7988-03
 SPAN 1 CHORD 3 STEADY# 1.8890-01
 COSINE COEFFICIENTS
 -2.1163-01 3.2840-01-1.6134-01-7.4263-02-3.7848-02 4.3147-02-9.6868-03 9.2986-03
 6.5271-03 4.3619-03-1.8861-03-5.7542-03-6.2236-03-7.6062-03-3.0733-03-4.7009-04
 -1.3567-03 1.5421-03 5.3935-03 1.5111-03 3.1283-03 1.2200-03 2.7522-03 3.1988-03
 -1.0480-03-1.8849-03 9.4185-04-2.2565-03-3.8551-03-3.4882-03
 SINE COEFFICIENTS
 8.9873-02 1.0249-02 1.6048-01-4.0467-03-3.7758-02 2.0715-03 1.0686-02-1.0537-02
 -1.7477-02-1.0229-02-1.2466-02-7.8926-03-6.2611-03 1.4166-03 9.2012-04 9.5054-03
 5.1543-03 4.7969-03 1.7600-03 2.9961-04-2.0060-03-2.1518-03-6.1817-04 2.9234-03
 -5.4433-03-1.1648-03-5.8600-03-1.6078-03 2.5289-03 9.1946-04
 SPAN 1 CHORD 4 STEADY# 0.0000
 COSINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SINE COEFFICIENTS
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
 SPAN 1 CHORD 5 STEADY# 2.4822-01
 COSINE COEFFICIENTS
 1.5614-02-7.0506-02-9.8549-03 1.8233-02 1.3463-02-9.2831-03-6.2258-03-1.7259-03
 -1.9158-04-1.6235-03-3.0597-04 8.2641-04 6.1880-04 3.6085-04-8.3794-04 5.6118-05
 3.4340-04-8.1961-04-2.3392-03 2.4796-04 5.5208-04 2.2820-04 1.4864-03 2.7087-04
 7.7029-04 6.3238-04-5.7180-05-6.2263-04-1.6305-03-8.7847-04
 SINE COEFFICIENTS
 3.0899-02-3.8654-03 1.9442-02 7.4190-03-8.0427-03-7.1367-03 3.7625-05-6.2299-04
 -6.7709-04-1.4674-03 4.7060-04-5.5450-04 1.0394-03-1.0342-03-2.8766-04 3.3704-04
 1.6435-04-1.0668-03-1.3921-03-3.3349-04 1.2718-03 1.6211-03 3.0092-04-6.2560-04
 -9.0254-04 1.3053-04 1.0119-03-4.7312-04-1.2227-03-4.8450-05

TABLE IX - Continued

SPAN 2 CHORD 1 STEADY 4.7725800
 COSINE COEFFICIENTS
 3.5886-01 2.9252800-1.0779800 3.0307-01-2.3727-01 9.2486-02-1.2349-01-1.2012-01
 -7.3617-04-8.4920-04-7.7934-02 4.0506-02-5.9496-02 2.9282-02-8.6680-03 1.1381-02
 2.2748-03 1.3671-02 1.9562-03 3.2678-02-3.3773-02 4.1828-02-3.5414-02 3.2025-02
 -2.8650-02 1.2830-02-1.7567-02 9.1328-03-1.2558-02 1.2953-02
 SINE COEFFICIENTS
 4.9567-01 1.2248800 1.3854800-6.0349-01 1.2426-01-7.9076-02 2.3082-01-1.0683-01
 -2.8400-02-7.7081-03 1.6900-03-4.0056-02 3.5206-02-8.5150-02 3.8878-02-4.9115-02
 6.3483-03-2.5685-02-8.9622-04-1.2825-03-2.4891-03-5.7976-03 1.0123-02-1.1098-02
 2.4122-02-8.1665-03 1.8098-02-3.3055-04-5.4594-03 8.7333-03
 SPAN 2 CHORD 2 STEADY 1.8233800
 COSINE COEFFICIENTS
 3.1961-01 1.2757800-4.4302-01-7.6088-02 1.3925-02 5.2431-02-1.7461-02-4.3483-02
 3.3540-02-2.6191-03-2.5856-02 9.6249-03-6.4617-03-7.7001-04 1.4277-02-6.5255-03
 -2.5207-03 5.1948-04 1.4825-02-3.7499-03-4.7894-05-1.1009-03-8.3118-03-9.7630-03
 2.3863-03 7.1919-03 3.0449-03-1.0802-03-9.6495-03-4.5486-03
 SINE COEFFICIENTS
 -1.7829-01 5.2018-01 6.8865-01-4.1142-01-7.8270-02 4.2288-02 7.0980-02-2.1698-02
 -3.6989-02 3.6121-02-9.4956-03-1.4694-02 6.0133-05-1.8418-02 7.7414-03 3.1900-03
 -2.3059-03-6.5619-03-7.0880-03 2.7527-03 2.9923-03 5.3803-03 7.2488-03-3.8511-03
 1.0714-03 4.2441-03 8.3747-03 2.5766-03-1.7599-03 2.4739-04
 SPAN 2 CHORD 3 STEADY 1.5831800
 COSINE COEFFICIENTS
 1.3964-01 6.5127-01-1.8722-01-5.4681-02-2.4686-02 4.6989-02 4.5694-03-3.5030-02
 7.6772-03 7.7846-03-1.0395-03 2.5103-03-1.3304-03 9.3567-05 2.6334-03 1.6923-03
 -1.8535-03-5.2507-03 5.5020-03-4.7049-06 9.9842-04-3.2128-03 1.2410-03 4.3784-04
 -5.6905-03 7.5569-04 6.9370-03-2.1862-03 1.5069-04-3.8407-03
 SINE COEFFICIENTS
 1.9357-01 2.1102-01 3.8881-01-1.7702-01-3.7097-02-1.0510-03 4.3610-02 9.6184-04
 -3.0440-02 6.8360-03 1.9298-03-1.3726-04-9.8667-04-3.9929-03-1.9949-03 1.3234-03
 3.0610-03-3.4377-03-2.0478-03-1.8753-03-1.4940-03-4.0519-04 2.9016-03 2.1982-03
 -7.7300-04-6.5659-03 1.2434-03-2.1935-03 4.0903-03 1.1065-03
 SPAN 2 CHORD 4 STEADY 2.969801
 COSINE COEFFICIENTS
 -1.6812-01 4.4107-01-2.5996-02-2.6129-02-3.1692-02 2.6235-02 1.6997-02-8.6634-03
 -3.5682-04 5.7083-03 3.1925-03-6.5668-04 2.6990-03 6.8954-04-1.4317-03 8.3379-04
 -1.1503-03 1.6816-03 1.6105-03-8.4667-04 2.6705-03-2.4780-03-2.4271-05 6.1104-04
 8.6131-04 2.3324-03-1.7690-03-4.1630-04-1.8893-04-6.7245-04
 SINE COEFFICIENTS
 -2.3039-01 2.5502-02 1.5832-01-6.4467-02 8.9594-03-1.2335-02 1.9288-02 8.9155-03
 -1.0667-02-1.0577-03 3.8078-03 1.3407-03-2.4538-03 1.7861-03-7.9197-04 5.6083-04
 -1.0135-03-1.6816-03 7.8811-04-1.2548-03 2.0948-03 1.4230-03-1.5010-03-7.3272-04
 1.0526-04-1.1521-04 1.0061-03-2.0286-03 6.3431-04-1.6102-03
 SPAN 2 CHORD 5 STEADY -2.633701
 COSINE COEFFICIENTS
 -9.6094-03 1.1584-01 1.1843-02-3.7187-03-9.2077-03 6.1254-03 6.6090-03 6.6840-04
 -7.3581-04 4.2037-05 2.7349-03-1.3286-03 2.2495-03-1.1916-04-2.1904-03 2.3284-04
 -2.0128-04 1.5013-03-1.9171-03-1.7734-04 1.7155-03-1.3118-03-1.1317-03 1.5036-03
 1.9337-03 5.0786-05-1.8781-03 4.1324-04 1.0974-03 2.0379-03
 SINE COEFFICIENTS
 -2.6818-01 1.4077-03 1.5463-02-3.3815-03 8.9460-03-6.5003-03 1.4724-03 2.6025-03
 -5.7282-05-2.8664-03 8.7875-04-1.1582-03-1.8454-03 2.8902-03 3.2435-04-1.9370-03
 -1.3834-03 5.0776-04 1.2286-03-2.0535-03 5.6025-04 1.2567-03-1.1583-03-7.6596-04
 1.1521-05 8.6136-04-2.1141-04-1.2757-03-7.1546-04-1.6703-03

TABLE IX - Continued

SPAN 3 CHORD 1 STEADY 5.1823800

COSINE COEFFICIENTS

2.2570800 3.1470800-5.1358-01 4.7075-01 1.2882-01 1.6706-01-1.0173-01 5.8350-02
 1.4786-02-3.1681-02-7.4824-03-4.5033-02-3.9007-02 2.9783-02-3.5841-02-2.0117-02
 6.5171-03 5.8995-03-3.4599-02 7.8900-03-1.2573-01 -5.0944-03-7.2155-03 1.4967-02
 -4.6724-03 1.7131-02-1.2802-02-8.0220-05-3.1287-03-1.3133-03

SINE COEFFICIENTS

-5.2157-01 1.2374800 1.0522800-6.3274-01-1.7517-01 2.3778-01 5.7513-02-7.3329-03
 5.9612-02-5.2277-02-2.6550-03-1.9116-02-1.2255-03-2.7036-02 6.0808-02-2.4482-02
 3.0979-02 1.5172-02 3.6989-02-2.1385-02 2.1488-02-1.8920-02 1.0348-02-1.0370-02
 -7.4861-04-9.0604-03 4.6982-03-1.2918-02-1.0903-02 1.5720-03

SPAN 3 CHORD 2 STEADY 2.9432-01

COSINE COEFFICIENTS

1.1562800 1.3687800-3.5691-01-7.2984-02-7.9698-02-4.1210-02 1.4928-01-1.9936-02
 3.3960-02-5.2807-02 8.6209-03-3.2444-02-7.0769-03 1.5901-02-1.0014-02 4.6495-02
 -1.3014-02 2.6046-02-4.0787-02 1.0527-02-1.9177-02 3.1263-03 1.2110-03 1.5618-02
 -7.6344-03 2.5235-02-5.8727-03-1.0174-02-8.0782-03-3.3886-03

SINE COEFFICIENTS

-1.3979800 5.9095-01 6.2184-01-3.5393-01-2.6881-02-1.3717-01 1.3156-02 8.8141-02
 1.5721-02 3.5897-02-3.9840-02 3.7051-02-5.8721-02 1.7827-02-4.3910-02 1.3409-02
 -2.8059-04 2.2199-02 5.2531-03-1.0736-02 2.2385-03-1.0367-02-1.0495-02 5.6654-03
 -1.0692-03-6.1727-03 2.6606-02-7.5391-03 1.0790-02-2.0367-02

SPAN 3 CHORD 3 STEADY 1.5635800

COSINE COEFFICIENTS

2.6394-01 8.1040-01-1.8544-01-2.8748-01 2.5070-01 8.3947-02-1.6072-01 5.8006-02
 -1.4270-01 9.8226-02 1.3071-01-9.5408-02 2.4625-03-3.3271-02 2.3541-03 4.4794-02
 3.7848-03-1.3678-02 5.9855-03-7.1641-03-3.5504-02 3.6803-02 1.1060-03-1.6391-02
 2.6050-02-4.1956-02-2.5654-04 3.0831-02-1.0887-02 6.0531-03

SINE COEFFICIENTS

-4.1649-01 1.3298-01 5.0604-01-3.5456-01-2.3495-01 2.8707-01-2.9178-02 2.8247-02
 -3.3893-03-1.8608-01 1.2862-01 5.2693-02-2.0410-02 5.3400-03-5.6513-02 4.6060-03
 2.1219-02 8.8411-03-1.4151-02 2.1004-02-2.2470-02-2.5048-02 3.9990-02-1.6786-02
 1.6027-02 1.2984-02-4.7072-02 1.1164-02 8.3027-03-4.4989-03

SPAN 3 CHORD 4 STEADY -5.7183-01

COSINE COEFFICIENTS

5.5642-02 3.8949-01 4.9369-03-3.9735-03-7.3704-02 2.9052-02 3.9419-02-2.0415-02
 -7.4937-03 9.8424-03-1.7218-03-3.4748-04 4.9164-03-4.1153-03-7.7982-04 1.6645-03
 -2.1633-03-1.2891-03 1.4029-03 5.1527-04-1.0016-03-2.1729-04-6.9404-05-1.3335-03
 1.5218-04-8.9753-04 1.1859-04 5.5289-04-7.1255-05

SINE COEFFICIENTS

-3.5234-01 1.8736-02 1.1472-01-2.2027-02-2.7132-04-5.2074-02 2.1845-02 2.4717-02
 -1.6450-02-3.0566-03 2.3071-03-1.5874-03 4.2682-03 2.2857-03-3.2485-03 6.0910-04
 7.0283-04-2.5972-03-1.2007-03 1.8825-03-5.6223-05-5.4322-04 1.1514-03-1.4698-03
 8.5548-04 4.0374-04-2.3657-04 3.9440-04 9.2572-04 3.3942-04

SPAN 3 CHORD 5 STEADY -1.9950-01

COSINE COEFFICIENTS

6.6056-03 7.7608-02 2.5922-02 1.7370-03-1.3234-02 7.0057-03 7.8664-03-9.5143-04
 -2.4890-03 2.7065-03-3.0657-03 3.8332-04 2.0433-03-1.6609-03 1.6934-04 6.6970-04
 -1.1377-03-5.8068-04-1.0953-03 2.4207-04-4.2831-04 1.4273-03 1.8256-03-1.5489-04
 9.0107-05-1.4097-03 1.8377-03 1.2672-03 7.8430-05-1.1206-03

SINE COEFFICIENTS

-1.8934-01-1.6027-02 5.5875-03 1.5515-03 1.2511-02-6.6645-03 3.6865-03 6.7642-03
 3.6086-04 2.2528-04-9.6297-04-2.0166-03 2.3234-03 9.5871-04-2.0024-03 6.2201-04
 4.7360-04-1.1812-03 2.4081-03 1.2569-04-1.8319-04-2.5294-04-6.0310-05-9.8397-04
 1.1753-04 1.0303-03-2.5195-04 2.1241-03-2.4639-04-1.3206-03

TABLE IX - Continued

SPAN 4 CHORD 1 STEADYH 4.4997800

COSINE COEFFICIENTS

2.5692800 2.5774800-8.6861-02 4.1095-01-1.5493-01 1.5648-01-2.0620-02 1.1915-02
 8.0607-02 1.0422-01 3.8312-02 2.2419-02 1.0381-02 1.1083-02 1.1115-03-9.4664-03
 -1.8215-02-3.3762-03 1.2935-03 2.6999-04 1.2487-02 1.2486-02 1.8888-03 5.4762-03
 -4.9377-03-7.8480-03-1.8752-02-9.0277-03-7.4173-03 3.4371-03

SINE COEFFICIENTS

-1.7935800 1.6543-01 2.9866-01-4.0499-01-2.7766-01 5.2550-02 8.2447-02 2.3807-02
 -7.0703-03-2.3133-02 6.8030-03-2.0897-02-2.6632-02-3.2720-02-1.8053-02-2.5287-02
 -5.6197-03-4.0333-04 1.0117-03 1.1917-02 4.4435-03-3.4998-03-1.5068-02-8.3073-03
 -1.8186-02-4.2309-04 1.0566-02 1.4275-02 2.6792-02 2.6774-02

SPAN 4 CHORD 2 STEADYH 1.6640800

COSINE COEFFICIENTS

1.9254800 1.4196800-4.8549-01-2.1387-01-4.6178-01-2.0788-01-5.2214-02-6.2245-02
 1.3855-01 7.1662-02 1.2143-01-2.8076-02 9.3311-02 3.7116-02 3.3236-02-7.9065-02
 -2.5649-02-6.4054-02-2.6111-02-5.1895-02-1.8235-02 1.6183-02 3.6028-03 9.6549-03
 1.6620-02 4.1044-02 6.1626-03 8.9025-03-2.3564-02 3.9167-03

SINE COEFFICIENTS

-7.9952-01 7.1398-01 7.4940-01-1.9815-01-6.0630-02-2.7136-01-7.8233-02-1.6083-01
 -4.7123-02-3.7802-02 4.7038-02 1.5594-02-2.5104-02 4.7073-02 6.2923-02 5.2083-02
 -1.8213-02 2.6636-02-2.4713-02 1.9475-02-6.0333-02 1.4833-02-2.5057-02 1.1041-02
 -3.7956-02 2.2852-02 7.6268-03 3.0766-02-6.7535-03 1.4643-02

SPAN 4 CHORD 3 STEADYH 1.1109800

COSINE COEFFICIENTS

7.6488-01 6.2993-01-3.5769-01-2.2520-01 1.3009-01 1.3308-01 1.2370-01 1.0342-02
 -1.3118-01-8.0909-02-1.9700-01 2.5813-02 3.4778-02 1.2466-01 6.5851-02-1.0015-01
 -8.9782-03-9.5197-02 3.1653-02 3.4087-02 5.0123-02 1.3483-02-1.9190-02-8.3020-03
 -5.2123-02 4.9681-02-1.8984-02 3.6314-02 1.5776-02-2.2453-02

SINE COEFFICIENTS

-4.1626-01 1.8368-01 2.9603-01-4.7852-01-2.9824-01 9.3601-03 1.6665-02 2.1565-01
 6.3029-02 6.2728-02-5.7216-02-1.4151-01-2.4167-02-3.4666-02 1.7017-01 3.4614-02
 2.5815-02-2.6698-02-7.9718-02 1.1229-02-7.8825-03 6.8186-02 4.0363-03 4.1701-02
 -3.7331-02-2.0558-02 1.3430-02-3.5182-02 4.5702-02-2.5652-02

SPAN 4 CHORD 4 STEADYH -5.7031-02

COSINE COEFFICIENTS

1.0097-01 2.2139-01 1.2210-01 7.5849-02-1.4001-01-1.0300-02-2.4536-02-7.7384-03
 5.1075-02-1.6996-02-4.7516-02 2.6770-02-6.9292-03-7.4781-03 1.5011-02-1.0395-02
 -1.6128-02 1.0451-02 7.7227-03-1.0708-02-6.0688-03 7.7821-03-8.9027-04 2.5197-03
 -4.0571-03-4.3248-03 4.2781-03 7.1494-03-1.7505-03-1.0685-03

SINE COEFFICIENTS

-5.4576-01-1.3472-01-1.4746-02 8.4265-02 4.0551-02-2.7462-02-5.7068-03-3.6138-02
 1.1193-02 5.8583-02-2.3600-02-1.4565-02 2.4995-02-1.2354-02 5.4550-03 2.0561-02
 -5.5836-03-1.1342-02 1.2721-02 4.9536-03-9.6957-03 1.8488-03 2.1008-03-4.1565-04
 1.2389-03 1.1227-04-7.2288-03 9.8765-04 3.4533-03-8.6452-03

SPAN 4 CHORD 5 STEADYH -5.8878-01

COSINE COEFFICIENTS

-8.3080-02 3.9914-02 4.4827-02 4.9705-03-2.8020-02 6.5446-03 1.0631-02-5.5015-03
 -1.1308-02 5.3233-03 4.4510-03-7.3973-04 1.2494-03 4.0847-03-2.4798-03-1.0872-03
 3.7422-03-2.8996-03-3.7564-04-3.5183-03-3.2536-03-5.4585-03 1.3675-03-6.3272-03
 -6.7118-03 2.8503-04-7.8514-03-3.5754-03-3.7225-03 3.3623-03

SINE COEFFICIENTS

-2.7098-01-6.6386-02-1.4476-02 2.3105-02 2.0055-03-2.3576-02-2.0902-03 1.0912-02
 -5.1237-03-5.3327-03 4.2315-03-1.4173-03 2.3106-03-1.5879-03 4.6499-03 1.1406-03
 -2.3584-03 5.1113-04 1.4798-03 1.6360-03-1.1989-03 2.8964-03 1.5285-04 5.2953-08
 1.2698-03-3.8162-04-6.7273-03 3.8531-03 2.4502-05-7.3904-03

TABLE IX - Concluded

SPAN 5 CHORD 1 STEADY 4.5892800

COSINE COEFFICIENTS

2.8633800 2.7698800 9.1614-02 4.4193-01 5.1579-02 1.0216-01-6.7607-02-5.7356-02
 8.4680-02 6.4952-02 9.6763-03-4.0066-02-4.7657-02 2.5327-02-8.5713-03-3.2209-02
 -1.2784-02-2.4354-02-3.1326-02-3.2158-02-3.7541-02-3.5606-03 1.5858-02 2.8527-02
 1.6343-02 9.2622-03 4.4607-03 1.4459-02 1.6778-02-9.4630-03

SINE COEFFICIENTS

-1.3014800 1.7734-01 4.8163-01-4.4156-01-2.3911-01 5.0871-02 4.7032-02-5.2641-02
 -8.3331-02-4.8772-02-2.2755-02-1.2429-02-4.8134-03-1.1673-01-2.6348-02-2.5343-02
 -3.0608-02 5.3978-03 2.0897-02 4.1260-02 8.5068-03 1.6655-02 1.3342-02 1.3835-02
 8.3063-03 8.7411-03-7.0301-03-5.5649-02-8.6941-03 1.9748-02

SPAN 5 CHORD 2 STEADY 1.3087800

COSINE COEFFICIENTS

5.8805-01 7.3414-01-8.3101-01-4.0179-01 6.6345-03 1.2108-02 5.8080-02 1.1176-01
 7.7600-02 1.8018-01 5.1774-02-5.6002-02-1.7865-02-1.4554-01-8.9212-02 4.0102-02
 -7.6362-03 5.3603-03 3.2117-02 3.0673-02 7.8260-02-1.9205-02-5.8138-02-1.6849-03
 -4.0478-02-1.8610-02 1.1218-02-6.8134-03 2.7798-02 2.9902-02

SINE COEFFICIENTS

-2.4093-01 6.8113-01 5.6526-01-5.6885-01-3.0105-01-7.1629-02-1.3772-01-1.3542-02
 -1.9872-02 2.1723-02 1.7664-01 6.2527-02 8.0349-02 5.5729-02-1.0979-01-5.7094-02
 -3.2182-03-4.7143-02-1.3207-02-2.2000-02 3.6913-02 9.7585-02 1.9502-03 2.1886-03
 8.8781-03-3.7690-02-1.5275-02-1.8044-02-2.6807-02 1.3391-02

SPAN 5 CHORD 3 STEADY -1.2170-03

COSINE COEFFICIENTS

-4.2044-01 8.1966-01-2.2005-01-3.2109-01 2.8609-02 2.6447-01 2.0720-01-1.5296-01
 -1.1673-01-8.1589-02-8.0813-02 1.4809-01 7.5671-02 2.3262-02-1.0018-02-6.9505-02
 -4.3227-02 9.2045-03 5.0920-02-5.1389-03-7.9441-03-1.3288-02-1.7663-02 3.6466-03
 2.5691-02 7.2725-03-1.8693-02-1.4444-02-3.8747-03 1.4549-02

SINE COEFFICIENTS

-1.1259800-1.6904-01 5.6224-01-2.8326-01-3.0063-01-4.4006-02 2.2398-01 2.4494-01
 -2.6009-02 1.0834-02-1.5503-01-1.0245-01 6.5102-02 4.2509-02 7.3504-02 1.4972-02
 -3.6853-02-5.5661-02 1.7612-03 3.6214-02 1.1746-02 1.4542-02-1.0538-02-1.7226-02
 -1.4107-03 2.6351-02 1.2409-02-1.6244-03-1.3184-02-9.4976-03

SPAN 5 CHORD 4 STEADY -2.0898-01

COSINE COEFFICIENTS

-4.9155-01 1.3699-01 7.9957-02 5.4904-02-9.1894-02-2.1110-03 5.8429-03-5.7488-03
 -1.8761-03-1.5937-02-6.2445-03 2.8863-04-4.9712-03-5.7009-03 2.7911-03 3.6283-03
 2.6452-04-1.6967-03-4.3513-03-6.1058-04-6.8322-03-5.0659-03-5.2010-03-4.8705-03
 -5.1444-03-4.7818-03-4.2085-03-3.2433-03-1.3762-03-2.5017-04

SINE COEFFICIENTS

-3.6452-01-2.0124-01 4.1346-03 2.2739-02 2.3865-02-3.9308-02-2.1961-02-8.7742-03
 5.4129-03 5.4569-03-3.8893-03 2.5616-04 6.2542-03-1.6618-03-1.0369-03 1.9410-03
 2.2989-04-2.3096-03-5.8958-03-4.7214-03-1.8487-03-3.1720-03-1.3685-04 2.4101-04
 1.1800-03 2.5333-03 2.1945-03 3.3253-03 1.4362-03 2.4963-03

SPAN 5 CHORD 5 STEADY -5.6370-01

COSINE COEFFICIENTS

-1.5700-01-2.3667-03 2.6760-02 3.1444-02-2.8040-02 5.1128-03 1.1036-02-1.1704-03
 -9.3548-03-7.4234-03 1.6355-02 1.3589-02 1.5759-02-4.6509-02-1.5987-03 4.1420-03
 -4.6091-03-8.6759-03 9.5424-04 6.2858-03 2.2362-03-8.4122-04-6.7600-03-6.8967-03
 -1.9119-03 6.5765-03 1.2308-02-2.0583-03-6.6752-03-6.0387-03

SINE COEFFICIENTS

-3.0373-01-5.6127-02-1.7757-02 1.2359-02-1.0442-02-3.6979-02-1.4981-02 7.3772-03
 -9.9536-03-2.6300-03-6.9568-03 5.8757-03 1.1404-02-8.6524-03-7.6217-03 2.6439-03
 4.5117-03-2.9020-03-4.0178-03-9.0200-03-1.7294-03-3.0837-03-7.0056-04-4.6568-03
 -4.3504-03-3.7263-03 3.9826-03 1.1402-02 2.3687-03-1.2653-02

TABLE X. AERODYNAMIC DATA - 170-KNOT, WEST-TO-EAST FLIGHT

BURST NO. # 19 *** ROTOR NOISE PULSED OUTPUT ***
 BLADE PITCH HARMONICS
 1.5280801 4.6161800-8.7611800 NCOLLECTIVE, LONGITUDINAL, LATERAL RESPECTIVELY
 ROTOR FLAPPING ANGLE HARMONICS
 1.7527800 6.5371-01 0.0000 NPOSITIVE TAIL HIGH -- DEGREES
 DIFFERENTIAL PRESSURE HARMONICS FOR 4 CHORD STATIONS AT EACH OF THE 5 SPANS
 MEASURING FROM THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY.
 SPAN 1 CHORD 1 STEADY 1.1973800
 COSINE COEFFICIENTS
 -1.1367800 1.3108800-6.7139-01-2.4904-01-1.8298-01 1.1502-01-1.0455-01-3.6747-02
 -1.3179-02-2.2318-02-1.3193-02-2.4750-02-1.3826-02-2.0115-02-1.3912-02 1.4478-03
 0.1159-03 3.2395-02 1.7598-02 2.3198-02 2.1458-02 2.1137-02 4.5993-03 8.9851-03
 3.6702-03-2.9763-03-9.0618-03-1.2432-02-8.3881-03-8.9101-03
 SINE COEFFICIENTS
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 1.0487-02 6.8672-03 2.2152-02 5.5265-03 5.0289-03-1.4249-03
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 7.4468-04 6.4562-04-2.6219-04-2.2776-05 9.7369-05-1.8308-05

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 3.4232-02-2.6993-02 5.2480-03-1.3081-02-1.1735-02-5.5445-03

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 1.2169-03-4.9179-03 8.6680-04-3.3315-03-3.7060-03 8.4274-03-7.9745-03-1.6020-03
 2.9807-03-8.9656-04 4.4142-03-8.5993-03 5.8597-03-1.4180-03

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 2.9924-03-2.9127-03-5.4843-03 2.1334-03-4.2069-03 2.3300-04

SPAN 2 CHORD 4 STEADYM 2.0323-01

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SPAN 2 CHORD 5 STEADYM -2.5088-01

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SPAN 3 CHORD 2 STEADY 2.3388-01

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SPAN 3 CHORD 3 STEADY -2.2684-01

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SPAN 3 CHORD 5 STEADY -1.6344-01

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 7.3493-04-3.6981-04 7.7213-04-8.9325-05 8.1435-05-7.1852-04

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 -0.0972-02 3.2996-02 3.9979-02 6.9683-03-2.8208-02-2.1835-04 1.0840-02-1.5438-03
 -1.0699-02 1.2660-03-4.3263-04-9.4291-04-2.6302-03-1.9961-03-1.6262-03-5.1682-03
 1.6857-03-1.9143-03 1.0538-03-1.2567-03 4.0846-04 8.0337-04-2.2056-03-3.5955-03
 4.9678-04 4.6480-03 3.0634-03 6.1349-04 1.3938-03 8.1854-03
 SINE COEFFICIENTS
 -2.6124-01-6.0774-02-1.4956-02 1.9319-02 7.1580-03-2.1317-02-7.9041-03 9.2636-03
 -1.3450-03-6.0326-03-4.8744-04-3.6688-03-2.4867-03-5.8977-03 2.7827-03 2.0457-03
 -5.1659-03-7.9302-04 2.0484-03-2.0790-03-4.8293-03 7.9175-04 1.7573-03 7.3065-04
 -4.0974-03 2.1691-03 3.2185-03 2.5558-03 4.7534-03-2.0144-04

TABLE X Concluded

SPAN 5 CHORD 1 STEADY 4.3714800
 COSINE COEFFICIENTS
 2.737800 2.759380 2.0321-01 4.5946-01 6.8829-02 1.6418-01-3.4084-02-1.1315-01
 1.3476-02 5.8099-02 4.9743-02-1.4363-02 2.9845-03-8.9468-02-3.0797-02-3.6555-02
 -4.1046-02-5.2707-02-3.9971-02-3.3311-02 8.3219-03 1.0134-02 9.8701-03 1.2552-02
 2.9235-03 2.0192-02 1.2513-02-1.5632-03 1.1286-02 1.1075-02
 SINE COEFFICIENTS
 -1.3257800-8.8339-02 3.9693-01-4.7290-01-2.7674-01 2.3649-02 9.0834-02-3.3156-02
 -1.0972-01-7.4225-02-3.0455-02-2.0079-02-7.7535-03-1.0203-01-3.4406-02-1.5188-02
 -1.5526-02-3.8571-02 5.6404-03 8.4011-03 4.1529-02 3.8647-02 2.3119-02 1.6471-02
 1.8252-02-1.4357-02-2.9109-02-1.9164-02-1.1765-02 5.3937-03
 SPAN 5 CHORD 2 STEADY 1.2520800
 COSINE COEFFICIENTS
 5.0493-01 7.4529-01-7.5595-01-3.0287-01 4.3558-02 7.3003-02 7.1778-02 1.0476-01
 4.0224-02 1.4148-01 6.5716-02-8.0587-02-1.8287-02-1.1443-01-1.0450-01 3.3472-02
 2.8826-02 3.5992-02 4.0730-02 5.5714-03 7.0368-02 2.1271-02-7.7009-02-3.2011-02
 -2.8008-02-1.6162-02 1.4016-02-2.6342-03 2.7750-02 4.2720-02
 SINE COEFFICIENTS
 -3.0512-01 5.1823-01 5.2469-01-5.7726-01-3.2488-01-5.5625-02-8.5631-02 3.3984-02
 2.1239-02 1.5708-02 1.7326-01 7.7830-02 4.9492-02 6.2539-02-1.0143-01-9.3661-02
 -2.9990-02-8.0855-02 3.2603-03-6.1854-03 1.2767-03 1.0266-01 3.7977-02-1.6049-02
 -4.7320-03-3.2325-02-1.9257-02-1.0069-02-3.0750-02 1.9382-02
 SPAN 5 CHORD 3 STEADY -8.7778-03
 COSINE COEFFICIENTS
 -4.5268-01 8.3064-01-1.5175-01-3.2281-01-1.3295-02 2.4358-01 2.1067-01-1.3908-01
 -1.5659-01-8.7462-02-8.0176-02 1.3623-01 1.1644-01 1.6165-02-9.1977-03-7.8773-02
 -5.1961-02 4.3808-03 7.2125-02 3.1227-02-9.5547-03-1.6055-02-3.1352-02-1.9091-03
 2.3932-02 2.7768-02-6.5692-03-1.3963-02-1.5325-02 2.2713-04
 SINE COEFFICIENTS
 -1.1174800-2.5351-01 5.6996-01-2.2840-01-2.9273-01-6.3932-02 1.9858-01 2.6651-01
 -3.8067-02-7.3695-03-1.2334-01-1.3354-01 7.3285-02 7.2002-02 7.4047-02 2.1442-02
 -5.0548-02-7.5035-02-2.2246-02 4.6958-02 2.6175-02 1.8517-02-7.0507-03-3.2155-02
 -2.0829-02 1.4263-02 2.2565-02-6.0743-03-1.0754-02-2.5821-02
 SPAN 5 CHORD 4 STEADY -2.2891-01
 COSINE COEFFICIENTS
 -4.0663-01 1.2575-01 6.4962-02 5.3635-02-9.1654-02-4.8927-03 1.3559-02 1.4914-03
 1.1967-03-1.4913-02-9.6172-03-8.1797-03-8.6882-03-1.2209-02-7.0609-03-6.4245-03
 -9.0932-03-8.5356-03-8.1948-03-2.1891-03-2.9901-03-2.8060-03-1.8497-03-1.2524-03
 3.6228-03 5.1070-03 3.3520-03 7.0846-03 7.0674-03 8.8665-03
 SINE COEFFICIENTS
 -3.2074-01-1.9110-01 7.9528-03 1.9418-02 2.9890-02-4.5022-02-2.6775-02-8.1156-03
 5.3649-03 3.3914-03-1.0311-02-7.9115-03-6.2563-04 4.9735-04 5.1116-04 5.1458-03
 5.1098-03 6.8762-03 5.7814-03 5.4434-03 9.7513-03 8.6038-03 9.6596-03 8.6771-03
 6.7609403 7.4923-03 5.4650-03 3.8115-03 2.8083-03 2.2457-03
 SPAN 5 CHORD 5 STEADY -5.0104-01
 COSINE COEFFICIENTS
 -1.7749-01-6.0144-03 1.3876-02 3.0909-02-2.6989-02 1.9799-03 1.0931-02 6.7939-03
 -2.5439-03-1.1020-02 9.6259-03 5.3299-03 1.0945-02-3.2643-02-5.1064-04-2.3541-03
 -3.7777-03-6.0282-03 2.9022-03-1.7787-03-4.6323-03-6.8704-04-3.3911-03 5.0265-03
 -4.3233-03 2.0855-03-4.2973-03 3.6942-03 3.2752-04 1.7731-03
 SINE COEFFICIENTS
 -2.7422-01-5.4820-02-1.6145-02 1.1136-02 6.2709-03-4.1626-02-1.8555-02 1.8362-03
 1.3022-03-1.0041-02-1.4302-02-9.0268-03-1.1211-02 3.9885-02-5.3402-04 7.1120-03
 3.3042-03 7.6460-03-4.9142-03 8.5319-03-1.0004-03 3.1839-03 8.5765-04 2.0242-04
 7.6902-03-6.9246-04 4.4177-03 4.2896-03 5.2101-03-6.3603-03

NOT REPRODUCIBLE

TABLE XI. AIRCRAFT TRIM CONDITIONS				
Nominal Airspeed (kt)	Calibrated Airspeed (kt)	Aircraft Heading (deg)	Rotor Speed (rpm)	Shaft Angle (deg)
0	0	030	188	-1.7
0	0	210	188	- .7
0	0	270	188	- .9
120	115	290	188	-3.7
120	116	110	188	-4.9
140	139	290	190	-4.8
140	139	110	189	-4.8
170	163	290	189	-5.7
170	164	110	188	-6.3

APPENDIX III
PREDICTED AERODYNAMIC LOADING

Tables XII through XV contain 10 predicted harmonics of aerodynamic section loading (pounds per inch of span) for forward flight and for hover. These section loading data include the effects of variable inflow from a prescribed helicoidal wake analysis and the effects of blade motions from a normal modes blade dynamics analysis. Ten harmonics of loading are considered to be the practical limit of the section loading prediction method in its present form.

