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FUSELAGE UPWASH EFFECTS ON RSRA ROTOR SYSTEMS

J. Cowan
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Prepared for
Ames Research Center
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National Aeronautics and
Space Administration

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C_d	Blade element drag coefficient, drag/qc
C_ℓ	Blade element lift coefficient, lift/qc
C_m	Blade element pitching moment coefficient about the quarter chord, moment/qc^2
D	Rotor diameter, ft
DE	Rotor equivalent drag, rotor power/V-X, pounds
fe	Flat plate equivalent area, ft^2
FZF	Vertical hub force fourth harmonic amplitude, lbs
GW	Gross Weight, pounds
L	Wing lift, pounds
M	Mach number
P	Auxiliary thrust, pounds
PLL	Pitch link vibratory load, lbs
q	Dynamic pressure, $\frac{1}{2}\rho V_\infty^2$
Q_n	nth harmonic of rotor torque, ft-pounds
Q_o	Steady or average rotor torque, ft-pounds
R	Blade radius, ft
T	Vertical corponent of rotor thrust, pounds
T_n	nth harmonic of rotor thrust, pounds Also, particular value of T in Tables II and III, pounds
T_o	Steady or average rotor thrust, pounds
UP	Nondimensional difference between out-of-disk velocity component in the presence of fuselage/wings/engines and out-of-disk velocity component in the absence of fuselage/wings/engines
UT	Nondimensional difference between in-disk chordwise velocity component in the presence of fuselage/wings/engines and in-disk chordwise velocity component in the absence of fuselage/wings/engines

LIST OF SYMBOLS
(Continued)

V	Flight velocity, ft/sec or knots
V_T	Rotor tip speed, ft/sec
x	Fuselage station in fuselage coordinate system, in
X	Rotor propulsive force, pounds
$\bar{X}$	Nondimensional rotor propulsive force, $X/qD^2\sigma$
y	Buttline in fuselage coordinate system, in
z	Waterline in fuselage coordinate system, in
α_s	Rotor shaft angle, degrees
ΔU_P	Same as UP but not nondimensionalized by rotor tip speed, ft/sec
ΔU_T	Same as UT but not nondimensionalized by rotor tip speed, ft/sec
μ'	Nondimensional flight velocity, V/V_T
σ	Rotor solidity
Ψ	Blade azimuth angle, degrees

1.0 SUMMARY

The effects of RSRA fuselage configurations on rotor performance and loads have been quantified analytically by means of currently available potential flow and rotor analysis methods.

Four configurations of the Rotor Systems Research Aircraft (RSRA) were considered in this study. They were:

1) Fuselage alone (conventional helicopter)
2) Fuselage with auxiliary propulsion
3) Fuselage with wings (auxiliary lift)
4) Fuselage with both auxiliary lift and propulsion

The rotor system investigated was identical to a CH-47D front rotor except that it had four instead of three blades. Two scaled-down versions of the same rotor were was also analyzed to determine the effect of rotor scale on the fuselage upwash effects.

The flight conditions considered for the upwash study are discussed. The potential flow models for the RSRA configuration, with and without the wings and the auxiliary propulsion system, are presented. The results of fuselage/wing/propulsion system upwash on performance and loads are also presented.

The plethora of data resulting from this study reflected the existence of complicated flow interactions and did not lend itself to straightforward interpretation in all cases. More often than not though, neglecting fuselage upwash causes an underestimation of performance and an underestimation of loads.

The appendices contain potential flow model coordinates, upwash vlaue tabulations, loads analysis comparisons supplementary to those shown in figures, and examples of surface plots.

2.0 INTRODUCTION

The proximity of the fuselage to the rotor of a helicopter has a significant effect on the flow environment at the rotor. Recent flight tests (particularly the YUH-61A flight test experience) have shown that rotor/fuselage separation is one of the dominant parameters in determining rotor-induced vibratory loads, with associated detrimental effects ranging from pilot/passenger discomfort to reduced fatigue life of blades and control system, and to a possible degradation of performance and rotor limits. The fuselage proximity effects would be further magnified on helicopters utilizing auxiliary means of lift and propulsion because of the additional flow changes introduced by wings and fans.

The Rotor System Research Aircraft (RSRA) is the ideal system to explore combinations of rotors with auxiliary lift and auxiliary propulsion devices, but the understanding of the results of a flight test program would be strongly influenced by the degree to which mutual interference effects between helicopter components can be quantified.

The analytical methods necessary to assess fuselage, wing, and propulsion system effects on the flow field have been sufficiently improved to allow calculations of this nature to be carried out on computers having an adequate capacity. At the same time rotor loads and performance analysis methods have been developed which successfully predict the characteristics of helicopter rotors at all but the more extreme flight conditions.

The combination of three-dimensional potential flow and rotor loads/performance analysis methods has been the subject of research during recent years. The preliminary results have been encouraging, and data handling procedures have been developed which have considerably reduced the interface problems between potential flow and rotor analysis codes.

During this study, an approximation to the effects of fuselage/wing/engine proximity was determined by the coupling of a three-dimensional potential flow program with rotor loads and performance analyses. The approximation was made in order to assess the character of these effects on loads and performance. A close approximation would have involved an iterative process - determining the influence of fuselage/wing/engine proximity on loads and performance, determining the influence of rotor-induced downwash on the potential flow about the structures, and repeating the cycle. This study was limited to using only the first step, determining the initial influence of structural proximity on the rotor environment. The iterative process was outside the scope of the present study.

Previous efforts to determine the effects of fuselage proximity on rotor loads and performance were limited by the crudeness of the potential flow models or the rotor analyses. Two of these efforts were reported by Rahnema (Reference 1) and by Bain and Landgrebe (Reference 2). Rahnema investigated the alleviation of rotor loads with calculations that used only a single point source in a uniform free stream to model the flow about a fusleage. Bain and Landgrebe used a lifting line for the wing of a compound helicopter. The present study, by contrast, uses a fully three-dimensional panel method with wing vorticity distributed chordwise to model the flow about aerodynamic bodies.

3.0 A GENERAL DESCRIPTION OF FUSELAGE/WING/ENGINE UPWASH EFFECTS AND OF THEIR MODELING

Although isolated rotor tests and calculations are most often employed in the definition of advanced rotor systems, it is understood that the final success of a rotor system depends on its integration with fuselage components. In particular, test and theory have shown that the placement of the rotor with respect to the fuselage of a helicopter introduces changes in the rotor flow field which must be accounted for to determine realistic load and performance levels.

The presence of substantial lifting elements on the fuselage and the effect of auxiliary propulsion devices is very likely to increase the influence of the fuselage upwash on rotor performance and loads, making it even more critical that well documented rotor placement guidelines be established. Estabishing these guidelines is outside the scope of the present study, but such establishing must be based on analyses such as those reported herein or data gathered from tests.

The overall effects of fuselage/wing/engine upwash on a rotor were the object of this investigation. Considering only a single blade element, the structure induces an increment to the velocity component normal to the local free stream which would exist if no other structures were near the rotor. This increment changes the local angle of attack and, therefore, the airloads, flapping, and stresses.

The flow about three-dimensional bodies can be evaluated by computational potential flow methods, as well as methods involving more fundamental, and therefore more complex and expensive, approaches. In particular, the singularity panel methods are the simplest and least expensive for 3-D flow. They are adequate for the present purpose, since the effects of viscosity and vorticity, neglected by such methods, are significant only close to the fuselage/wings/engines, not in the off-body region where the rotor blades are located.

To obtain a 3-D potential flow solution with TEA-230 (Reference 3), a panel method, the surface of a body is approximated by a number of flat, or nearly flat surfaces (panels), where the size of the panels is dictated by the local surface curvature and by the need for accuracy in the calculated surface velocities. A potential flow solution for a given body is then obtained by prescribing, among other conditions, the requirement that there be no flow through the panels. Local velocities are then estimated at the centroid of each panel and at any required point off the body.

Figure 3-1 illustrates the overall logic in carrying out rotor/fuselage upwash interaction calculations. The rotor analysis program shown in the diagram is the B-65 performance code, Reference 4. The C-60 loads analysis, Reference 5, can be introduced in the same way.

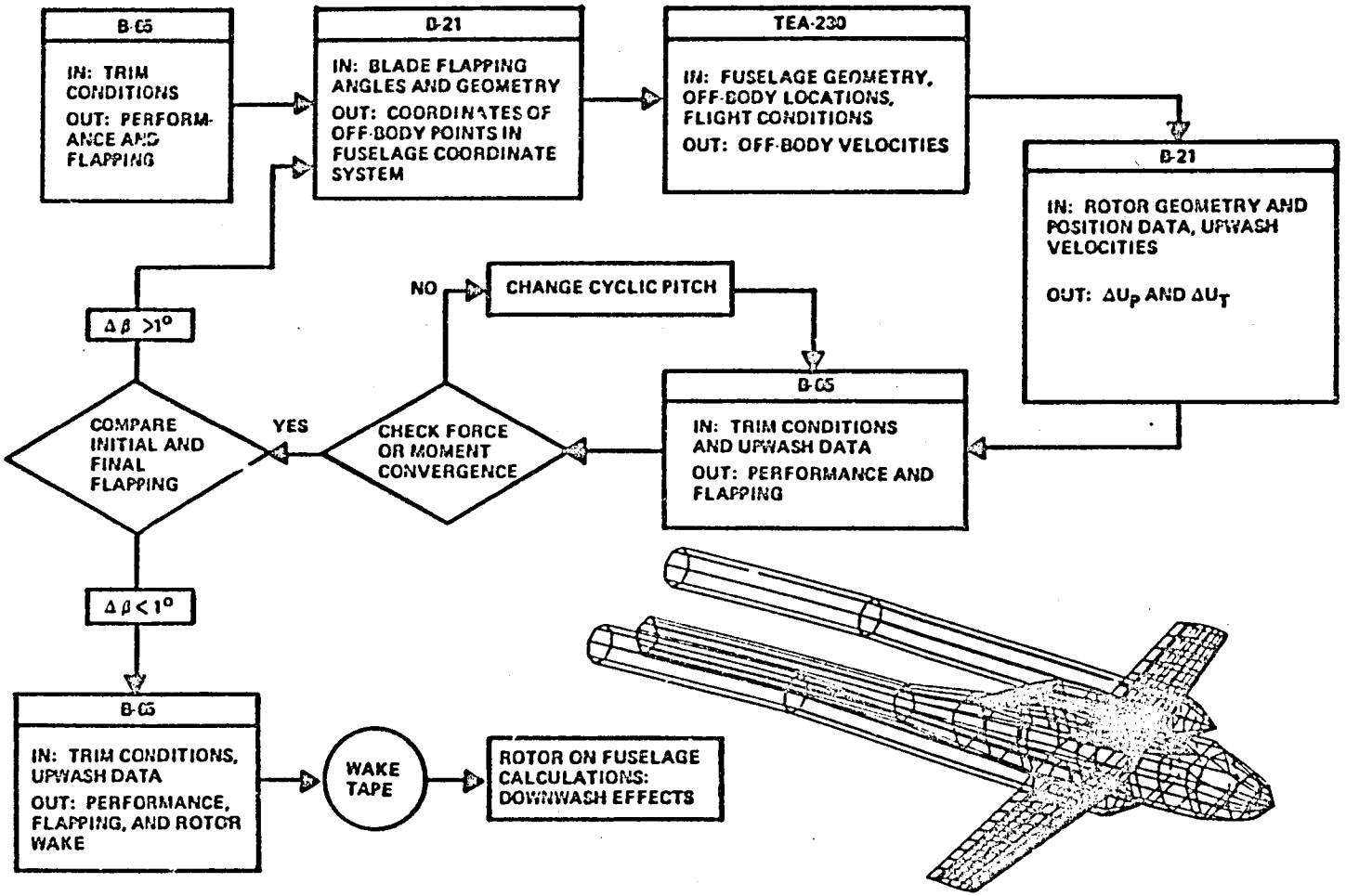

Figure 3-1. Single Rotor Upwash Calculation Procedure

The process is started with isolated rotor trim conditions. The initial blade flapping schedule is used by the B-21 processor code to calculate the coordinates of blade computation points in the fuselage coordinate system. The off-body point coordinates are then input into the 3-D analysis (TEA-230) and off-body velocities are calculated. The B-21 code converts the off-body velocities into incremental rotor velocities which are introduced into B-65 or C-60. Finally, B-65 or C-60 is run until a solution is obtained which satisfies the required trim in the presence of the fuselage upwash velocities at the blade computation points. The process is repeated only if substantial changes in blade flapping angles take place.

The manipulation of output from one program into input for another is performed automatically by the B-21 code. The only manual operations necessary are entering some of the B-65 or C-60 output into B-21 input, merging the B-21 output into TEA-230, and merging some of the TEA-230 output into the final B-21 input.

4.0 DESCRIPTION OF THE CODES USED

4.1 The B-65 Rotor Performance Analysis

The Rotor Performance Analysis, B-65, is described in Reference 4. The code was developed at Boeing Vertol. The basis for the code is a model of the wake trailed by each blade, which wake is represented by groups of straight vortex segments with linearly varying vorticity from one end to the other of each segment. A root and a tip vortex are rolled up after a fixed azimuthal interval (1/8th of a revolution) at a radial location which is determined from the instantaneous spanwise blade loading (Betz criteria). The vortex sheet trailed by each blade is modeled by a system of vortices identified as the near-wake, attached to the blade quarter chord line and trailed 1/24th of a revolution ($\Delta\Psi = 15°$), and a mid-wake, which extends for two additional time intervals ($\Delta\Psi = 30°$) beyond the near-wake.

As the B-65 code subdivides a rotor blade into 13 spanwise segments of equal length, cutout to tip, the vortex sheet trailed by each blade is represented by 13 horseshoe vortices. Except for the initial Betz rollup criteria which set the spanwise location of the tip vortices, the wake model is otherwise rigid, and its displacement is a combination of flight kinematics with a uniform induced downwash velocity.

Blade elastic properties are represented by a modal approach. Two flap bending and one torsion mode are used to model the elastic properties. The aerodynamic formulation, based on a lifting line system, includes an approximation of unsteady effects, dynamic stall delay, radial flow, reverse flow, and three-dimensional tip relief effects.

The sectional characteristics are obtained by look-up and interpolation of tables of two-dimensional airfoil data compiled from experimental or analytical sources. The tabulated airfoil characteristics are listed in the following sequence:

(a) Lift Coefficient, C_ℓ. Presented as a function of angle of attack at fixed Mach number levels, for angles from 0° to 20°, and from -20° (340°) back to 0° (360°), for Mach numbers from M = 0.0 to M = 1.0. Lift data from 20° to 340° is simulated by equations based on test data for the NACA 0012 airfoil, Reference 4. These equations are independent of Mach number as they are meant to approximate the high angle-of-attack flow conditions inside the reverse flow circle.

(b) Drag Coefficient, C_d. Drag is presented as a function of Mach number, for M = 0.0 to M = 1.0, at constant angle of attack levels over an angle of attack range which can be specified in the input. Outside of the specified angle of attack range the drag is approximated by equations independent of Mach number and based on NACA 0012 test data.

(c) Pitching Moment Coeffient, C_m. Pitching moments are tabulated as a function of Mach number, from M = 0.0 to M = 1.0, for angles of attack from 0° to 16°, and from -16° (344°) to 0° (360°). Equations based on NACA 0012 data cover the rest of the high angle of attack range.

B-65 output consists of airload and power distributions across the blades at 24 azimuthal locations. It also includes the distribution of elastic twist and deflections at those locations. Flapping angle is output in harmonic form and the other distributions can be harmonically analyzed. No specific number of harmonics is modeled because flapping is determined by solving a differential equation for flapping angle instead of simply finding the Fourier coefficients of an assumed harmonic behavior.

The accuracy of this code is reflected in Figure 4-1. In this figure, "Configuration 6" designates a particular blade planform, "BVWT" means Boeing Vertol Wind Tunnel, "BVWT 256" is a particular wind tunnel test, and "WOZ" means "wind-off zero."

4.2 The C-60 Dynamics Loads Analysis

The Dynamics Loads Analysis was developed at Boeing Vertol by the Rotor Dynamics Group. A detailed description of C-60 can be found in Reference 5.

C-60 uses a lumped-mass representation of a rotor blade, including up to 25 masses. The elastic properties are represented by elastic, massless rods connecting the masses. The airloads are evaluated on a relatively coarse radial and azimuthal grid from which dense airload distributions can be generated by intepolation and harmonic analysis.

Although C-60 has provisions for a trailed vortex sheet, satisfactory airloads have been calculated by means of induced velocities from the root and tip vortices only.

Without the limitations of the modal approach of B-65, the C-60 analysis can evaluate the motions and deflections of a rotor blade in whatever complexity the dynamics and aerodynamics of the problem dictate. Blade and control loads can be then defined and analyzed in detail with the harmonic content.

C-60 output consists of airload and internal load distributions across the blades at 24 azimuthal locations. It also includes pitch link and hub loads. Ten harmonics of the blade can be and were modeled, in order to obtain the highest definition of the above distributions. The accuracy of this code is reflected in Figure 4-2.

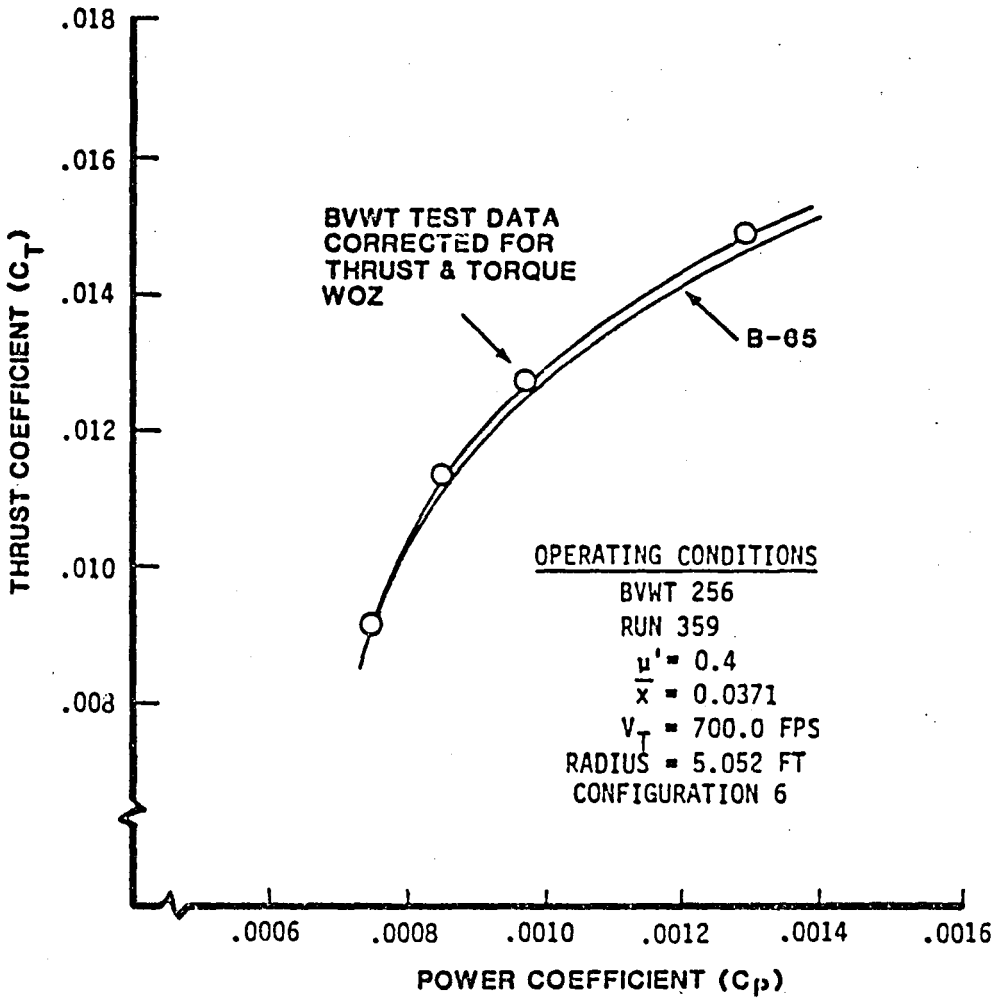

Figure 4-1. Comparison of Measured and Calculated Rotor Performance

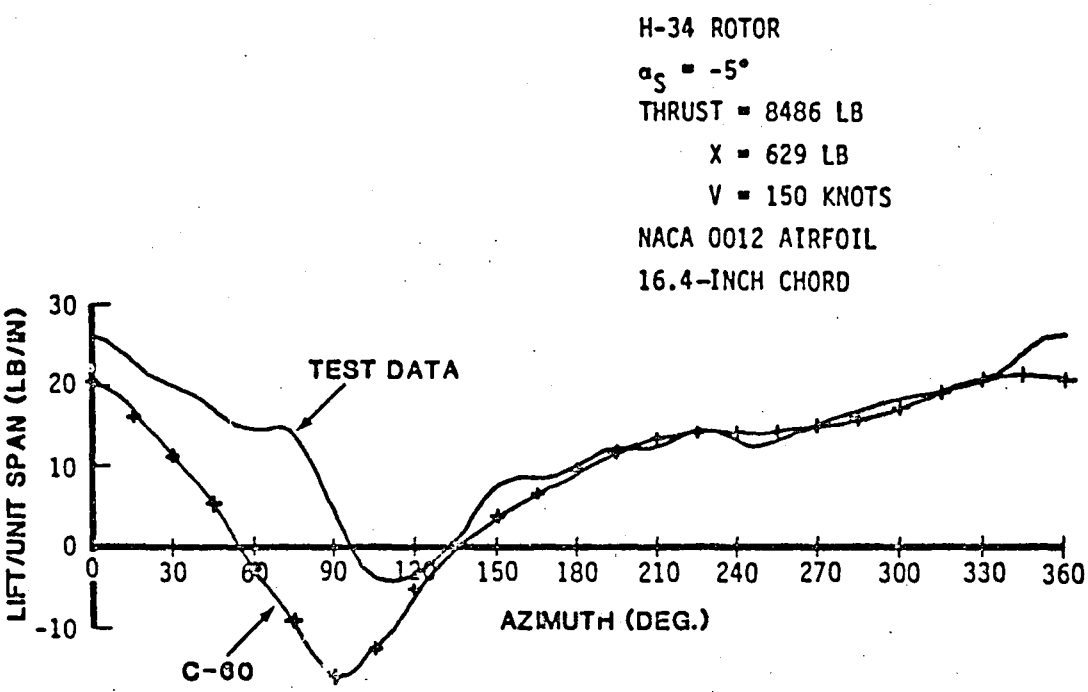

Figure 4-2. Comparison of Measured and Calculated Lift per Unit Span

4.3 The B-21 Rotor/Wake/Fuselage Interaction Processor

The B-21 Rotor/Wake/Fuselage Interaction Code was developed at Boeing Vertol. This code carries out all interface calculations necessary to couple a 3-D potential flow analysis, in particular TEA-230, with a rotor performance or loads analysis.

B-21 takes the flapping angle Fourier coefficients from B-65 output plus the rotor geometry and finds from these the coordinates in the fuselage coordinate system of all blade computational points at all azimuths. These computational points are output from B-21 in exactly the format required for off-body velocity computation by TEA-230. They are then simply merged with the on-body geometry of TEA-230 input. The off-body velocities as they appear in TEA-230 output then serve as another B-21 input without manipulation.

4.4 The TEA-230 Potential Flow Analysis

The three-dimensional potential flow analysis, TEA-230 (Boeing/Seattle), can simulate lifting and non-lifting bodies and engine flow. The code has provisions for on-body and off-body velocity calculations. To obtain a 3-D potential flow solution the surfaces of the body are approximated, as mentioned in Section 3, by a number of flat, or nearly flat surfaces (panels). A potential flow solution on the surface of a given body is then obtained by prescribing, among other conditions, the requirement that there be no flow through the panels. Local velocities and therefore pressures are then estimated at the centroid of each panel and at any required point off the body.

The TEA-230 analysis used in this study is described in detail in Reference 3.

5.0 DESCRIPTION OF RSRA CONFIGURATION AND FLIGHT CONDITIONS

A potential flow model of the RSRA fuselage was defined with provisions to combine the following components:

A. The body of the fuselage, including the tail boom, but no tail surfaces.

B. Wings and wing/fuselage fairing areas.

C. Engines providing auxiliary propulsion.

D. An approximate model of separated regions behind the fuselage and engines.

The individual and combined elements of the potential flow model were processed through diagnostic programs to verify the quality of the paneling. Computer-generated plots were provided to document the mathematical models.

The fuselage model was only as detailed as necessary to evaluated upwash velocities at the main rotor.

The matrix of operating conditions with and without auxiliary lift, and with and without auxiliary propulsion, were defined. The fuselage and rotor configurations were limited to:

A. The basic fuselage.
B. The basic fuselage with one set of wings.
C. The basic fuselage with auxiliary propulsion.
D. The basic fuselage with wings and auxiliary propulsion.
E. Three rotor diameters at one hub position.

Fuselage upwash and rotor performance calculations were carried out for three rotor diameters, three gross weight levels, two auxiliary lift levels, four auxiliary propulsion levels, and combinations of both auxiliary lift and propulsion. All three rotors were set at the same height above the fuselage and, for the purposes of the current study, this height was not varied from the current RSRA configuration since such variation would require redesign of the RSRA.

A summary of the computation conditions is presented in Table I. The relationships of the parameters defining the flight conditions to the gross weights and flight velocities selected are shown in Table II, along with identification of the effects illustrated by various comparisons among the flight conditions. Table II is read in the following way: The numbers labled "CONDITION" refer to the 27 flight conditions. The numbers opposite the key parameters GW, T, etc., refer to specific values; e.g., "1" in the row opposite "GW" means the gross weight is GW_1 (flight conditions 1, 2, 5, 6, etc.). The "2" in the

row opposite "T" means the vertical component of rotor thrust is T_2 (flight conditions 3, 4, 5, 6, etc.). These key parameter values are defined in Table II.

The conditions shown in Table I were based on the relationships shown in Table II plus both the necessity of not letting the thrusts, gross weights, and velocities be unrealistic for the RSRA, and the desirability of not letting the different values of those same parameters be too close together, thus making the effects of the differences difficult to detect. These conflicting requirements left little room for arbitrariness in the choices of computational conditions.

TABLE I

RSRA UPWASH STUDY FLIGHT CONDITIONS

CONDITION	GROSS WEIGHT (POUNDS)	VERTICAL COMPONENT OF ROTOR THRUST (POUNDS)	FLIGHT VELOCITY (KNOTS)	WING LIFT (POUNDS)	AUXILIARY THRUST (POUNDS)	ROTOR DIAMETER (FEET)
1	26,400	26,400	112.5	0	0	60
2	26,400	26,400	162.5	0	0	60
3	18,333.3	18,333.3	112.5	0	0	60
4	18,333.3	18,333.3	162.5	0	0	60
5	26,400	18,333.3	112.5	8,066.7	0	60
6	26,400	18,333.3	162.5	8,066.7	0	60
7	18,333.3	18,333.3	112.5	0	983	60
8	18,333.3	18,333.3	162.5	0	2,051	60
9	26,400	18,333.3	112.5	8,066.7	983	60
10	26,400	18,333.3	162.5	8,066.7	2,051	60
11	18,333.3	18,333.3	112.5	0	0	50
12	18,333.3	18,333.3	162.5	0	0	50
13	18,333.3	18,333.3	112.5	0	983	50
14	18,333.3	18,333.3	162.5	0	2,051	50
15	26,400	18,333.3	112.5	8,066.7	0	50
16	26,400	18,333.3	162.5	8,066.7	0	50
17	26,400	18,333.3	112.5	8,066.7	983	50
18	26,400	18,333.3	162.5	8,066.7	2,051	50
19	22,366.7	22,366.7	162.5	0	0	60
20	22,366.7	18,333.3	162.5	4,033.3	0	60
21	22,366.7	18,333.3	162.5	4,033.3	2,051	60
22	18,333.3	18,333.3	162.5	0	1,025.5	60
23	22,366.7	18,333.3	162.5	4,033.3	1,025.5	60
24	22,366.7	22,366.7	162.5	0	0	55.2
25	26,400	26,400	137.5	0	0	60
26	26,400	18,333.3	137.5	8,066.7	0	60
27	18,333.3	18,333.3	137.5	0	1,468.5	60

TABLE II. RSRA UPWASH STUDY

DEFINITION OF KEY PARAMETER VARIATION

$$GW_1 = T_1;\ GW_2 = T_2;\ GW_3 = \frac{GW_1 + GW_2}{2};\ GW_1 > GW_2$$

$$V_2 > V_1 \quad V_3 = (V_1 + V_2)/2$$

$$L_1 = GW_1 - T_2;\ L_2 = L_{1/2} = GW_3 - T_2$$

$$D_2 = D_1\sqrt{\frac{GW_2}{GW_1}};\ D_3 = D_1\sqrt{\frac{GW_3}{GW_1}}$$

$$P_1 = fe\ q_1,\ P_2 = fe\ q_2 \quad P_3 = \frac{fe}{2}\ q_2 \quad P_4 = fe\ q_3$$

CONDITION / VARIABLE	LARGE DIAMETER										SMALL DIAMETER								LINEARITY CHECK								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
GW	1	1	2	2	1	1	2	2	1	1	2	2	2	2	1	1	1	1	3	3	3	2	3	3	1	1	2
T	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	3	1	2	2
V	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	2	2	2	2	2	3	3	3
L	–	–	–	–	1	1	–	–	1	1	–	–	–	–	1	1	1	1	–	2	2	–	2	–	–	1	–
P	–	–	–	–	–	–	1	2	1	2	–	–	1	2	–	–	1	2	–	–	2	3	3	–	–	–	4
DIA	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	3	1	1	1
EFFECT OF VELOCITY																											
EFFECT OF DISK LOAD																											
EFFECT OF WING LIFT																				X = 0							
EFFECT OF PROP FORCE																									WITH LIFT		
EFFECT OF LIFT & PROP F																											
EFFECT OF DIAMETER	DISK LOAD = CONST GW = CONST GW = CONST & X = 0 GW&L = CONST GW&L = CONST & X = 0																										

TABLE III
VALUES OF KEY PARAMETERS

GW_1	= 26,400	pounds
GW_2	= 18,333.3	pounds
GW_3	= 22,366.7	pounds
T_1	= 26,400	pounds
T_2	= 18,333.3	pounds
T_3	= 22,366.7	pounds
V_1	= 112.5	knots
V_2	= 162.5	knots
V_3	= 137.5	knots
L_1	= 8,066.7	pounds
L_2	= 4,033.3	pounds
D_1	= 60	feet
D_2	= 50	feet
D_3	= 55.2	feet
P_1	= 983	pounds
P_2	= 2,051	pounds
P_3	= 1,025.5	pounds
P_4	= 1,468.5	pounds

6.0 POTENTIAL FLOW MODELS OF THE RSRA

There were four significantly different potential flow models used in this study: the RSRA fuselage (Figures 6-1 and 6-2), the fuselage with auxiliary propulsion engines (Figures 6-3 and 6-4), the fuselage with auxiliary wings (Figures 6-5 and 6-6), and the fuselage with both auxiliary wings and auxiliary engines (Figures 6-7 and 6-8). Two more combinations of fuselage and auxiliary wings, one with and one without auxiliary engines, were used. The wings of these were at different incidence angles. They strongly resembled the combinations in Figures 6-5 and 6-7.

In all of these models the tail surfaces and engine supports were omitted. The cylindrical tube behind each truncated fuselage is used to represent, in rough approximation, the aft fuselage, fuselage boundary layer, and fuselage wake. The cylindrical tubes behind the engines are used to approximate the exhaust jets.