Airpseed: 170 kt

Blade Pitch at Root: 18.067°

A_{is}: 2.000

Inflow : Variable

Rotor Shaft Angle : -8.468° (fwd)

B_{is}: -9.000

TABLE XII. 170-KNOT CRUISE AIRLOADS (lb/in.)

Airloading Harmonic Number	98.5% SPAN		94.1% SPAN		88.3% SPAN		79.8% SPAN		38.3% SPAN	
	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine
STEADY	0.2771		34.8891		34.9268		30.6087		5.9336	
1	-.3275	.3149	-9.0662	12.1640	-5.9314	4.6795	-3.8742	-.5892	3.7311	-4.2441
2	-.3564	-.0676	1.3862	16.7727	1.4551	20.5090	1.3202	23.2733	-1.1523	5.9897
3	-.1347	-.2584	5.6775	6.5508	8.0448	7.1403	8.4552	3.6182	3.6033	.4125
4	+.1079	-.1625	-.6739	2.8777	.7224	-.1272	.3464	-1.2710	1.4280	.5723
5	+.1797	.0154	2.2296	-.4683	.6613	-.7593	1.5272	.4423	.7080	-.7097
6	+.0540	.1004	-.8972	-1.0289	-.0049	.1595	-.4684	.0143	-.1915	.0865
7	-.0537	.0771	1.3638	1.3896	.9864	.3238	-.0071	.4053	.3450	.2123
8	-.0495	-.0051	1.2948	.0716	.1464	-.1356	.6739	-.0662	-.2825	.0457
9	-.0002	-.0427	.8053	-.7882	.8975	-.2760	.2308	.2128	.8711	.1797
10	+.0215	-.0145	-.3447	-.8009	-.3272	-.7493	-.1277	-.0924	-.5503	-.9153

Airspeed: 140 kt Blade Pitch at Root: 13.801° A_{1s}: +2.000
 Inflow: Variable Rotor Shaft Angle: -6.650°(fwd) B_{1s}: -5.000

TABLE XIII. 140-KNOT CRUISE AIRLOADS (lb/in.)											
Airloading Harmonic Number	98.5% SPAN		94.1% SPAN		88.3% SPAN		79.8% SPAN		5.5119		38.3% SPAN
	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	
STEADY	0.0432		32.1562		32.9131		29.1304		5.5119		
1	.0344	.0059	+12.0380	-3.4406	4.6208	-3.9159	-1.3674	-3.5540	-3.0354	4.4670	
2	-.0175	-.0069	3.3554	-5.6222	8.2819	-5.7225	12.1635	-3.0718	2.5126	-.7131	
3	-.0075	-.0149	4.6631	-.8978	5.8059	2.1099	3.0618	3.2793	.4691	1.0319	
4	+0.0026	-.0069	.2990	-.5617	-1.0220	-.8627	.3693	-2.9325	.5579	1.0731	
5	+0.0009	-.0002	-.3969	-2.4232	.0375	-2.9653	-.0366	.0693	-.8611	.5496	
6	-.0034	-.0024	.3872	-1.2138	1.1321	.4331	-.1178	-.2770	-.5274	-.2659	
7	+0.0042	-.0042	1.7338	-.0734	.0770	.3897	.7934	.2279	-.0889	-.9283	
8	+0.0037	+0.0050	.2188	1.3698	.5892	-.3548	.0491	-.6395	1.3744	.1140	
9	-.0035	+0.0029	-.4309	-.8629	.5336	-.4563	.8525	-.0403	-.5071	1.1284	
10	-.0034	-.0028	-.1201	-.1418	-.6592	.4934	-1.3641	1.1039	-.4840	-.6068	

Airspeed : 120 kt Blade Pitch at Root: 12.600° A_{ls} : -1.500
 Inflow : Variable Rotor Shaft Angle : -4.170 (fwd) B_{ls} : + 5.000

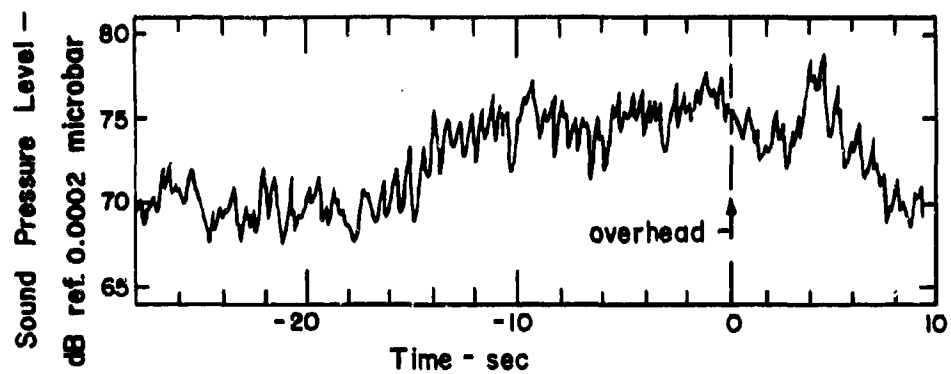
TABLE XIV. 120-KNOT CRUISE AIRLOADS (lb/in.)											
Airloading Harmonic Number	98.5% SPAN		94.1% SPAN		88.3% SPAN		79.5% SPAN		38.3 SPAN		
	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	
STEADY	0.0467		35.4338		35.8693		32.0217		6.7611		
1	.0307	.0013	+8.7841	-3.3866	2.0889	-3.9953	-2.4914	-3.6462	-2.4743	4.6143	
2	-.0138	-.0096	2.3521	-6.2696	7.1741	-6.0052	11.1633	-1.5397	1.9734	-.8133	
3	-.0078	-.0144	3.6054	-1.6737	4.6207	1.4388	.4686	.8783	.3839	.3178	
4	+ .0030	-.0056	1.2238	-1.1348	-.3132	-1.9736	1.5938	-4.3840	1.9376	.7998	
5	.0027	.0035	-.5474	-1.3549	-.6322	-1.8785	-.7179	1.3471	-1.2212	2.0714	
6	-.0025	.0009	.5069	-.8239	1.0478	.1487	.4944	-1.1818	-1.0441	-1.5058	
7	.0025	-.0024	1.3055	1.2260	.5708	.8813	.3239	-.1144	1.3853	-.9341	
8	.0044	.0040	-.1527	.5486	.5772	-1.2566	-.2277	-1.1106	.4869	1.8736	
9	-.0035	.0032	-.0811	-.3725	1.1232	.4458	1.8609	2.3049	-1.4299	-1.0215	
10	-.0033	-.0034	-.4420	-.6011	-.6988	.5848	-2.0736	.4954	1.4369	.1567	

Airspeed : Hover Blade Pitch at Root: 12.799° A_{ls}: 0.0
 Inflow : Variable Rotor Shaft Angle : 0.0 B_{ls}: 0.0

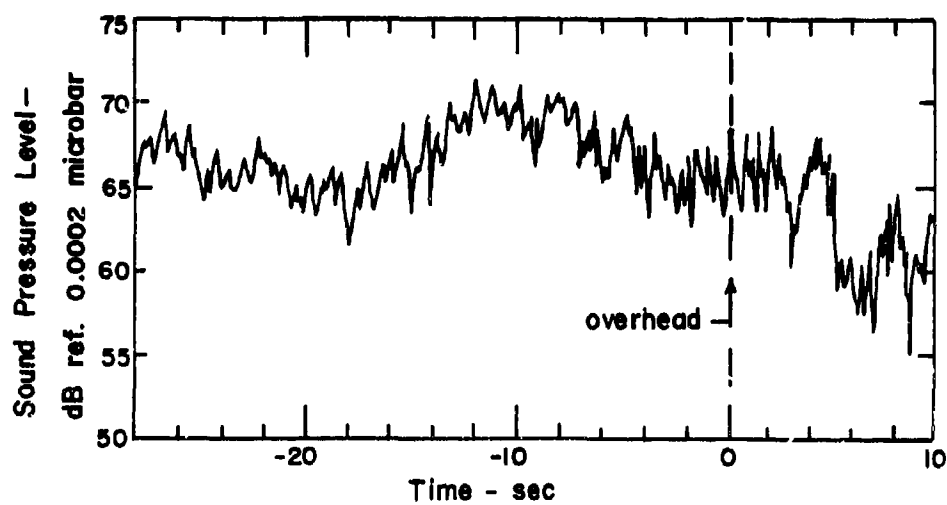
TABLE XV. HOVER AIRLOADS (lb/in.)											
Airloading Harmonic Number	98.0% SPAN		95.0% SPAN		85.0% SPAN		75.0% SPAN		40.0% SPAN		
	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	Cosine	Sine	
STEADY	0.0373		33.2492		30.7245		26.4747		8.236		
1	-.0001	-.0001	-.0570	-.0846	-.0387	-.1043	-.0195	-.1215	.0379	-.0322	
2	.0	-.0001	-.0153	-.0490	-.0168	-.0531	-.0140	-.0503	.0149	-.0122	
3	-.0001	-.0001	-.0491	-.0761	-.0522	-.0614	-.0471	-.0394	.0392	.0157	
4	.0	.0	-.0063	-.0367	-.0221	-.0545	-.0371	-.0606	-.0336	.0170	
5	-.0003	.0	-.1110	-.0349	-.0307	-.0902	.0315	-.1301	-.0368	.0152	
6	-.0001	-.0001	-.0357	-.0346	+.0149	-.0165	.0519	.0080	.0315	.0413	
7	.0	-.0001	-.0164	-.0551	.0037	-.0360	.0204	-.0192	-.0392	-.0076	
8	.0	-.0001	-.0171	-.0402	-.0053	-.0239	.0060	-.0104	-.0958	-.0072	
9	-.0001	-.0001	-.0313	-.0284	-.0170	-.0186	-.0029	-.0091	-.0061	-.0053	
10	-.0001	.0	-.0276	-.0252	-.0137	-.0174	-.0017	-.0096	-.0062	-.0036	

APPENDIX IV
MEASURED ACOUSTIC OCTAVE DATA

Octave band noise data for the forward flight cases is presented in Figures 53 through 55 as plots of SPL vs time. These data are for flyovers at an altitude of 1000 feet for the nominal airspeeds given in the figure titles. Figure 56 presents azimuthal plots of the noise level in each octave. Levels tend to be highest in the vicinity of 330 degrees of azimuth, corresponding to the occurrence of RIN as explained in Section 4.2.1. Figures 57 and 58 are included to show the difference between typical RIN and no-RIN hover noise observed during this program. Each spectrum is an average of 16 spectra. Averaging tends to broaden the peaks of the discrete frequency components because of slight variations in rotor rotational speed and small deviations due to lead-lag motion of the rotor blades.

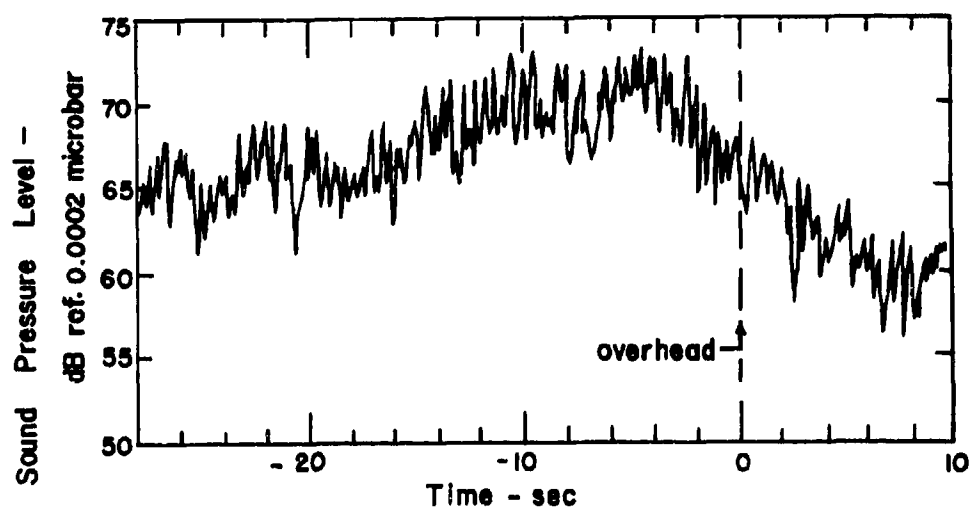


a. Overall

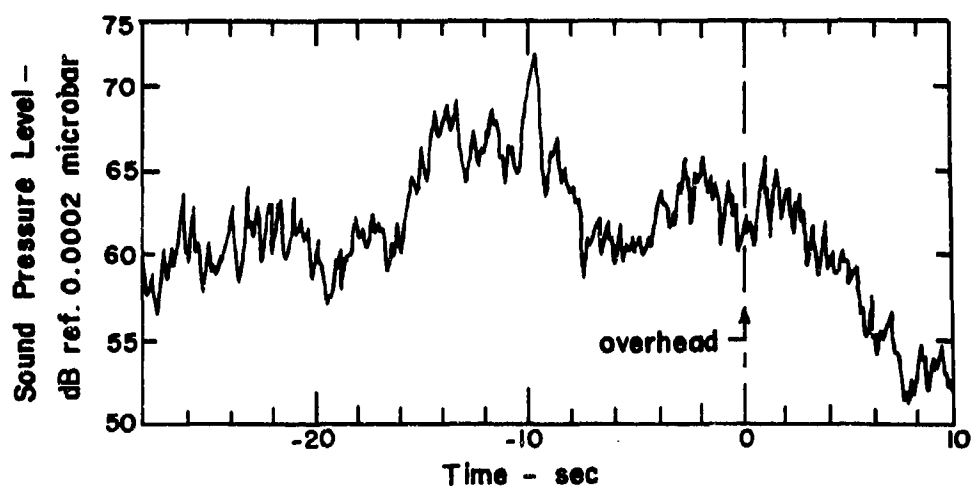


b. 31.5 Hz Octave

Figure 53 Octave Band Flyover Noise - 120 kt.

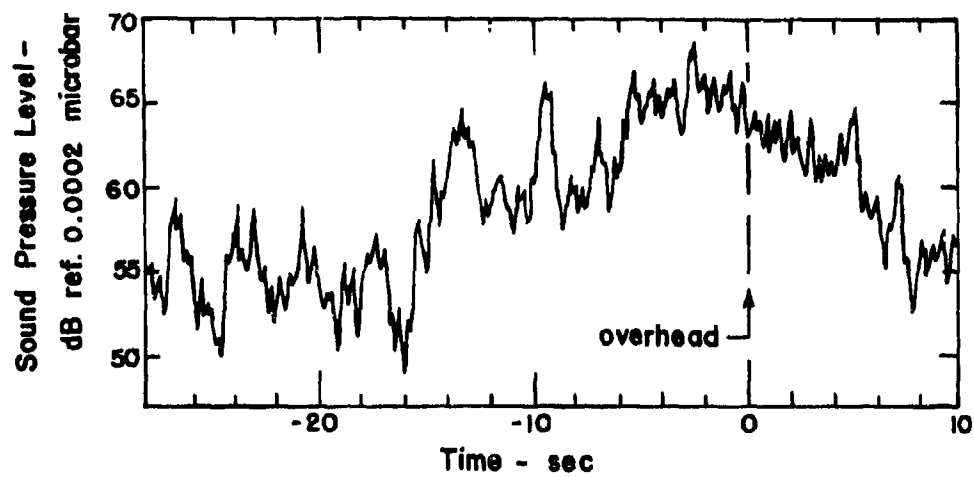


c. 63 Hz Octave

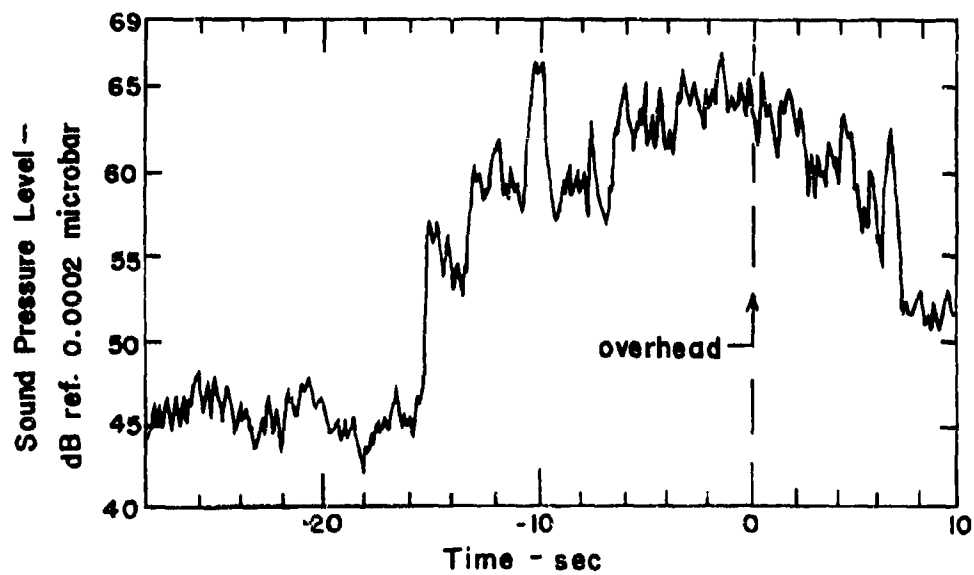


d. 125 Hz Octave

Figure 53. Continued.



e. 250 Hz Octave



f. 500 Hz Octave

Figure 53. Continued.

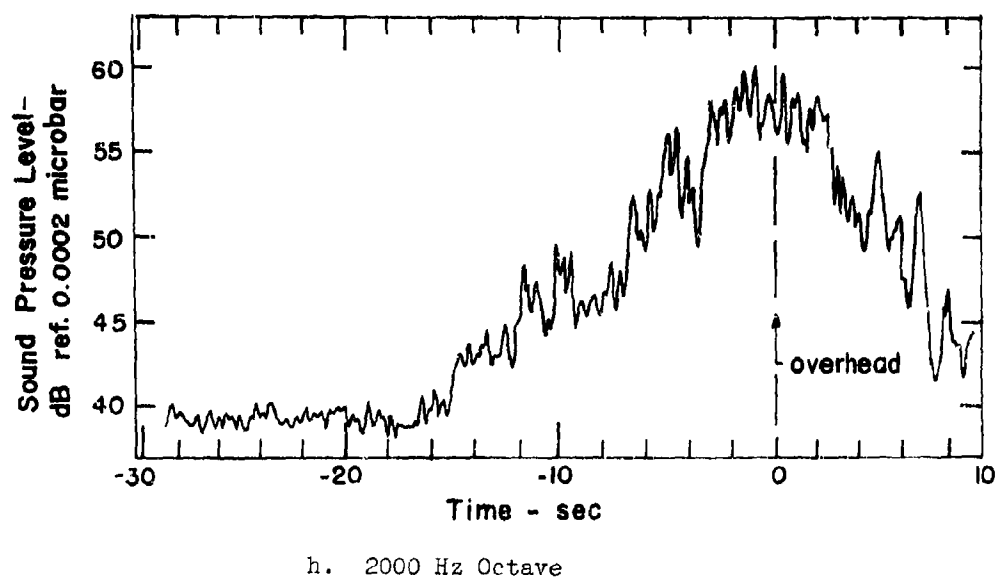
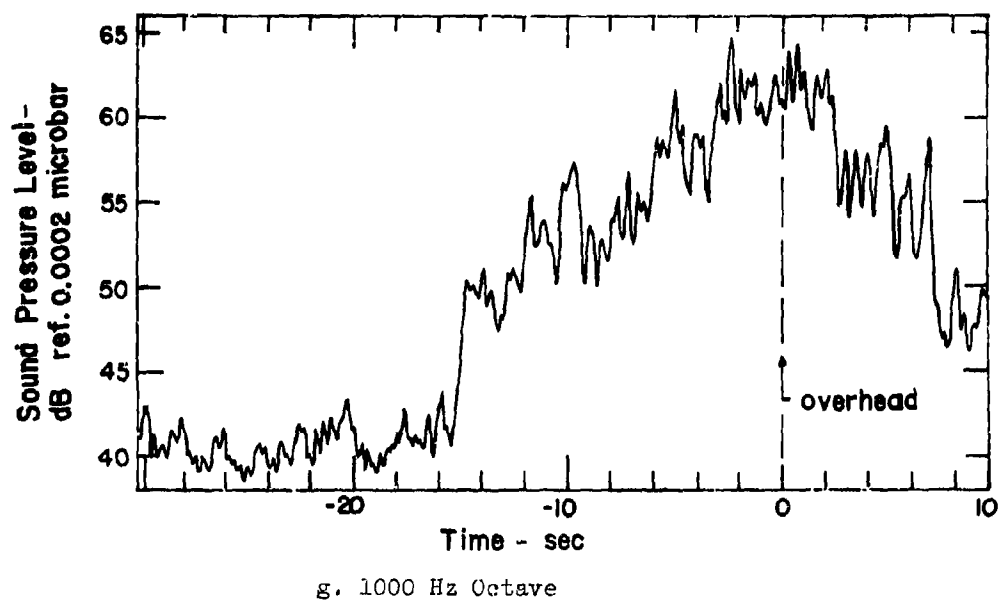
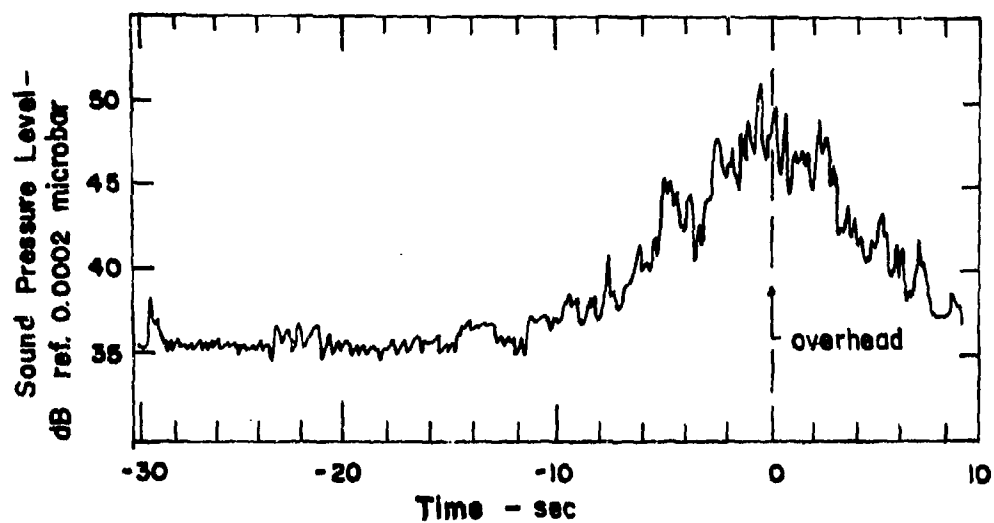
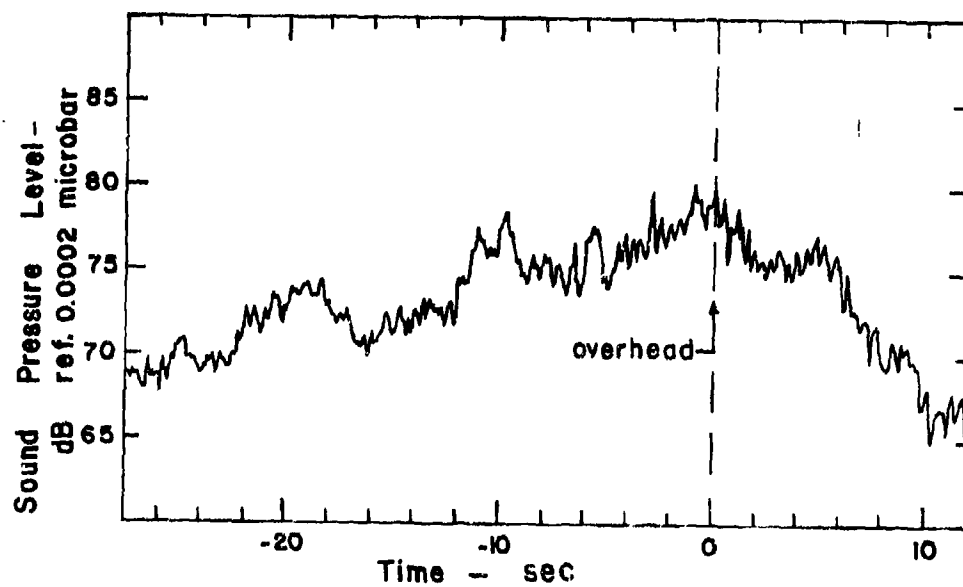


Figure 53. Continued.



i. 4000 Hz Octave

Figure 53. Concluded.



a. Overall

Figure 54. Octave Band Flyover Noise - 140 kt.