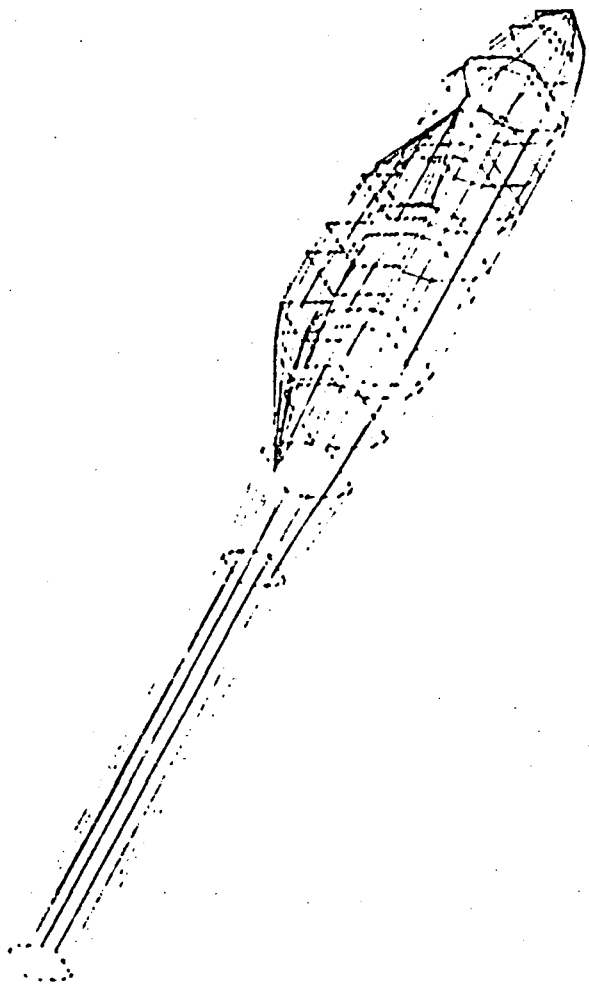

Figure 6-1. Potential Flow Model of the RSRA Fuselage.

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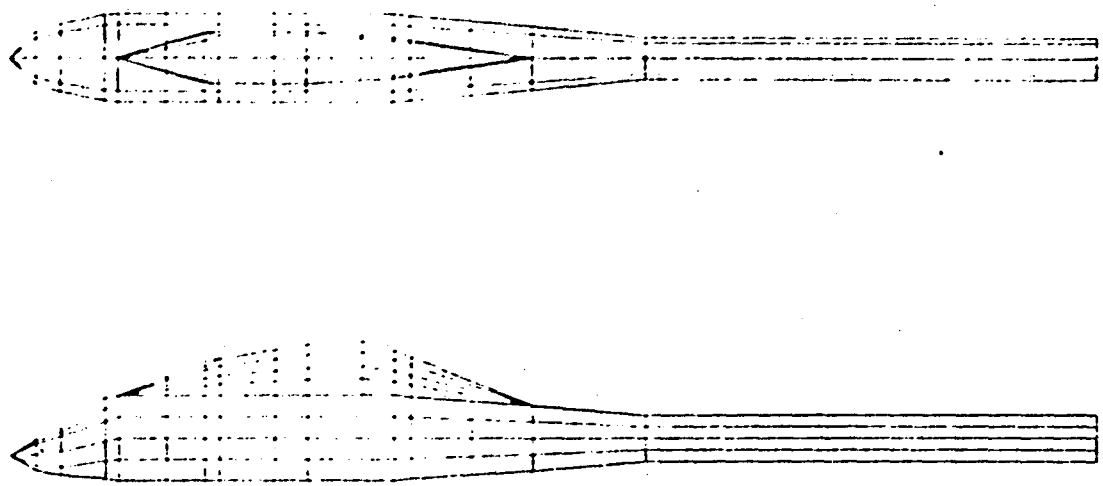

Figure 6-2. Potential Flow Model of the RSRA Fuselage. Top and Side Views.

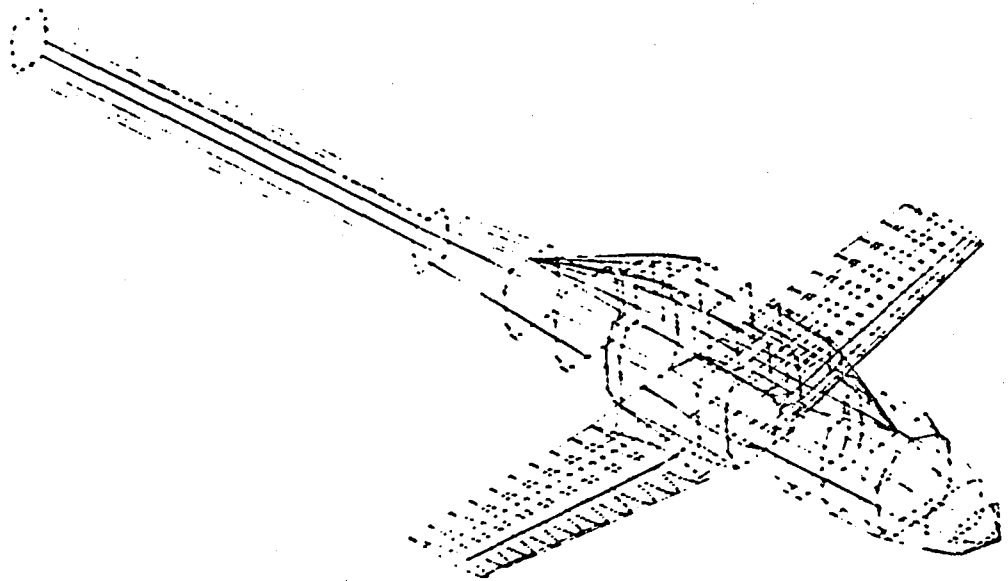

Figure 6-3. Potential Flow Model of the RSRA Fuselage with Auxiliary Wings.

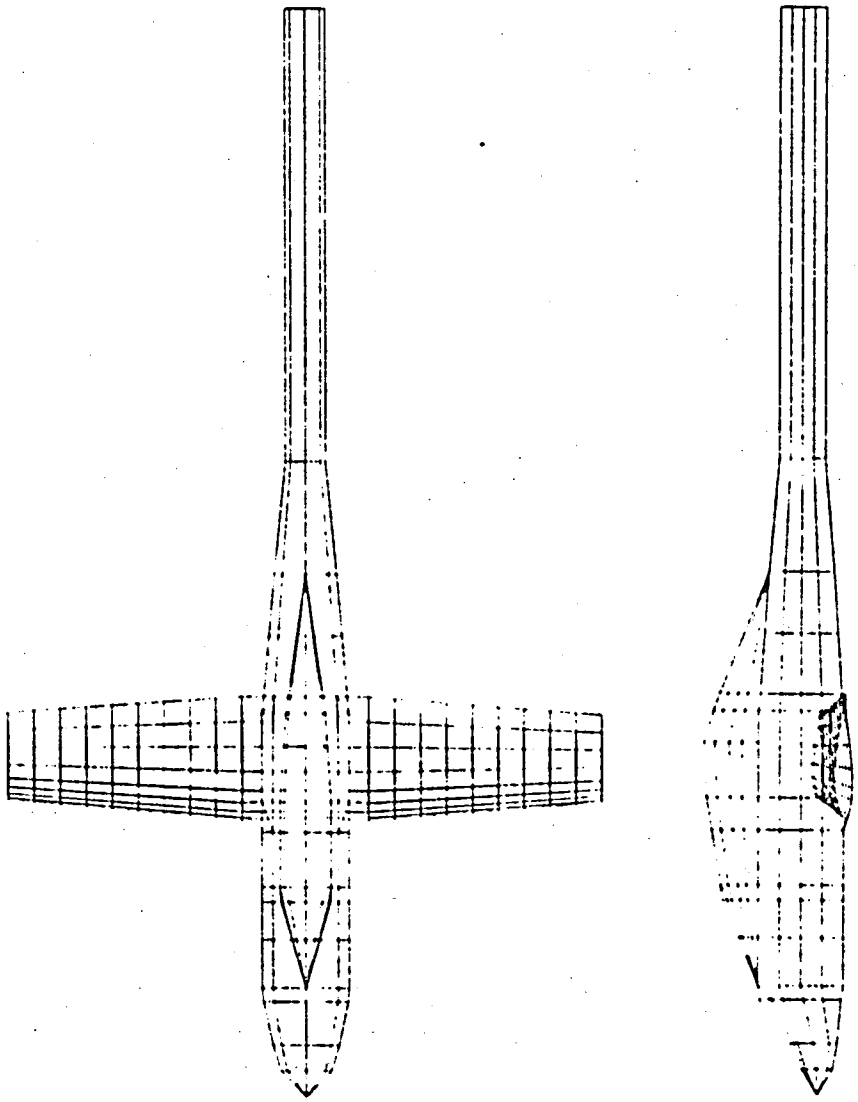

Figure 6-4. Potential Flow Model of the RSRA Fuselage with Auxiliary Wings. Top and Side Views.

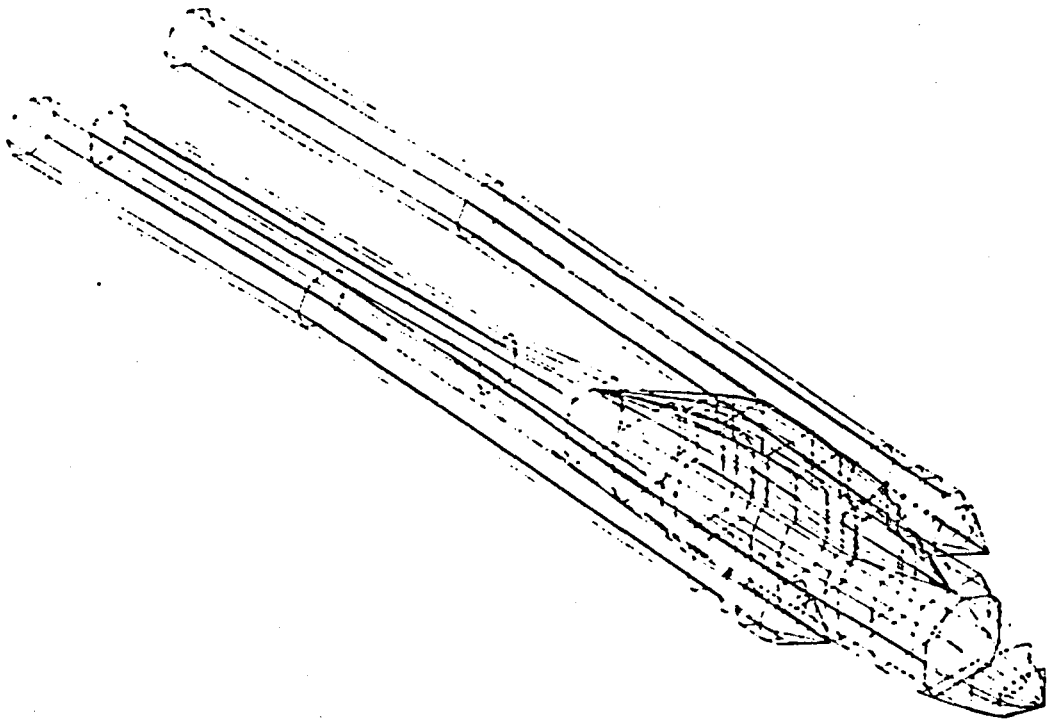

Figure 6-5. Potential Flow Model of the RSRA Fuselage with Auxiliary Engines.

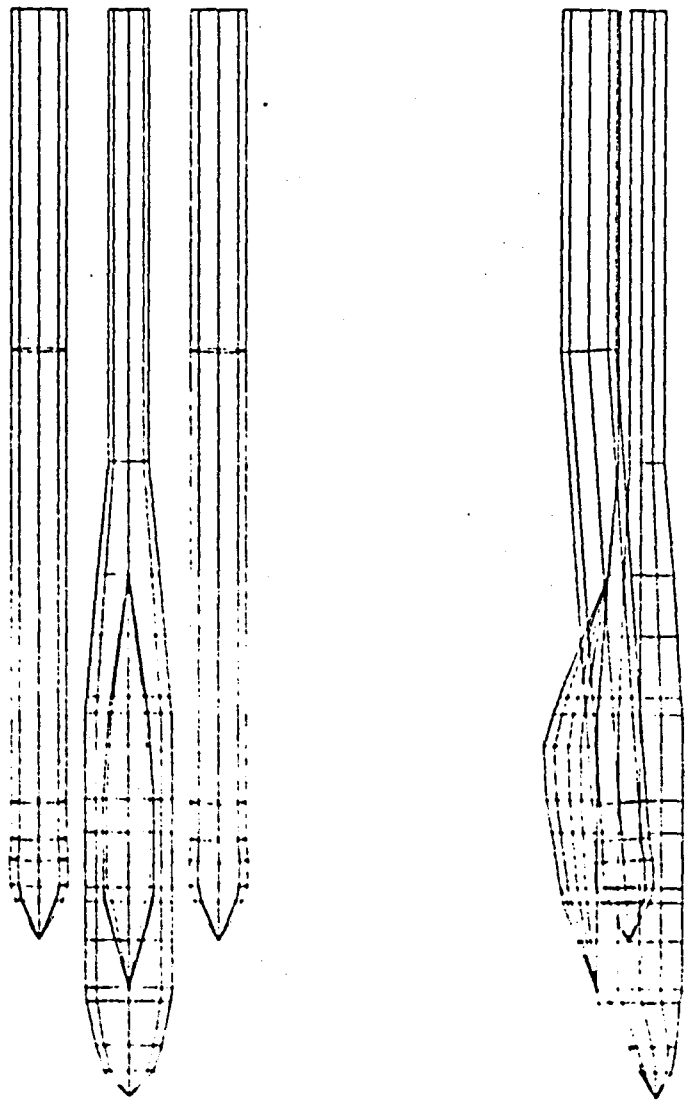

Figure 6-6. Potential Flow Model of the RSRA Fuselage with Auxiliary Engines. Top and Side Views.

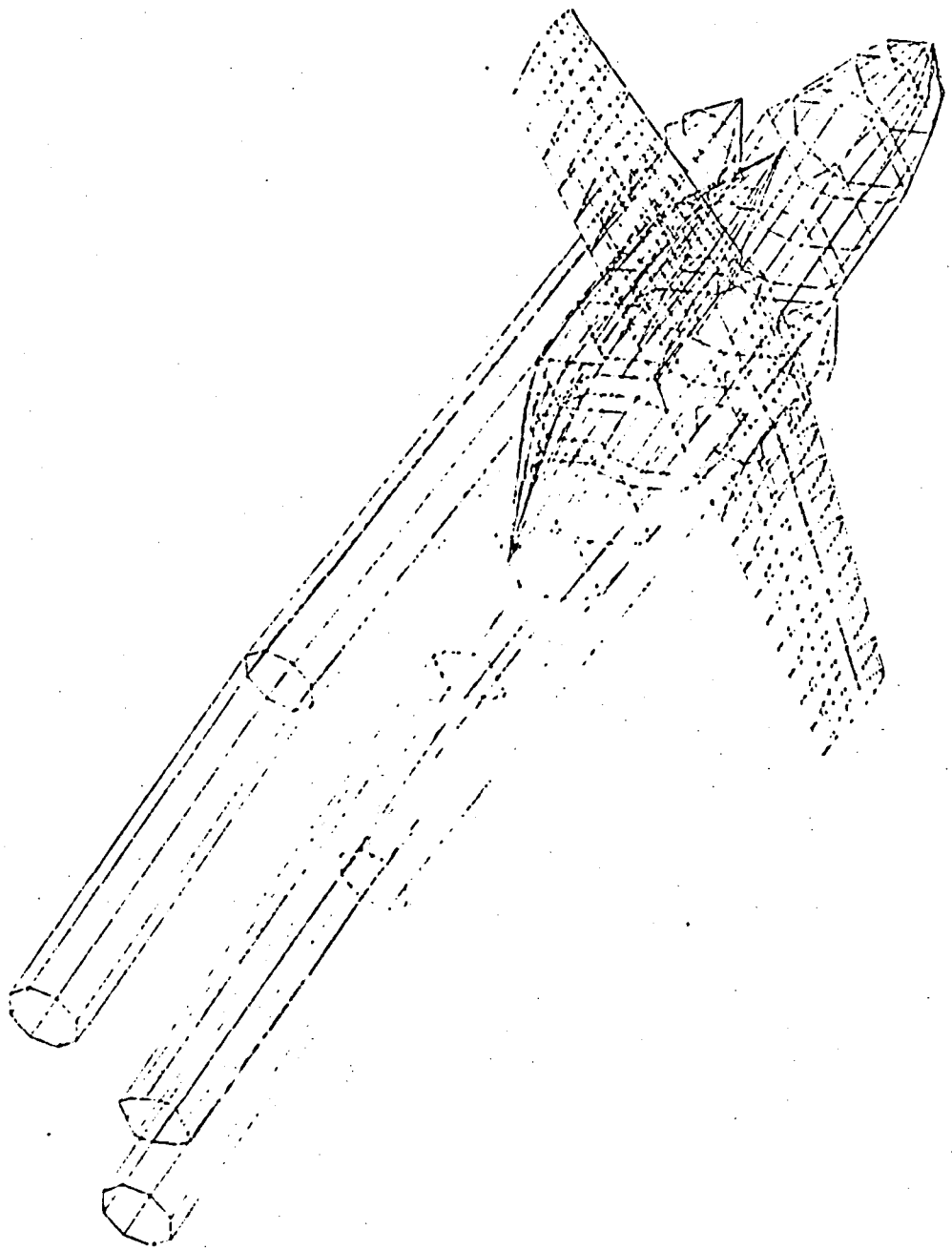

Figure 6-7. Potential Flow Model of Complete RSRA Configuration.

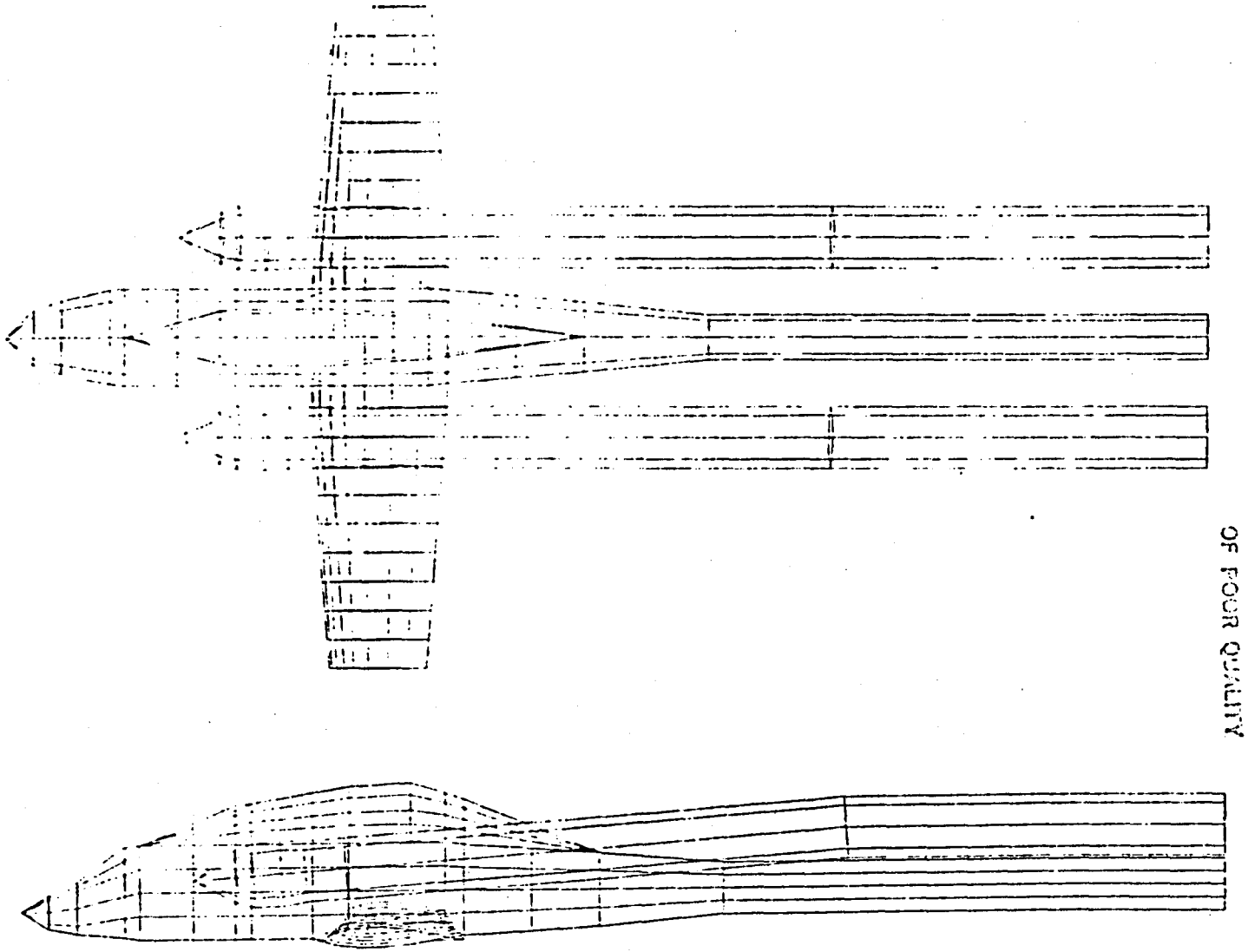

Figure 6-8. Potential Flow Model of Complete RSRA Configuration. Top and Side Views.

7.0 DESCRIPTION OF MAIN ROTOR CHARACTERISTICS

The rotor used in this study is identical to a CH-47D front rotor except that it has four instead of three blades. The radius of this rotor is 30 feet and the chord 32 inches. The airfoil, from the cutout at 21% of the radius to 85% of the radius, is the Boeing Vertol VR-7. At the tip, the airfoil is the VR-8. The airfoil of the last 15% of the blade is a linear transition between these two. The VR-7 is 12% thick, the VR-8 is 8%. The planform of the blade is rectangular. The twist is linear, decreasing 7.63° between the cutout and 85% of the radius and another 0.7° between the 85% point and the tip. For some of the flight conditions, a 25-foot Mach-scaled version of the same rotor is used, and, for condition 24, a 27.61 foot rotor, also Mach-scaled, as defined in Table II. Mach scaling here means that velocities (and therefore Mach numbers) and densities are conserved as lengths are changed in the scaling process. Therefore, airfoil shapes, disk loadings, twist angles, pressures, thicknesses as fractions of chord, and moduli of elasticity are conserved, but masses, lengths, forces, areas, volumes, and accelerations are not. Masses are proportional to the cube of the rotor radius, while lengths are proportional to the radius itself. Forces, except for weight, which is not scaled correctly, are proportional to the square of the radius. Areas and volumes are proportional to the second and third powers of the radius, while accelerations are inversely proportional to the first power. In particular, the 25-foot radius rotor has a 26.67-inch chord, while the 27.61-foot rotor has a 29.45-inch chord.

8.0 DISCUSSION OF THE EFFECTS OF FUSELAGE/WING/ENGINE UPWASH ON THE PERFORMANCE AND LOADS OF THE RSRA ROTOR

The effects of upwash on performance is shown in Figures 8-1 through 8-5.

Figure 8-1 displays the values of required rotor horsepower determined by B-65 for the 27 flight conditions shown in Table II. To keep from splitting hairs too finely, it was deemed necessary to consider an influence due to fuselage/wing/engine upwash which changed the rotor power by less than 400 horsepower to be questionable. Considering only consequential influences, it appears that for only Flight Conditions 2, 8, 16, and 21 does fuselage/wing/engine upwash increase the required rotor power, while for only Flight Conditions 7, 13, 14, 22, and 23 does the upwash decrease that power. From these observations one can conclude that, at least in general, fuselage/wing/engine upwash increases required rotor power at high flight velocities when the sum of rotor and wing lift is high, while auxiliary engine upwash without wing upwash decreases the required power.

Figure 8-2 displays the values of equivalent lift-to-drag ratio determined by B-65. If one considers here that differences in L/DE of less than 0.6 are not significant, one finds that fuselage/wing/engine upwash significantly increases L/DE for Flight Conditions 7, 13, 14, 22, 23, and 27 and significantly decreases L/DE for Flight Conditions 8 and 21. From these observations one can conclude that, in general, engine upwash can significantly influence L/DE in the presence of little or no wing upwash. One can conclude also that the engine upwash increases L/DE except possibly when auxiliary thrust is high.

In comparing Figures 8-1 and 8-2 and while noting that the only quantity contributing to L/DE which should change due to fuselage/wing/engine upwash is the rotor power, one should expect changes in L/DE due to fuselage/wing/engine upwash to be opposite changes in rotor horsepower. This indeed is the case, except for Flight Conditions 2 and 4, where the changes in power are slight and are offset by the changes in lift and X allowed by the convergence tolerances.

Figure 8-3 displays the vibratory component of the blade tip elastic twist deflection as calculated by B-65. If one decides that differences in $\Delta\theta_{EL}$ less than 0.016 radians are questionable one finds fuselage/wing/engine upwash significantly decreases $\Delta\theta_{EL}$ for Flight Conditions 2, 12, 14, 19, and 27 but never significantly increases $\Delta\theta_{EL}$. It is somewhat difficult to find commonality in these five flight conditions, although they all involve high flight velocities or auxiliary propulsion. None involve wing lift. Most of these conditions involve reasonably high disk loading.

Figure 8-4 displays the normalized magnitudes of the fourth and eighth harmonics of rotor thrust as determined by B-65. If one considers differences in T_4/T_0 less than 0.014 to be insignificant, one finds that fuselage/wing/engine upwash significantly increases T_4/T_0 for Flight Conditions 21 and 22 and significantly decreases it for Flight Conditions 2, 4, 6, 12, 24, and 26. These Flight Conditions are at medium and high flight velocities and usually involve disk loadings that are not high. In particular, the two flight conditions for which fuselage/wing/engine upwash increases T_4/T_0 involve a high flight velocity and reasonably low disk loadings. But these are the only flight conditions among the eight significant ones which involve auxiliary propulsion. The other six flight conditions involve no auxiliary propulsion and experience decreases in T_4/T_0 due to fuselage/wing upwash.

If one uses 0.014 as also the lower limit of significant differences in T_8/T_0, one finds that fuselage/wing/engine upwash significantly increases T_8/T_0 for Flight Conditions 5, 8, 13, 19, 21, 22, and 23 and significantly decreases it for Flight Conditions 2, 6, 14, 16, 18, 24, and 25. These 14 flight conditions have little in common except that most of them involve the highest flight velocity. Why fuselage/wing/engine upwash increases or decreases T_8/T_0 is not clear at all.

Figure 8-5 displays the normalized magnitudes of the fourth and eighth harmonics of rotor torque as determined by B-65. A comparison of differences in Q_4/Q_0 due to fuselage/wing/upwash show little correlation with the key parameters of the flight conditions or the RSRA potential flow models, except that the largest differences occur at high flight velocity. If one considers differences in Q_8/Q_0 less than 0.022 to be insignificant, one finds that fuselage/wing/engine upwash significantly increases Q_8/Q_0 for Flight Conditions 7, 9, 13, and 17 and significantly decreases it for Flight Condition 22. The flight conditions for which Q_8/Q_0 is significantly increased are all at the lowest flight velocity and all use auxiliary propulsion. Flight condition 22, by contrast, uses the highest flight velocity and, by comparison, also uses auxiliary propulsion. However, other flight conditions using auxiliary propulsion and high flight velocity do not experience significant changes in Q_8/Q_0 due to fuselage/wing/engine upwash.

The effects of upwash on loads is shown in Figures 8-6 through 8-41. In each figure, the solid curve indicates the isolated rotor, the dashed curve the rotor influenced by upwash induced by fuselage and/or auxiliary wings and/or auxiliary engines.

The figures are grouped according to the independent variable and the constant parameters. Figures 8-6 through 8-9 show functions of flight velocity in which the upwash (if any) is caused by only the RSRA fuselage. Figures 8-10 though 8-13 are similar except that the influence of the wings has been added.

Figures 8-14 through 8-17 are like Figures 8-6 through 8-9 except that the influence of the auxiliary engines has been added. Figures 8-18 through 8-21 show functions of disk loading in which the upwash is caused by only the fuselage. Figures 8-22 through 8-25 show functions of wing lift. Figures 8-26 through 8-29 show functions of the flat plate area for the thrust from the auxiliary engines. Figures 8-30 through 8-33 are similar but with wing lift added. Figures 8-34 through 8-37 show functions of auxiliary engine flat plate area and wing lift as both increase together. Finally, Figures 8-38 through 8-41 show functions of rotor size at a constant disk loading. Table IV lists the flight conditions and potential flow models for each of the above groups of figures.

Another grouping can be considered in which the figures of each group display the same dependent, as opposed to independent, variable. Figures 8-6, 8-10, 8-14, 8-18, 8-22, 8-26, 8-30, 8-34, and 8-38 display the variation of equivalent lift-to-drag ratio with several different parameters and at many different flight conditions. Figures 8-7, 8-11, 8-15, 8-19, 8-23, 8-27, 8-31, 8-35, and 8-39 display the variation of pitch link load vibratory amplitude with the same parameters and at the same flight conditions. Figures 8-8, 8-12, 8-16, 8-20, 8-24, 8-28, 8-32, 8-36, and 8-40 display the variation of flap hinge vertical shear vibratory amplitude while Figures 8-9, 8-13, 8-17, 8-21, 8-25, 8-29, 8-33, 8-37, and 8-41 display the variation of FZF, the vertical hub force fourth harmonic amplitude.

It will be most instructive to discuss these figures according to this last grouping, beginning with the equivalent lift-to-drag ratio.

Fuselage upwash alone generally slightly increases L/DE regardless of flight velocity (Figure 8-6) or disk loading (Figure 8-18). Wing plus fuselage upwash slightly decreases L/DE regardless of flight velocity (Figure 8-10), but generally increases it at low values of wing lift (Figure 8-22). There is a significant increase in L/DE due to the upwash of the fuselage and auxiliary engines for all flight velocities (Figure 8-14) and for all values of the flat plate area opposing the auxiliary engines (Figure 8-26). The upwash of fuselage, wing, and auxiliary engines generally increases L/DE despite variation in flat plate area (Figures 8-30 and 8-34) or wing lift (Figure 8-34). There appears to be little effect due to fuselage upwash alone if the rotor size varies but disk loading remains constant (Figure 8-38).

These results are not identical to those determined by B-65. The primary reason for the differences is probably the fact that the C-60 loads analysis performs calculations considerably different from those in the B-65 performance analysis. The differences in these calculations were outlined in Sections 4.1 and 4.2.

TABLE IV

FLIGHT CONDITIONS AND POTENTIAL FLOW MODELS
FOR LOAD ANALYSIS ILLUSTRATED COMPARISONS

FIGURES	FLIGHT CONDITIONS			POTENTIAL FLOW MODEL
8-6 through 8-9	1	2	25	Fuselage only
8-10 through 8-13	5	6	26	Fuselage and wing
8-14 through 8-13	7	8	27	Fuselage and engines
8-18 through 8-21	2	4	19	Fuselage only
8-22 through 8-25	4*	6	20	Fuselage and wing
8-26 through 8-29	4*	8	22	Fuselage and engines
8-30 through 8-33	6**	10	23	Fuselage, wing, and engines
8-34 through 8-37	4*	10	23	Fuselage, wing, and engines
8-38 through 8-41	2	12	24	Fuselage only

*Fuselage only **Fuselage and wing only

In contrast to its effect on L/DE, fuselage upwash alone increases the pitch link load vibratory amplitude significantly at high flight velocities (Figures 8-7 and 8-19). The fuselage and engine upwash together produce the same result if the engines are providing most of the forward thrust (Figures 8-15 and 8-27). The fuselage-plus-wing upwash increases the PLL amplitude at all flight velocities (Figure 8-11), and the addition of the engines does not generally change this result (Figure 8-31). The fuselage-plus-wing upwash alone increases the PLL amplitude at all values of wing lift (Figure 8-23). The addition of engines has the same effect, generally, if the wing lift and engine thrust increase together (Figure 8-35). With the fuselage alone causing upwash, the PLL amplitude increases quickly with rotor size (Figure 8-39).

The effects of upwash on the vertical shear vibratory amplitude at the flap hinge are somewhat similar to the effects on L/DE. The fuselage upwash alone increases the vibratory amplitude at all flight velocities (Figure 8-8), all disk loadings (Figure 8-20), and all rotor sizes (Figure 8-40). The addition of upwash from the wing decreases the amplitude at all flight velocities (Figure 8-12) and all rotor if the wing lift is high, but not otherwise (Figure 8-24). The fuselage-plus-engine upwash generally increases the amplitude at high but not at low velocities (Figure 8-16) and then only when the auxiliary thrust is large (Figure 8-28). The upwash from the complete RSRA configuration generally increases the flap hinge vertical shear vibratory amplitude (Figures 8-32 and 8-36), at least at high values of auxiliary thrust.

The vertical hub force fourth harmonic amplitude (FZF) is decreased by fuselage upwash at high flight velocities (Figure 8-9). When wing upwash is added FZF is increased at all flight velocities (Figure 8-13) but not all values of wing lift (Figure 8-25). The fuselage-plus-engine upwash decreases FZF at all flight velocities (Figure 8-17) and all values of auxiliary thrust (Figure 8-29). The upwash from the fuselage alone decreases FZF for all values of disk loading (Figure 8-21) and for all rotor sizes (Figure 8-41). The upwash from the complete configuration decreases FZF at high values of auxiliary thrust when the wing lift is also high (Figures 8-33 and 8-37).