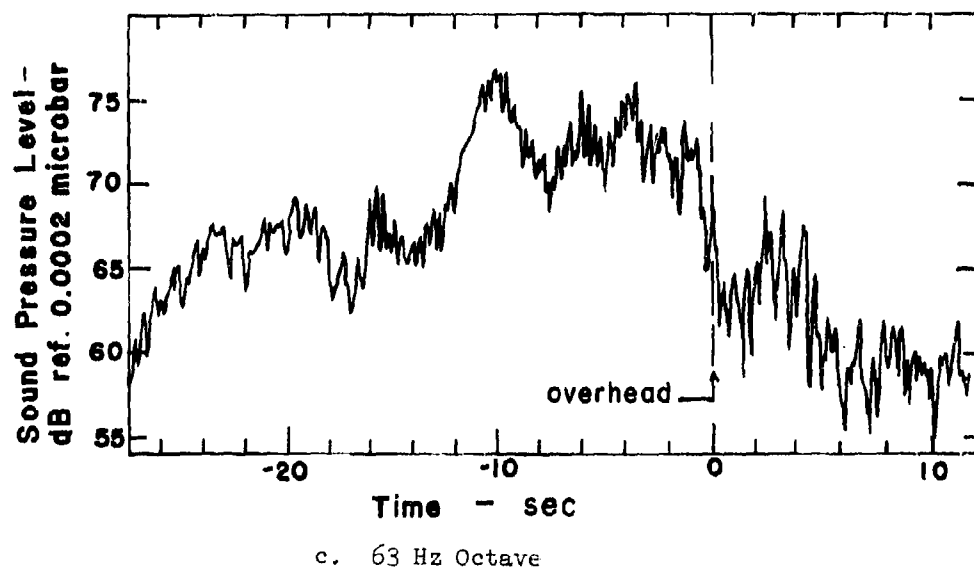
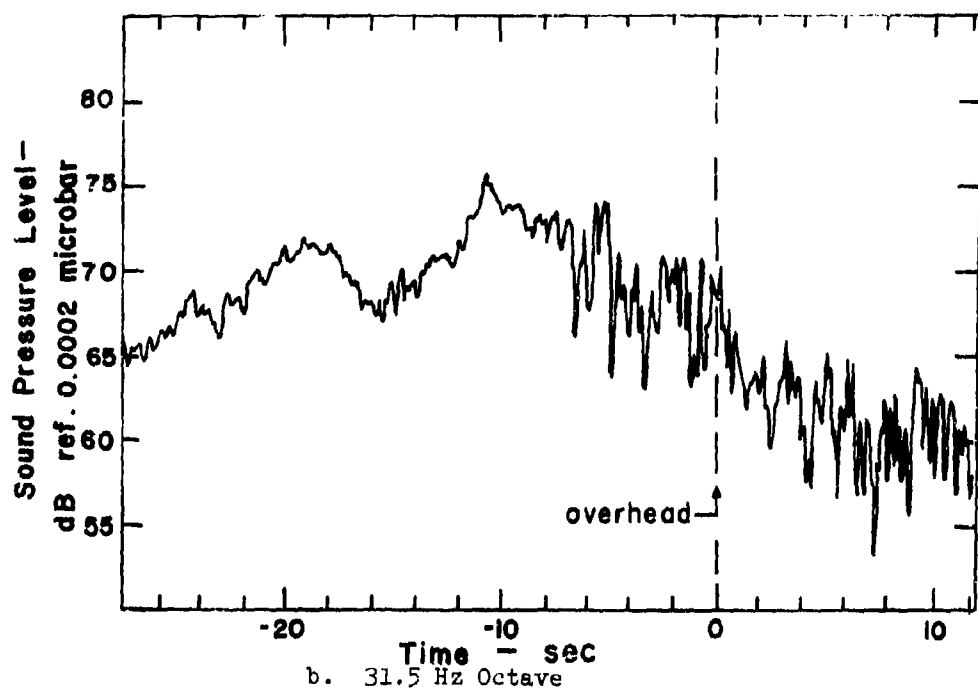
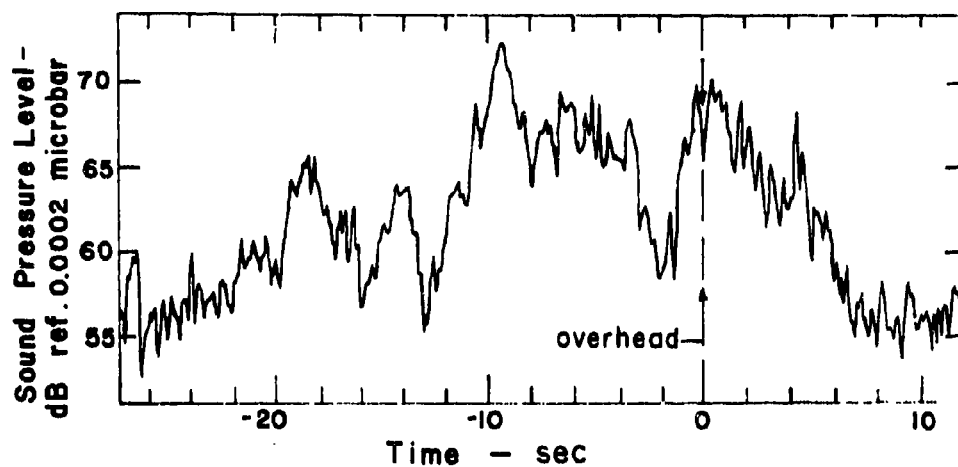
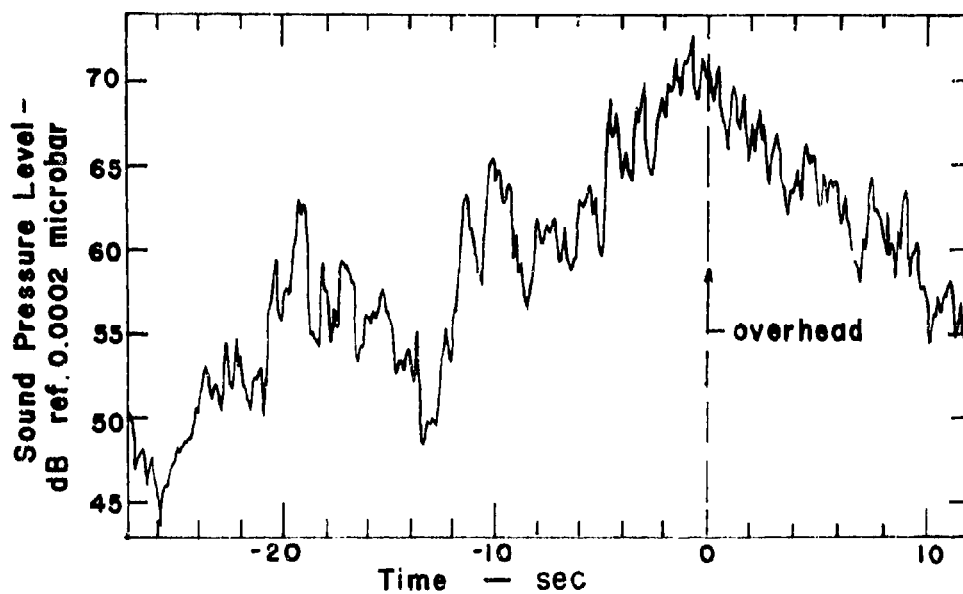


Figure 54. Continued.



d. 125 Hz Octave



e. 250 Hz Octave

Figure 54. Continued.

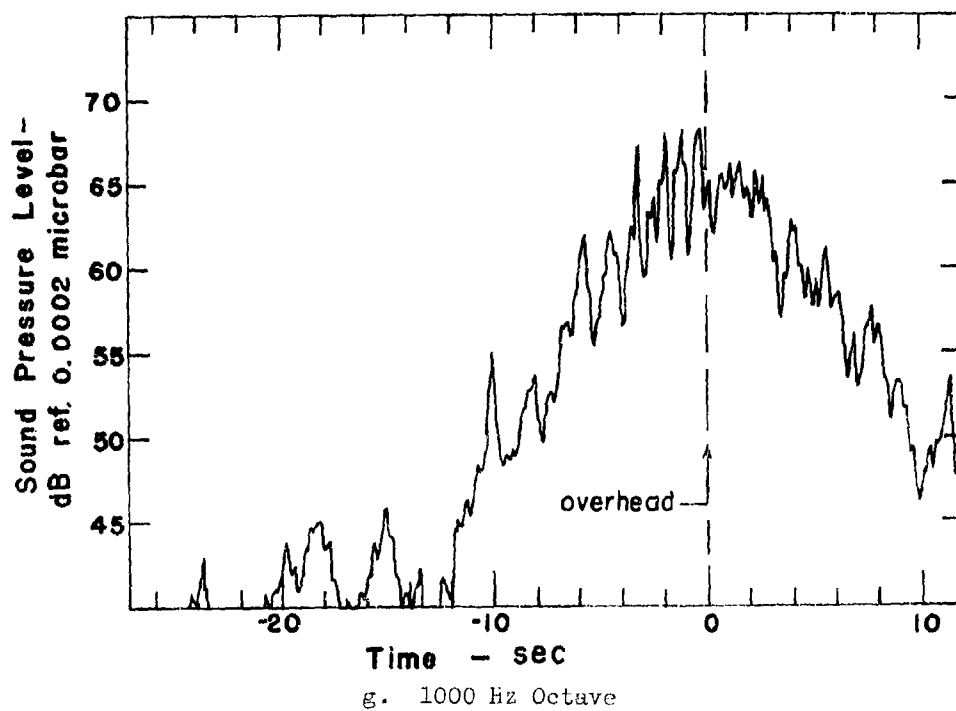
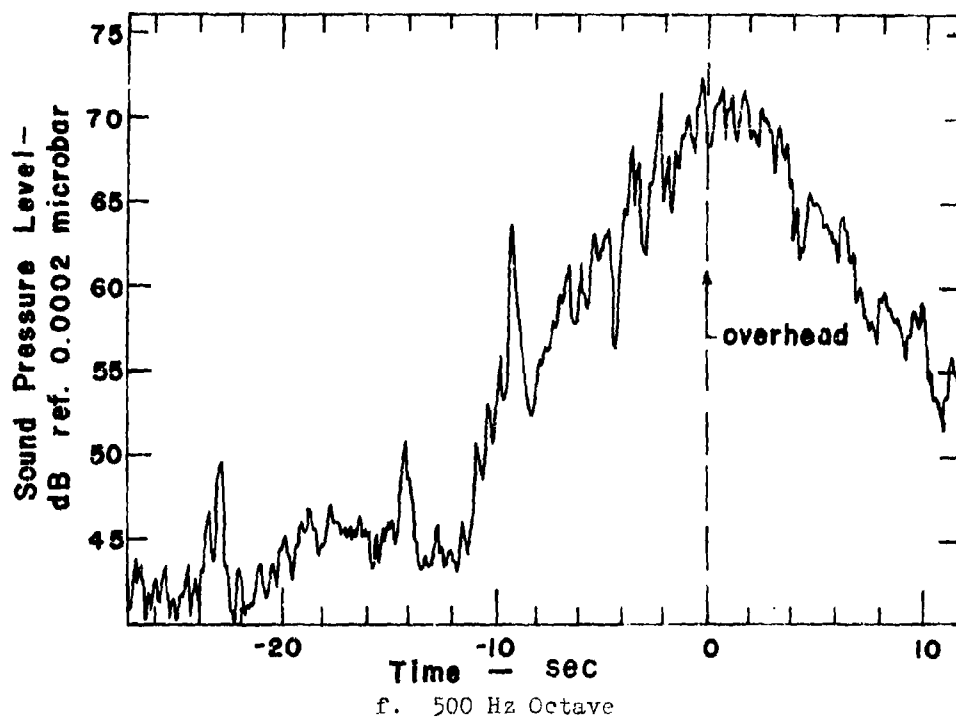


Figure 54. Continued.

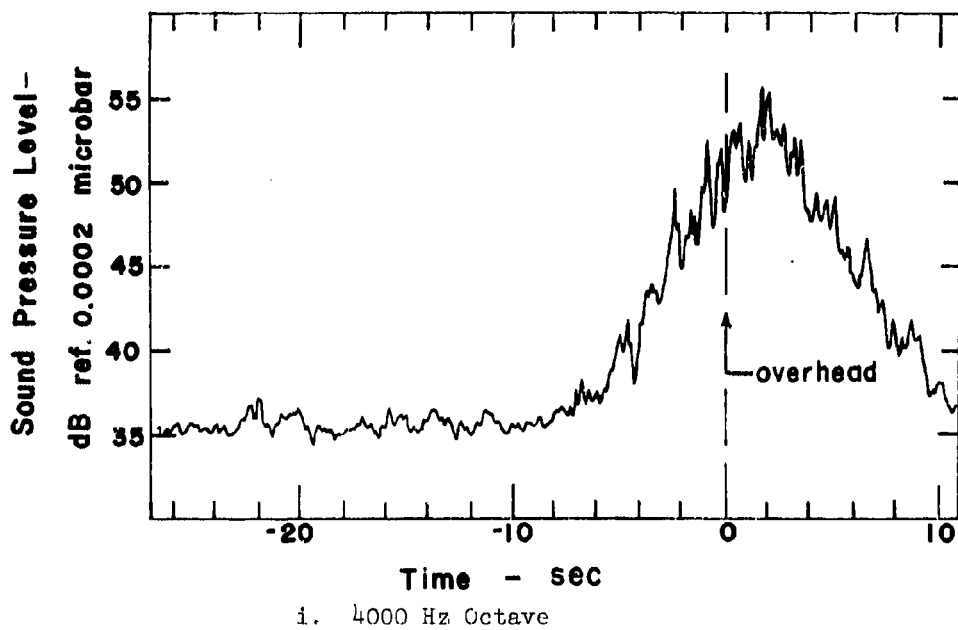
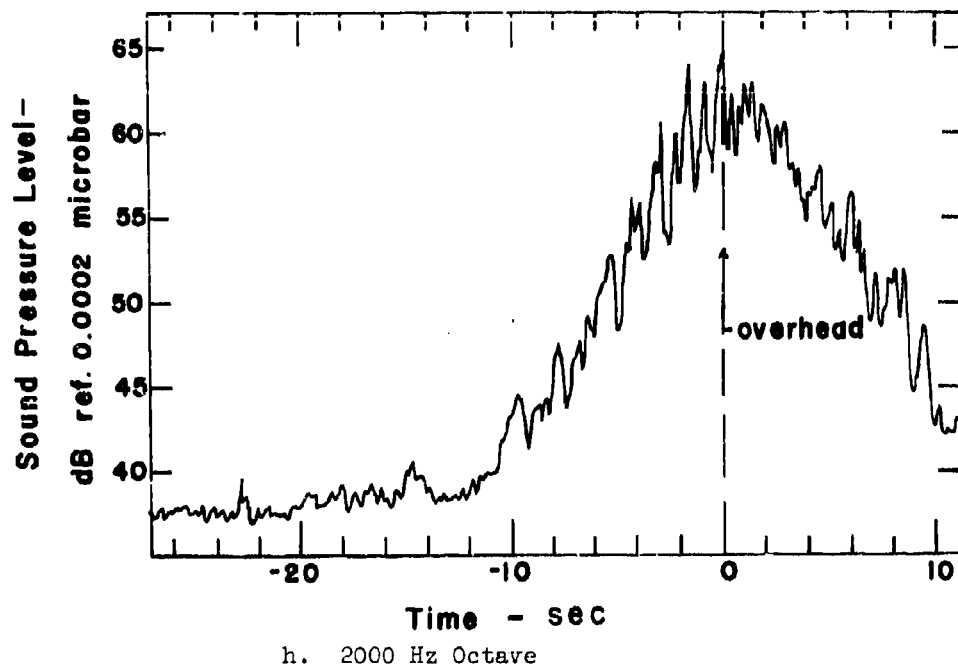
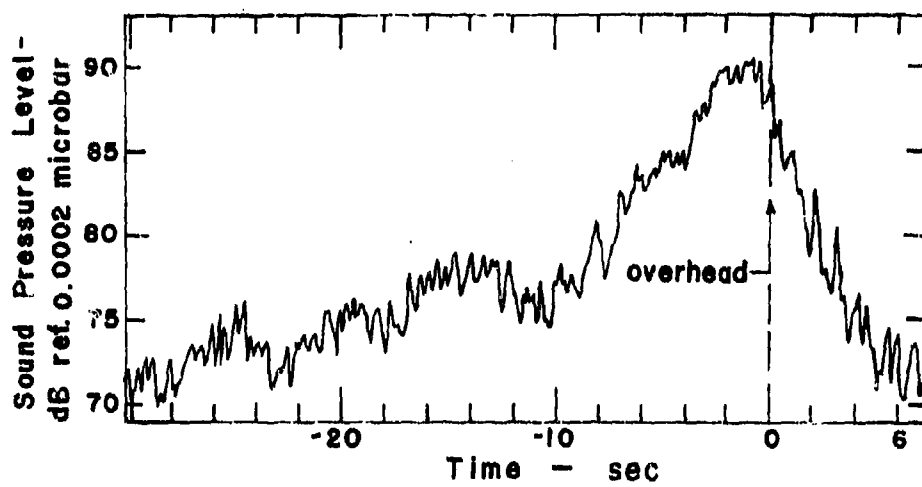
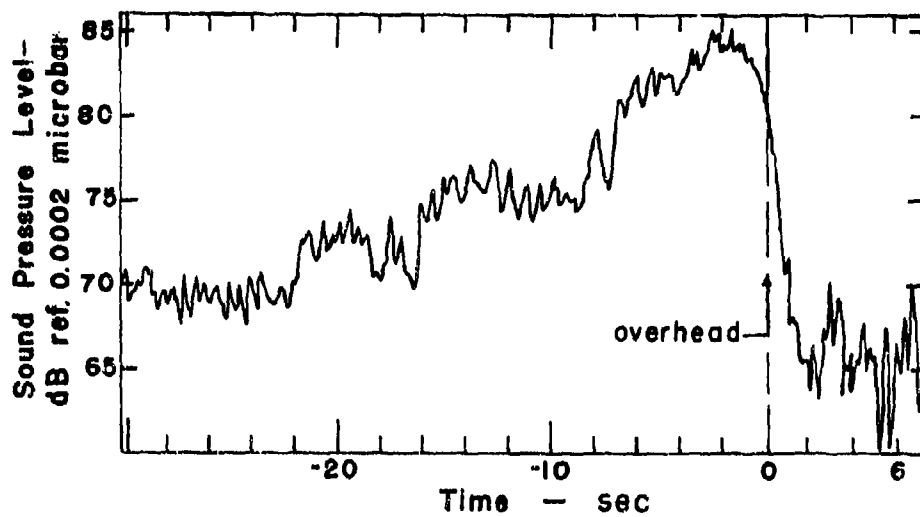


Figure 54. Concluded.

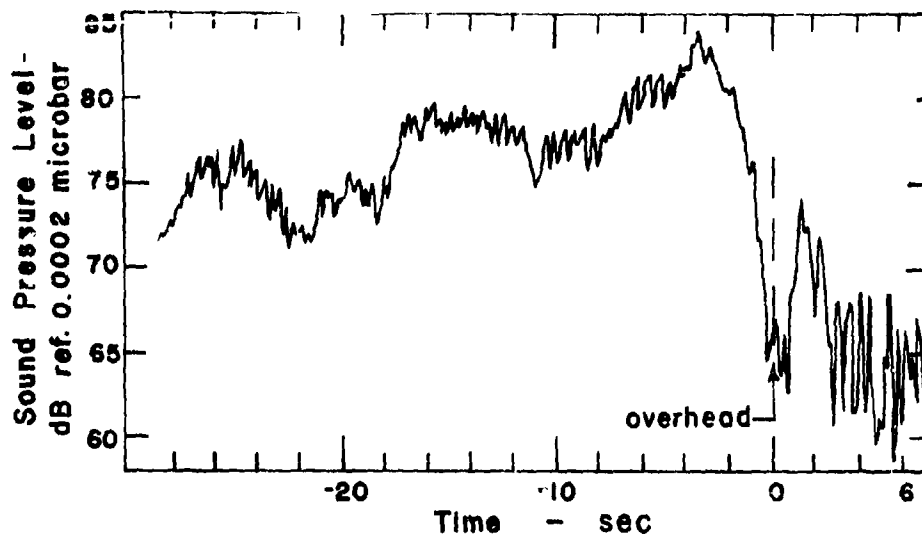


a. Overall

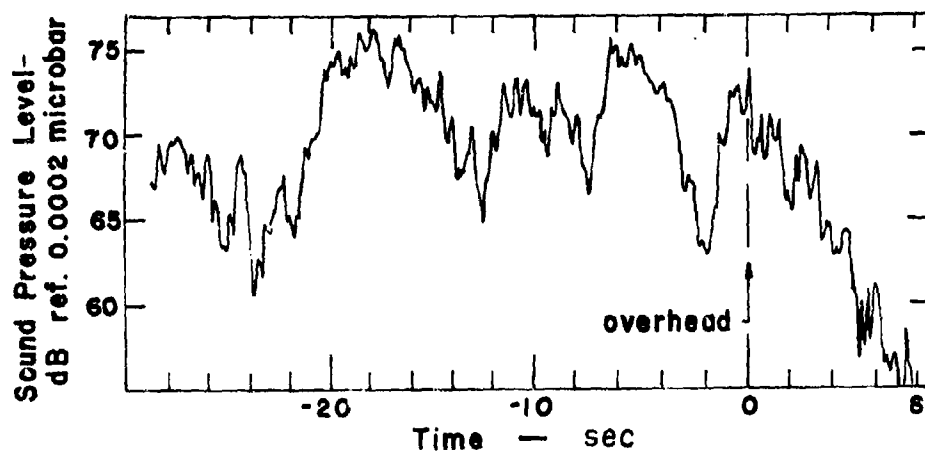


b. 31.5 Hz Octave

Figure 55. Octave Band Flyover Noise - 170 kt.

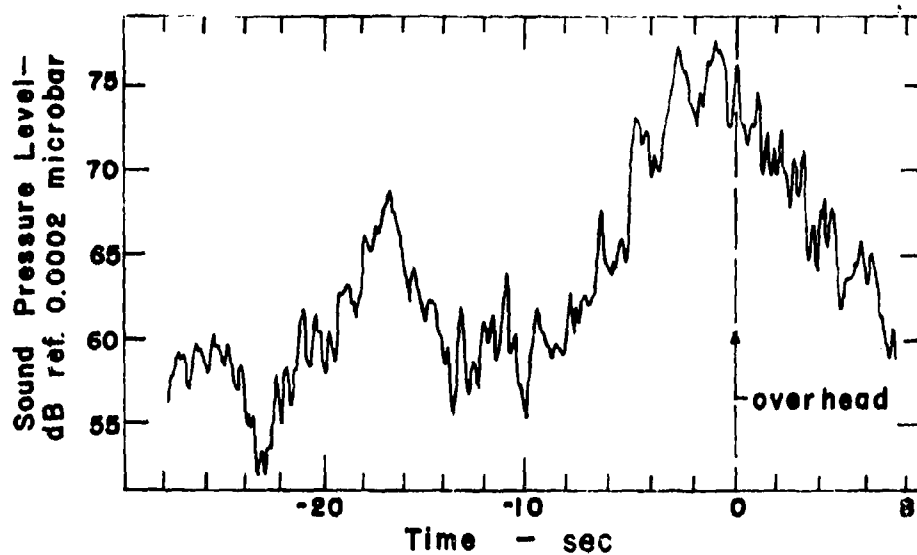


c. 63 Hz Octave

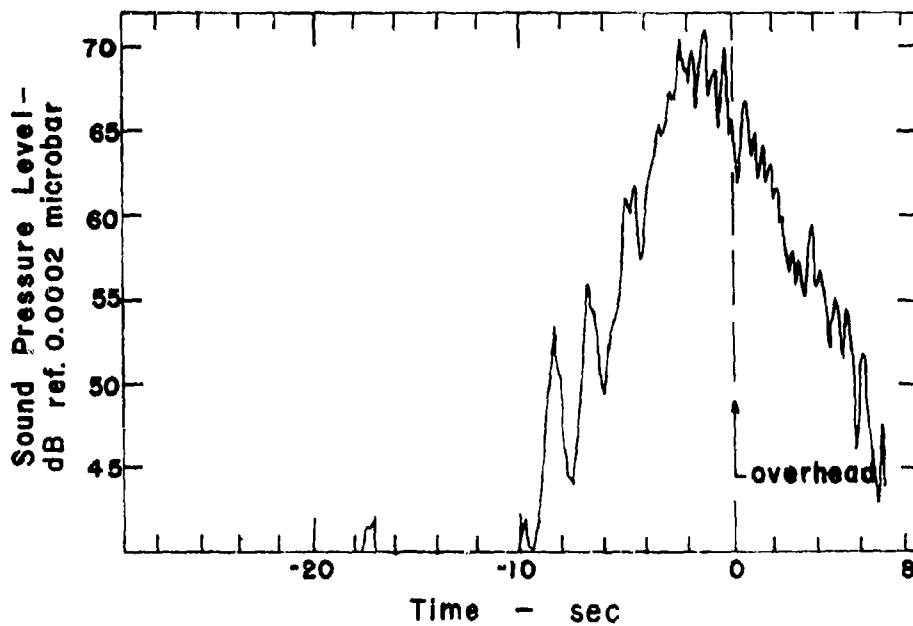


d. 125 Hz Octave

Figure 55. Continued.

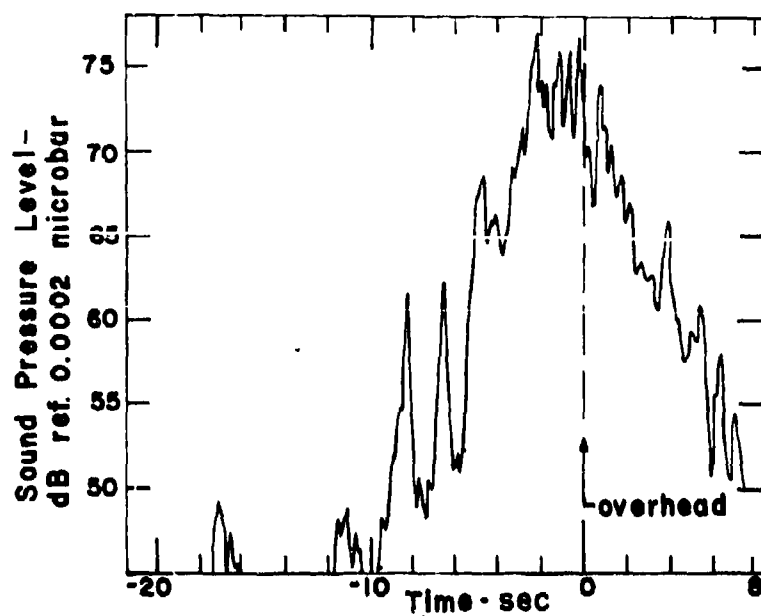


e. 250 Hz Octave

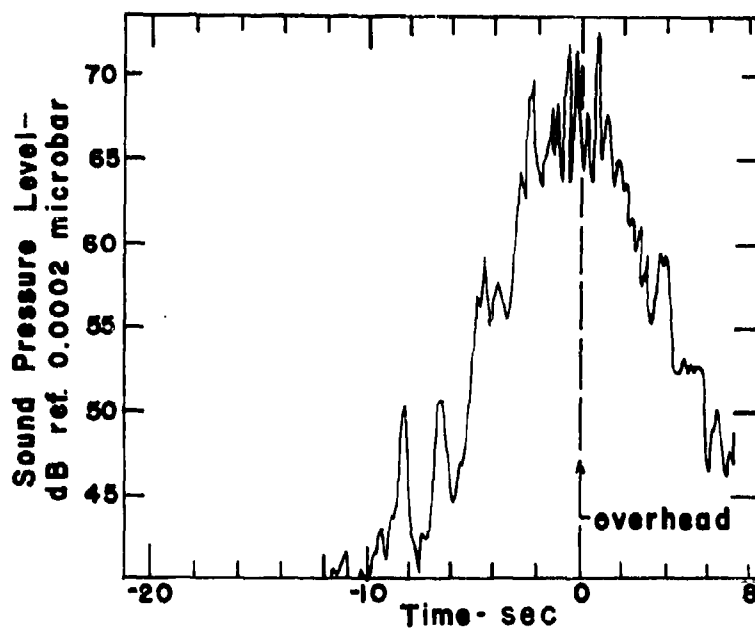


f. 500 Hz Octave

Figure 55. Continued.

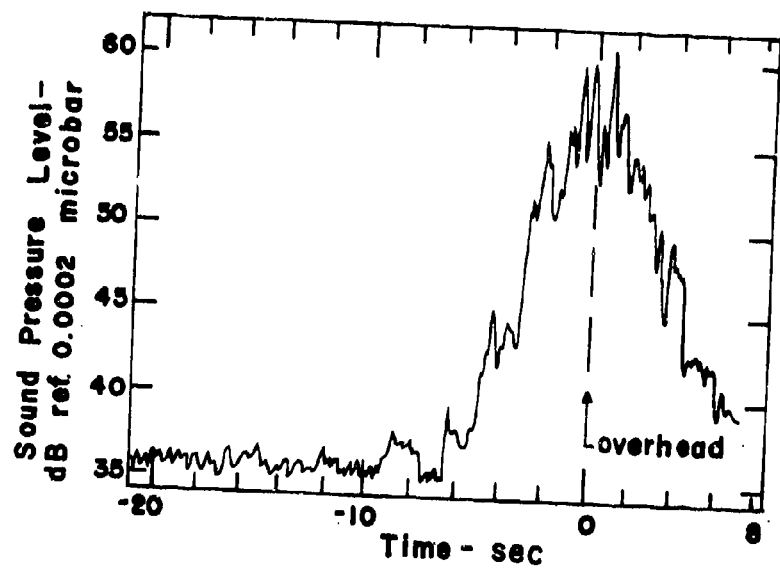


g. 1000 Hz Octave



h. 2000 Hz Octave

Figure 55. Continued.



1. 4000 Hz Octave

Figure 55. Concluded.

Altitude = 200 Ft

Sideline Distance = 500 Ft

—•— overall
△--△ 31.5 Hz
X--X 63 Hz

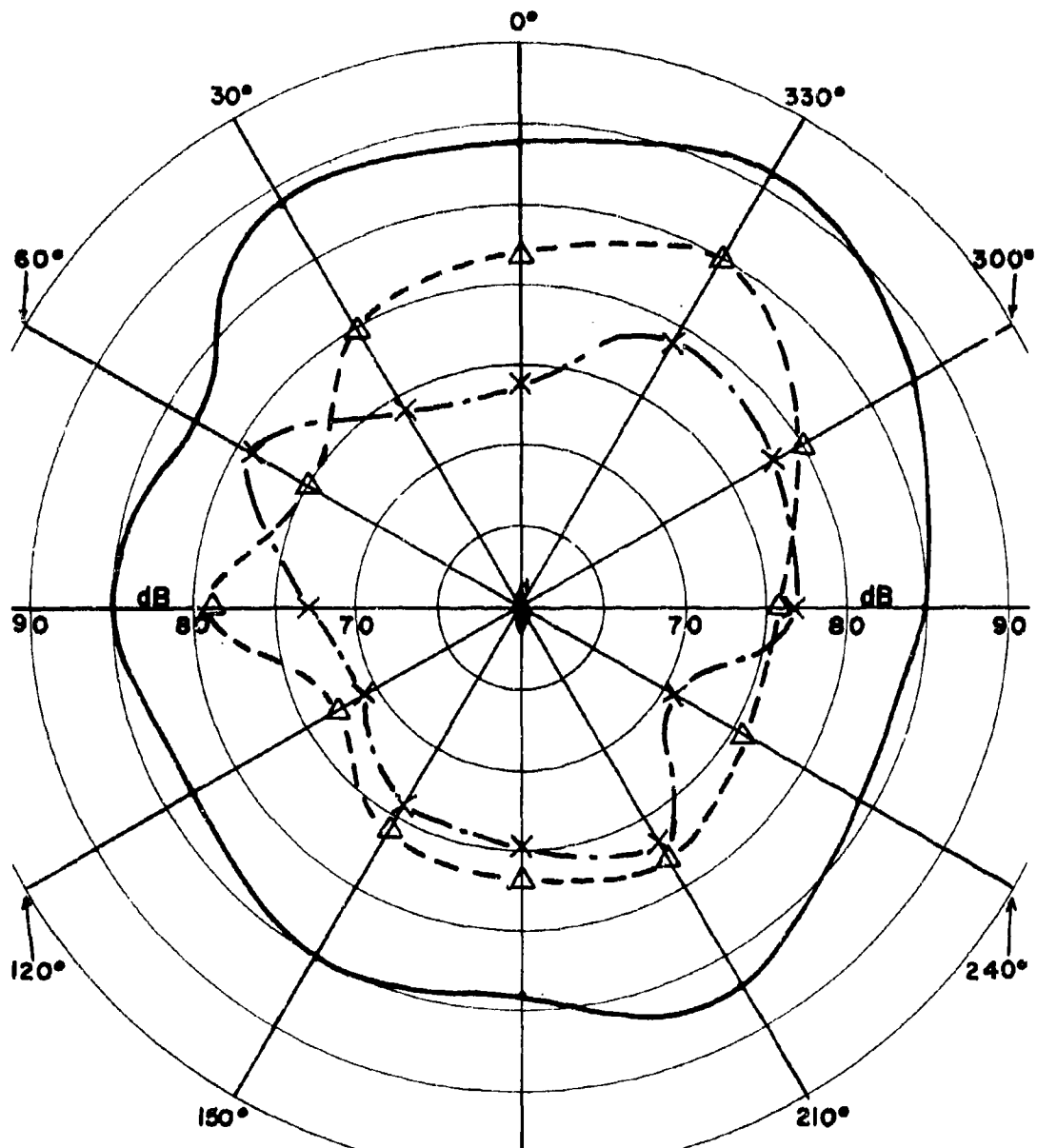


Figure 56. Octave Band Hover Noise Contours.

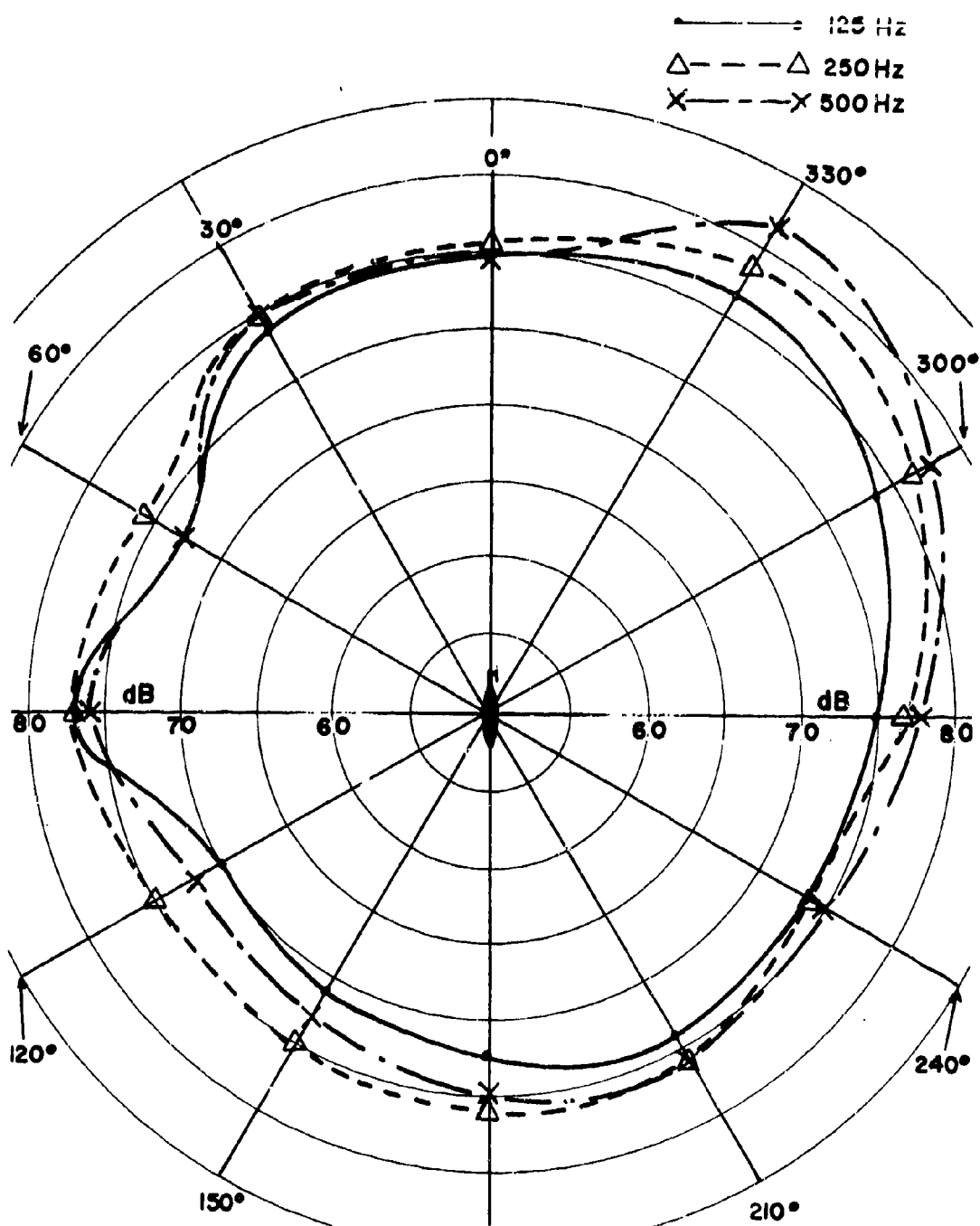


Figure 56. Continued.

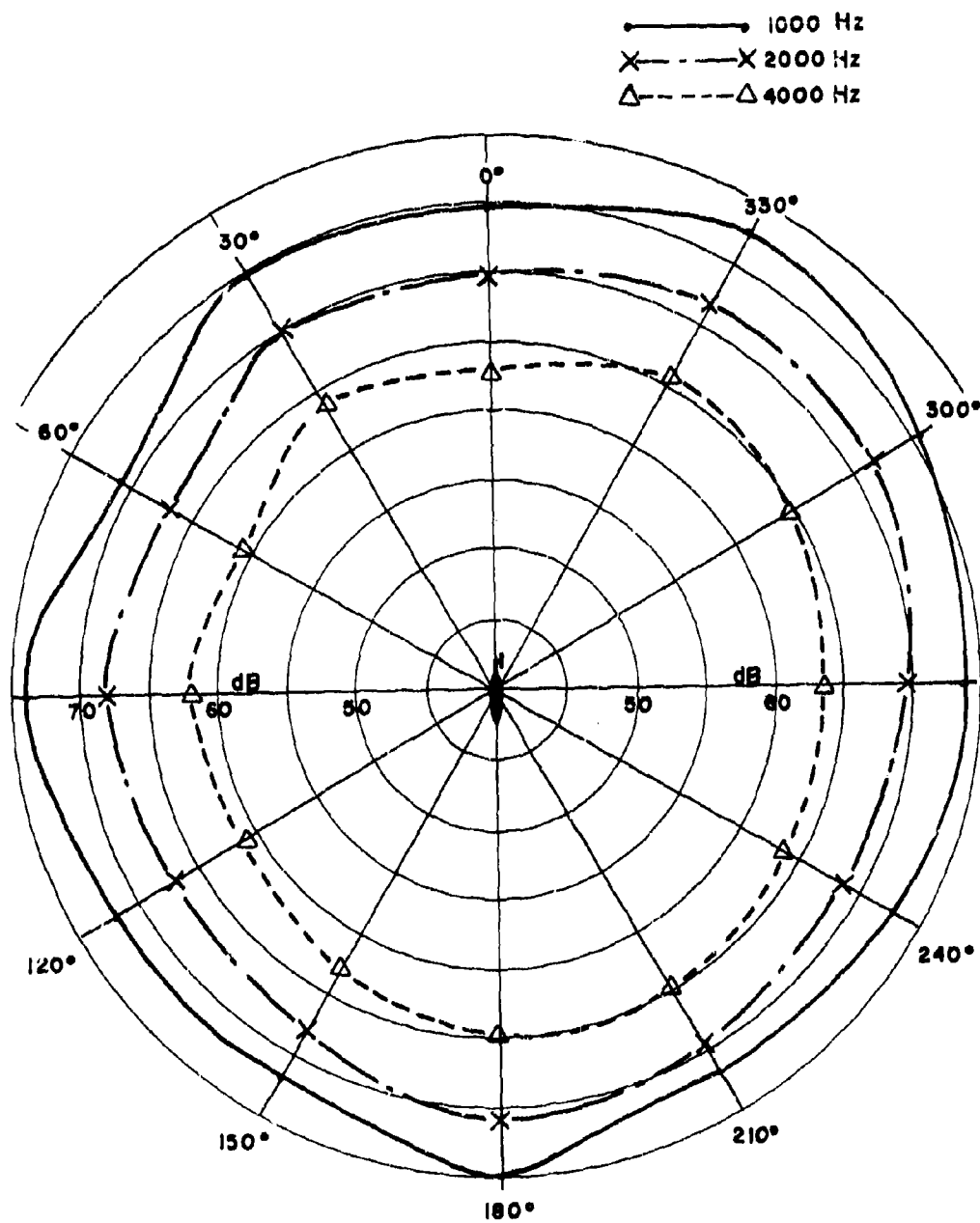


Figure 56. Concluded.

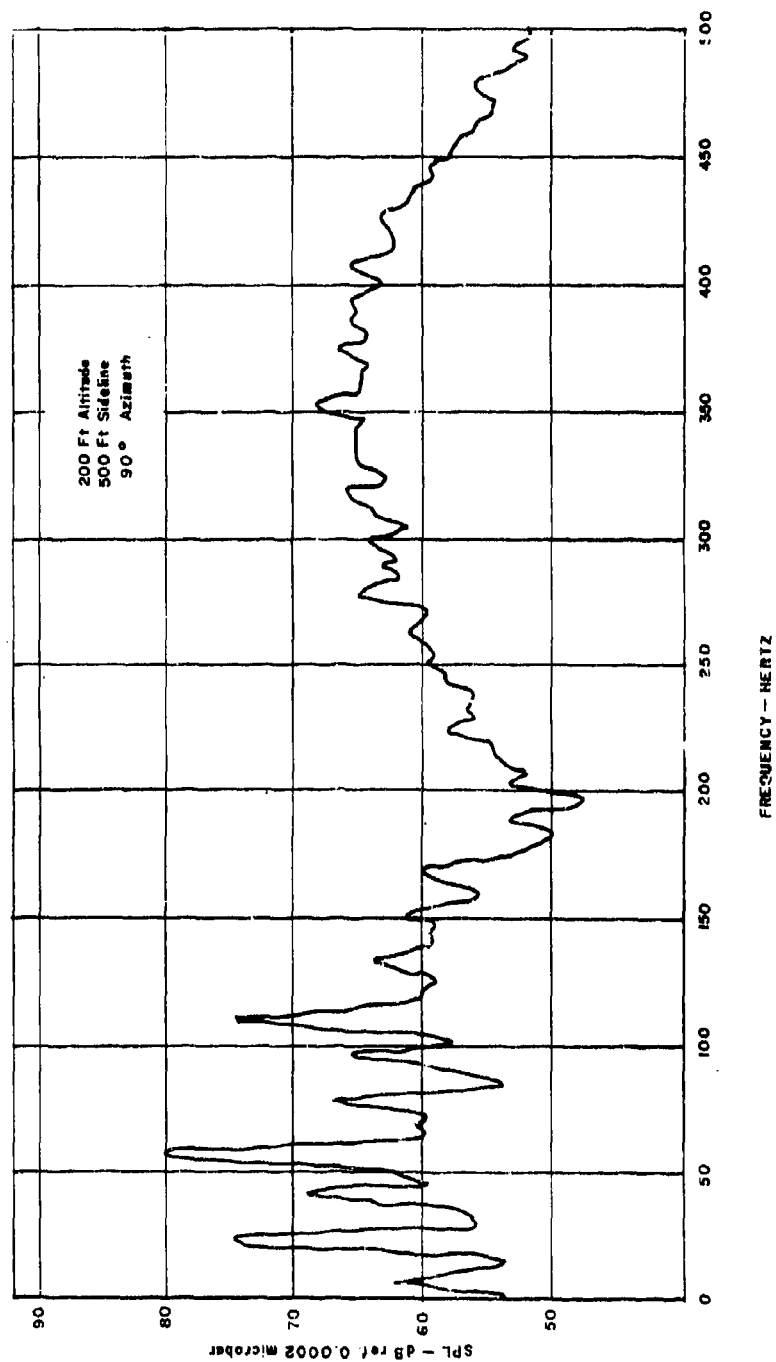


Figure 57. Narrow Bandwidth Spectrum (2.5 Hz) of CH-53A Hover Noise, No RIN.

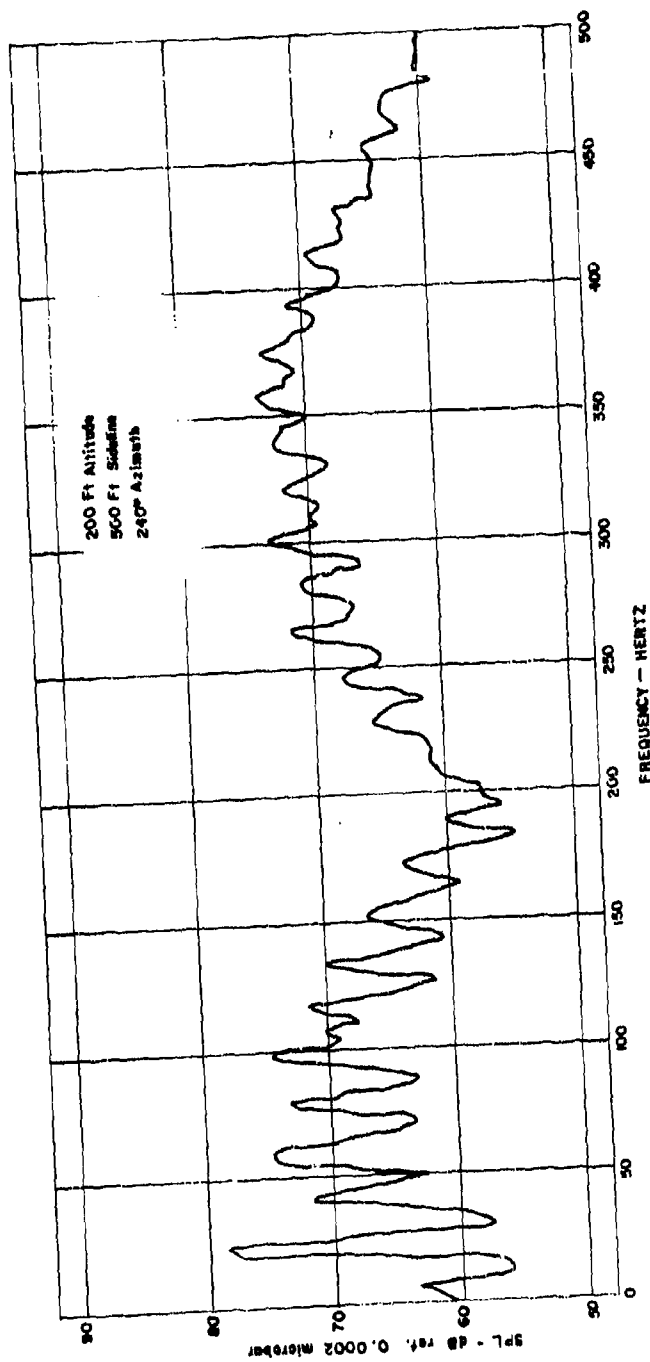


Figure 58. Narrow Bandwidth Spectrum (2.5 Hz)
of CH-53A Hover Noise, RIN.

APPENDIX V

COMPUTER PROGRAM DESCRIPTION

The mechanics of a rotational noise prediction computer program are described in this appendix. Basic equations are presented in terms of engineering symbols, and names of variables used in the program are defined. User instructions, and hardware and software requirements are not repeated here since Appendix I contains this information.

V.1 Fundamental Equations

The notation of Sections I.2 through I.4 is used in the following equations. The acoustic pressure of harmonic m as a function of time is

$$p_m[t] = u_m \cos m\omega t + v_m \sin m\omega t$$

where ω is the blade passage frequency. Since acoustic data normally are root-mean-square quantities, the preceding equation is more readily used in the form

$$p_{m,rms} = \frac{1}{\sqrt{2}} \sqrt{u_m^2 + v_m^2}$$

which is the basis of sound pressure level of the m^{th} harmonic in decibels given by

$$SPL_m = 20 \log_{10} \left[\frac{p_{m,rms}}{2.9 \times 10^{-9}} \right]$$

The constant (2.9×10^{-9}) is the acoustic reference pressure converted from microbar units to pound per square inch units.

The following equations trace the progression from u_m and v_m values back to the starting point of differential pressure c the rotor blades.

$$u_m = \frac{1}{4\pi} \int_0^{2\pi} \int_0^R b q_1 q_2 r dr d\psi$$

$$v_m = \frac{1}{4\pi} \int_0^{2\pi} \int_0^R b q_1 q_3 r dr d\psi$$

The factors q_1 , q_2 , and q_3 are given by

$$\begin{aligned}
q_1 = & [x - r \cos \psi] \left\{ \cos \theta [\sin \beta \sin \psi - \cos \beta \sin \theta \cos \psi + \sin \theta \cos \beta \cos \phi] \right\} \\
& - [y - r \sin \psi] \left\{ \cos \beta \sin \theta \sin \psi + \sin \beta \cos \psi \right\} \\
& + z \left\{ \cos \theta \cos \beta \cos \phi + \sin \theta [\cos \beta \sin \theta \cos \psi - \sin \beta \sin \psi] \right\}
\end{aligned}$$

$$q_2 = g_m \left(-\frac{\cos \eta}{s^3} - \frac{m\omega \sin \eta}{a_0 s^2} \right) + h_m \left(\frac{\sin \eta}{s^3} - \frac{m\omega \cos \eta}{a_0 s^2} \right)$$

$$q_3 = g_m \left(-\frac{\sin \eta}{s^3} + \frac{m\omega \cos \eta}{a_0 s^2} \right) + h_m \left(-\frac{\cos \eta}{s^3} - \frac{m\omega \sin \eta}{a_0 s^2} \right)$$

where

$$\eta = m\omega \left(\frac{\psi}{\Omega} + \frac{z}{a_0} \right)$$

and s , the distance from a point in the rotor disk to an observer, is

$$s = \sqrt{(x - r \cos \psi)^2 + (y - r \sin \psi)^2 + z^2}$$

The final link in the progression connects the g_m and h_m terms with the differential pressure $L(r, \psi)$ acting across the blade chord at radial station r and azimuthal blade location ψ .

$$g_m = \frac{n}{\pi b} \int_{\psi/2r}^{\psi/2r} L(r, \psi) \cos mn\psi d\psi$$

$$h_m = \frac{n}{\pi b} \int_{\psi/2r}^{\psi/2r} L(r, \psi) \sin mn\psi d\psi$$

Here, n is the number of rotor blades, b is the maximum thickness of the blade, and c is the length of the blade chord.

The present analysis assumes that b is not a function of radius and, therefore, may be treated as a constant term in all integrations.

Important correspondences between engineering symbols and the symbols used in the programmed equations are

g_m	=	GMAR, GMARI
h_m	=	HMAR, HMARI
s	=	S
$r q_1$	=	Q1
q_2, q_1	=	Q2

q_3	=	Q3
u_m	=	UMF
v_m	=	VMF
P_m	=	PMRMS
SPL_m	=	SPLM

V.2 Program Symbols

The following symbols are generated within the program and are used for the CARD or DRUM input modes (input modes are explained in Section I.5.4). Symbols used during the processing of raw data from analog tapes (TAPE input mode) are not included because the tape notation and format is unique to Sikorsky Aircraft, and inclusion of these particular symbols would not make the computer program any easier to review. Symbols for input data are described in Section I.5.4.

AZMTH(I)	Azimuth array 0 to 360 deg in 2.5-deg increments (I = 1 to 144)
AZMTH2(I)	Azimuth array 0 to 2π rad in $(2.5\pi/180)$ rad increments (I = 1 to 144)
AZMTH3(I)	Azimuth array every DPRAD radians from 0 to 2π , maximum I of 288
AZRAD	2.5° expressed in radians
AZ41(I)	Azimuth points I along the chord for a given nominal azimuth
B	Blade pitch angle
BEE	Equals "B" in Hollerith used to designate bottom of blade
BLADES	Number of blades
CHORD(I)	Chord station array used in the average quadratics integration to get airloads (I = chord)
CHORD2(I)	Interpolated chord station array used in integration of $g_m(\psi, R)$ and $h_m(\psi, R)$
COSINE(I)	Cosine array defined every DPSI degrees

COSRN(I)	Cosine array whose elements are calculated at each instrumented chord station and used in calculating Fourier coefficients of acoustic airloads
DATA1(I, J, K)	Scaled and corrected average pressure cycles where: I = data point, J = chord, K = radial station
DEE	Equals "D" in Hollerith used to designate differential pressure
DPRAD	$\Delta\psi$ expressed in radians
DPSI1(I)	Differential pressure array along chord, used in averaged quadratics integration
FI(I, J)	Gaussian integration factors for radial station I and chord station J
FN(I)	Temporary array used to store airloads just before harmonic analysis
GMAR(I, K)	m^{th} cosine coefficient of acoustic pressure pulse where K = radial station, I = azimuthal station
GMARI(I, K)	m^{th} cosine coefficient of acoustic pressure pulse after interpolation. I = up to 288, K = 10 or 20
GPSI(I)	Differential pressure array along a chord, used in average quadratics integration
GPSI1(I)	Array used in integration of $g_m(\psi, R)$ and $h_m(\psi, R)$
GPSI2(I)	Differential pressure array along a chord, used in average quadratics integration
HARMS	Array name for pitch and flapping angle harmonics used for DRUM input mode
HMAR(I, K)	m^{th} sine coefficient of acoustic pressure pulse where K = radial station, I = azimuthal station
HMARI(I, K)	m^{th} sine coefficient of acoustic pressure pulse after interpolation. I = up to 288, K = 10 or 20

IRS(I)	Instrumented radial station counter, counting from blade root. If station bad, then IRS(I) = 0
ISI	$ISI = (DPSI/2.5) \geq 1$; if ≤ 0 then ISI = 1
IX	The number of radial intervals to be used in the double integration
IY	The number of azimuthal intervals to be used in the double integration
LAZI	The number of azimuth stations as a result of interpolation. This is calculated knowing DPSI
LIRS	Number of good radial stations
NBLANK	Word with all blanks in it
NCH(I)	Total number of chord stations for radial position I
NCHAN(I,J)	Blade instrumented station designation for radial station I, chord station J. If = 0, then that station is not useable
NO	Control word used to check whether or not to execute an option
NOPTS1	Number of radial stations before interpolation (including end points .194 and 1.0) (up to 7)
NX	Number of Gauss points and weights to be used
PI	$PI = 3.14159$
PI2	$PI2 = 6.28318$
PMRMS(I,J)	Sound pressure of harmonic I at field point J
POINT(15)	Gauss integration points (normalized)
Q1(I,J) Q2(I,J) Q3(I,J)	Functions used in a double integration, I = azimuth and J = span
S	Distance from element of rotor disk to field point
SINE(I)	Sine array defined every DPSI degrees

SINRN(I)	Sine array calculated for each instrumented chord station and used in Fourier analysis of acoustic airloads
SPAN(I)	Radial stations used in a double integration, L = 1 to 20
SPLM(I,J)	Sound pressure level of harmonic I at field point J
TEE	Equals "T" in Hollerith used to designate top of blade
TEM1(I)	Temporary arrays used in Fourier analysis
TEM2(I)	subroutine arguments
TEMP1(I)	Temporary work arrays used in the
TEMP2(I)	interpolation of GMAR and HMAR
TEMP3(I)	
UMF(I,J)	Components of sound pressure, I = harmonic
VMF(I,J)	order, J = field point number
W(I)	Temporary work array, I = 1,14
WPOINT(I)	Gauss integration weights, I = 1,15
XLM(I,J)	Cosine component of section loading harmonic J at radial station I
XMM(I,J)	Sine component of section loading harmonic J at radial station I
XLO(I)	Steady component of section loading at radial station I
XO(I)	Array used in interpolation routine
YES	Control word used to check whether or not to execute an option
YO(I)	Array used in interpolation routine

V.3 Program Logic and Subroutine Names

The general flow of operations in the program is as follows for the CARD input mode.

1. Accept harmonics of differential pressure from cards. Sum these harmonics to produce the differential pressure at each span and chord station every DPSI degrees of azimuth.

2. If output from E386 is desired, calculate the blade section loading (airload, pounds per inch of span) by integrating the differential pressures across the chord at each span station. A trapezoidal integration routine is used. If E386 is not desired, skip to Step 4.
3. Proceed through E386.
4. If noise levels based on the actual chordwise pressure distribution are required, interpolate to provide 41 points along the blade chord. These points are required to define the Fourier coefficients of the pulse shape (chordwise pressure distribution). If noise based on the actual chordwise distribution is not desired, skip to Step 12.
5. Calculate GMAR and HMAR for a particular noise harmonic and store them on magnetic tape via I/O unit 14.
6. Interpolate GMAR and HMAR if 288 azimuthal and/or 20 radial points are desired. This interpolation produces GMARI and HMARI.
7. Calculate Q arrays for the first field point.
8. Calculate UMF and VMF components of acoustic pressure for the first field point.
9. Calculate SPLM for the first field point.
10. Repeat steps 7, 8, and 9 for the rest of the field points (field point loop).
11. Repeat steps 5 through 10 for the rest of the noise harmonics (harmonic loop).
12. Repeat steps 1 through 11 for the remaining flight conditions or "data bursts" (burst loop).

Steps 1 through 5 are omitted when the DRUM input mode is used. The GMAR and HMAR coefficients stored on tape are read into the memory of the computer, and calculations begin with the interpolation to produce GMARI and HMARI.

Subroutines called by the main program, E676, are listed below. System subroutines, such as COS, SIN, ALOG10, NTRAN, etc., are not mentioned. Sequence codes are explained in Section V.4.

AVQUAD	Performs integration by averaged quadratics based on Lagrange interpolation; sequence code is L76A.
BLODAT	BLOCK DATA subroutine; sequence code is L76B.
CUBIC	Subroutine used by CURVIT; sequence code is L76F.

CUE	Calculates an array (Q1, Q2, Q3) which is a function of azimuth, radius and observer location. A double integration of this variable yields the sound pressure components u_m and v_m ; sequence code is L76C.
CURVIT	Cubic interpolation subroutine; sequence code is L76V.
DFSRIE	Computes the coefficients of a Fourier series; sequence code is L76D.
E386RN	Calculates SPL based on a rectangular chordwise distribution of pressure; sequence code is L76E.
INPUTA	Reads and prints out card input; sequence code is L76I.
INTERP	Linearly interpolates pressure pulse harmonics up to 20 blade span stations and 288 azimuths; sequence code is L76P.
OUTSPL	Output subroutine; sequence code is L76O.
PARAM	Subroutine used by CURVIT; sequence code is L76X.
SIMCOR	Simpson's integration routine; sequence code is L76S.
TRIDAG	Subroutine used by CURVIT; sequence code is L76T.

The next three subroutines are used to process aerodynamic data contained on digital tape.

MERGES	Combines the absolute pressure of the instrumented top and bottom blade stations, to produce only differential pressures for all blade stations; sequence code is L76G.
RDKU	Reads in one record from the proper input tape, where two records make up one azimuthal pressure cycle; sequence code is L76R.
UNPACK	Unpacks an array containing tape information (two records) into separate arrays representing azimuthal pressure cycles for each pressure transducer channel; sequence code is L76U.

V.4 Program Listing

Figures 59 and 60 contain a listing of the source deck of the computer program. The last 8 columns of the 80-column cards have been used to sequence the deck. The first 4 characters of a sequence number identify a

statement with a specific subroutine or with the main program, and the last 4 characters locate the statement serially within the appropriate area of the program. Symbols are defined in Sections I.5.4 and V.2.

```

01 FOR E676
C ROTOR NOISE PROGRAM FOR W. BAUSCH BY G. CAMPE.
COMMON /BK1/ 100,88,AA,AA(5,5),DPS1,RR(5),OMEG,CC,MBLAGE,MLIMRN,
* MLIMP,XFP(20),YFP(20),ZFP(20),GAMA,NO,BLADEL,BO,BIC,BIS,PUNCH,
* LSPAN,FROC(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,
* IRS(5),ITRACK(5),F1(5,5),NCHAN(5,5),E386OP,NFT,ANG,KEY1,KEY2,
* KEY3,NMH,CAPRF(20),THETAF(20),ALFAP(20),OPRONO,HCH(5),INTERM,
* IREEL,NC,NTB0X(5,10),NSTATC(5,10),NSTATR(5,10),ISET(5),IREELS,
* NOCH(5),LAZI
COMMON /BK2/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL(7),XLM(7,40),
* XMM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),P1,AZMTH2(144),AZMTH(144),
* OPRAD,AZRAD,NO,YES,NBLANK,TEE,DEE,DEE,GMAR1(288,20),
* HMAR1(288,20),XO(20)
COMMON /BK3/ SPLM(10,20),AZMTH3(288),
* SPAN(20), PMRMS(10,20),
* ICHANL(10,5),COSINE(288),SINE(288),BLADES,CARD,TAPE
INTEGER TCOP,CARD,TAPE,E386OP,OPRONO,YES
DIMENSION ID(10)
DATA ID/'H1','H2','H3','H4','H5','H6','H7','H8','H9','H10'/
COMMON /TEMPS/ TIME,COUNT
DIMENSION DATA1(144,10,5),DATA2(144,10,5),FN(144),CHORD(7),
* GPS1(7),GPS11(7),TEM1(30),TEM2(30),CHORD2(41),GPS12(41),GPS13(41),
* COSRN(41),SINRN(41)
EQUIVALENCE (ND1,DATA1),(ND2,DATA2),(NN,FN),(TEMP1,CHORD),
* (TEMP2,GPS1),(TEMP3,GPS11)
DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),
* GMAR(144,5),HMAR(144,5)
* Q1(288,20),Q2(288,20)
EQUIVALENCE (ND2,5761),HMAR),
S (GMAR1,AN),
* (GMAR1(1551),BN),(HMAR1,CN),(HMAR1(776),SN),(ND2,Q2)
EQUIVALENCE (ND1,5761),GMAR),(ND1,Q1)
DIMENSION AZ41(41)
DIMENSION DBI(289)
EQUIVALENCE (DBI,SINE)
COMMON /NEW/ FO,F1C,F1S,TOTIME,THETA
DIMENSION XU(10,20),XV(10,20),P(41),COSARG(41,20),SINARG(41,20)
DIMENSION HARM5(6),BHARM(3),FHARM(3)
EQUIVALENCE (BO,BHARM),(FO,FHARM)
NTIME=0
MSTART=1
CALL INPUTA
IF(TCOP.NE.TAPE) GO TO 199
REWIND 8
REWIND 9
REWIND 10
REWIND 11
REWIND 12
REWIND 13
199 LIRS = 0
PI = 3.14159265
DO 1 I=1,5
IF(IRS(I).NE.0) LIRS = LIRS+1
1 CONTINUE
OPRAD = DPS1*6.28318531/360.
AZRAD = (2.5*PI)/180.
AZMTH(1) = 0.
AZMTH2(1) = 0.
DO 2 I=2,144
AZMTH2(I) = AZMTH2(I-1)+AZRAD
2 AZMTH(I) = AZMTH(I-1)+2.5
PI2 = 6.283185
AZMTH3(1)=0.
COSINE(1)=1.

```

Figure 59. Main Program E676.

SINE(1)=0.	L76M0650	00066
T1=(PI2/OPRAD)+.001	L76M0660	00067
J=1	L76M0670	00068
IF(J.LE.288) GO TO 211	L76M0680	00069
WRITE(6,212)	L76M0690	00070
212 FORMAT(1H1, 63H THE DIMENSION OF AZMTH3 HAS BEEN EXCEEDED AT STATEM	L76M0700	00071
ENT NO. 211)	L76M0710	00072
WRITE(6,35) (AZMTH3(L),L=1,288)	L76M0720	00073
WRITE(6,35)PI2	L76M	00074
STOP	L76M0730	00075
211 DO 4 LAZI=2,J	L76M0740	00076
AZMTH3(LAZI) = AZMTH3(LAZI-1)+OPRAD	L76M0750	00077
COSINE(LAZI) = COS(AZMTH3(LAZI))	L76M0760	00078
4 SINE(LAZI) = SIN(AZMTH3(LAZI))	L76M0770	00079
IF(1DD.NE.1) GO TO 210	L76M0780	00080
WRITE(6,213)	L76M0790	00081
213 FORMAT(1H1,11HAZMTH3(288))	L76M0800	00082
WRITE(6,35) (AZMTH3(L),L=1,288)	L76M0810	00083
210 BLADES = NOLADE	L76M0820	00084
T1 = 1./41.	L76M0830	00085
CHORD2(1) = 0.	L76M0840	00086
DO 6 L=2,40	L76M0850	00087
6 CHORD2(L) = CHORD2(L-1) + T1	L76M0855	00088
C	L76M0860	00089
C *** A LONG LOOP ON BURSTS IS NEXT.	L76M0870	00090
7 IF(1DD.NE.1) GO TO 9300	L76M0880	00091
CALL START	L76M0890	00092
9300 IF(1COP.EQ.CARD) GO TO 10	L76M0900	00093
C	L76M0907	00094
C CARD L76M0910 BRANCHES TO STATEMENT 57 IF DRUM INPUT REQUESTED	L76M0908	00095
C	L76M0909	00096
C IF (1COP.EQ.'DRUM') GO TO 57	L76M0910	00097
READ(5,8) IBURST	L76M0920	00098
C GET START OF BURST TIME	L76M0930	00099
8 FORMAT(11X,13)	L76M0940	00100
C	L76M0950	00101
C *** A CHOISE I MADE NEXT (OPTION) TO EITHER ACCEPT TAPE OR CARD INPUT.	L76M0960	00102
DO 9 I=1,144	L76M0970	00103
DO 9 J=1,10	L76M0980	00104
DO 9 K=1,5	L76M0990	00105
9 ND2(I,J,K) = 0	L76M1000	00106
C	L76M1010	00107
C *** LOOP ON TAPE REELS FOLLOWS.	L76M1020	00108
DO 11 IREEL=1,IREELS	L76M1030	00109
KU = KUNIT(IREEL)	L76M1040	00110
IF(1DD.EQ.1)	L76M1050	00111
XWRITE(6,231) IREEL,KU	L76M1060	00112
12 CA.L RDKU(1)	L76M1070	00113
IF(1BURST.NE.KBURST) GO TO 12	L76M1080	00114
IF(1DD.EQ.1)	L76M1090	00115
XWRITE(6,231) IREEL,KU,KREC,KBURST,KTRACK	L76M1100	00116
GO TO (13,13,13,13,13,13,13,14,15,16,17),KU	L76M1110	00117
13 BACKSPACE 8	L76M1120	00118
GO TO 18	L76M1130	00119
14 BACKSPACE 9	L76M1140	00120
GO TO 18	L76M1150	00121
15 BACKSPACE 10	L76M1160	00122
GO TO 18	L76M1170	00123
16 BACKSPACE 11	L76M1180	00124
GO TO 18	L76M1190	00125
17 BACKSPACE 12	L76M1200	00126
BACKSPACE 13	L76M1210	00127
18 NCYCLE = 0	L76M1220	00128
C *** THE FIRST CYCLE IN BURST IBURST IS READ.	L76M1230	00129
CALL RDKU(1)	L76M1240	00130
CALL RDKU(2)	L76M1250	00131

Figure 59. Continued.