It should be noted at this point that the flight conditions labeled "LINEARITY CHECK" in Table II show that the results in Figures 8-6 through 8-41 are, in general, highly nonlinear. This nonlinearity is most prominent in the variation of flap hinge vertical shear vibratory amplitude. In fact, the vertical shear vibratory amplitude appears to be lowest at these "LINEARITY CHECK" flight conditions.

Although curve crossings have not been specifically mentioned as such, they appear in most of the figures which display loads analysis results. They are prominent in those figures which involve variations in flat plate equivalent area for auxiliary thrust. Most of these figures which display loads indicate that, in general, loads are decreased by fuselage/wing/engine upwash at low values of fe, but are increased at high values of fe.

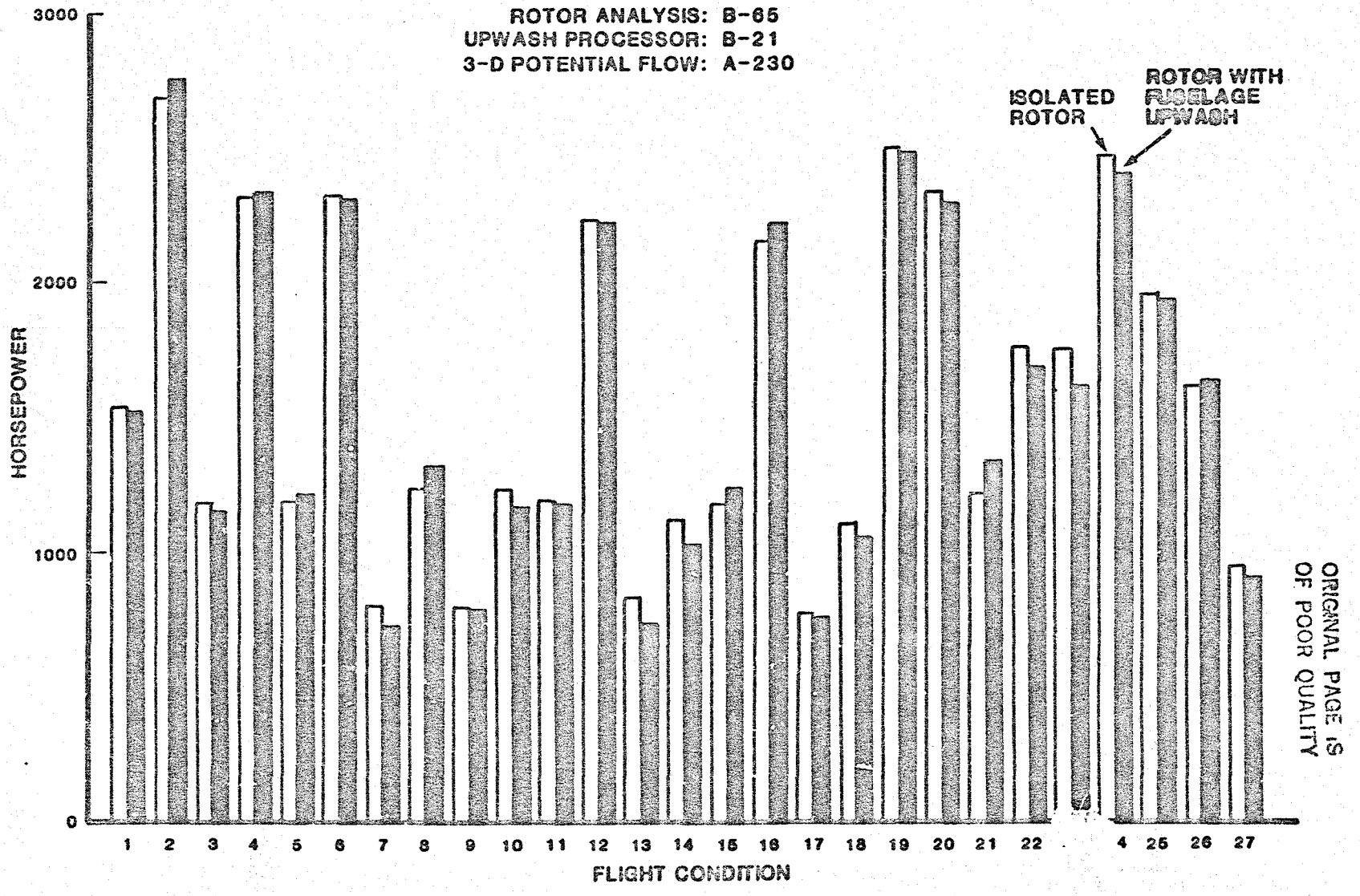

Figure 8-1. Effect of RSRA Upwash on Calculated Rotor Power

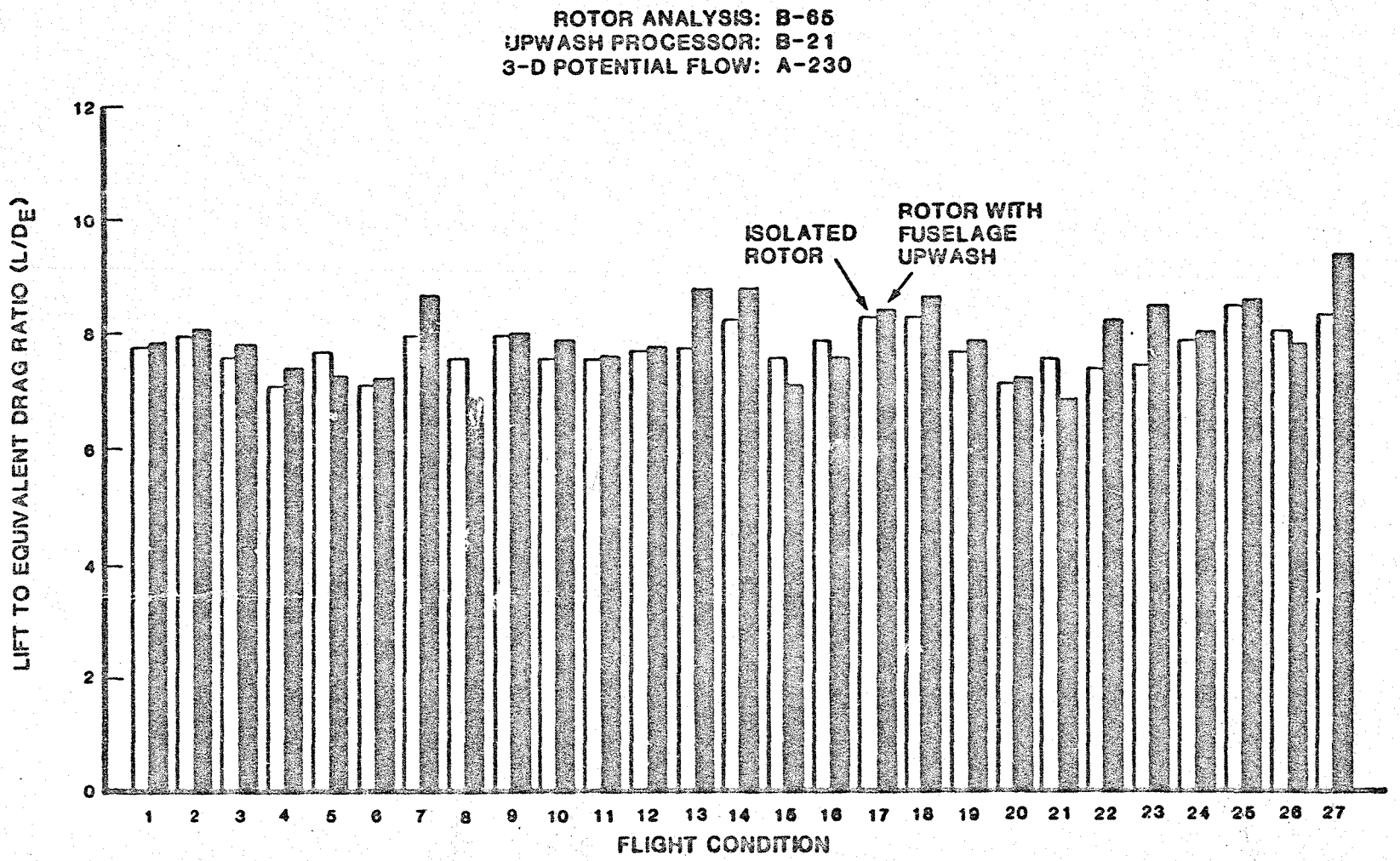

Figure 8-2. Effect of RSRA Upwash on Calculated Equivalent Lift-to-Drag Ratio

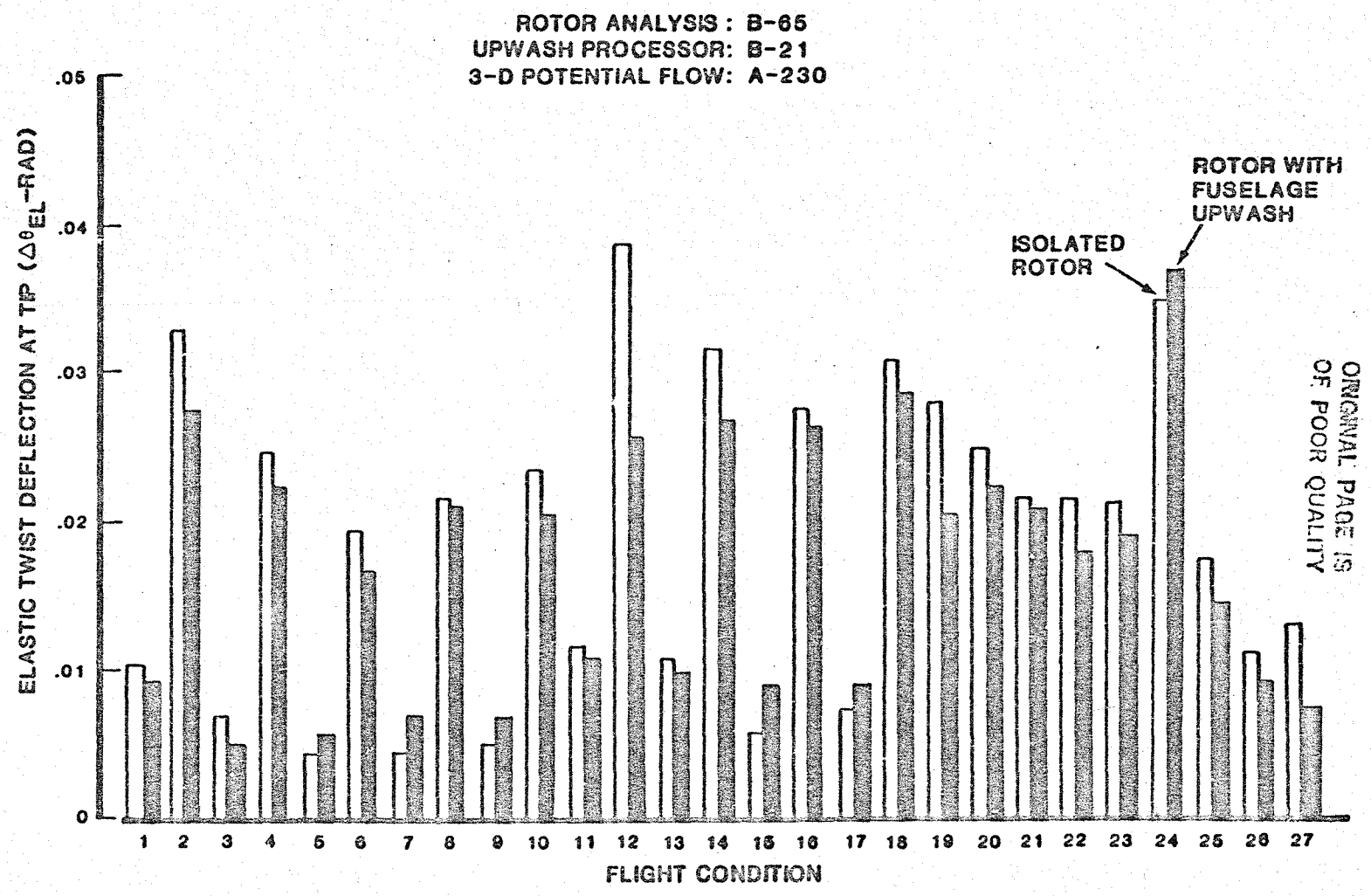

Figure 8-3. Effect of RSRA Upwash on the Calculated Elastic Twist Deflection at the Tip – Vibratory Component

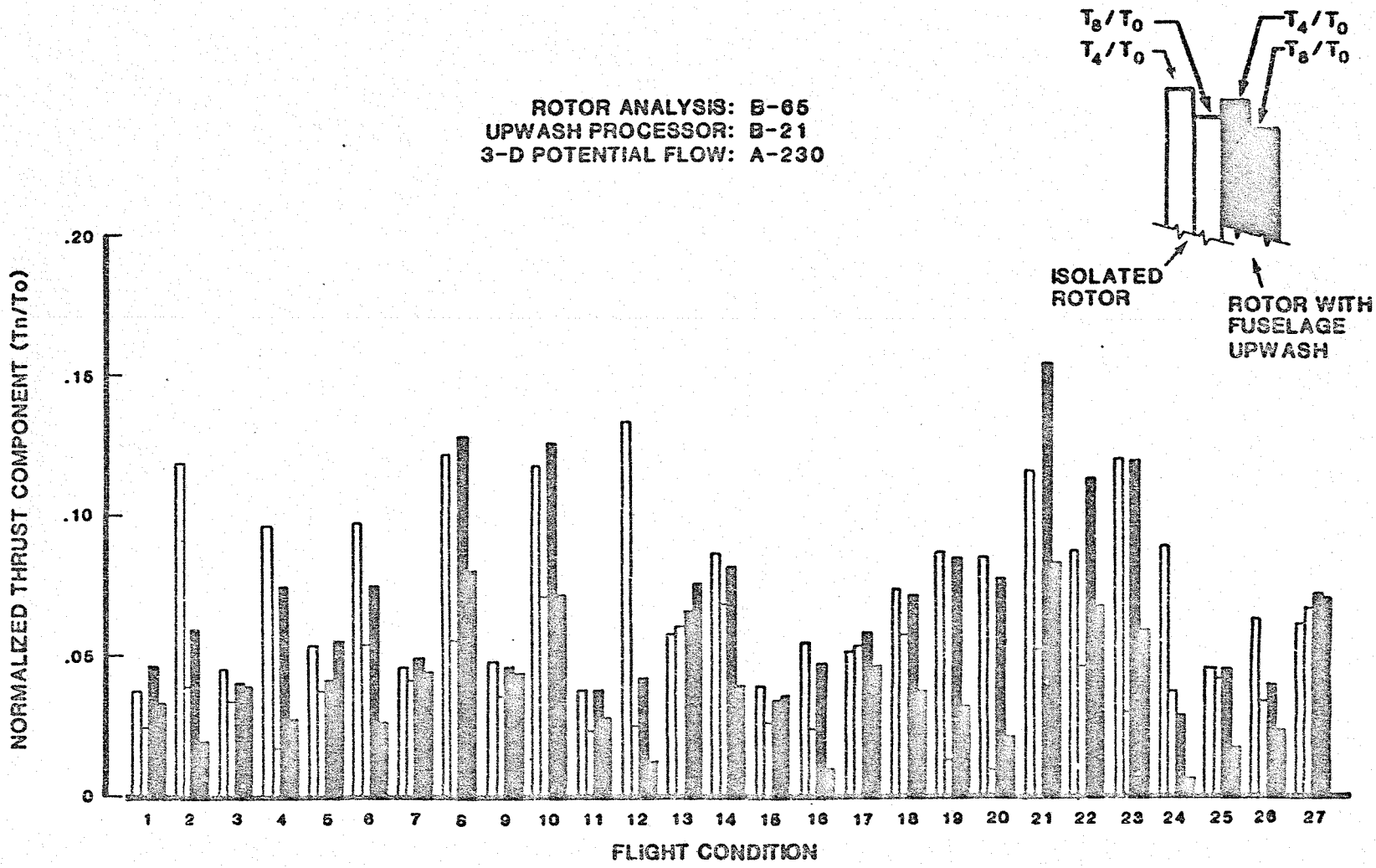

Figure 8-4. Effect of RSRA Upwash on the Calculated Fourth and Eighth Harmonics of Rotor Thrust