KB = KBURST	L76M1260	00132
GO TO 19	L76M1270	00133
C *** THE REMAINING CYCLES IN BURST IBURST ARE READ AND AVERAGED.	L76M1280	00134
20 CALL RDKU(1)	L76M1290	00135
IF(KBURST,NE,KB) GO TO 21	L76M1300	00136
CALL RDKU(2)	L76M1310	00137
IF(KBURST,NE,KB) GO TO 21	L76M1320	00138
C	L76M1330	00139
C *** SUBR. UNPACK UNPACKS NN(435) TO FORM ND1(I,J,K) WHERE I=DATA POINT	L76M1340	00140
C *** J=CHANNEL, K=REEL NO.	L76M1350	00141
19 CALL UNPACK	L76M1360	00142
NCYCLE = NCYCLE+1	L76M1370	00143
C *** CHANNEL LOOP	L76M1380	00144
K = NOCH(IREEL)	L76M1390	00145
DO 22 J=1,K	L76M1400	00146
NC = ICHANL(J,IREEL)	L76M1410	00147
IF(100-1) 234,236,234	L76M1420	00148
236 IF(IREEL-1) 234,235,234	L76M1430	00149
235 IF(100-1) WRITE(6,231) NCYCLE,K,NC,ND1(I,NC,IREEL	L76M1440	00150
X L)	L76M1450	00151
234 CONTINUE	L76M1460	00152
231 FORMAT(4I13)	L76M1470	00153
DO 22 I=1,144	L76M1480	00154
ND2(I,NC,IREEL) = ND2(I,NC,IREEL) + ND1(I,NC,IREEL)	L76M1490	00155
22 CONTINUE	L76M1500	00156
GO TO 20	L76M1510	00157
C *** AT THIS POINT THE END OF BURST HAS BEEN REACHED.	L76M1520	00158
21 GO TO (27,23,23,23,23,23,23,23,24,25,26,27),KU	L76M1530	00159
23 BACKSPACE 8	L76M1540	00160
GO TO 28	L76M1550	00161
24 BACKSPACE 9	L76M1560	00162
GO TO 28	L76M1570	00163
25 BACKSPACE 10	L76M1580	00164
GO TO 28	L76M1590	00165
26 BACKSPACE 11	L76M1600	00166
GO TO 28	L76M1610	00167
27 BACKSPACE 12	L76M1620	00168
BACKSPACE 13	L76M1630	00169
28 CYCLES = NCYCLE	L76M1640	00170
C *** THE AVERAGE CYCLES ARE FOUND NEXT.	L76M1650	00171
K = NOCH(IREEL)	L76M1660	00172
DO 29 J=1,K	L76M1670	00173
NC = ICHANL(J,IREEL)	L76M1680	00174
DO 29 I=1,144	L76M1690	00175
T1 = ND2(I,NC,IREEL)	L76M1700	00176
29 DATA2(I,NC,IREEL) = T1/CYCLES.	L76M1710	00177
11 CONTINUE	L76M1720	00178
C *** FILTER ROLL OFF CORRECTION AND TAPE DATA SCALING FOLLOWS.	L76M1730	00179
DO 30 IREEL=1,IREELS	L76M1740	00180
K = NOCH(IREEL)	L76M1750	00181
DO 30 J=1,K	L76M1760	00182
NC = ICHANL(J,IREEL)	L76M1770	00183
DO 31 I=1,144	L76M1780	00184
31 FN(I) = DATA2(I,NC,IREEL)	L76M1790	00185
CALL OPSR1E (144,MLIMDP,FN,TEM1,TEM2)	L76M1800	00186
AN(I,NC,IREEL) = TEM1(I)	L76M1810	00187
DO 32 I=1,MLIMDP	L76M1820	00188
AN(I+1,NC,IREEL) = TEM1(I+1)	L76M1830	00189
32 BN(I,NC,IREEL) = TEM2(I+1)	L76M1840	00190
IF(100-1) GO TO 30	L76M1850	00191
WRITE(6,33) IREEL,NC,(FN(NAZ),NAZ=1,144)	L76M1860	00192
33 FORMAT(1H0, 5HREEL=,I3, 7X, 8HCHANNEL=, I3, 7X, 35HAVE, CYCLE AND	L76M1870	00193
ITS HARMONICS FOLLOW // (2X,1PE10.3,12E10.3))	L76M1880	00194
I=MLIMDP+1	L76M1890	00195
WRITE(6,34) (AN(L,NC,IREEL),L=1,I)	L76M1900	00196
WRITE(6,35) (BN(L,NC,IREEL),L=1,MLIMDP)	L76M1910	00197

Figure 59. Continued.

34	FORMAT(1H0,1X,1PE10.3 / (2X,13E10.3))	L76M1920	00198
35	FORMAT(/ (2X,1PE10.3,12E10.3))	L76M1930	00199
36	CONTINUE	L76M1940	00200
	DO 36 IREEL=1,IREELS	L76M1950	00201
	IF(100,20,1) WHILE(0,40) IREEL	L76M1960	00202
40	FORMAT(1H0,10HREEL NO. =,13,10X, 77HAVE. PRESSURE CYCLE HARMONICS	L76M1970	00203
	X(CORRECTED FOR FILTER ROLL-OFF AND ENGR. UNITS))	L76M1980	00204
	K=NOCH(IREEL)	L76M1990	00205
	DO 36 J=1,K	L76M2000	00206
	NC = ICHANL(J,IREEL)	L76M2010	00207
	AN(I,NC,IREEL) = AN(I,NC,IREEL)*SLOPE(NC,IREEL)+OFFSET(NC,IREEL)	L76M2020	00208
	DO 37 I=1,MLIMDP	L76M2030	00209
	T1 = FROC(I)*SLOPE(NC,IREEL)	L76M2040	00210
	AN(I+1,NC,IREEL) = AN(I+1,NC,IREEL)*T1	L76M2050	00211
37	BN(I,NC,IREEL) = BN(I,NC,IREEL)*T1	L76M2060	00212
	IF(100,NE,1) GO TO 36	L76M2070	00213
	WRITE(6,38) NC,AN(1,NC,IREEL),(AN(I+1,NC,IREEL),I=1,MLIMDP)	L76M2080	00214
38	FORMAT(1X, 8HCHANNEL=,13,5X, 11(1PE10.3 / (27X,10E10.3 /))	L76M2090	00215
	WRITE(6,39) (BN(I,NC,IREEL),I=1,MLIMDP)	L76M2100	00216
39	FORMAT(27X,10(1PE10.3) / (27X,10E10.3))	L76M2110	00217
36	CONTINUE	L76M2120	00218
C ***	THE FOLLOWING SUBR. COMBINES THE TOP AND BOTTOM ABSOLUTE PRESSURE	L76M2130	00219
C	COEFFICIENT	L76M2140	00220
C	TO PRODUCE DIFFERENTIAL PRESS. COEFF. CN(31,5,5), SN(30,5,5)WHERE	L76M2150	00221
C	FIRST SUBS. = HARMONIC, SECOND SUBS. = CHORD, THIRD SUBS. = SPAN.	L76M2160	00222
C	BLADE PITCH HARMONICS, B0,B1C,B1S ARE ALSO CALCULATED.	L76M2170	00223
	CALL MERGES	L76M2180	00224
	IF(100,NE,1) GO TO 240	L76M2190	00225
	DO 239 I=1,5	L76M2200	00226
	DO 239 J=1,5	L76M2210	00227
	WRITE(6,47) CN(I,J,1)	L76M2220	00228
	WRITE(6,47) (CN(K+1,J,1),K=1,MLIMDP)	L76M2230	00229
239	WRITE(6,47) (SN(K,J,1),K=1,MLIMDP)	L76M2240	00230
C ***	NOW THE DIFFERENTIAL PRESSURE FOURIER COEFFICIENTS OF THE AVERAGE	L76M2250	00231
C	CYCLES IS PUNCHED OUT.	L76M2260	00232
C	CYCLES IS PUNCHED OUT.	L76M2270	00233
	IF(PUNCH,NE,YES) GO TO 41	L76M2280	00234
240	WRITE(7,42) IBURST	L76M2290	00235
42	FORMAT(11HBURST NO. =,13,11X, 34H*** ROTOR NOISE PUNCHED OUTPUT *	L76M2300	00236
	X**)	L76M2310	00237
	WRITE(7,43) B0,B1C,B1S,F0,F1C,F1S	L76M2320	00238
43	FORMAT('BLADE PITCH HARMONICS'/1P3E10.4,2X'(COLLECTIVE, LONGITUDINL	L76M2330	00239
	SAL, LATERAL RESPECTIVELY)'/2'ROTOR FLAPPING ANGLE HARMONICS'/1P3E10L	L76M2340	00240
	5,4,2X'(POSITIVE TAIL HIGH -- DEGREES)')	L76M2350	00241
	WRITE(7,431)	L76M2360	00242
431	FORMAT('DIFFERENTIAL PRESSURE HARMONICS FOR 5 CHORD STATIONS AT EACH OF THE 5 SPANS'/(MEASURING FROM	L76M2370	00243
	THE LEADING EDGE AND THE BLADE ROOT RESPECTIVELY).')	L76M2380	00244
		L76M2390	00245
C ***	SPAN LOOP	L76M2400	00246
	DO 44 I=1,5	L76M2410	00247
C ***	CHORD LOOP	L76M2420	00248
	DO 44 J=1,5	L76M2430	00249
	WRITE(7,49) I,J,CN(I,J,1)	L76M2440	00250
49	FORMAT(4HSPAN,12,2X, 5HCHORD,12,7X, 8HSTEADY= , 1PE10.4)	L76M2450	00251
	WRITE(7,45)	L76M2460	00252
45	FORMAT(19HCOSINE COEFFICIENTS)	L76M2470	00253
47	FORMAT(8(1PE10.4))	L76M2480	00254
	WRITE(7,47) (CN(K+1,J,1),K=1,MLIMDP)	L76M2490	00255
	WRITE(7,48)	L76M2500	00256
48	FORMAT(17HSINE COEFFICIENTS)	L76M2510	00257
44	WRITE(7,47) (SN(K,J,1),K=1,MLIMDP)	L76M2520	00258
	GO TO 41	L76M2530	00259
C ***	CARD INPUT (INSTEAD OF TAPE INPUT) IS ACCEPTED NEXT.	L76M2540	00260
10	READ(5,42) IBURST	L76M2550	00261
	READ(5,43) B0,B1C,B1S,F0,F1C,F1S	L76M2560	00262
	READ(5,431)	L76M2570	00263

Figure 59. Continued.

C *** SPAN LOOP	L76M2580	00264
DO 50 I=1,5	L76M2590	00265
C *** CHORD LOOP	L76M2600	00266
DO 50 J=1,5	L76M2610	00267
READ(5,49) IN,JN,CN(1,JN,IN)	L76M2620	00268
READ(5,45)	L76M2630	00269
READ(5,47) (CN(K+1,J,I),K=1,MLIMP)	L76M2640	00270
READ(5,48)	L76M2650	00271
50 READ(5,47) (SN(K,J,I),K=1,MLIMP)	L76M2660	00272
C *** AVERAGE DIFFERENTIAL PRESSURE CYCLES FOR SPAN I CHORD J AZIMUTH K	L76M2670	00273
C FOUND BY SUMMING THE CORRECTED HARMONICS.	L76M2680	00274
C *** SPAN LOOP	L76M2690	00275
C A) THIS POINT THE PRESSURE INPUT HAS BEEN ACCEPTED (TAPE OR CARD INPUT)	L76M2700	00276
41 CONTINUE	L76M2710	00277
DO 120 I=1,3	L76M2720	00278
HARMS(I)=BHARM(I)	L76M2730	00279
120 HARMS(I+3)=FHARM(I)	L76M2740	00280
C CARD L76M2750 STORES BLADE ANGLE HARMONICS ON DRUM	L76M2748	00282
C	L76M2749	00283
C CALL DATCUR ('HARMS',0,14,HARMS,6)	L76M2750	00284
IF(IDD.NE.1) GO TO 9301	L76M2760	00285
CALL CLOCK	L76M2770	00286
9301 DO 51 I=1,5	L76M2780	00287
C *** CHORD LOOP	L76M2790	00288
DO 51 J=1,5	L76M2800	00289
T1 = -AZRAD	L76M2810	00290
C *** AZIMUTH (POINT) LOOP	L76M2820	00291
DO 51 K=1,144	L76M2830	00292
DATA1(K,J,I) = CN(1,J,I)	L76M2840	00293
T1 = T1+AZRAD	L76M2850	00294
T3 = 0.	L76M2860	00295
C *** HARMONIC LOOP	L76M2870	00296
DO 51 L=1,MLIMP	L76M2880	00297
T3 = T3+1.	L76M2890	00298
T2 = T1+T3	L76M2900	00299
51 DATA1(K,J,I) = DATA1(K,J,I)+CN(L+1,J,I)*COS(T2)+SN(L,J,I)*SIN(T2)	L76M2910	00300
WRITE(6,54)	L76M2920	00301
54 FORMAT(1H1,59HDIFFERENTIAL PRESSURE CYCLES AT INSTRUMENTED BLADE	L76M2930	00302
XTATIONS //)	L76M2940	00303
DO 53 I=1,5	L76M2950	00304
DO 53 J=1,5	L76M2960	00305
WRITE(6,55) I,J	L76M2970	00306
55 FORMAT(1H0, 12HSPAN STATION,13,5X,13HCHORD STATION, 13//)	L76M2980	00307
53 WRITE(6,56) (DATA1(K,J,I),K=1,144)	L76M2990	00308
56 FORMAT(2X,10(1PE13.4))	L76M3000	00309
C *** THE FOLLOWING INPUT OPTION DESIGNS WHETHER OR NOT TO CALL THE ACOUL	L76M3010	00310
C STICS PROGRAM E386 WHICH IS A SIMPLIFIED VERSION OF THIS PROGRAM.	L76M3020	00311
52 IF(E386OP.NE.YES) GO TO 57	L76M3030	00312
KK = 1	L76M3040	00313
XL0(1) = 0.	L76M3050	00314
DO 9501 J=1,NHH	L76M3060	00315
XLN(1,KK) = 0.	L76M3070	00316
9501 XNN(1,KK) = 0.	L76M3080	00317
C *** RADIAL STATION LOOP	L76M3090	00318
DO 58 I=1,5	L76M3100	00319
KK = KK+1	L76M3110	00320
IF(IRS(I).EQ.0) GO TO 58	L76M3120	00321
IF(NCH(I).EQ.5) GO TO 59	L76M3130	00322
NT1 = NCH(I)+2	L76M3140	00323
K=1	L76M3150	00324
CHORD(1) = 0.	L76M3160	00325
DO 60 L=1,5	L76M3170	00326
IF(NCHAN(L).EQ.0) GO TO 60	L76M3180	00327
K=K+1	L76M3190	00328
CHORD(K)=XA(L,I)	L76M3200	00329

Figure 59. Continued.

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80 CONTINUE
  CHORD(K+1)=1.
  GPSI(1)=0.
  DO 61 J=1,144
    K=1
    DO 62 L=1,5
      IF (CHANI(L),EQ,0) GO TO 62
      K=K+1
      GPSI(K) = DATA(J,L,K)
62 CONTINUE
  GPSI(K+1) = 0.
  CALL AVQUAD(NT1,CHORD,OPSI,AREA)
61 FN(J) = AREA*AA
  DO 63 J=1,144
    FN(J) = 0.
    DO 65 L=1,5
      FN(J) = FN(J)+DATA(J,L,K)*FI(L,K)
64 FN(J) = FN(J)*AA
63 CALL DFSRIE(144,NHH,FN,TEM1,TEM2)
  XLO(KK) = TEM1(1)
  DO 66 J=1,NHH
    XLM(KK,J) = TEM1(J+1)
    XMM(KK,J) = TEM2(J+1)
66 XMM(KK,J) = TEM2(J+1)
58 CONTINUE
  KK = KK+1
  XLO(KK) = 0.
  DO 9500 J=1,NHH
    XLM(KK,J) = 0.
    XMM(KK,J) = 0.
9500 WRITE(6,201)
201 FORMAT(1H1, 11HXLO XLM XMM ,///)
    DO 202 KK=1,7
      WRITE(6,203) XLO(KK), (XLM(KK,J),J=1,NHH), (XMM(KK,J),J=1,NHH)
203 FORMAT(//1PE13.5)
202 CONTINUE
200 CALL E386RN
57 IF (OPRONO.NE.YES) GO TO 7
C
C CARDS L76M3600 THRU L76M3640 READ PRESSURES FROM DRUM
C
C IF (TCOP.NE. 'DRUM') GO TO 122
C CALL PCFDRD ('HARMS',0,HARMS,6)
C DO 121 I=1,3
C   BHARM(I) = HARMS(I)
C   FHARM(I) = HARMS(I+3)
C 122 CONTINUE
C BEGINNING OF ROTOR NOISE ANALYSIS
  IF (IDD.NE.1) GO TO 9302
  CALL START
9302 T1 = LSPAN-1
  T1 = (0.7695 * BLADEL)/T1
  SPAN(1) = 99.9
  DELSPN = 0.5*T1
  DO 67 L=2,LSPAN
    SPAN(L) = SPAN(L-1)+T1
    L=LMSTART-1
    FM=L
    T4 = BLADES/(PI*BB)
    DIMENSION RS0(18)
    REMIND 28
    IF (IDD.NE.1) GO TO 9103
    GC2=SPAN(1)*DELSPN
    J=LSPAN-2
    DO 10005 I=1,J
      L76M3210 00330
      L76M3220 00331
      L76M3230 00332
      L76M3240 00333
      L76M3250 00334
      L76M3260 00335
      L76M3270 00336
      L76M3280 00337
      L76M3290 00338
      L76M3300 00339
      L76M3310 00340
      L76M3320 00341
      L76M3330 00342
      L76M3340 00343
      L76M3350 00344
      L76M3360 00345
      L76M3370 00346
      L76M3380 00347
      L76M3390 00348
      L76M3400 00349
      L76M3410 00350
      L76M3420 00351
      L76M3430 00352
      L76M3440 00353
      L76M3450 00354
      L76M3460 00355
      L76M3470 00356
      L76M3480 00357
      L76M3490 00358
      L76M3500 00359
      L76M3510 00360
      L76M3520 00361
      L76M3530 00362
      L76M3540 00363
      L76M3550 00364
      L76M3560 00365
      L76M3570 00366
      L76M3580 00367
      L76M3590 00368
      L76M3597 00369
      L76M3598 00370
      L76M3599 00371
      L76M3600 00372
      L76M3610 00373
      L76M3620 00374
      L76M3630 00375
      L76M3640 00376
      L76M3650 00377
      L76M3660 00378
      L76M3670 00379
      L76M3680 00380
      L76M3690 00381
      L76M3700 00382
      L76M3710 00383
      L76M3720 00384
      L76M3730 00385
      L76M3740 00386
      L76M3750 00387
      L76M3760 00388
      L76M3770 00389
      L76M3780 00390
      L76M3790 00391
      L76M3800 00392
      L76M3810 00393
      L76M3820 00394
      L76M3830 00395

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Figure 59. Continued.

GC1=GC2+T1	L76M3840	00396
RSQ(1)=PI*(GC1**2-CC2**2)/(288.*SPAN(I+1))	L76M3850	00397
10005 GC2=GC1	L76M3860	00398
WRITE(6,8826) (RSQ(1),I=1,18)	L76M3870	00399
GO TO 9103	L76M3880	00400
9100 WHITE(6,9104) LSD2	L76M3890	00401
9104 FORMAT(1H0,11HNTRAN ERROR , 5I13)	L76M3900	00402
STOP	L76M3910	00403
9103 IF (COP.EQ.'DRUM') GO TO 114	L76M3920	00404
WRITE (28) ND1	L76M3930	00405
114 CONTINUE	L76M3940	00406
WRITE(28) (SINE(I),I=1,288),BLADES	L76M3950	00407
END FILE 28	L76M3960	00408
LSD2= 1	L76M3970	00409
C *** HARMONIC LOOP	L76M3980	00410
DO 83 M=START,MLIMRN	L76M3990	00411
REWIND 28	L76M4000	00412
FM = FM+1.	L76M4010	00413
C	L76M4017	00414
C CARD L76M4020 BY PASSES HARMONIC GENERATION	L76M4018	00415
C	L76M4019	00416
C IF (COP.EQ.'DRUM') GO TO 111	L76M4020	00417
READ (28) (ND1(I),I=1,7200)	L76M4030	00418
C *** RADIAL STATION LOOP	L76M4040	00419
CALL NTRAN(29,10)	L76M4050	00420
DO 69 K=1,5	L76M4060	00421
IF (IRS(K).EQ.0) GO TO 69	L76M4070	00422
T5=AA/(2.*RR(K)*BLADEL)	L76M4080	00423
C *** AZIMUTHAL LOOP	L76M4090	00424
DO 99 I=1,144	L76M4100	00425
T1=-T5	L76M4110	00426
T2= T5	L76M4120	00427
T3 = (T2-T1)/40.	L76M4130	00428
T6=T1*BLADES*FM	L76M4140	00429
COSRN(1) = COS(T6)	L76M4150	00430
SINRN(1) = SIN(T6)	L76M4160	00431
T6=T2*BLADES*FM	L76M4170	00432
COSRN(41) = COS(T6)	L76M4180	00433
SINRN(41) = SIN(T6)	L76M4190	00434
AZ41(1)=T1	L76M4200	00435
AZ41(41)=T2	L76M4210	00436
L=0	L76M4220	00437
DO 71 J=2,40	L76M4230	00438
T1=T1+T3	L76M4240	00439
T6=T1*BLADES*FM	L76M4250	00440
AZ41(J)=T1	L76M4260	00441
COSRN(J) = COS(T6)	L76M4270	00442
SINRN(J) = SIN(T6)	L76M4280	00443
71 CONTINUE	L76M4290	00444
NT1 = NCH(K)+2	L76M4300	00445
KKK = 1	L76M4310	00446
CHORD(1)=0.	L76M4320	00447
GPSI(1)=0.	L76M4330	00448
DO 72 L=1,5	L76M4340	00449
IF (NCHAN(K,L).EQ.0) GO TO 72	L76M4350	00450
KKK = KKK + 1	L76M4360	00451
CHORD(KKK) = XA(L,K)	L76M4370	00452
GPSI(KKK) = DATA1(I,L,K)	L76M4380	00453
72 CONTINUE	L76M4390	00454
CHORD(KKK+1) = 1.	L76M4400	00455
GPSI(KKK+1) = 0.	L76M4410	00456
C *** THE MEASURED PRESSURE POINTS ALONG THE CHORD ARE INTERPOLATED TO	L76M4420	00457
C 41 POINTS	L76M4430	00458
CHORD2(1)=0.	L76M4440	00459
CHORD2(41) = 1.	L76M4450	00460
AREA = 1./41.	L76M4460	00461

Figure 59. Continued.

9307	CHORD2(L) = CHORD2(L-1) + AREA	L76M4470	00462
	CALL CURVIT(NT1,CHORD,GPST,W,41,CHORD2,GPST2)	L76M4480	00463
	DO 73 L=1,41	L76M4490	00464
73	GPST3(L) = GPST2(L)*COSRN(L)	L76M4500	00465
	CALL AVQUAD(41,AZ41,GPST3,AREA)	L76M4510	00466
	AREA = AREA*T4	L76M4520	00467
2105	IF(LSD2+1) 9100,9105,9106	L76M4530	00468
9106	CALL NTRAH(29,1,1,AREA,LSO2)	L76M4540	00469
	IF(DD.NE.1) GO TO 2741	L76M4550	00470
	IF(1.01.10) GO TO 2741	L76M4560	00471
	IF(K.GT.2) GO TO 2741	L76M4570	00472
	WRITE(6,2742) I,K,M,NT1	L76M4580	00473
2742	FORMAT(1H0,2H1=,15,5X,2H2=,15,5X,2H3=,15,10X,	L76M4590	00474
	X 33 ACOUSTIC PRESSURE PULSE COS TERM ,10X,15)	L76M4600	00475
	WRITE(6,2747) COSRN	L76M4610	00476
	WRITE(6,2747) CHORD	L76M4620	00477
	WRITE(6,2747) GPST	L76M4630	00478
	WRITE(6,2747) CHORD2	L76M4640	00479
	WRITE(6,2747) GPST2	L76M4650	00480
	WRITE(6,2747) T1,T2,T3,T4,T5,GMAR(I,K),AREA,FM	L76M4660	00481
2747	FORMAT(2X,1P10E13,5)	L76M4670	00482
2741	DO 74 L=1,41	L76M4680	00483
74	GPST3(L) = GPST2(L)*SINRN(L)	L76M4690	00484
	CALL AVQUAD(41,AZ41,GPST3,AREA)	L76M4700	00485
	AREA = AREA*T4	L76M4710	00486
9107	IF(LSD2+1) 9100,9107,9108	L76M4720	00487
9108	CALL NTRAH(29,1,1,AREA,LSO2)	L76M4730	00488
	99 CONTINUE	L76M4740	00489
	69 CONTINUE	L76M4750	00490
9200	IF(LSD2+1) 9100,9200,9201	L76M4760	00491
9201	CALL NTRAH(29,10)	L76M4770	00492
	DO 9109 K=1,5	L76M4780	00493
	DO 9109 I=1,144	L76M4790	00494
9110	IF(LSD2+1) 9100,9110,9111	L76M4800	00495
9111	CALL NTRAH(29,2,1,AREA,LSO2)	L76M4810	00496
9112	IF(LSD2+1) 9100,9112,9113	L76M4820	00497
9113	GMAR(I,K)=AREA	L76M4830	00498
	CALL NTRAH(29,2,1,AREA,LSO2)	L76M4840	00499
9114	IF(LSD2+1) 9100,9114,9115	L76M4850	00500
9115	HMAR(I,K) = AREA	L76M4860	00501
9109	CONTINUE	L76M4870	00502
C	CARDS L76M4890 AND L76M4900 STORE NEW HARMONICS ON DRUM	L76M4880	00503
C		L76M4887	00504
C	CALL DATCUR ('GMAR',ID(M),14,GMAR,720)	L76M4888	00505
C	CALL DATCUR ('HMAR',ID(M),14,HMAR,720)	L76M4889	00506
C	GO TO 112	L76M4890	00507
C	CARDS L76M4920 AND L76M4930 READ IN HARMONICS FROM DRUM	L76M4900	00508
C		L76M4910	00509
C	CALL PCFDRD ('GMAR',ID(M),GMAR,720)	L76M4917	00510
C	CALL PCFDRD ('HMAR',ID(M),HMAR,720)	L76M4918	00511
112	CONTINUE	L76M4919	00512
	WRITE(6,76) M	L76M4920	00513
76	FORMAT(1H0,123H COS AND SIN COEFFICIENTS OF ACOUSTIC PRESSURE PULSE	L76M4930	00514
	X AT EACH OF 144 AZIMUTHAL STATIONS AT EACH BLADE STATION FOR HARMOL	L76M4940	00515
	XNIC M=,13)	L76M4950	00516
	DO 77 I=1,5	L76M4960	00517
	WRITE(6,78) I	L76M4970	00518
78	FORMAT(1H0,14H BLADE STATION=,12)	L76M4980	00519
	WRITE(6,56) (GMAR(K,I),K=1,144)	L76M4990	00520
77	WRITE(6,56) (HMAR(K,I),K=1,144)	L76M5000	00521
C ***	THE FOLLOWING SUBR. INTERPOLATES ACOUSTIC PRESSURE PULSE HARMONIC	L76M5010	00522
C	UP TO 288 AZIMUTH AND 20 BLADE STATIONS	L76M5020	00523
	75 IF(DD.NE.1) GO TO 9303	L76M5030	00524
		L76M5040	00525
		L76M5050	00526
		L76M5060	00527

Figure 59. Continued.

CALL CLOCK	L76M5070	00528
9303 CALL INTERP	L76M5080	00529
IF(100,NE,1) GO TO 79	L76M5090	00530
CALL CLOCK	L76M5100	00531
WRITE(6,80) LAZI,LSPAN	L76M5110	00532
80 FORMAT(1H1, 51HINTERPOLATED ACOUSTIC PRESSURE PULSE COEFFICIENTS	L76M5120	00533
X,13,1X,17HHAZIMUTH STATIONS,13,1X,17HBLADE STATIONS) ///	L76M5130	00534
DO 81 I=1,LSPAN	L76M5140	00535
WRITE(6,82) SPAN(I)	L76M5150	00536
82 FORMAT(1H0,11HBLADE SPAN=,F8.2,10X,21HGMARI(J,I),GMARI(J,I))	L76M5160	00537
WRITE(6,56) (GMARI(J,I),J=1,LAZI)	L76M5170	00538
81 WRITE(6,56) (HMARI(J,I),J=1,LAZI)	L76M5180	00539
C *** DOUBLE INTEGRATION FOLLOWS	L76M5190	00540
79 ISI = (DPSI/2.5)*.01	L76M5200	00541
YI = BB/(4.*PI)	L76M5210	00542
C *** FIELD POINT LOOP	L76M5220	00543
DO 83 NFIELD=1,NFT	L76M5230	00544
NFIELD = NFIELD	L76M5240	00545
IF(INTERM,EG,NO) GO TO 84	L76M5250	00546
WRITE(6,85) NFIELD,XFP(NFIELD),YFP(NFIELD),ZFP(NFIELD),H	L76M5260	00547
85 FORMAT(1H1, 12HFIELD POINTS=,I3,5X, 4HXFP=,1PE10.4,5X,4HYFP=,1PE10.4,5X, 4HZFP=,1PE10.4,5X, 11HHARMONIC M=,I3)	L76M5270	00548
C *** SUBR. CUE WILL CALCULATE Q1 AND Q2=Q1*Q2 Q1(288,20),Q2(288,20)	L76M5280	00549
84 READ(28) (SINE(I),I=1,288),BLADES	L76M5290	00550
BACKSPACE 28	L76M5300	00551
CALL CUE(12,FM,NFIELD)	L76M5310	00552
IF(INTERM,EG,NO) GO TO 86	L76M5320	00553
WRITE(6,87) LAZI,LSPAN	L76M5330	00554
87 FORMAT(1H0, 3HQ1(,I3,1H,,I2,1H))	L76M5340	00555
DO 88 I=1,LSPAN	L76M5350	00556
WRITE(6,89) I,XO(I)	L76M5360	00557
89 FORMAT(1H0, 13HSPAN STATION=,I3, 1H(,F6.3,1H))	L76M5370	00558
88 WRITE(6,90) (Q1(J,I),J=1,LAZI)	L76M5380	00559
90 FORMAT(2X,I3(1PE10.3))	L76M5390	00560
C *** THE FOLLOWING LOOP EFFECTS A DOUBLE INTEGRATION WHICH YIELDS THE	L76M5400	00561
C SOUND PRESSURE COMPONENTS UMF(H,NFIELD) AND VMF(H,NFIELD).	L76M5410	00562
86 DO 91 K=1,2	L76M5420	00563
IF(INTERM,EG,NO) GO TO 92	L76M5430	00564
I=K+1	L76M5440	00565
WRITE(6,93) I,LAZI,LSPAN	L76M5450	00566
93 FORMAT(1H0, 1HQ,I1,1H(,I3,1H,,I2,1H))	L76M5460	00567
DO 94 I=1,LSPAN	L76M5470	00568
WRITE(6,89) I,XO(I)	L76M5480	00569
94 WRITE(6,90) (Q2(J,I),J=1,LAZI)	L76M5490	00570
C *** A DOUBLE INTEGRATION IS DONE NEXT.	L76M5500	00571
92 IF(100,NE,1) GO TO 9304	L76M5510	00572
CALL CLOCK	L76M5520	00573
C RING ITEGRATION	L76M5530	00574
IAUDRE=LSPAN-2	L76M5540	00575
AREA=0.	L76M5550	00576
DO 1006 J=1,IAUDRE	L76M5560	00577
GAVR = 0.	L76M5570	00578
DO 1007 I=1,LAZI	L76M5580	00579
GAVR=GAVR+Q2(I,J+1)	L76M5590	00580
10007 GAVR=GAVR+RSO(J)	L76M5600	00581
WRITE(6,10068) J,GAVR	L76M5610	00582
10008 FORMAT(5H RING=,I3,20X,E13.5)	L76M5620	00583
10006 AREA=AREA+GAVR	L76M5630	00584
IF(K,EG,2) GO TO 10009	L76M5640	00585
URING=AREA*T1	L76M5650	00586
GO TO 10010	L76M5660	00587
10009 VRING=AREA*T1	L76M5670	00588
10010 CONTINUE	L76M5680	00589
9304 IAUDRE = LSPAN-1	L76M5690	00590
DO 8820 I=1,LAZI	L76M5700	00591
DEI(I)=0.	L76M5710	00592
	L76M5720	00593

Figure 59. Continued.

```

      DO 8821 J=2,IAUDRE
8821 DBI(I)=DBI(I)+Q2(I,J)
8820 DBI(I)= (DBI(I)+2.*Q2(I,1)+Q2(I,ISPAN))*DELSPN
      DBI(LAZI+1) = DBI(I)
      IF(100.NE.1) GO TO 8825
      WRITE(6,8826) (DBI(I),I=1,145),DELSPN
8826 FORMAT(1H0,1X,10E13.5)
      CALL SIMCOR(LAZI+1,DPRAD,DBI,GAVR,I)
      TEMP1(K)=GAVR
8825 GAVR = 0.
      DO 9701 I=1,LAZI
9701 GAVR=GAVR+DBI(I)
      GAVR=GAVR+DPRAD*T1
      IF(K.EQ.2) GO TO 9703
      UTRAP=GAVR
      GO TO 9702
9703 VTRAP=GAVR
      C SIMPSON S
9702 IF(100.NE.1) GO TO 9305
      GAVR=2.*DELSPN
      DO 10000 I=1,LAZI
      DO 10001 J=1,IAUDRE
10001 AZ41(J)=Q2(I,J+1)
      CALL SIMCOR(IAUDRE,GAVR,AZ41,AREA,J)
10000 DBI(I)=AREA
      DBI(LAZI+1) = DBI(I)
      WRITE(6,8826) (DBI(I),I=1,145),GAVR
      CALL SIMCOR(LAZI+1,DPRAD,DBI,GAVR,I)
      IF(K.EQ.2) GO TO 10002
      VSIMP=GAVR*T1
      GO TO 10003
10002 VSIMP=GAVR*T1
10003 WRITE(6,2222) TEMP1(K),R0,BLADEL,T1,BB
2222 FORMAT(1H0,5E20.6),
      CALL CLOCK
      GAVR=0.
      DO 901 IROMA=1,20
      DO 901 IAUDRE=1,144
901 GAVR=GAVR+Q2(IAUDRE,IROMA)
      GAVR=GAVR/2880.
      WRITE(6,902) GAVR
902 FORMAT(1H0,11H0 AVERAGE= ,1PE20.5)
9305 IF(K.EQ.2) GO TO 91
      C *** SUBR. CUE WILL CALCULATE Q2=G1*Q2
      READ(28) (SINE(I),I=1,288),BLADES
      BACKSPACE 28
      CALL CUE(3,FM,NFIELD)
91 CONTINUE
      XU(M,NFIELD)=UTRAP
      XV(M,NFIELD)=VTRAP
      READ(28) (SINE(I),I=1,288),BLADES
      BACKSPACE 28
      TEMP1(1) = TEMP1(1)*T1
      TEMP1(2) = TEMP1(2)*T1
      IF(100.NE.1) GO TO 95
      WRITE(6,9704)
9704 FORMAT(1H0,85 HTHE FOLLOWING ANSWERS ARE OBTAINED BY USING TRAPAZOL
      XIDAL INTERGRATION ALONG THE BLADE. /
      X 44HAND SIMPSON S INTEGRATION ALONG THE AZIMUTH.
      WRITE(6,96) M,NFIELD,TEMP1(1) ,N,NFIELD,TEMP1(2)
96 FORMAT(1H0, 4HUMF(,I2,1H,,I2,3H) =,1PE10.4,13X,
      X 4HVMF(,I2,1H,,I2,3H) =,1PE10.4 )
      C *** SOUND PRESSURE AND SOUND PRESSURE LEVEL ARE CALCULATED NEXT
95 PMRMS(M,NFIELD) = (1./1.41421356)*SQRT(UTRAP**2+VTRAP**2)
      SPL(M,NFIELD) = 20.*ALOG10(PMRMS(M,NFIELD)/2.9E-09)
      IF(INTERM.EQ.NO) GO TO 31000

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L76M5730 00594
L76M5740 00595
L76M5750 00596
L76M5760 00597
L76M5770 00598
L76M5780 00599
L76M5790 00600
L76M5800 00601
L76M5810 00602
L76M5820 00603
L76M5830 00604
L76M5840 00605
L76M5850 00606
L76M5860 00607
L76M5870 00608
L76M5880 00609
L76M5890 00610
L76M5900 00611
L76M5910 00612
L76M5920 00613
L76M5930 00614
L76M5940 00615
L76M5950 00616
L76M5960 00617
L76M5970 00618
L76M5980 00619
L76M5990 00620
L76M6000 00621
L76M6010 00622
L76M6020 00623
L76M6030 00624
L76M6040 00625
L76M6050 00626
L76M6060 00627
L76M6070 00628
L76M6080 00629
L76M6090 00630
L76M6100 00631
L76M6110 00632
L76M6120 00633
L76M6130 00634
L76M6140 00635
L76M6150 00636
L76M6160 00637
L76M6170 00638
L76M6180 00639
L76M6190 00640
L76M6200 00641
L76M6210 00642
L76M6220 00643
L76M6230 00644
L76M6240 00645
L76M6250 00646
L76M6260 00647
L76M6270 00648
L76M6280 00649
L76M6290 00650
L76M6300 00651
L76M6310 00652
L76M6320 00653
L76M6330 00654
L76M6340 00655
L76M6350 00656
L76M6360 00657
L76M6370 00658
L76M6380 00659

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Figure 59. Concluded.

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WRITE(6,97) M,NFIELD,MHMSIM,NFIELD,M,NFIELD,SPLMIM,NFIELD/
97 FORMAT(1H0, 6HPHMS(,I2,1H,,I2,3H) =,1PE10.4,1H,
X 6H SPLM(,I2,1H,,I2,3H) =,1PE10.4 )
31000 IF(100.NE.1) GO TO 83
WRITE(6,9705)
9705 FORMAT(1H0,95 HTHE FOLLOWING ANSWERS ARE OBTAINED BY USING TRAPAZO
XIDAL INTEGRATION ALONG THE BLADE AND AZIMUTH )
WRITE(6,96) M,NFIELD, P,M,NFIELD,VTRAP
UTRAP=(1./1.41421356)*SQRT(UTRAP**2+VTRAP**2)
VTRAP=20.*ALOG10(UTRAP/2.9E-09)
WRITE(6,97) M,NFIELD,UTRAP,M,NFIELD,VTRAP
WRITE(6,10004)
10004 FORMAT(1H0, 17H SIMPSON, SIMPSON )
WRITE(6,96) M,NFIELD,USIMP,M,NFIELD,VSIMP
USIMP=(1./1.41421356)*SQRT(USIMP**2+VSIMP**2)
VSIMP=20.*ALOG10(USIMP/2.9E-09)
WRITE(6,97) M,NFIELD,USIMP,M,NFIELD,VSIMP
WRITE(6,10011)
10011 FORMAT(1H0, 6H RINGS )
WRITE(6,96) M,NFIELD,URING,M,NFIELD,VRING
URING=(1./1.41421356)*SQRT(URING**2+VRING**2)
VRING=20.*ALOG10(URING/2.9E-09)
WRITE(6,97) M,NFIELD,URING,M,NFIELD,VRING
83 CONTINUE
DO 115 I=1,NFT
WRITE(6,116) I,(XU(J,I),J=1,MLIMRN)
116 FORMAT('OUTRAP VALUES FOR FIELD POINT',I3,'(1P10E13.6)')
WRITE(6,117) I,(XV(J,I),J=1,MLIMRN)
117 FORMAT('OVRTAP VALUES FOR FIELD POINT',I3,'(1P10E13.6)')
115 CONTINUE
DO 98 I=1,MLIMRN
COSARG(1,I)=1.
98 SINARG(1,I)=0.
DT=TOTIME/(NTIME-1)
FAC=BLADES*OMEG*PI/30.*DT
FAC2=0.
DO 100 I=2,NTIME
FAC2=FAC2+FAC
DO 100 J=1,MLIMRN
ARG=FAC2*J
COSARG(1,J)=COS(ARG)
100 SINARG(1,J)=SIN(ARG)
DO 101 I=1,NFT
DO 102 J=1,NTIME
SUM=0.
DO 103 K=1,MLIMRN
103 SUM=SUM+XU(K,I)*COSARG(J,K)+XV(K,I)*SINARG(J,K)
102 P(J)=SUM
101 WRITE(6,104) I,(P(J),J=1,NTIME)
104 FORMAT('OPPRESSURES AT FIELD POINT',I4,'(1P10E13.6)')
C *** THE FOLLOWING SUBR, PRINTS OUT SOUND PRESSURE LEVELS FOR ALL
C CALCULATED HARMONICS.
CALL OUTSPL
IF(100.NE.1) GO TO 105
CALL CLOCK
105 IF(TCOP.NE.'DRUM') GO TO 7
END
91 FOR BLODAT
BLOCK DATA
COMMON /BK1/ 100, BB, AA, XA(5,5), DPSI, RR(5), OMEG, CC, NBLADE, MLIMRN,
* MLIMRN, XFP(20), YFP(20), ZFP(20), GAMMA, HQ, BLADEL, B0, B1C, B1S, PUNCH,
* LSPAN, FROC(30), TCOP, SLOPE(10,5), OFFSET(10,5), KUUNIT(5), IBURST,
* IRS(5), ITRACK(5), FI(5,5), NCHAN(5,5), E3B6OP, NFT, ANG, KEY1, KEY2,
* KEY3, NHH, CAPRF(20), THETA(20), ALFAP(20), OPRONO, NCH(5), INTERM,
* IREEL, NC, NTBDX(5,10), NSTATC(5,10), NSTATR(5,10), ISET(5), IREELS,
* NOCH(5), LAZI
L76M6340 00660
L76M6340 00661
L76M6410 00662
L76M6420 00663
L76M6430 00664
L76M6440 00665
L76M6450 00666
L76M6460 00667
L76M6470 00668
L76M6480 00669
L76M6490 00670
L76M6500 00671
L76M6510 00672
L76M6520 00673
L76M6530 00674
L76M6540 00675
L76M6550 00676
L76M6560 00677
L76M6570 00678
L76M6580 00679
L76M6590 00680
L76M6600 00681
L76M6610 00682
L76M6620 00683
L76M6630 00684
L76M6640 00685
L76M6650 00686
L76M6660 00687
L76M6670 00688
L76M6680 00689
L76M6690 00690
L76M6700 00691
L76M6710 00692
L76M6720 00693
L76M6730 00694
L76M6740 00695
L76M6750 00696
L76M6760 00697
L76M6770 00698
L76M6780 00699
L76M6790 00700
L76M6800 00701
L76M6810 00702
L76M6820 00703
L76M6830 00704
L76M6840 00705
L76M6850 00706
L76M6860 00707
L76M6870 00708
L76M6880 00709
L76M6890 00710
L76M6900 00711
L76M6910 00712
L76M6920 00713
L76M6930 00714
L76M6940 00715
L76M6950 00716
L76M6950 00717
L76B0010 00718
L76B0020 00719
L76B0030 00720
L76B0040 00721
L76B0050 00722
L76B0060 00723
L76B0070 00724
L76B0080 00725

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a. End of E676, Start of BLODAT

Figure 60. Subroutines.

```

COMMON /BK27/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL0(7),XLM(7,40),
* XMM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),
* DPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GMARI(288,20),
* HMARI(288,20),XO(20)
COMMON /BK3/ SPLH(10,20),AZMTH3(288),
* SPAN(20),
* ICHANL(10,5),COSINE(288),SINE(288),BLADES,CARD,TAPE
DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),
* GMAR(144,5),HMAR(144,5)
* Q1(288,20),Q2(288,20)
EQUIVALENCE (ND1(5761),GMAR), (ND1,Q1)
* (GMARI(1551),BN), (HMARI,CN), (HMARI(776),SN), (ND2,Q2)
EQUIVALENCE (ND1(5761),GMAR), (ND1,Q1)
C IRS(I) IS AN INSTRUMENTED RADIAL STATION COUNTER, COUNTING FROM THE
C BLADE ROOT.
C IF IRS(I)=0, THEN THAT STATION IS NO GOOD.
DATA (IRS(I),I=1,5) /1,2,3,4,5/
C NCHAN(I,J) IS AN INSTRUMENTED CHORD STATION COUNTER J FOR EACH RADIAL
C STATION I
C IF CHORD STATION J IS NO GOOD, THEN NCHAN(I,J)=0
DATA (NCHAN(I,J),J=1,5),I=1,5 /1,2,3,0,5, 1,2,3,4,5, 1,2,3,4,5, 1,2,3,4,5,
X 1,2,3,4,5, 1,2,3,4,5/
C NCH(I) IS THE TOTAL NO. OF CHORD STATIONS FOR RADIAL STATION I.
DATA (NCH(I),I=1,5) /5,5,5,5,5/
C F(I,J) GAUSSIAN INTEGRATION FACTORS FOR RADIAL STATION I, CHORD
C STATION J.
DATA (F(I,J),I=1,5),J=1,5 /1,1,1,222,355,222,
X 1,1,1,222,355,222,
X 1,1,1,222,355,222,
DATA (NDIV(I),I=1,4) /0 001 000 000 000, 0 000 001 000 000,
X 0 000 000 001 000, 0 000 000 000 001/ (BMASK(I),I=1,6) /
X 0 777 000 000 000, 0 000 777 000 000, 0 000 000 777 000,
X 0 000 000 000 777, 0 777 777 000 000, 0 000 000 777 777/
X YES/1HT/,NO/1HN/,TAPE/4HTAPE/,CARD/4HCARD/
DATA TEE,BEE,DEE /1HT,1HB,1HD/
END
BI FOR INPUTA
SUBROUTINE INPUTA
C THIS SUBR. RECEIVES CARD INPUT
COMMON /BK1/ IDD,BB,AA,XA(5,5),DPSI,RR(5),ONEG,CC,NBLADE,MLIMRN,
* MLINDP,XFP(20),YFP(20),ZFP(20),GAMA,RO,BLADEL,BG,BIC,BIS,PUNCH,
* LSPAN,FROC(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUHIT(5),IBURST,
* IRS(5),ITRACK(5),F1(5,5),NCHAN(5,5),E386OP,NFT,ANG,KEY1,KEY2,
* KEYS,NMH,CAPRF(20),THETA(20),ALFAF(20),OPRONO,NCH(5),INTERM,
* IREEL,NC,NIBDX(5,10),NSTATC(5,10),NSTATK(5,10),ISET(5),IREELS,
* NOCH(5),LAZI
COMMON /BK2/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL0(7),XLM(7,40),
* XMM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),
* DPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GMARI(288,20),
* HMARI(288,20),XO(20)
COMMON /BK3/ SPLH(10,20),AZMTH3(288),
* SPAN(20),
* ICHANL(10,5),COSINE(288),SINE(288),BLADES,CARD,TAPE
EQUIVALENCE (ND1(5761),HMAR),
* (GMARI,AN),
* (GMARI(1551),BN), (HMARI,CN), (HMARI(776),SN), (ND2,Q2)
DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),
* GMAR(144,5),HMAR(144,5)
* Q1(288,20),Q2(288,20)
EQUIVALENCE (ND1(5761),GMAR), (ND1,Q1)
COMMON /NEW/ FO,F1C,F1S,TOTIME,THETA
INTEGER TCOP,CARD,TAPE,E386OP,YES,OPRONO
READ(5,1) (NN(I),I=1,14)

```

```

L7680090 00720
L7680100 00727
L7680110 00728
L7680120 00729
L7680130 00730
L7680140 00731
L7680150 00732
L7680160 00733
L7680170 00734
L7680180 00735
L7680190 00736
L7680200 00737
L7680210 00738
L7680220 00739
L7680230 00740
L7680240 00741
L7680250 00742
L7680260 00743
L7680270 00744
L7680280 00745
L7680290 00746
L7680300 00747
L7680310 00748
L7680320 00749
L7680330 00750
L7680340 00751
L7680350 00752
L7680360 00753
L7680370 00754
L7680380 00755
L7680390 00756
L7680400 00757
L7680410 00758
L7680420 00759
L7680430 00760
L7680440 00761
L7680450 00762
L7680460 00763
L7610010 00764
L7610020 00765
L7610030 00766
L7610040 00767
L7610050 00768
L7610060 00769
L7610070 00770
L7610080 00771
L7610090 00772
L7610100 00773
L7610110 00774
L7610120 00775
L7610130 00776
L7610140 00777
L7610150 00778
L7610160 00779
L7610170 00780
L7610180 00781
L7610190 00782
L7610200 00783
L7610210 00784
L7610220 00785
L7610230 00786
L7610240 00787
L7610250 00788
L7610260 00789
L7610270 00790

```

b. End of BLODAT, Start of INPUTA

Figure 60. Continued.

```

1 FORMAT( 13A6,A2 )
WRITE(6,2) (NN(I),I=1,14)
2 FORMAT(1H1,25X,13A6,A2)
READ(5,3) BB,AA,BLADEL,GAMA,R0,CC,OMEG,DPSI,NBLADE,MLIMOP,MLIMRN,
* LSPAN,IREELS,TCOP,PUNCH,INTERM,IDD
3 FORMAT( 2E7,2,1Y,1,1,3,1Y,12,1,1Y,1,1,1,1Y,4,2,1Y,1,1,1Y,1,1 )
READ(5,15) RR,XA
15 FORMAT(5F10,0)
READ(5,15) TOTIME,THETA
IF(TCOP,NE,TAPE) GO TO 45
DO 100 I=1,5
DO 100 JJ=1,10
NSTATC(I,JJ) = 100
100 NSTATR(I,JJ) = 100
DO 16 JJ=1,IREELS
READ(5,4) IREEL,ITRACK(IREEL),ISET(IREEL),KUNIT(IREEL)
WRITE(6,77)
X IREEL,ITRACK(IREEL),ISET(IREEL),KUNIT(IREEL)
77 FORMAT( 5I13 )
4 FORMAT(1,2,1X,I2),6X,I2)
NOCH(IREEL)= 0
6 READ(5,5) NC,NTBDX(IREEL,NC),NSTATC(IREEL,NC),NSTATR(IREEL,NC),
* SLOPE(NC,IREEL),OFFSET(NC,IREEL),NCEND
5 FORMAT(2X,I2,1X,A1,2(1X,I1),1X,E13,1,3X,E13,1,39X,I1)
NOCH(IREEL) = NOCH(IREEL)+1
K=NOCH(IREEL)
ICHANL(K,JJ) = NC
IF(NCEND,EQ,0) GO TO 6
16 CONTINUE
READ(5,7) (FROC(J),J=1,30)
7 FORMAT(6E13,1,2X)
45 READ(5,8) E386OP,OPRNO,NFT
8 FORMAT(1X,2(1X,A1),2X,I2)
IF(E386OP,NE,YES)GO TO 9
READ(5,10) ANG,INH,KEY1,KEY2,KEY3
10 FORMAT( E7,0,4(2X,I2) )
9 DO 11 I=1,NFT
IF(E386OP,NE,YES)GO TO 12
READ(5,13) CAPRF(I),THETA F(I),ALFA F(I),XFP(I),YFP(I),ZFP(I)
13 FORMAT( 3E10,1,20X,3E10,1 )
GO TO 11
12 READ(5,14) XFP(I),YFP(I),ZFP(I)
14 FORMAT( 50X,3E10,1 )
11 CONTINUE
C *** NOW THE INPUT IS PRINTED OUT.
WRITE(6,20) BB,R0,AA,CC,BLADEL,OMEG,DPSI,GAMA
20 FORMAT(1H0,1X, 28HBLADE THICKNESS (IN) = , E10,4, 8X,
1 35HZERO TWIST BLADE STA. (IN) = , E10,4 // 2X,
2 28HBLADE CHORD (IN) = ,E10,4, 8X,35HSPEED OF SOUND
3 (IN/SEC) = ,E10,4 // 2X,28HBLADE LENGTH (IN) =
3 , E10,4,8X,
4 35HROTOR ROT. SPEED (RPM) = ,E10,4 // 48X,35HAZIMUTH
5 INCREMENT (DEG) = ,E10,4 / 2X, 28HBLADE TWIST RATE (DEG/L7610790
6 IN) = ,E10,4 )
WRITE(6,21) NBLADE,TCOP,MLIMOP,PUNCH,MLIMRN,INTERM,LSPAN,IREELS
21 FORMAT(10 NUMBER OF BLADES,32X,= 12,14X,TAPE / CARD / DRUM OPTIO
5N'7X'= 'A4//2X 49HNO. OF HARMONICS TO REPRESENT PREL7610830
25SURE CYCLES = , 13, 14X, 35HPRESSURE HARMONIC PUNCH OPTION =L7610840
3 , A1 // 2X, 28HNO. OF ROTOR NOISE HARMONICS, 20X,2H= , 12, 14X,
4 26HINTERMEDIATE OUTPUT OPTION, 7X, 2H= , A1 // 2X, 33HNO. OF INTEL7610860
5RPOLATED SPAN STATIONS, 15X, 2H= , 12 // 2X, 23HTOTAL NO. OF TAPE7610870
6REELS, 25X,2H= , 12 / )
WRITE(6,17) THETA,TOTIME
17 FORMAT(10COMBINED ROTOR SHAFT INCLINATION AND FUSELAGE PITCH ATTITL7610900
%UDE = 'E10,4,' DEGREES'/10TOTAL TIME FOR ACOUSTIC PRESSURE COMPUTL7610910
SATIONS IS 'E10,4,' SECONDS')
L7610920

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c. INPUTA Continued

Figure 60. Continued.

* IRS(5), ITRACK(5), FI(5,5), NCHAN(5,5), E386OP, NFT, ANG, KEY1, KEY2,	L76R0060	00924
* KEY3, NHH, CAPRF(20), THETAF(20), ALFAF(20), OPRONO, NCH(5), INTER,	L76R0070	00925
* IREEL, NC, NTBDX(5,10), NSTATC(5,10), NSTATR(5,10), ISET(5), IREELS,	L76R0080	00926
* NOCH(5), LAZI	L76R0090	00927
COMMON /BK2/ NCYCLE, CYCLES, KU, NDIV(4), BMASK(6), NN(435), LIRS,	L76R0100	00928
* KTRACK, KBURST, KREC, ND1(144,10,5), ND2(144,10,5), XLO(7), XLM(7,40),	L76R0110	00929
* XMM(7,40), TEMP1(7), TEMP2(7), TEMP3(7), P1, AZMTH2(144), AZMTH(144),	L76R0120	00930
* DPRAD, AZRAD, NO, YES, NBLANK, TEE, DEE, DEE, GMARI(288,20),	L76R0130	00931
* HMARI(288,20), XO(20)	L76R0140	00932
DIMENSION CN(31,5,5), SN(30,5,5), AN(31,10,5), RN(30,10,5),	L76R0150	00933
* GMAR(144,5), HMAR(144,5)	L76R0160	00934
DIMENSION NNPS(219)	L76R0170	00935
EQUIVALENCE (ND2(5761), HMAR),	L76R0180	00936
5 (GMARI, AN),	L76R0190	00937
* (GMARI(1551), BN), (HMARI, CN), (HMARI(776), SN)	L76R0200	00938
EQUIVALENCE (FTRACK, KTRACK), (FURST, KBURST), (FREC, KREC)	L76R0210	00939
EQUIVALENCE (ND1(5761), GMAR)	L76R0220	00940
GO TO (1,2), N	L76R0230	00941
1 LIM1 = 1	L76R0240	00942
LIM2 = 219	L76R0250	00943
GO TO 3	L76R0260	00944
2 LIM1 = 217	L76R0270	00945
LIM2 = 435	L76R0280	00946
3 I=KU-7	L76R0290	00947
GO TO (4,5,6,7,8), I	L76R0300	00948
4 READ(8) (NN(I), I=LIM1, LIM2)	L76R0310	00949
GO TO 9	L76R0320	00950
5 READ(9) (NN(I), I=LIM1, LIM2)	L76R0330	00951
GO TO 9	L76R0340	00952
6 READ(10) (NN(I), I=LIM1, LIM2)	L76R0350	00953
GO TO 9	L76R0360	00954
7 READ(11) (NN(I), I=LIM1, LIM2)	L76R0370	00955
GO TO 9	L76R0380	00956
8 READ(12) (NN(I), I=LIM1, LIM2)	L76R0390	00957
READ (13) (NNPS(I), I=1, 219)	L76R0400	00958
I=-1	L76R0410	00959
DO 20 J=LIM1, LIM2, 3	L76R0420	00960
I=I+3	L76R0430	00961
20 NN(J)=NNPS(I)	L76R0440	00962
9 FTRACK = AND(NN(LIM2-2), BMASK(6))	L76R0450	00963
FBURST = AND(NN(LIM2-1), BMASK(6))	L76R0460	00964
FREC = AND(NN(LIM2), BMASK(6))	L76R0470	00965
IF (IOD, EO, 1)	L76R0480	00966
XWRITE(6,10) (NN(I), I=LIM1, LIM2)	L76R0490	00967
10 FORMAT(1H0, 19H(NN(I), I=LIM1, LIM2) / (2X,10013))	L76R0500	00968
RETURN	L76R0510	00969
END	L76R0520	00970
Q1 FOR UNPACK		00971
SUBROUTINE UNPACK	L76U0010	00972
C *** THIS SUBR. UNPACKS A CYCLE NN(435) TO FORM THE ARRAY	L76U0020	00973
C NO1(144,10, IREEL)	L76U0030	00974
C WHERE THE FIRST SUBSCRIPT REPRESENTS AZIMUTH, AND THE SECOND ARRAY	L76U0040	00975
C REPRESENTS CHANNEL NO.	L76U0050	00976
COMMON /BK1/ IOD, BB, AA, XA(5,5), OPSI, RR(5), ONEG, CC, NBLADE, MLIMRN,	L76U0060	00977
* MLINDP, XFP(20), YFP(20), ZFP(20), GAMAR, RO, BLADEL, BO, BIC, B1S, PUNCH,	L76U0070	00978
* LSPAN, FROC(30), TCOP, SLOPE(10,5), OFFSET(10,5), KUNIT(5), IBURST,	L76U0080	00979
* IRS(5), ITRACK(5), FI(5,5), NCHAN(5,5), E386OP, NFT, ANG, KEY1, KEY2,	L76U0090	00980
* KEY3, NHH, CAPRF(20), THETAF(20), ALFAF(20), OPRONO, NCH(5), INTER,	L76U0100	00981
* IREEL, NC, NTBDX(5,10), NSTATC(5,10), NSTATR(5,10), ISET(5), IREELS,	L76U0110	00982
* NOCH(5), LAZI	L76U0120	00983
COMMON /BK2/ NCYCLE, CYCLES, KU, NDIV(4), BMASK(6), NN(435), LIRS,	L76U0130	00984
* KTRACK, KBURST, KREC, ND1(144,10,5), ND2(144,10,5), XLO(7), XLM(7,40),	L76U0140	00985
* XMM(7,40), TEMP1(7), TEMP2(7), TEMP3(7), P1, AZMTH2(144), AZMTH(144),	L76U0150	00986
* DPRAD, AZRAD, NO, YES, NBLANK, TEE, DEE, DEE, GMARI(288,20),	L76U0160	00987
* HMARI(288,20), XO(20)	L76U0170	00988
EQUIVALENCE (ND2(5761), HMAR),	L76U0180	00989

e. End of RDKU, Start of UNPACK

Figure 60. Continued.

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      * (GMARI(1551),BN), (HMARI,CN), (HMAPI(776),SN)
      DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),
      * GMARI(144,5),HMAR(144,5)
      EQUIVALENCE (ND1(5761),GMAR)
      DATA SIN/O 400 000 000 000/
      EQUIVALENCE (V2,IV2)
      WRITE(6,6) NN
      A FORMAT(2X,10U10)
      NW = 0
C *** AZIMUTH POINT LOOP
      DO 1 I=1,144
      NCT = 0
C *** WORDS IN A FRAME LOOP
      DO 1 J=1,3
      NW = NW+1
      N10 = 5
C *** DATA WORDS TO UNPACK LOOP
      DO 1 K=1,4
      N10 = N10-1
      IF(J.EQ.3.AND.K.GT.2) GO TO 1
      NCT = NCT+1
      N1 = NN(NW)
      IF(K.EQ.1) GO TO 2
      N1 = N1*NDIV(N10)
      2 N1 = N1/NDIV(1)
      IV2=N1
      V2=AND(V2,SIN)
      IV2=IV2/2
      IF(IV2.NE.0) N1=N1-1
      ND1(I,NCT,IREEL) = N1
      1 CONTINUE
      IF(100.NE.1.AND.NCYCLE.GT.0) RETURN
      WRITE(6,5) IREEL, (ND1(I,K,IREEL),K=1,10)
      5 FORMAT(1H0, 6HIREEL=,13,10X,
      X 10HND1(144,10,IREEL) /2X,10I13)
      RETURN
      END
DI FOR MERGES
      SUBROUTINE MERGES
C *** THIS SUBR. PRODUCES DIFFERENTIAL PRESSURES FROM ABSOLUTE TOP AND
      C BOTTOM READINGS.
      COMMON /BK1/ IDD,BB,AA,XA(5,5),DPS1,RR(5),OMEG,CC,NBLADE,MLIMRN,
      * MLINDP,XFP(20),YFP(20),ZFP(20),GAMA,R0,BLADEL,B0,B1C,B1S,PUNCH,
      * LSPAN,FROC(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,
      * IRS(5),ITRACK(5),FI(5,5),NCHAN(5,5),E3860P,NFT,ANG,KEY1,KEY2,
      * KEY3,NHH,CAPRF(20),THETAF(20),ALFAF(20),OPRONO,NCH(5),INTERM,
      * IREEL,NC,NTBDX(5,10),NSTATC(5,10),NSTATR(5,10),ISCT(5),IREELS,
      * NOCH(5),LAZI
      COMMON /NEW/ F0,F1C,F1S
      COMMON /BK2/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NM(435),LIRS,
      * KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL0(7),XLM(7,40),
      * XMM(7,40),TEMP(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),
      * DPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GMARI(288,20),
      * HMARI(288,20),X0(20)
      DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),
      * GMAR(144,5),HMAR(144,5)
      EQUIVALENCE (ND2(5761),HMAR),
      * (GMARI,AN),
      * (GMARI(1551),BN), (HMARI,CN), (HMAPI(776),SN)
      EQUIVALENCE (ND1(5761),GMAR)
      INTEGER DEE,BEE
      DO 1 I=1,5
      DO 1 J=1,5
      CN(I,1,J) = 0.0
      DO 1 K=1,30

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L76U0190 00990
L76U0200 00991
L76U0210 00992
L76U0220 00993
L76U0230 00994
L76U0240 00995
L76U0250 00996
L76U0260 00997
L76U0270 00998
L76U0280 00999
L76U0290 01000
L76U0300 01001
L76U0310 01002
L76U0320 01003
L76U0330 01004
L76U0340 01005
L76U0350 01006
L76U0360 01007
L76U0370 01008
L76U0380 01009
L76U0390 01010
L76U0400 01011
L76U0410 01012
L76U0420 01013
L76U0430 01014
L76U0440 01015
L76U0450 01016
L76U0460 01017
L76U0470 01018
L76U0480 01019
L76U0490 01020
L76U0500 01021
L76U0510 01022
L76U0520 01023
L76U0530 01024
L76U0540 01025
L76U0550 01026
L76U0560 01027
L76G0010 01028
L76G0020 01029
L76G0030 01030
L76G0040 01031
L76G0050 01032
L76G0060 01033
L76G0070 01034
L76G0080 01035
L76G0090 01036
L76G0100 01037
L76G0110 01038
L76G0120 01039
L76G0130 01040
L76G0140 01041
L76G0150 01042
L76G0160 01043
L76G0170 01044
L76G0180 01045
L76G0190 01046
L76G0200 01047
L76G0210 01048
L76G0220 01049
L76G0230 01050
L76G0240 01051
L76G0250 01052
L76G0260 01053
L76G0270 01054
L76G0280 01055

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f. End of UNPACK, Start of MERGES

Figure 60. Continued.