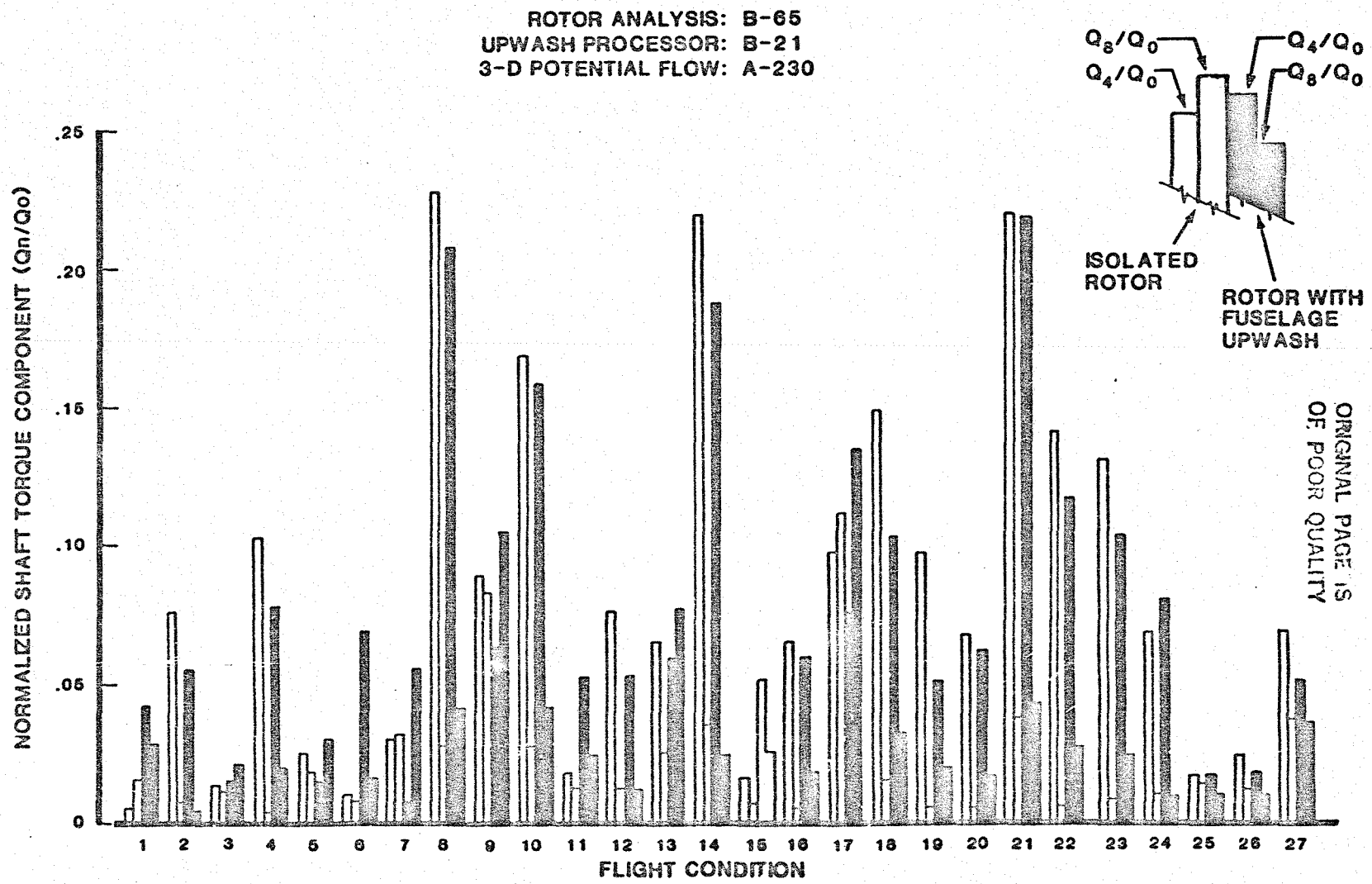

Figure 8-5. Effect of RSRA Upwash on the Calculated Fourth and Eighth Harmonics of Rotor Torque

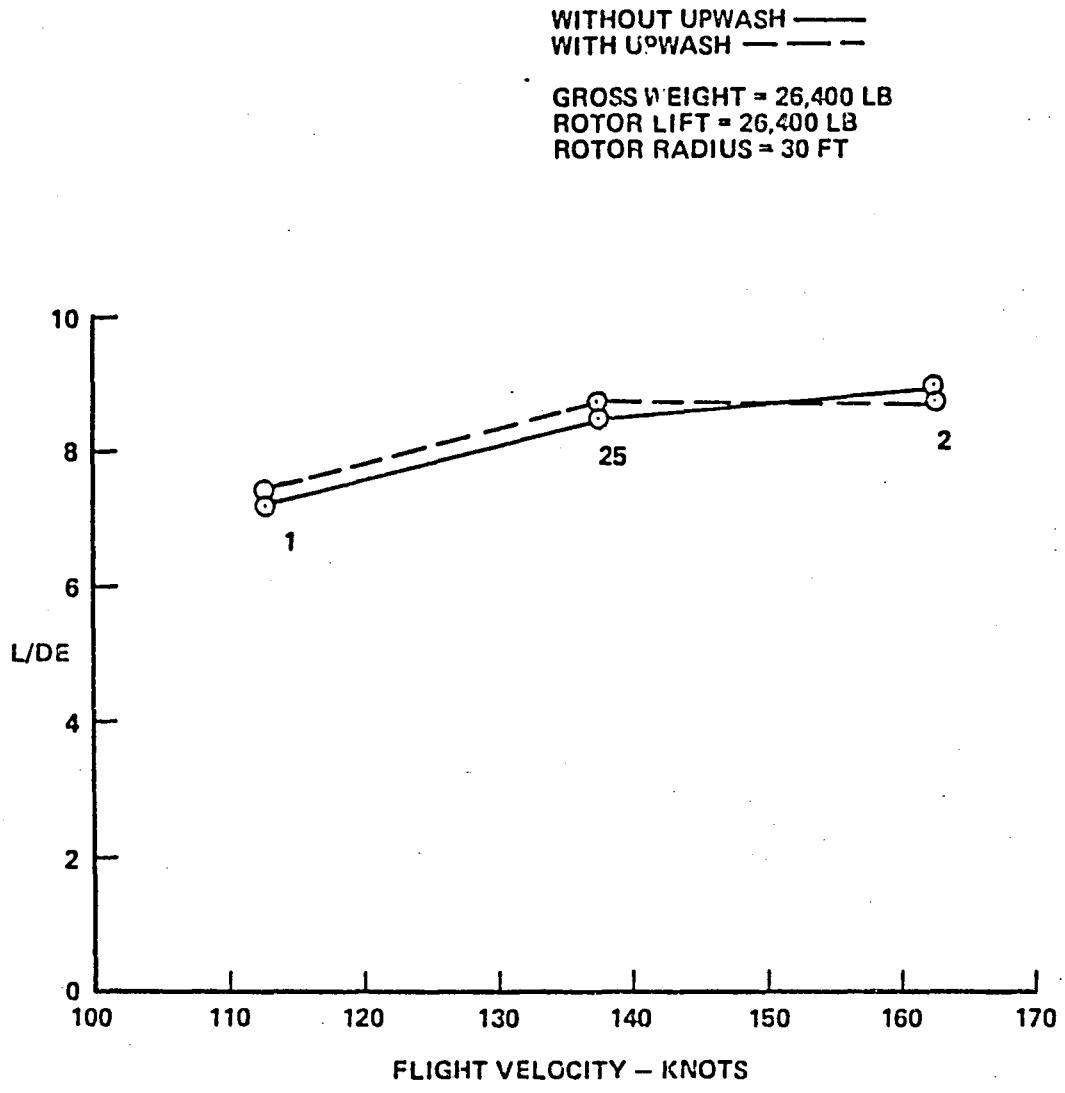

Figure 8–6. Variation of Equivalent Lift-to-Drag Ratio With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

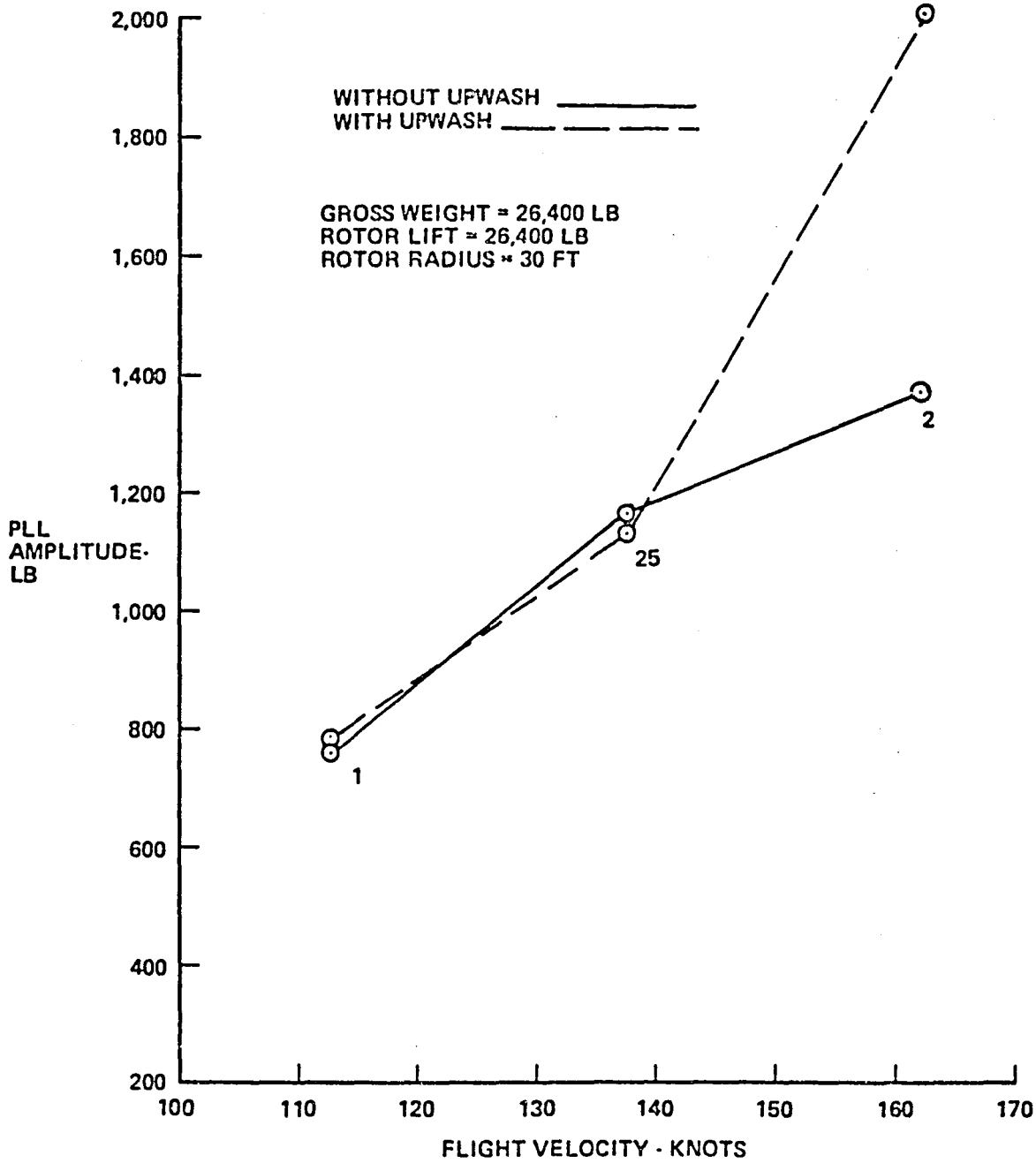

Figure 8-7 Variation of Pitch Link Load Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