CN(K+1,I,J) = 0.0	L7600280	01056
1 SN(K,I,J) = 0.0	L7600290	01057
C *** SPAN LOOP	L7600300	01058
ISWTCM=0	L7600310	01059
DO 2 I=1,5	L7600320	01060
C *** CHORD LOOP	L7600330	01061
DO 2 J=1,5	L7600340	01062
ISW = 0	L7600350	01063
IRFEL = 0	L7600360	01064
3 IREEL = IRFEL+1	L7600370	01065
IF (IREEL.GT. 5) GO TO 2	L7600380	01066
NC = 0	L7600390	01067
4 NC = NC+1	L7600400	01068
IF(1DD.NE.1) GO TO 25	L7600410	01069
WRITE(6,20) I,J,NC,IREEL,NSTATR(IREEL,NC),NSTATC(IREEL,NC),	L7600420	01070
X NTBDX(IREEL,NC)	L7600430	01071
20 FORMAT(6I13,5X,A6)	L7600440	01072
25 IF(NC.GT.10) GO TO 3	L7600450	01073
IF(NSTATR(5,2).EQ.0 .AND. IREEL.EQ.5 .AND. NC.EQ.2) GO TO 5	L7600460	01074
IF(NSTATR(5,3).EQ.0 .AND. IREEL.EQ.5 .AND. NC.EQ.3) GO TO 55	L7600470	01075
15 IF(NSTATR(IREEL,NC).NE.1) GO TO 4	L7600480	01076
IF(NSTATC(IREEL,NC).NE.J) GO TO 4	L7600490	01077
IF(NTBDX(IREEL,NC).EQ.DEE) GO TO 6	L7600500	01078
IF(NTBDX(IREEL,NC).EQ.BEE) GO TO 7	L7600510	01079
IRTOP = IREEL	L7600520	01080
NCTOP = NC	L7600530	01081
ISW = ISW+1	L7600540	01082
GO TO 8	L7600550	01083
7 IRBOT = IREEL	L7600560	01084
NCBOT = NC	L7600570	01085
ISW = ISW+1	L7600580	01086
8 IF(ISW.NE.2) GO TO 4	L7600590	01087
CN(1,J,I) = AN(1,NCBOT,IRBOT) - AN(1,NCTOP,IRTOP)	L7600600	01088
DO 10 K=1,30	L7600610	01089
CN(K+1,J,I) = AN(K+1,NCBOT,IRBOT) - AN(K+1,NCTOP,IRTOP)	L7600620	01090
10 SN(K,J,I) = BN(K,NCBOT,IRBOT) - BN(K,NCTOP,IRTOP)	L7600630	01091
GO TO 2	L7600640	01092
C *** COLLECTIVE, LONGITUDINAL CYCLIC, AND LATERAL CYCLIC PITCH ANGLES	L7600650	01093
C FOUND NEXT.	L7600660	01094
5 CONTINUE	L7600670	01095
B0 = AN(1,2,5)	L7600680	01096
B1C = AN(2,2,5)	L7600690	01097
B1S = BN(1,2,5)	L7600700	01098
IF (1DD.EQ. 1) WRITE(6,21) B0,B1C,B1S,IREEL,NC,I,J	L7600710	01099
GO TO 4	L7600720	01100
55 CONTINUE	L7600730	01101
F0 = AN(1,3,5)	L7600740	01102
F1C = AN(2,3,5)	L7600750	01103
F1S = BN(1,3,5)	L7600760	01104
IF (1DD.EQ. 1) WRITE(6,21) F0,F1C,F1S,IREEL,NC,I,J	L7600770	01105
21 FORMAT('7G13.6)	L7600780	01106
GO TO 4	L7600790	01107
6 CN(1,J,I) = AN(1,NC,IREEL)	L7600800	01108
DO 11 K=1,30	L7600810	01109
CN(K+1,J,I) = AN(K+1,NC,IREEL)	L7600820	01110
11 SN(K,J,I) = BN(K,NC,IREEL)	L7600830	01111
2 CONTINUE	L7600840	01112
RETURN	L7600850	01113
END	L7600860	01114
DI FOR DFSRIE	L7600010	01115
SUBROUTINE DFSRIE(NP,NH,Y,A,B)	L7600020	01116
DIMENSION Y(NP),A(1),B(1)	L7600030	01117
C -----	L7600040	01118
C NUMBER OF HARMONICS MUST NOT EXCEED HALF	L7600050	01119
C THE NUMBER OF DATA POINTS INPUTED.	L7600060	01120
C -----		01121

g. End of MERGES, Start of DFSRIE

Figure 60. Continued.

NNH=MINO(NH,NP/2)	L76D0070	01122
C-----	L76D0080	01123
C INITIALIZATION AND CONSTANTS,	L76D0090	01124
C-----	L76D0100	01125
SP=0.	L76D0110	01126
CP=1.	L76D0120	01127
RN=2./NP	L76D0130	01128
PI=PI/180.	L76D0140	01129
A(1)=0.	L76D0150	01130
ARG=RN*3.14159265	L76D0160	01131
C=COS(ARG)	L76D0170	01132
S=SIN(ARG)	L76D0180	01133
C-----	L76D0190	01134
C COMPUTE A FOR THE ZEROth HARMONIC	L76D0200	01135
C-----	L76D0210	01136
DO10 I=1,NP	L76D0220	01137
A(1)=A(1)+Y(I)	L76D0230	01138
A(1)=RN*A(1)/2.	L76D0240	01139
C-----	L76D0250	01140
C MAIN LOOP.	L76D0260	01141
C-----	L76D0270	01142
DO 100 K=1,NNH	L76D0280	01143
X=C*CP-S*SP	L76D0290	01144
SP=C*SP+S*CP	L76D0300	01145
CP=X	L76D0310	01146
U=0.	L76D0320	01147
V=0.	L76D0330	01148
C COMPUTE RECURSIVE U,S	L76D0340	01149
DO20 J=2,NP	L76D0350	01150
J=NP-J+2	L76D0360	01151
W=Y(J)+2.*CP*V-U	L76D0370	01152
U=V	L76D0380	01153
V=W	L76D0390	01154
20 A(K+1)=RN*(Y(1)+CP*V-U)	L76D0400	01155
100 B(K+1)=RN*SP*V	L76D0410	01156
RETURN	L76D0420	01157
END	L76D0430	01158
Q1 FOR CUE		01159
SUBROUTINE CUE(N,FN,MFIELD)	L76C0010	01160
COMMON /BK1/ ID,BB,AA,XA(5,5),DPS1,RR(5),OMEG,CC,NBLADE,MLIMRN,	L76C0020	01161
* MLINDP,XFP(20),YFP(20),ZFP(20),GAMA,R0,BLADEL,B0,B1C,B1S,PUNCH,	L76C0030	01162
* LSPAN,FROC(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,	L76C0040	01163
* IRS(5),ITRACK(5),FI(5,5),NCHAN(5,5),E386OP,NFT,ANG,KEY1,KEY2,	L76C0050	01164
* KEY3,NNH,CAPRF(20),THETAF(20),ALFAF(20),OPRONO,NCH(5),INTERM,	L76C0060	01165
* IREEL,NC,NTBOX(5,10),NSTATC(5,10),NSTATR(5,10),ISET(5),IREELS,	L76C0070	01166
* NOCH(5),LAZI	L76C0080	01167
COMMON /BK2/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,	L76C0090	01168
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XLQ(7),XLM(7,40),	L76C0100	01169
* XMM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),	L76C0110	01170
* DPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GMARI(288,20),	L76C0120	01171
* HMARI(288,20),X0(20)	L76C0130	01172
COMMON /BK3/ SPLM(10,20),AZMTH3(288),	L76C0140	01173
* SPAN(20),	L76C0150	01174
* ICHANL(10,5),COSINE(288),SINE(288),BLADES,CARD,TAPE	L76C0160	01175
EQUIVALENCE (ND2(5761),HMAR),	L76C0170	01176
S (GMARI,AN),	L76C0180	01177
* (GMARI(1551),BN),(HMARI,CN),(HMARI(776),SN),(ND2,Q2)	L76C0190	01178
DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),	L76C0200	01179
* GMAR(144,5),HMAR(144,5)	L76C0210	01180
* ,Q1(288,20),Q2(288,20)	L76C0220	01181
EQUIVALENCE (ND1(5761),GMAR),(ND1,Q1)	L76C0230	01182
COMMON /NEW/ F0,F1C,F1S,TOTIME,THETA	L76C0240	01183
GAMMA(J) = (F0 + F1C*COSINE(J) + F1S*SINE(J)) * TS	L76C0250	01184
TI=PI/30.	L76C0260	01185
TS=PI/180.	L76C0270	01186
THETAR=THETA*TS	L76C0280	01187

h. End of DFSRIE, Start of CUE

Figure 60. Continued.

```

C *** SPAN LOOP
IF (IDD.NE.1) GO TO 7
WRITE(6,3) XFP
WRITE(6,3) YFP
WRITE(6,3) ZFP
WRITE(6,3) SPAN
WRITE(6,3) COSINE
WRITE(6,3) SINE
WRITE(6,3) AZMTH3
WRITE(6,3) OMEG,CC,GAMA,RO,BQ,B1C,B1S,FM,BLADES,T1,T5
3 FORMAT(1H0,12X,1P10E13.5)
7 DO 1 I=1, LSPAN
C *** AZIMUTH LOOP
DO 1 J=1, LAZI
S = SQRT((XFP(MFIELD)-SPAN(I)*COSINE(J))**2 + (YFP(MFIELD)-SPAN(I)*SINE(J))**2)
X = SINE(J)**2 + ZFP(MFIELD)**2
B = (BQ - GAMA*(SPAN(I)-RO) + B1C*COSINE(J) + B1S*SINE(J))*T5
SINB = SIN(B)
COSB = COS(B)
T4 = FM*BLADES*(AZMTH3(J)+(S+OMEG*T1)/CC)
T2 = COS(T4)
T3 = SIN(T4)
T4 = (FM*BLADES*OMEG/(CC*S**2))*T1
IF (N.EQ.3) GO TO 2
Q1(J,I) = SPAN(I)
* ( (XFP(MFIELD) - SPAN(I)*COSINE(J))
* ( (SINB*SINE(J) - COSB*SIN(GAMMA(J))*COSINE(J))
* COS(THETAR) )
+ COSB*COS(GAMMA(J))*SIN(THETAR) )
- (YFP(MFIELD) - SPAN(I)*SINE(J))
* (SINB*COSINE(J)
+ COSB*SIN(GAMMA(J))*SINE(J) )
+ ZFP(MFIELD) * ( COSB*COS(GAMMA(J))*COS(THETAR)
+ (COSB*SIN(GAMMA(J))*COSINE(J)
- SINB*SINE(J))*SIN(THETAR) ) )
Q2(J,I) = Q1(J,I)*(GMARI(J,I)*(-T2/S**3 - T4*T3) +
X HMARI(J,I)*(T3/S**3 - T4*T2))
IF (IDD.NE.1) GO TO 1
IF (I.GT.2) GO TO 1
IF (J.GT.20) GO TO 1
WRITE(6,4) I,J,MFIELD
4 FORMAT(1H0,6I13)
WRITE(6,3) S,B,SINB,COSB,T2,T3,T4,GMARI(J,I),HMARI(J,I)
X Q1(J,I),Q2(J,I)
GO TO 1
2 Q2(J,I) = Q1(J,I)*(GMARI(J,I)*(-T3/S**3 + T4*T2) +
X HMARI(J,I)*(T2/S**3 - T4*T3))
1 CONTINUE
RETURN
END
B1 FOR INTERP
SUBROUTINE INTERP
C *** THIS SUBR. INTERPOLATES PRESSURE PULSE HARMONICS FOR UP TO 20 SPANL
C STATIONS AND 288 AZIMUTHS.
COMMON /BK1/ IDD,BB,AA,XA(5,5),DPS1,RR(5),OMEG,CC,NBLADE,MLIMRN,
* MLIMOP,XFP(20),YFP(20),ZFP(20),GAMA,RO,BLADL,BQ,B1C,B1S,PUNCH,
* LSPAN,PROC(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,
* IRS(5),ITRACK(5),FI(5,5),NCHAN(5,5),E3B6OP,NFT,ANG,KEY1,KEY2,
* KEY3,NMH,CAPRF(20),THETA(20),ALFA(20),OPRONG,NCH(5),INTERP,
* IREEL,NC,NTBOX(5,10),NSTATC(5,10),NSTATR(5,10),YSET(5),IREELS,
* NOCH(5),LAZI
COMMON /BK2/ NCYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL0(7),XLM(7,40),
* XNM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),
* OPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GMARI(288,20),
* HMARI(288,20),XG(20)
L76C0290 01188
L76C0300 01189
L76C0310 01190
L76C0320 01191
L76C0330 01192
L76C0340 01193
L76C0350 01194
L76C0360 01195
L76C0370 01196
L76C0380 01197
L76C0390 01198
L76C0400 01199
L76C0410 01200
L76C0420 01201
L76C0430 01202
L76C0440 01203
L76C0450 01204
L76C0460 01205
L76C0470 01206
L76C0480 01207
L76C0490 01208
L76C0500 01209
L76C0510 01210
L76C0520 01211
L76C0530 01212
L76C0540 01213
L76C0550 01214
L76C0560 01215
L76C0570 01216
L76C0580 01217
L76C0590 01218
L76C0600 01219
L76C0610 01220
L76C0620 01221
L76C0630 01222
L76C0640 01223
L76C0650 01224
L76C0660 01225
L76C0670 01226
L76C0680 01227
L76C0690 01228
L76C0700 01229
L76C0710 01230
L76C0720 01231
L76C 01232
L76C0730 01233
L76C0740 01234
L76C0750 01235
L76C0760 01236
L76C0770 01237
01238
L76P0010 01239
L76P0020 01240
L76P0030 01241
L76P0040 01242
L76P0050 01243
L76P0060 01244
L76P0070 01245
L76P0080 01246
L76P0090 01247
L76P0100 01248
L76P0110 01249
L76P0120 01250
L76P0130 01251
L76P0140 01252
L76P0150 01253

```

1. End of CUE, Start of INTERP

Figure 60. Continued.

```

DIMENSION CN(10,5),SRT(10,5),AN(10,5),EN(10,5)
* GMAR(144,5),HMAR(144,5)
EQUIVALENCE (ND2(5761),HMAR),
5 (GMAR,AN),
* (GMAR(1551),BN),(HMAR,CN),(HMAR(776),SN)
EQUIVALENCE (ND1(5761),GMAR)
DIMENSION YO(20)
T1 = .2305
T2 = .7695
C *** WE FIRST DEFINE THE RADIAL STATION GRID XO(20)
XO(1) = T1
XO(LSPAN) = 1.
K=LSPAN-1
DEL=K
DEL = T2/DEL
DO 1 J=2,K
1 XO(J)=XO(J-1)+DEL
KKK = 1
TEMP1(1) = 0.
TEMP3(1) = 0.
TEMP2(1) = T1
C *** RADIAL STATION LOOP (ZERO AZIMUTH BEGIN)
DO 2 K=1,5
IF(IRS(K),EQ.0) GO TO 2
KKK = KKK+1
TEMP1(KKK) = GMAR(1,K)
TEMP3(KKK) = HMAR(1,K)
TEMP2(KKK) = RR(K)
2 CONTINUE
NOPTS1 = KKK+1
TEMP1(NOPTS1) = 0.
TEMP3(NOPTS1) = 0.
TEMP2(NOPTS1) = 1.
CALL CURVIT(NOPTS1,TEMP2,TEMP1,W,LSPAN,XO,YO)
DO 3 K=1,LSPAN
3 GMAR(1,K) = YO(K)
CALL CURVIT(NOPTS1,TEMP2,TEMP3,W,LSPAN,XO,YO)
DO 4 K=1,LSPAN
4 HMAR(1,K) = YO(K)
D = (DPSI/2.5) + .00001
ISI = 0
JJ = ISI
JAZ2 = 1
J = 3
ISI2=ISI
IF(ISI,EO,0) ISI2=1
LOW = ISI2+1
C *** AZIMUTH LOOP
DO 5 JAZ=LOW,144,ISI2
JAZ2 = JAZ2+1
KKK=1
DO 6 K=1,5
IF(IRS(K),EQ.0) GO TO 6
KKK = KKK+1
TEMP1(KKK) = GMAR(JAZ,K)
TEMP3(KKK) = HMAR(JAZ,K)
6 CONTINUE
CALL CURVIT(NOPTS1,TEMP2,TEMP1,W,LSPAN,XO,YO)
IF(ISI,GE,1) J=JAZ2
DO 7 K=1,LSPAN
7 GMAR(J,K) = YO(K)
CALL CURVIT(NOPTS1,TEMP2,TEMP3,W,LSPAN,XO,YO)
DO 8 K=1,LSPAN
8 HMAR(J,K) = YO(K)
IF(JJ,NE,0) GO TO 5
DO 9 K=1,LSPAN

```

```

L76P0160 01254
L76P0170 01255
L76P0180 01256
L76P0190 01257
L76P0200 01258
L76P0210 01259
L76P0220 01260
L76P0230 01261
L76P0240 01262
L76P0250 01263
L76P0260 01264
L76P0270 01265
L76P0280 01266
L76P0290 01267
L76P0300 01268
L76P0310 01269
L76P0320 01270
L76P0330 01271
L76P0340 01272
L76P0350 01273
L76P0360 01274
L76P0370 01275
L76P0380 01276
L76P0390 01277
L76P0400 01278
L76P0410 01279
L76P0420 01280
L76P0430 01281
L76P0440 01282
L76P0450 01283
L76P0460 01284
L76P0470 01285
L76P0480 01286
L76P0490 01287
L76P0500 01288
L76P0510 01289
L76P0520 01290
L76P0530 01291
L76P0540 01292
L76P0550 01293
L76P0560 01294
L76P0570 01295
L76P0580 01296
L76P0590 01297
L76P0600 01298
L76P0610 01299
L76P0620 01300
L76P0630 01301
L76P0640 01302
L76P0650 01303
L76P0660 01304
L76P0670 01305
L76P0680 01306
L76P0690 01307
L76P0700 01308
L76P0710 01309
L76P0720 01310
L76P 01311
L76P0730 01312
L76P0740 01313
L76P0750 01314
L76P0760 01315
L76P0770 01316
L76P0780 01317
L76P0790 01318
L76P0800 01319

```

j. INTERP Continued

Figure 60. Continued.

MMARI(J-1,K) = (MMARI(J,K)+MMARI(J-2,K))/2.	L76P0810	01320
9 MMARI(J-1,K) = (MMARI(J,K)+MMARI(J-2,K))/2.	L76P0820	01321
J=J+2	L76P0830	01322
5 CONTINUE	L76P0840	01323
IF(JJ.NE.0) RETURN	L76P0850	01324
J=J-2	L76P0860	01325
DO 10 K=1,LSPAN	L76P0870	01326
MMARI(J+1,K) = (MMARI(J,K) + MMARI(J-1,K))/2.	L76P0880	01327
10 MMARI(J+1,K) = (MMARI(J,K) + MMARI(J-1,K))/2.	L76P0890	01328
RETURN	L76P0900	01329
END	L76P0910	01330
BI FOR CURVIT		01331
SUBROUTINE CURVIT (MM, X9, Y9, W, N, X0, Y0)	L76V0010	01332
C	L76V0020	01333
C	L76V0030	01334
C PRESENTLY W IS NOT USED IN THIS ROUTINE. HOWEVER, IT SHOULD BE	L76V0040	01335
C DIMENSIONED IN THE CALLING PROGRAM.	L76V0050	01336
C	L76V0060	01337
C * W WILL BE USED LATER FOR A WORK VECTOR. -- COEF'S DIMENSION	L76V0070	01338
C***** WILL BE CHANGED ALSO.--SO FOR NOW ASSUME THE INPUT IS SORTED*****	L76V0080	01339
C	L76V0090	01340
C DIMENSION X(14),Y(7), W(1), X0(1), Y0(1), CUBE(5), ROOT(3),	L76V0100	01341
C * ROOT(1), X9(1), Y9(1)	L76V0110	01342
C COMMON /COTAN/ TIN(7,2), COEF(4, 7,2)	L76V0120	01343
DO 1 I=1,MM	L76V0130	01344
X(I) = X9(I)	L76V0140	01345
X(I+7) = Y9(I)	L76V0150	01346
1 Y(I) = Y9(I)	L76V0160	01347
IF (MM .GE. 2) GO TO 10	L76V0170	01348
IF (MM .EQ. 0) Y = 0.	L76V0180	01349
DO 5 I=1+N	L76V0190	01350
5 Y0(I) = Y	L76V0200	01351
WRITE (6,100) (X0(I), Y0(I), I=1,N)	L76V0210	01352
100 FORMAT (94H0 PROBLEM WITH CURVE FITS (CURVIT) - LESS THAN TWO POIL	L76V0220	01353
NTS ON THIS CURVE. - INPUT X OUTPUT Y, /172X, 2E11.4, /)	L76V0230	01354
RETURN	L76V0240	01355
10 CALL PARAM (MM, X, 2)	L76V0250	01356
DO 90 J=1,N	L76V0260	01357
TUM1=1	L76V0270	01358
DO 20 I=1,MM	L76V0280	01359
K=I-1	L76V0290	01360
20 IF(X0(J) .LT. X(I)) GO TO 30	L76V0300	01361
IF(X0(J) .EQ. X(I)) GO TO *8	L76V0310	01362
TUM1=-1	L76V0320	01363
I= MM	L76V0330	01364
25 TUM1=-TUM1	L76V0340	01365
SLOPE = TIN(I,2)/TIN(I,1)* TUM1	L76V0350	01366
CONST = Y(I) - SLOPE*X(I)	L76V0360	01367
Y0(J) = SLOPE*X0(J) + CONST	L76V0370	01368
GO TO 90	L76V0380	01369
30 IF (I .EQ. 1) GO TO 25	L76V0390	01370
35 IF (X0(J) .EQ. X9(K)) GO TO 64	L76V0400	01371
C K REFER TO THE SECTION FROM WHICH WE NEED THE COEFFICIENTS.	L76V0410	01372
D= COEF(4,K,1)	L76V0420	01373
DO 40 I=1,3	L76V0430	01374
40 CUBE(I) = COEF(I,K,1)/D	L76V0440	01375
CUBE(1) = CUBE(1) - X0(J)/D	L76V0450	01376
CALL CUBIC (CUBE(3), CUBE(2), CUDE, ROOT, ROOT1)	L76V0460	01377
DO 50 I=1,3	L76V0470	01378
IF (ABS(ROOT(I)) .LE. .0001) ROOT(I) = 0.	L76V0480	01379
IF (ABS(ROOT(I)-1.) .GT. .0001) GO TO 49	L76V0490	01380
48 ROOT(I) = 1.	L76V0500	01381
Y(J) = Y9(K+1)	L76V0510	01382
GO TO 90	L76V0520	01383
49 IF(ROOT1(I).NE.0.) GO TO 50	L76V0530	01384
IF(ROOT1(I).LT.0.) GO TO 50	L76V0540	01385