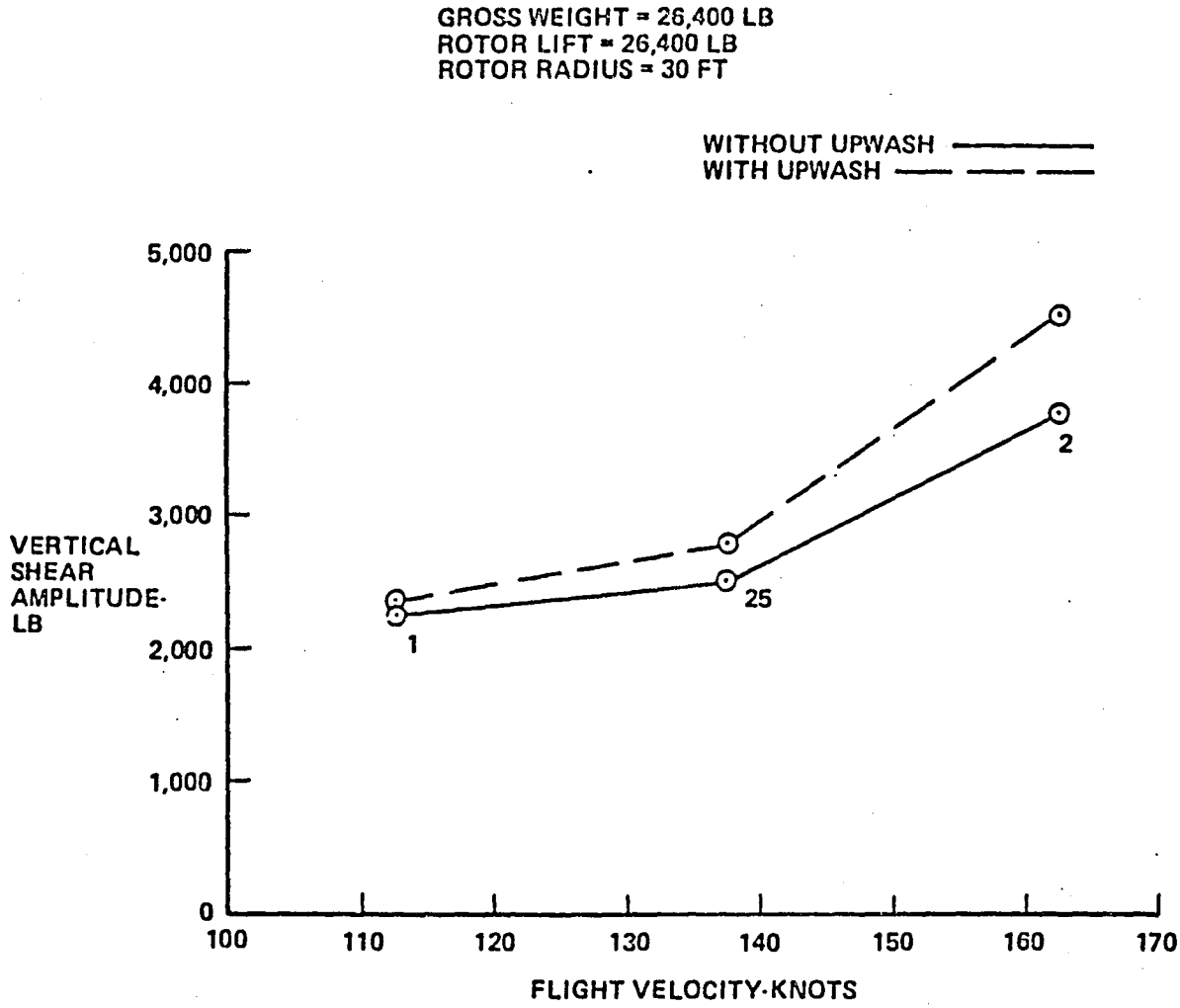

Figure 8-8. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

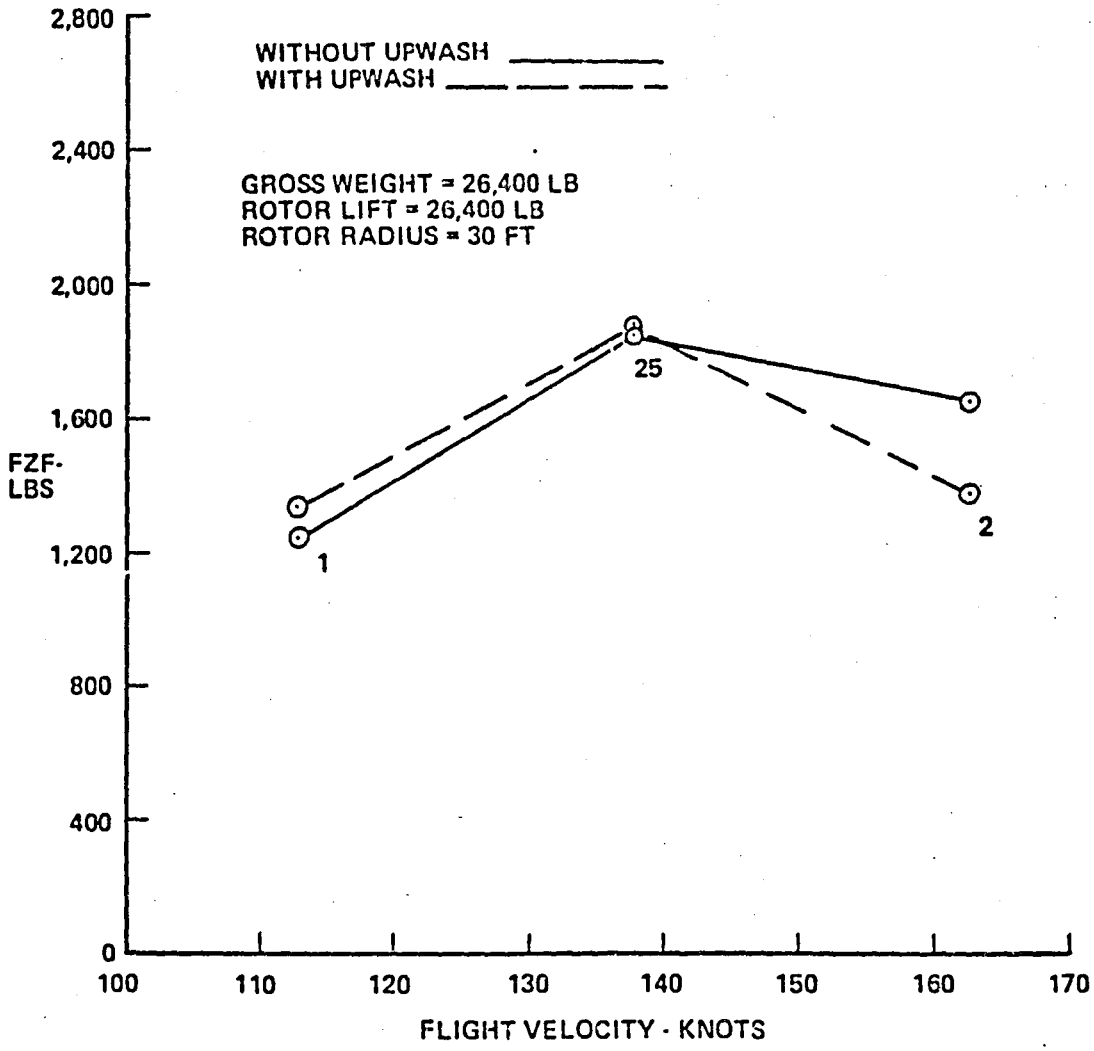

Figure 8-9. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

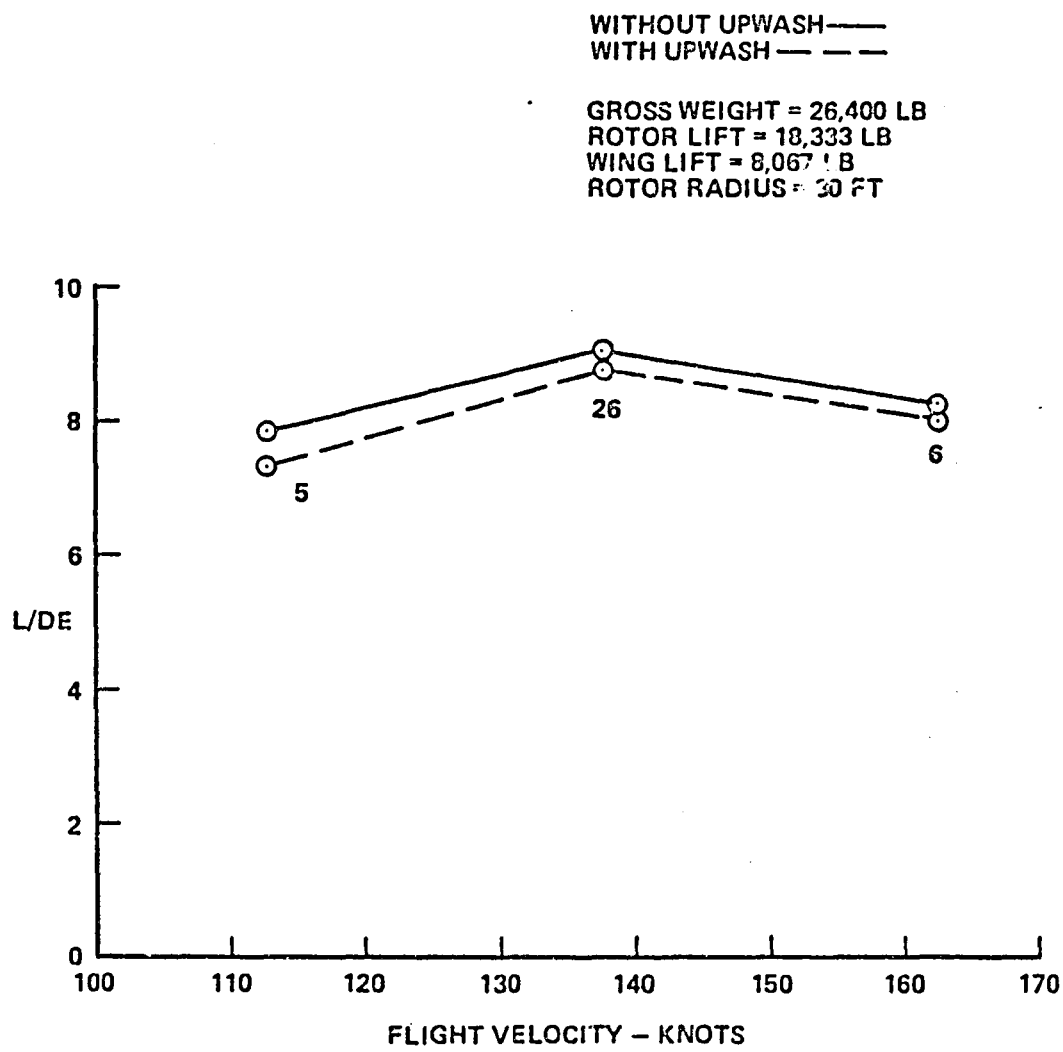

Figure 8–10. Variation of Equivalent Lift-to-Drag Ratio With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, Wing Lift, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

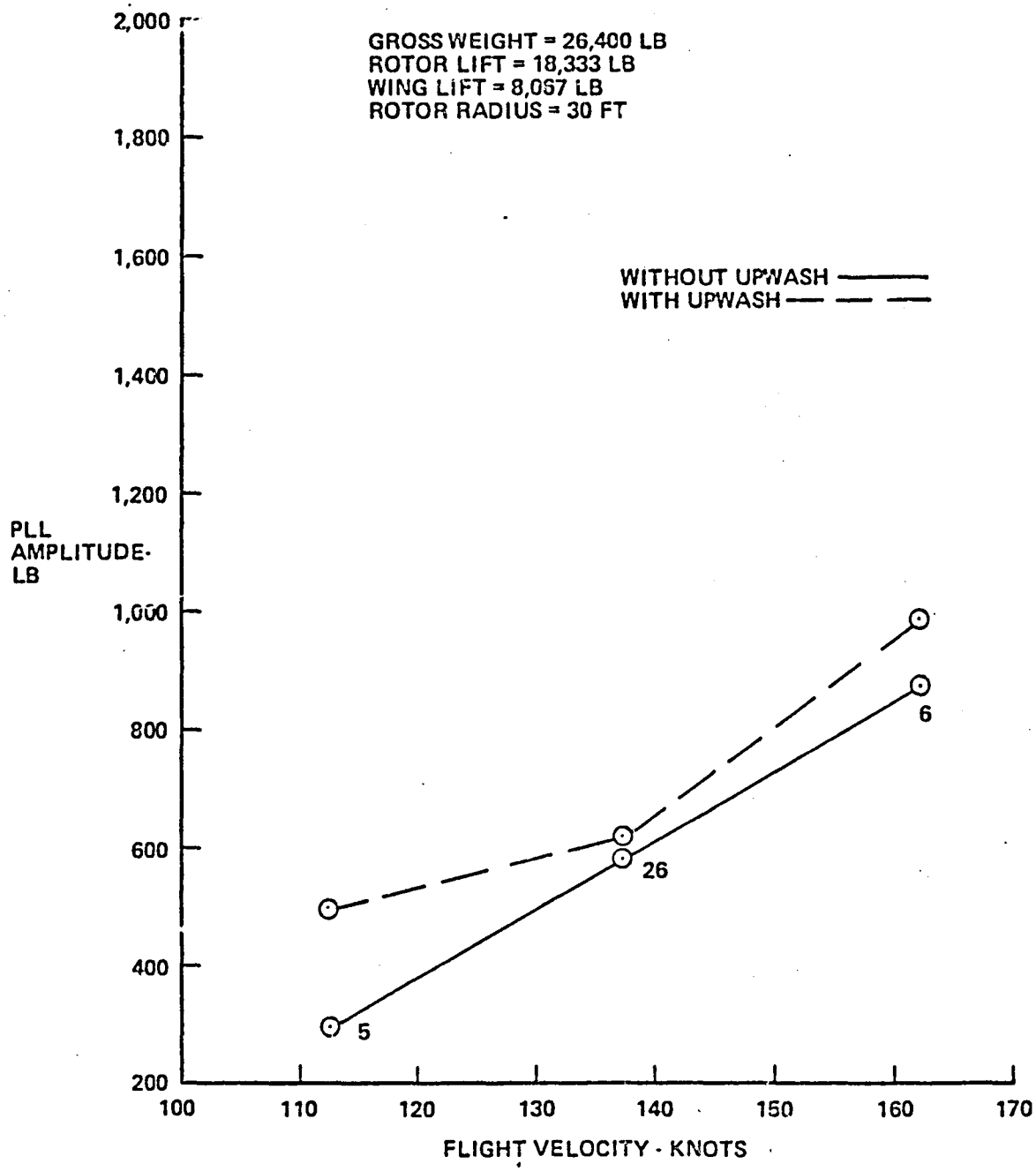

Figure 8-11. Variation of Pitch Link Load Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, Wing Lift, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

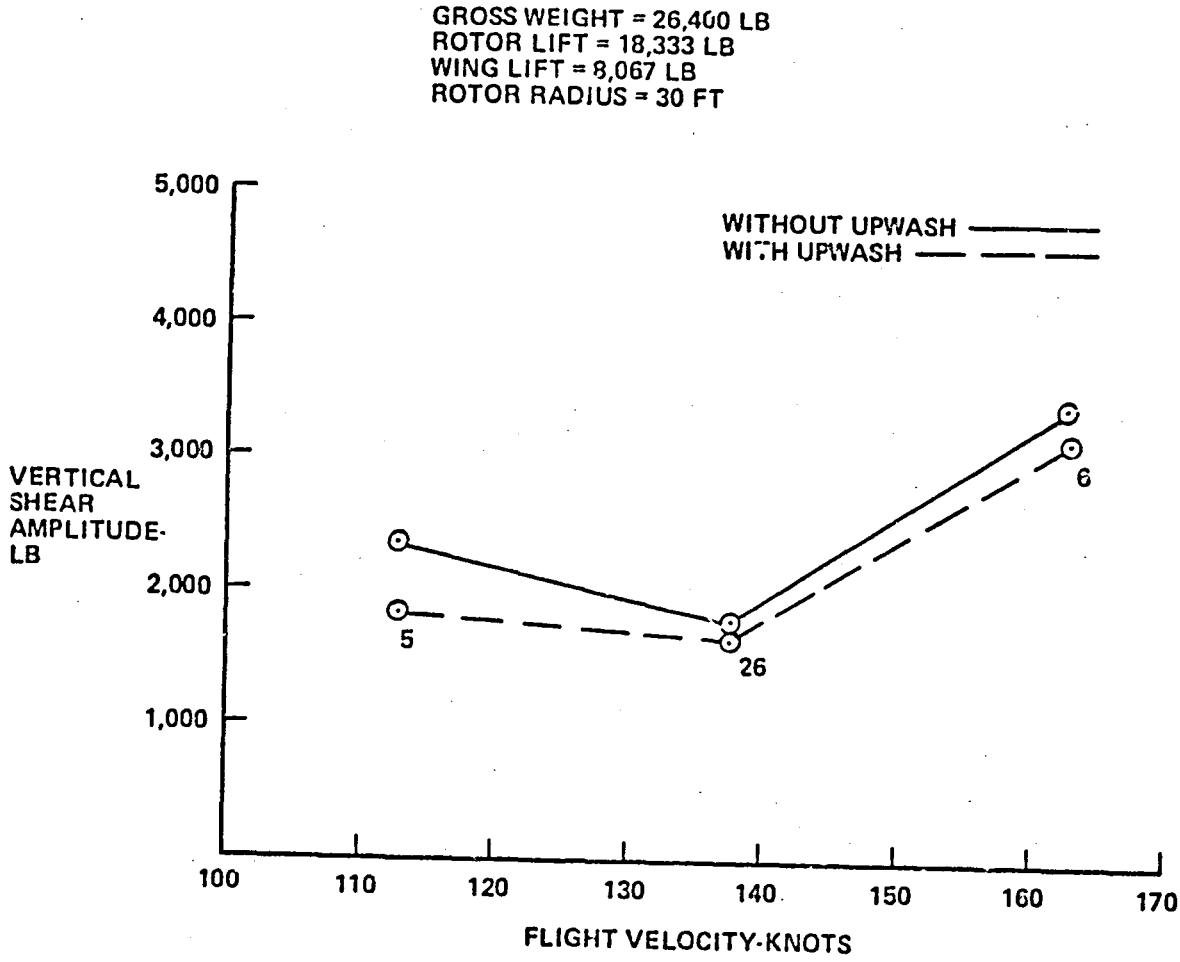

Figure 8-12. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, Wing Lift, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

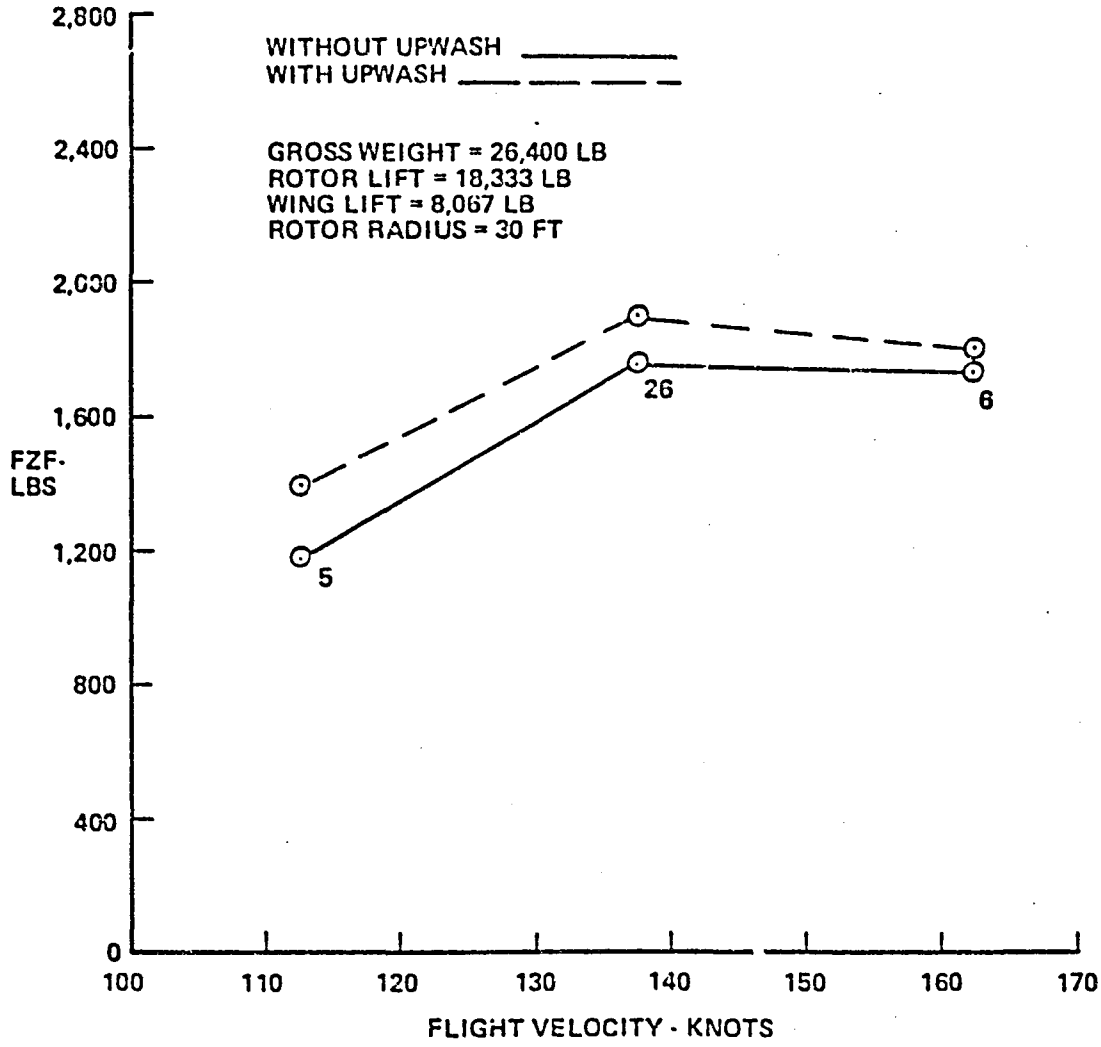

Figure 8-13. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, Wing Lift, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