k. End of INTERP, Start of CURVIT

Figure 60. Continued.

```

      IF (ROOT17.GT.1.7) GO TO 50
      GO TO 60
50  CONTINUE
      ** THERE IS NO SOLN. **
      WRITE(6,101) (COEF(I,K,1), I=1,4), K, Y0(J), (ROOT(I),ROOT1(I)), I=1,4
      - : 3
101  FORMAT ( 39H0  A ROOT FOR THE CUBIC EQUATION  X =, E11.4, 3H + , L76V0550  01386
      * E11.4, 7H * T + , E11.4, 9H * T*T + , E11.4, 7H * T**3, 13H IN SL76V0560  01387
      * ECTION, 13, // 6X, 42H DOES NOT EXIST BETWEEN 0. AND 1. WHEN X = ,L76V0570  01388
      *E15.5:47H AND THE ROOTS ARE - REAL IMAGINARY, (/77X, L76V0580  01389
      *E15.7: 2X(E15.7 ) ) L76V0590  01390
      T = .5 L76V0600  01391
      GO TO 61 L76V0610  01392
64  T = 0. L76V0620  01393
      GO TO 61 L76V0630  01394
60  T = ROOT(1) L76V0640  01395
61  Y0(J) = COEF(1,K,2) + COEF(2,K,2)*T + COEF(3,K,2)*T*T + L76V0650  01396
      * COEF(4,K,2)*T**3 L76V0660  01397
90  CONTINUE L76V0670  01398
      END L76V0680  01399
Q1  FOR AVQUAD L76V0690  01400
      SUBROUTINE AVQUAD (N,X,Y,AREA) L76V0700  01401
      C INTEGRATION BY AVERAGED QUADRATICS BASED ON LAGRANGE INTERPOLATION L76V0710  01402
      DIMENSION X(12),Y(12) L76V0720  01403
      AREA=0. L76V  01404
      T1=Y(1)/((X(1)-X(2))*X(1)-X(3))) L76V0730  01405
      T2=Y(2)/((X(2)-X(1))*X(2)-X(3))) L76A0010  01406
      T3=Y(3)/((X(3)-X(1))*X(3)-X(2))) L76A0020  01407
      A2=T1+T2+T3 L76A0030  01408
      B2=-T1*(X(2)+X(3))+T2*(X(1)+X(3))+T3*(X(1)+X(2)) L76A0040  01409
      C2=T1*(X(2)*X(3)+T2*(X(1)*X(3))+T3*(X(1)*X(2)) L76A0050  01410
      AREA=AREA+(A2/3.)*((X(2)**3)-X(1)**3)+(B2/2.)*((X(2)**2)-X(1)**2)+C2*(X(2)-X(1)) L76A0060  01411
      N2=N-2 L76A0070  01412
      DO 101 K=N2 L76A0080  01413
      A1=A2 L76A0090  01414
      B1=B2 L76A0100  01415
      C1=C2 L76A0110  01416
      T1=Y(K)/((X(K)-X(K+1))*X(K)-X(K+2))) L76A0120  01417
      T2=Y(K+1)/((X(K+1)-X(K))*X(K+1)-X(K+2))) L76A0130  01418
      T3=Y(K+2)/((X(K+2)-X(K))*X(K+2)-X(K+1))) L76A0140  01419
      A2=T1+T2+T3 L76A0150  01420
      B2=-T1*(X(K+1)+X(K+2))+T2*(X(K)+X(K+2))+T3*(X(K)+X(K+1)) L76A0160  01421
      C2=T1*(X(K+1)*X(K+2)+T2*(X(K)*X(K+2))+T3*(X(K)*X(K+1)) L76A0170  01422
      A=(A1+A2)/2. L76A0180  01423
      B=(B1+B2)/2. L76A0190  01424
      C=(C1+C2)/2. L76A0200  01425
101  AREA=AREA+(A/3.)*((X(K+1)**3)-X(K)**3)+(B/2.)*((X(K+1)**2)-X(K)**2)+C*(X(K+1)-X(K)) L76A0210  01426
      AREA=AREA+(A2/3.)*((X(N)**3)-X(N-1)**3)+(B2/2.)*((X(N)**2)-X(N-1)**2)+C2*(X(N)-X(N-1)) L76A0220  01427
      RETURN L76A0230  01428
      END L76A0240  01429
Q1  FOR CUBIC L76A0250  01430
      SUBROUTINE CUBIC ( P, Q, R, ROOT, ROOT1 ) L76A0260  01431
      C CUBIC FINDS THE REAL + COMPLEX ROOTS OF (X**3)+P*(X**2)+Q*(X)+R=0 L76A0270  01432
      DIMENSION ROOT(3),ROOT1(3) L76A0280  01433
90  DO 220 I=1,3 L76A0290  01434
      ROOT(I)= 0. L76A0300  01435
220  ROOT1(I)=0. L76A0310  01436
      P3 = P/3. L76A0320  01437
      SMALLA = Q - P*P3 L76U0010  01438
      SMALLB = 2. *P3**3 - P3* Q + R L76U0020  01439
      A03 = SMALLA/3. L76U0030  01440
      SB2 = SMALLB/2. L76U0040  01441
      B4 = SB2**2 L76U0050  01442
      L76U0060  01443
      L76U0070  01444
      L76U0080  01445
      L76U0090  01446
      L76U0100  01447
      L76U0110  01448
      L76U0120  01449

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1. End of CURVIT, AVQUAD, Start of CUBIC

Figure 60. Continued.

A27 = AD3 **3	L76U0130	01452
SMALLC = D4 + A27	L76U0140	01453
IF (SMALLC) 14, 1, 5	L76U0150	01454
1 XA=SQRT (-AD3)	L76U0160	01455
IF (SMALLB) 3, 4, 4	L76U0170	01456
3 XA=-XA	L76U0180	01457
4 ROOT(1) =XA-P3	L76U0190	01458
ROOT(2) = ROOT(1)	L76U0200	01459
ROOT(3) = -XA-XA-P3	L76U0210	01460
GO TO 22	L76U0220	01461
5 POWER = 1./ 3.	L76U0230	01462
B2 = - SMALLB / 2.	L76U0240	01463
SBA= SQRT (SMALLC)	L76U0250	01464
BIGA = B2 + SBA	L76U0260	01465
BIGB = B2 -SBA	L76U0270	01466
IF (BIGA) 6, 7, 8	L76U0280	01467
6 BIGA1 =-((-BIGA) ** POWER)	L76U0290	01468
GO TO 9	L76U0300	01469
7 BIGA1 =0.	L76U0310	01470
GO TO 9	L76U0320	01471
8 BIGA1 = (BIGA) ** POWER	L76U0330	01472
9 IF (BIGB) 10, 11, 12	L76U0340	01473
10 BIGB1 =-((-BIGB) ** POWER)	L76U0350	01474
GO TO 13	L76U0360	01475
11 BIGB1 = 0.	L76U0370	01476
GO TO 13	L76U0380	01477
12 BIG B1 = (BIGB) ** POWER	L76U0390	01478
13 AB = BIGA1+BIGB1	L76U0400	01479
ROOT (1) = AB-P3	L76U0410	01480
ROOTI(1) = 0.	L76U0420	01481
ROOT (2) = -AB/2.-P3	L76U0430	01482
ROOT (3) = ROOT(2)	L76U0440	01483
ROOTI(2) = SQRT (3.)/2. * (BIGA1 - BIGB1)	L76U0450	01484
ROOTI(3) = - ROOTI (2)	L76U0460	01485
GO TO 22	L76U0470	01486
14 RAD = 57.2957795	L76U0480	01487
CON = 120./ RAD	L76U0490	01488
A3 = SQRT (-AD3)	L76U0500	01489
IF (SMALLB) 15, 16, 17	L76U0510	01490
15 COT = 0.	L76U0520	01491
CP = 1.	L76U0530	01492
GO TO 18	L76U0540	01493
16 PH3 = 30./ RAD	L76U0550	01494
GO TO 19	L76U0560	01495
17 COT = 180. /RAD	L76U0570	01496
CP= -1.	L76U0580	01497
18 B4A27 = - B4 /A27	L76U0590	01498
COSPHI = CP* SQRT (B4A27)	L76U0600	01499
XK = SQRT (1.- B4A27)	L76U0610	01500
PHI = ATAN (XK/ COSPHI)	L76U0620	01501
PH3 = (COT + PHI*CP/3.)	L76U0630	01502
19 DO 20 I= 1,3	L76U0640	01503
20 ROOTI(I) = 0.	L76U0650	01504
AK = A3+ A3	L76U0660	01505
ANGLE =PH3	L76U0670	01506
DO 21 I = 1,3	L76U0680	01507
ROOT (I) = AK * COS (ANGLE)-P3	L76U0690	01508
21 ANGLE = ANGLE +CON	L76U0700	01509
22 RETURN	L76U0710	01510
END	L76U0720	01511
01 FOR SIMCOR	L76S0010	01512
SUBROUTINE SIMCOR (N,H,Y,XINT,IERR)	L76S0020	01513
C PURPOSE	L76S0030	01514
C TO INTEGRATE A FUNCTION F(X) OVER A RANGE (A,B)	L76S0040	01515
C	L76S0050	01516
C		01517

m. End of CUBIC, Start of SIMCOR

Figure 60. Continued.

C	METHOD	L76S0060	01518
C		L76S0070	01519
C	SIMPSON'S RULE WITH A CORRECTION FACTOR INCORPORATED	L76S0080	01520
C	IN THE EQUATION IS USED IF (N-1) IS DIVISIBLE BY	L76S0090	01521
C	BOTH 2 AND 4	L76S0100	01522
C		L76S0110	01523
C	SIMPSON'S RULE IS USED WITHOUT THE CORRECTION FACTOR	L76S0120	01524
C	IF (N-1) IS ONLY DIVISIBLE BY 2	L76S0130	01525
C		L76S0140	01526
C	IF (N-1) IS NOT DIVISIBLE BY 2 THIS IMPLIES THAT N	L76S0150	01527
C	IS EVEN AND THIS SUBROUTINE CAN NOT BE USED.	L76S0160	01528
C		L76S0170	01529
C	CALLING SEQUENCE	L76S0180	01530
C		L76S0190	01531
C	CALL SIMCOR (N,H,Y,XINT,IERR)	L76S0200	01532
C		L76S0210	01533
C	DESCRIPTION OF PARAMETERS	L76S0220	01534
C		L76S0230	01535
C	N -NUMBER OF POINTS THAT ARE TAKEN OVER THE CURVE	L76S0240	01536
C		L76S0250	01537
C	H -CONSTANT INTERVAL BETWEEN THE POINTS	L76S0260	01538
C		L76S0270	01539
C	Y -SUPPLIED FUNCTION	L76S0280	01540
C		L76S0290	01541
C	XINT-TOTAL AREA UNDER THE CURVE BETWEEN A AND B	L76S0300	01542
C		L76S0310	01543
C	IERR-ERROR CODE	L76S0320	01544
C	IERR = 0 (N-1) NOT DIVISIBLE BY 2 THEREFORE N IS EVEN	L76S0330	01545
C	IERR = 1 (N-1) IS DIVISIBLE BY 2	L76S0340	01546
C	IERR = 2 (N-1) IS DIVISIBLE BY BOTH 2 AND 4	L76S0350	01547
C		L76S0360	01548
C		L76S0370	01549
C		L76S0380	01550
C	DIMENSION Y(1)	L76S0390	01551
C	IERR = 0	L76S0400	01552
C	K = MOD ((N-1)/4) + 1	L76S0410	01553
C	IF (K .EQ. 2 .OR. K .EQ. 4) RETURN	L76S0420	01554
C	XINT = Y(1) + 4.* Y(N-1) + Y(N)	L76S0430	01555
C	N3 = N - 3	L76S0440	01556
C	DO 10 I = 2,N3/2	L76S0450	01557
C	10 XINT = XINT + 4.* Y(I) + 2.* Y(I+1)	L76S0460	01558
C	XINT = H/3.0 * XINT	L76S0470	01559
C	IERR = 1	L76S0480	01560
C	IF (K .EQ. 3 .OR. N .LT. 9) RETURN	L76S0490	01561
C	XINT1 = Y(1) + 4.* Y(N-2) + Y(N)	L76S0500	01562
C	N6 = N-6	L76S0510	01563
C	DO 20 I = 3,N6/4	L76S0520	01564
C	20 XINT1 = XINT1 + 4.* Y(I) + 2.* Y(I+2)	L76S0530	01565
C	XINT1 = 2.* H/3. * XINT1	L76S0540	01566
C	XINT = XINT + (XINT - XINT1)/15.	L76S0550	01567
C	IERR = 2	L76S0560	01568
C	RETURN	L76S0570	01569
C	END		01570
C	91 FOR TRIDAG	L76T0010	01571
C	SUBROUTINE TRIDAG(A,G,K1,Z)	L76T0020	01572
C	DIMENSION A(7*8),G(7),Z(7)	L76T0030	01573
C	1 FORMAT (10X,5QHT=0, .OR. S=0. IN TRIDAG, CANNOT DIVIDE BY 5 OR T)	L76T0040	01574
C		L76T0050	01575
C	PURPOSE	L76T0060	01576
C	TO SOLVE THE TRIDIAGONAL MATRIX EQUATION	L76T0070	01577
C		L76T0080	01578
C	*****----- ***	L76T0090	01579
C	* * * - * * * *	L76T0100	01580
C	* S * R * - * * *	L76T0110	01581
C	* * * - * * *	L76T0120	01582
C	***** - * * *	L76T0130	01583
C	* * * - * * *		

n. End of SIMCOR, Start of TRIDAG

Figure 60. Continued.

C	* T * S * R * - * *	* *	L76T0140	01584
C	* * * * - * *	* *	L76T0150	01585
C	***** * Z *	* *	L76T0160	01586
C	- * * * * - * *	* *	L76T0170	01587
C	- * T * S * R * * *	* *	L76T0180	01588
C	- * * * * * *	* *	L76T0190	01589
C	- ***** * *	* *	L76T0200	01590
C	- * * * * * *	* *	L76T0210	01591
C	- * T * S * * *	* *	L76T0220	01592
C	- * * * * * *	* *	L76T0230	01593
C	----- * *	* *	L76T0240	01594
C			L76T0250	01595
C	FOR THE SOLUTIONS Z, WHERE GAUSS IS NOT USED AND THE SUB-MATRICES		L76T0260	01596
C	ALL CONSIST OF A SINGLE ELEMENT.		L76T0270	01597
C	DESCRIPTION OF PARAMETERS		L76T0280	01598
C	A -- MATRIX WHOSE THREE DIAGONALS CENTERED ON THE PRINCIPAL		L76T0290	01599
C	DIAGONAL BECOME THE TRI-DIAGONAL MATRIX.		L76T0300	01600
C	G -- RIGHT HAND SIDE OF EQUATION, VECTOR OF LENGTH K1.		L76T0310	01601
C	K1 -- NUMBER OF ROWS IN THE MATRIX A.		L76T0320	01602
C	Z -- SOLUTIONS, VECTOR (COLUMN) OF LENGTH K1.		L76T0330	01603
C			L76T0340	01604
C			L76T0350	01605
C			L76T0360	01606
C	FIND THE LAST SOLUTION, Z(K1)		L76T0370	01607
C	S = A(1,1)		L76T0380	01608
C	R = A(1,2)		L76T0390	01609
C	IF (S .EQ. 0.) GO TO 25		L76T0400	01610
C	C = G(1)/S		L76T0410	01611
C	D = -R/S		L76T0420	01612
C	K2 = K1-1		L76T0430	01613
C	DO 10 I=2,K2		L76T0440	01614
C	Y = A(1,I-1)		L76T0450	01615
C	S = A(1,I)		L76T0460	01616
C	R = A(1,I+1)		L76T0470	01617
C	DENOM = T*D+S		L76T0480	01618
C	C = (G(I)-C*T)/DENOM		L76T0490	01619
C	D = -R/DENOM		L76T0500	01620
C	10 CONTINUE		L76T0510	01621
C	S = A(K1,K1)		L76T0520	01622
C	T = A(K1,K1-1)		L76T0530	01623
C	Z(K1) = (G(K1)-T*C)/(T*D+S)		L76T0540	01624
C			L76T0550	01625
C	CALCULATE OTHER SOLUTIONS, PROCEEDING BACKWARDS		L76T0560	01626
C			L76T0570	01627
C	IF (T .EQ. 0.) GO TO 25		L76T0580	01628
C	Z(K1-1) = (G(K1)-Z(K1)*S)/T		L76T0590	01629
C	15 K3=K2-1		L76T0600	01630
C	DO 20 I=2,K3		L76T0610	01631
C	J = K1-I		L76T0620	01632
C	S = A(J+1,J+1)		L76T0630	01633
C	R = A(J+1,J+2)		L76T0640	01634
C	T = A(J+1,J)		L76T0650	01635
C	IF (T .EQ. 0.) GO TO 25		L76T0660	01636
C	Z(J) = (G(J+1)-S*Z(J+1)-R*Z(J+2))/T		L76T0670	01637
C	20 CONTINUE		L76T0680	01638
C	Z(1) = (G(1)-A(1,2)*Z(2))/A(1,1)		L76T0690	01639
C	RETURN		L76T0700	01640
C	25 WRITE(6,1)		L76T0710	01641
C	RETURN		L76T0720	01642
C	END		L76T	01643
C	Q1 FOR PARAM		L76T0730	01644
C	SUBROUTINE PARAM (N, P, IJ)		L76X0010	01645
C	DIMENSION G(7), P(7,2), DEL(7,2), DIST(7), A(7, 8), Q(7,2)		L76X0020	01646
C	COMMON /COTAN/ T(7,2), COE (4, 7,2)		L76X0030	01647
C	N1 = N-1		L76X0040	01648

O. End of TRIDAG, Start of PARAM

Figure 60. Continued.

N2 = N-2	L76X0050	01650
N3 = N-3	L76X0060	01651
N0=N2	L76X0070	01652
I60 = 2	L76X0080	01653
DO 15 I=1,N1	L76X0090	01654
DO 10 J=1,2	L76X0100	01655
10 DEL(I,J) = P(I+1,J) - P(I,J)	L76X0110	01656
15 DIST(I) = SORT(DEL(I,1)**2 + DEL(I,2)**2)	L76X0120	01657
DO 20 I=1,N	L76X0130	01658
DO 20 J=1,N	L76X0140	01659
20 A(I,J) = 0.	L76X0150	01660
A(I,3) = DIST(I)	L76X0160	01661
A(N2,N2) = DIST(N1)	L76X0170	01662
DO 30 I=2,N3	L76X0180	01663
A(I,1) = DIST(I+1)	L76X0190	01664
A(I,I+1) = 2.*(DIST(I)+DIST(I+1))	L76X0200	01665
A(I,I+2) = DIST(I)	L76X0210	01666
DO 30 J=1,2	L76X0220	01667
30 Q(I,J) = 3.*(DIST(I)/DIST(I+1)*DEL(I+1,J)+DIST(I+1)/DIST(I)*DEL(I,J))	L76X0230	01668
* I,J)	L76X0240	01669
12 A(I,2) = 2.* DIST(I) + DIST(2)*1.5	L76X0250	01670
C 12 A(I,2) = 2.*(DIST(I) + DIST(2))	L76X0260	01671
DO 33 J=1,2	L76X0270	01672
C 33 Q(I,J) = 3.*(DIST(I)/DIST(2)*DEL(2,J)+DIST(2)/DIST(I)*DEL(1,J)) -	L76X0280	01673
33 Q(I,J) = 3.*(DIST(I)/DIST(2)*DEL(2,J)+DIST(2)/DIST(I)*DEL(1,J)/2.)	L76X0290	01674
C * DIST(2)* T(I,J)	L76X0300	01675
C 22 A(N2, N1) = 2.*(DIST(N2) + DIST(N1))	L76X0310	01676
22 A(N2, N1) = 1.5* DIST(N2) + DIST(N1)*2.	L76X0320	01677
DO 27 J=1,2	L76X0330	01678
27 Q(N2, J) = 1.5*(DIST(N2)/DIST(N1)*DEL(N1, J) +DIST(N1)/DIST	L76X0340	01679
C 27 Q(N2, J) = 3.*(DIST(N2)/DIST(N1)*DEL(N1, J) +DIST(N1)/DIST	L76X0350	01680
*(N2)*DEL(N2, J))	L76X0360	01681
C *(N2)*DEL(N2, J)) - DIST(N2)* T(N,J)	L76X0370	01682
17 DO 45 J=1,2	L76X0380	01683
DO 36 I=1,N0	L76X0390	01684
36 Q(I)=Q(I,J)	L76X0400	01685
CALL TRIDAG(A(1,2),6,N0,T(2,J))	L76X0410	01686
T(1,J) = 1.5/DIST*DEL(1,J) - .5*T(2,J)	L76X0420	01687
T(N,J) = 1.5/DIST(N1)*DEL(N1,J) - .5*T(N1,J)	L76X0430	01688
44 DO 45 I=1,N1	L76X0440	01689
COE(4,I,J)=-2.*DEL(I,J) + DIST(I)*(T(I+1,J)+T(1,J))	L76X0450	01690
COE(3,I,J)= 3.*DEL(I,J) - DIST(I)*(T(I+1,J)+2.*T(1,J))	L76X0460	01691
COE(2,I,J)= DIST(I)*T(I,J)	L76X0470	01692
45 COE(1,I,J)= P(I,J)	L76X0480	01693
RETURN	L76X0490	01694
END	L76X0500	01695
91 FOR E386RN		01696
SUBROUTINE E386RN	L76E0010	01697
C ACOUSTIC PRESSURE	L76E0020	01698
V.BERECZ FOR R.KING DECK E386	L76E0030	01699
COMMON /BK1/ IDD,BB,AA,XA(5,5),DPSI,RR(5),OMEG,CC,NBLADE,MLIMRN,	L76E0040	01700
* MLIMOP,XFP(20),YFP(20),ZFP(20),GAMA,R0,BLADL,B0,B1C,B1S,PUNCH,	L76E0050	01701
* LSPAN,FROC(30),TGOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,	L76E0060	01702
* IRS(5),ITRACK(5),FI(5,5),NCHAN(5,5),E386OP,NFT,ANG,KEY1,KEY2,	L76E0070	01703
* KEYS,NHH,CAPRF(20),THETA(20),ALFAF(20),OPRONG,NCH(5),INTERM,	L76E0080	01704
* IREEL,NC,NTBDX(5,10),NSTATC(5,10),NSTATR(5,10),ISET(5),IREELS,	L76E0090	01705
* NOCH(5),LAZI	L76E0100	01706
COMMON /BK2/ NOYCLE,CYCLES,KU,NDIV(4),BMASK(6),NN(435),LIRS,	L76E0110	01707
* KTRACK,KBURST,KREC,ND1(144,10,5),ND2(144,10,5),XL0(7),XLH(7,40),	L76E0120	01708
* XMM(7,40),TEMP1(7),TEMP2(7),TEMP3(7),PI,AZMTH2(144),AZMTH(144),	L76E0130	01709
* OPRAD,AZRAD,NO,YES,NBLANK,TEE,BEE,DEE,GHARI(288,20),	L76E0140	01710
* HMARI(288,20),X0(20)	L76E0150	01711
DIMENSION CN(31,5,5),SN(30,5,5),AN(31,10,5),BN(30,10,5),	L76E0160	01712
* GMAR(144,5),HMAR(144,5)	L76E0170	01713
EQUIVALENCE (ND2(5761),HMAR),	L76E0180	01714
S (GMARI,AN),	L76E0190	01715
* (GMARI(1551),BN),(HMAR,CN),(HMARI(776),SN)		

p. End of PARAM, Start of E386RN

Figure 60. Continued.

	EQUIVALENCE (ND1(5761),OMAR)	L76E0200	01716
	DIMENSION Q(721,8),R(8),V8(8),V8I(8),	L76E0210	01717
	1 V25(721),V25I(721),PSI(721),PRAD(721)	L76E0220	01718
	EQUIVALENCE (Q,ND1),(V25,ND2),(V25I,ND2(1,1,2)),(PSI,ND2(1,1,3)),	L76E0230	01719
	5 (PRAD,ND2(1,1,4))	L76E0240	01720
C	READ FLT, COND, PARAMETERS AND BLADE SECTION LOADING, PRINT SAME.	L76E0250	01721
C		L76E0260	01722
C	RBN=NB LADE	L76E0270	01723
	EQUIVALENCE	L76E0280	01724
	X (CH,AA),(SOS,CC),(B01,B0),(B1,B1C),(B11,B1S),(G,GAHA),	L76E0290	01725
	X (NHAR,MLIMRN),(NFT,NFP),(OMG,OMEG)	L76E0300	01726
	NRAD = LIRS+2	L76E0310	01727
	GATC1=B0	L76E0320	01728
	GATC2=B1C	L76E0330	01729
	GATC3=B1S	L76E0340	01730
	GATC4=GAHA	L76E0350	01731
	GATC5=OMEG	L76E0360	01732
	SOS = SOS/12.0	L76E0370	01733
	J=1	L76E0380	01734
	R(1)=0.	L76E0390	01735
	DO 730 I=1,5	L76E0400	01736
	J=J+1	L76E0410	01737
	IF (IRS(I).EQ.0) GO TO 730	L76E0420	01738
	R(J)=RR(I)*BLADEL	L76E0430	01739
730	CONTINUE	L76E0440	01740
	J=J+1	L76E0450	01741
	R(J)=BLADEL	L76E0460	01742
	RAD= 1./57.2957795	L76E0470	01743
	NP=(360./ANG)+1.001	L76E0480	01744
	NT=NP-1	L76E0490	01745
	PSI(1)= 0.	L76E0500	01746
	PRAD(1)=0.	L76E0510	01747
	DO 4 I=2,NP	L76E0520	01748
	PSI(I)= PSI(I-1)+ ANG	L76E0530	01749
4	PRAD(I)= PSI(I)*RAD	L76E0540	01750
	DO 77 I=1,NRAD	L76E0550	01751
	DO 77 J=1,NP	L76E0560	01752
	Q(J,I)=XL0(I)	L76E0570	01753
	DO 77 K=1,NMH	L76E0580	01754
	X=K	L76E0590	01755
77	Q(J,I)=Q(J,I)+XLN(I,K)*COS(X*PRAD(J))+XMM(I,K)*SIN(X*PRAD(J))	L76E0600	01756
	IF (KEY1.NE.99) GO TO 88	L76E0610	01757
	DO 86 I=1,NRAD	L76E0620	01758
86	WRITE (6,87) XL0(I),(XLN(I,J),XMM(I,J)),J=1,NHAR	L76E0630	01759
87	FORMAT (E25.87,(2E25.87))	L76E0640	01760
88	WRITE (6,8) B01,B1,B11,CH,OMG,RBN,R0,(R1),I=1,NRAD	L76E0650	01761
8	FORMAT (4H0B01,E15.6,4H B1,E15.6,5H B11,E15.6,7H CHORD,E15.6,	L76E0660	01762
1	7H OMEG,E15.6,8H BLADES,F7.0,25H RADIUS AT START OF TWIST,	L76E0670	01763
2	E15.6,30X,21HBLADE SECTION LOADING,7H RADIUS,10X,1H1,14X,	L76E0680	01764
3	1H2,14X,1H3,14X,1H4,14X,1H5,14X,1H6,14X,1H7,14X,1H8,7H AZIMUTH,	L76E0690	01765
4	2X,E15.6,77)	L76E0700	01766
	DO 9 I=1,NP	L76E0710	01767
9	WRITE (6,10) I,PSI(I),(Q(I,K),K=1,NRAD)	L76E0720	01768
10	FORMAT (I4,F7.1,E15.6)	L76E	01769
	OMG=3.14159265*OMG/30.	L76E0730	01770
	SOS=12.*SOS	L76E0740	01771
	B01=B01*RAD	L76E0750	01772
	B1=B1*RAD	L76E0760	01773
	B11=B11*RAD	L76E0770	01774
	G=G*RAD	L76E0780	01775
C		L76E0790	01776
C	BEGIN MAJOR LOOP ON FIELD POINTS	L76E0800	01777
C		L76E0810	01778
	DO 999 II=1,NFP	L76E0820	01779
	CAPR=CAPRF(II)	L76E0830	01780
		L76E0840	01781

q. E386RN Continued.

Figure 60. Continued.

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      THETA=THETA(11)
      ALFA=ALFA(11)
11  FORMAT (3F12.4)
      WRITE (6,12) CAPR,THETA,ALFA
12  FORMAT (12HOFIELD POINT,10X,6HRAIDUS,E15.6,5X,7HAZIMUTH,E15.6,5X,
1  9HELEVATION,E15.6,720X,8MHARMONIC,1X,14HSCUID PRESSURE,1X,
2  3HSPL)
      CAPR=12.*CAPR
      ALFA= RAD*ALFA
      THETA= RAD*THETA
      DO 999 M=1,NHAR
      DO 990 KK=1,NRAD
      DO 99 JJ=1,NT
      CAP5= SQRT(CAPR*CAPR+R(KK)*R(KK)-2.*CAPR*R(KK)*COS( ALFA)*
1  COS( PRAD(JJ)-THETA))
      BETA=B01-G*(R(KK)-R0)+B1+COS( PRAD(JJ) )+B11*SIN( PRAD(JJ) )
      SBTA=SIN(BETA)
      CBTA=COS(BETA)
      VE M
      VE V=(RBN*OMG*CAP5/SOS+.5*CH*RDN/R(KK)*RBN* PRAD(JJ))
      IF (KEY1.EQ.99) WRITE (6,9874) CAP5, BETA, V
9874 FORMAT (3E25.8)
      TEMPE= M
      V25(JJ)=(G(JJ,KK)*SIN(.5*TEMP*RBN*CH/R(KK))*(COS(V)/CAP5+(TEMP*RBN*
1  *OMG/SOS)*SIN(V)))+(SBTA+COS(ALFA)*SIN( PRAD(JJ)-THETA)+SIN(ALFA)
2  CBTA)*R(KK))/(TEMP*CAP5*CAP5)
      V25(IJJ)=(G(JJ,KK)*SIN(.5*TEMP*RBN*CH/R(KK))*(COS(V)*TEMP*RBN*OMG
1  /SOS-SIN(V)/CAP5)+(SBTA+COS(ALFA)*SIN( PRAD(JJ)-THETA)+SIN(ALFA)
2  CBTA)*R(KK))/(TEMP*CAP5*CAP5)
99  CONTINUE
      V25(NP)=V25(1)
      V25(NP)=V25(1)
      CALL SINCOR(NP,PRAD(2),V25,AR,IERR)
      IF(IERR.EQ.0) WRITE(6,8418)
8418 FORMAT(///25X,23HERROR IN SINCOR, IERR=0 ///)
      V8(KK)=AR
      CALL SINCOR(NP,PRAD(2),V25I,AR,IERR)
      IF(IERR.EQ.0) WRITE(6,8418)
      V8I(KK)=AR
      IF(KEY2.EQ.99) WRITE (6,9876) V8(KK),(V25(I),I=1,NP)
      IF(KEY2.EQ.99) WRITE (6,9876) V8I(KK),(V25I(I),I=1,NP)
9876 FORMAT (//E25.8,/(5E25.8,/)
990 CONTINUE
      CALL AVQUAD (NRAD,R,V8,PRTA)
      CALL AVQUAD (NRAD,R,V8I,PRTAI)
      IF (KEY1.EQ.99) WRITE (6,9875)PRTA,(V8(KK),KK=1,NRAD)
      IF (KEY1.EQ.99) WRITE (6,9875)PRTAI,(V8I(KK),KK=1,NRAD)
9875 FORMAT (//E25.8,/(4E25.8,/(4E25.8,/)
      PRTA=(.03582245*CAPR/CH)*SQRT(PRTA**2+PRTAI**2)
      SPL= 20.*ALOG10(ABS(PRTA/2.9E-9))
      WRITE (6,997) M,PRTA,SPL
997 FORMAT (25X,I2,5X,2E20.8)
999 CONTINUE
      B0=GATC1
      B1=GATC2
      B1S=GATC3
      GAMA=GATC4
      OMEG=GATC5
      RETURN
      END
Q1 FOR OUTSPL
      SUBROUTINE OUTSPL
      COMMON /BK1/ IDO,BB,AA,XA(5,5),DPSI,RR(5),OMEG,CC,NBLADE,MLIMRN,
      * MLIMDP,XFP(20),YFP(20),ZFP(20),GAMA,R0,BLADEI,B0,B1C,B1S,PUNCH,
      * LSPAN,FROCI(30),TCOP,SLOPE(10,5),OFFSET(10,5),KUNIT(5),IBURST,
      * IRS(5),ITRACK(5),FI(5,5),NCHAI(5,5),E386OP,NFT,ANG,KEY1,KEY2,
      L76E0850 01782
      L76E0850 01783
      L76E0870 01784
      L76E0880 01785
      L76E0890 01786
      L76E0900 01787
      L76E0910 01788
      L76E0920 01789
      L76E0930 01790
      L76E0940 01791
      L76E0950 01792
      L76E0960 01793
      L76E0970 01794
      L76E0980 01795
      L76E0990 01796
      L76E1000 01797
      L76E1010 01798
      L76E1020 01799
      L76E1030 01800
      L76E1040 01801
      L76E1050 01802
      L76E1060 01803
      L76E1070 01804
      L76E1080 01805
      L76E1090 01806
      L76E1100 01807
      L76E1110 01808
      L76E1120 01809
      L76E1130 01810
      L76E1140 01811
      L76E1150 01812
      L76E1160 01813
      L76E1170 01814
      L76E1180 01815
      L76E1190 01816
      L76E1200 01817
      L76E1210 01818
      L76E1220 01819
      L76E1230 01820
      L76E1240 01821
      L76E1250 01822
      L76E1260 01823
      L76E1270 01824
      L76E1280 01825
      L76E1290 01826
      L76E1300 01827
      L76E1310 01828
      L76E1320 01829
      L76E1330 01830
      L76E1340 01831
      L76E1350 01832
      L76E1360 01833
      L76E1370 01834
      L76E1380 01835
      L76E1390 01836
      L76E1400 01837
      L76E1410 01838
      L76E1420 01839
      L76E1430 01840
      L76E1440 01841
      L76E1440 01842
      L76E00010 01843
      L76E00020 01844
      L76E00030 01845
      L76E00040 01846
      L76E00050 01847

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r. End of E386RN, Start of OUTSPL

Figure 60. Continued.

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* KEY: NHH, CAPRF(20), THETA(20), ALFA(20), OPRNO, NCH(5), INTERM, L76J0060 01848
* JREEL, IC, NTBDX(5,10), NSTATC(5,10), NSTATR(5,10), ISET(5), IREELS, L76J0070 01849
* NOCH(5), LAZI L76J0080 01850
COMMON /BK2/ NCYCLE, CYCLES, KU, NDIV(4), BMASK(6), NN(435), LIRS, L76J0090 01851
* KTRACK, KBURST, KREC, ND1(144,10,5), ND2(144,10,5), XL0(7), XLM(7,40), L76J0100 01852
* XMM(7,40), TEMP1(7), TEMP2(7), TEMP3(7), PI, AZMTH2(144), AZMTH(144), L76J0110 01853
* DPRAD, AZEAD, NO, YES, NBLANK, TEE, DEE, GMARI(288,20), L76J0120 01854
* HMARI(288,20), XO(20) L76J0130 01855
COMMON /BK3/ SPLM(10,20), AZMTH3(288), L76J0140 01856
* SPAN(20), PMRMS(10,20), L76J0150 01857
* ICHANL(10,5), COSINE(288), SINE(288), GLADES, CARD, TAPE L76J0160 01858
DIMENSION CN(31,5,5), SN(30,5,5), AN(31,10,5), BN(30,10,5), L76J0170 01859
* GMAR(144,5), HMAR(144,5) L76J0180 01860
* Q1(288,20), Q2(288,20) L76J0190 01861
EQUIVALENCE (ND2(5761), HMAR), L76J0200 01862
* (GMARI, AN), L76J0210 01863
* (GMARI(1551), BN), (HMARI, CN), (HMARI(776), SN), (ND2, Q2) L76J0220 01864
EQUIVALENCE (ND1(5761), GMAR), (ND1, Q1) L76J0230 01865
C *** HARMONIC LOOP L76J0240 01866
DO 1 J=1, MLIMRN, 2 L76J0250 01867
WRITE(6,2) J L76J0260 01868
2 FORMAT(1H1, 28X, 29HROTATIONAL NOISE PROGRAM E676 / 8X, L76J0270 01869
X 10HHARMONIC =, 13 ) L76J0280 01870
WRITE(6,3) L76J0290 01871
3 FORMAT(1H0, 8X, 5HFIELD, 11X, 28HFIELD POINT COORDINATES (IN), L76J0300 01872
X 16X, 20HSOUND PRESSURE LEVEL / 8X, 5HPOINT, 10X, 1HX, 14X, 1HY, L76J0310 01873
X 14X, 1HZ, 20X, 8HDECIBELS / ) L76J0320 01874
C *** FIELD POINT LOOP L76J0330 01875
DO 4 J=1, NPT L76J0340 01876
4 WRITE(6,5) J, XFP(J), YFP(J), ZFP(J), SPLM(1,J) L76J0350 01877
5 FORMAT( 9X, 12, 2X, 3(5X, 1PE10, 4), 15X, 1PE10, 4 ) L76J0360 01878
IF(1, GE, MLIMRN) GO TO 7 L76J0370 01879
K=I+1 L76J0380 01880
WRITE(6,6) K L76J0390 01881
6 FORMAT(1H2 / 8X, 10HHARMONIC =, 13 ) L76J0400 01882
WRITE(6,3) L76J0410 01883
C *** FIELD POINT LOOP L76J0420 01884
DO 8 J=1, NPT L76J0430 01885
8 WRITE(6,5) J, XFP(J), YFP(J), ZFP(J), SPLM(K,J) L76J0440 01886
1 CONTINUE L76J0450 01887
7 RETURN L76J0460 01888
END L76J0470 01889
Q1 FOR START 01890
SUBROUTINE START L76Y0010 01891
COMMON /TEMPUS/ TIME, COUNT L76Y0020 01892
INTEGER COUNT L76Y0030 01893
DATA COUNT /0/ L76Y0040 01894
CALL RTMINS (TIME) L76Y0050 01895
COUNT = COUNT + 1 L76Y0060 01896
CALL CLOCK L76Y0070 01897
RETURN L76Y0080 01898
END L76Y0090 01899
Q1 FOR CLOCK 01900
SUBROUTINE CLOCK L76K0010 01901
COMMON /TEMPUS/ TIME, COUNT L76K0020 01902
INTEGER COUNT L76K0030 01903
CALL RTMINS (BALLS) L76K0040 01904
Y = BALLS - TIME L76K0050 01905
WRITE (6,100) COUNT, Y L76K0060 01906
100 FORMAT (1H255X, 18(1H*)/56X, 8H* (12, 8H) */56X, 18H* ELAPSEL76K0070 01907
XD TIME = */56X, 1H*16X, 1H*/56X, 2H* F8.4, 8H MIN */56X, 1H*16X, 1H*/5L76K0080 01908
X6X, 18(1H*)) L76K0090 01909
RETURN L76K0100 01910
END L76K0110 01911

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s. End of OUTSPL, START, CLOCK

Figure 60. Concluded.