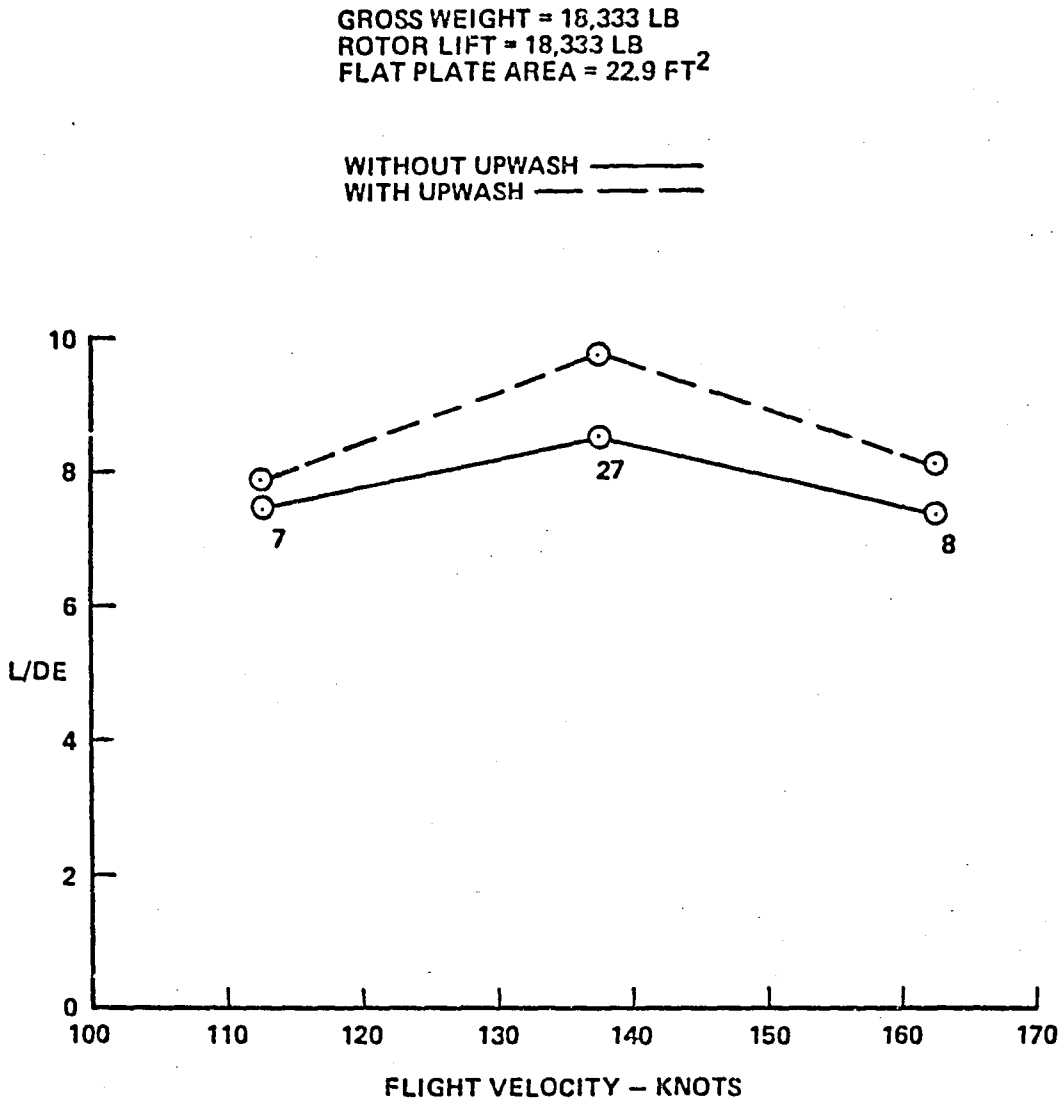

Figure 8–14. Variation of Equivalent Lift-to-Drag Ratio With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Equivalent Flat Plate Area Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

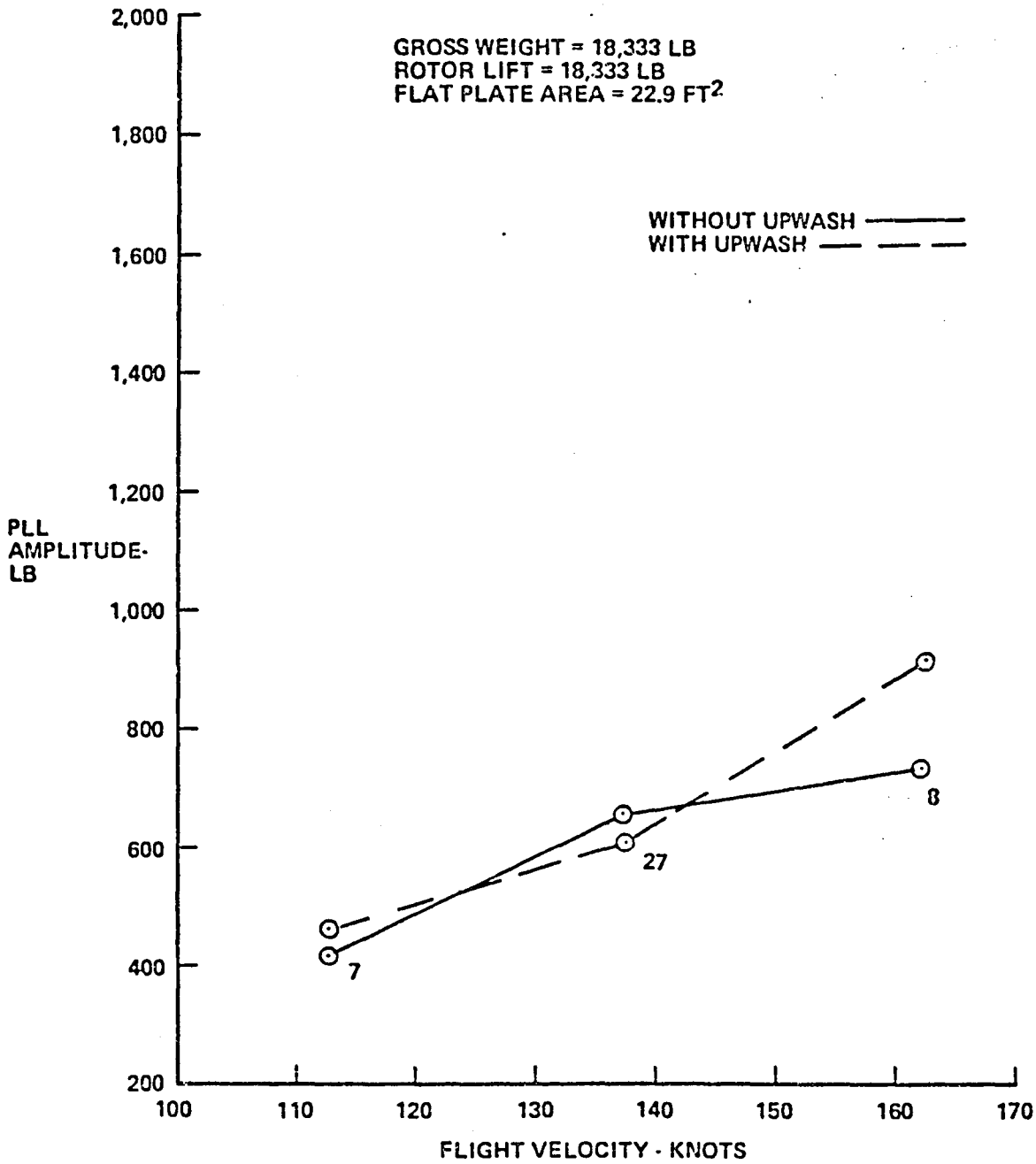

Figure 8-15. Variation of Pitch Link Load Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Equivalent Flat Plate Area Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

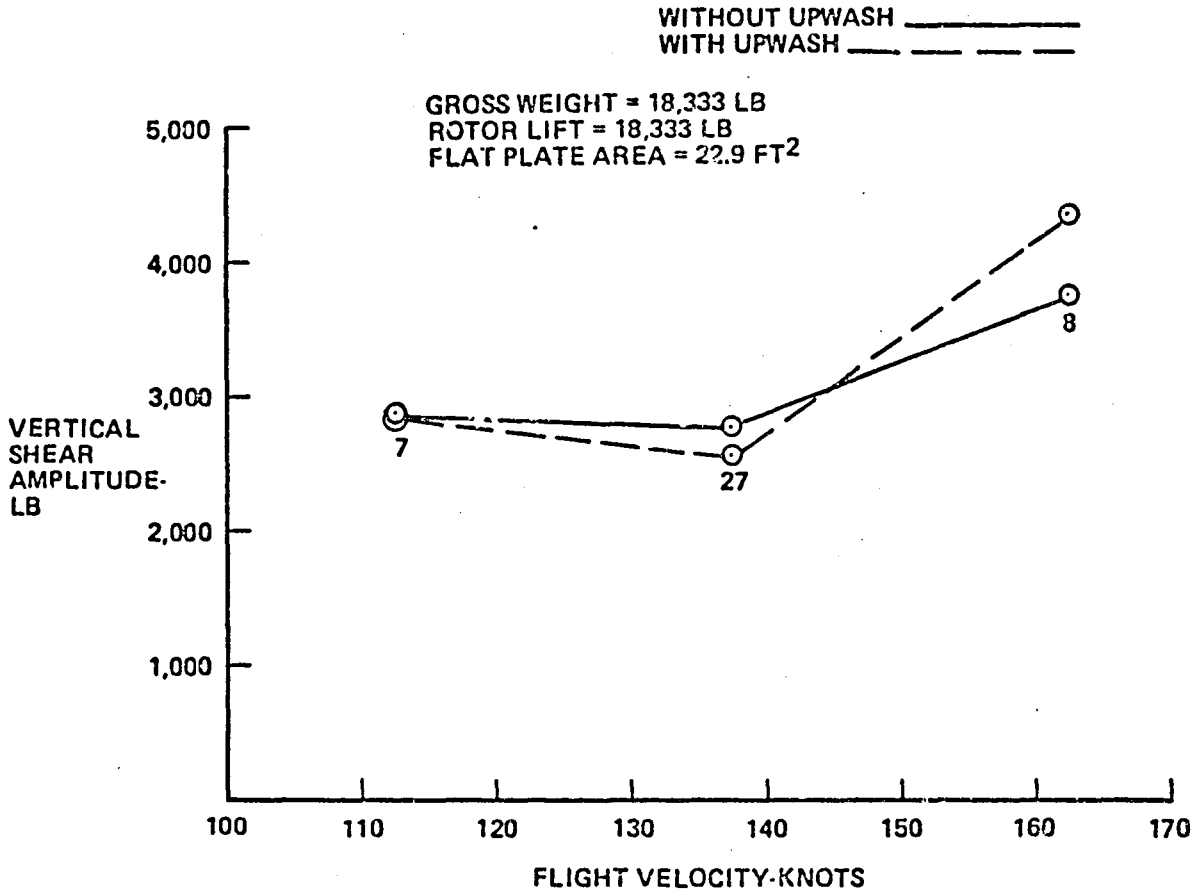

Figure 8-16. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Equivalent Flat Plate Area Are Constant. Numerals Near Symbols Indicate Flight Condition.

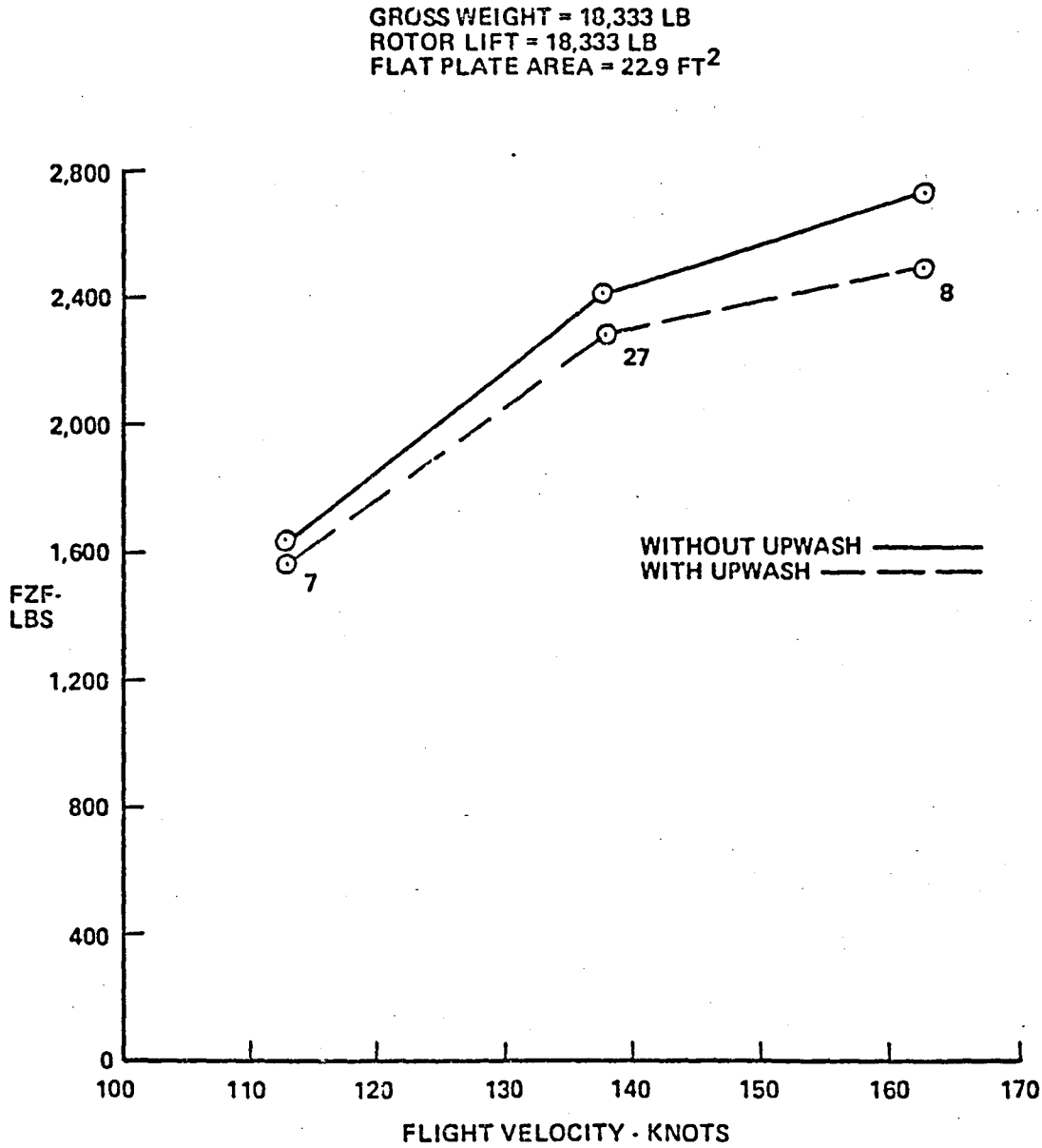

Figure 8-17. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flight Velocity From Loads Analysis. Rotor Lift, Gross Weight, and Equivalent Flat Plate Area Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

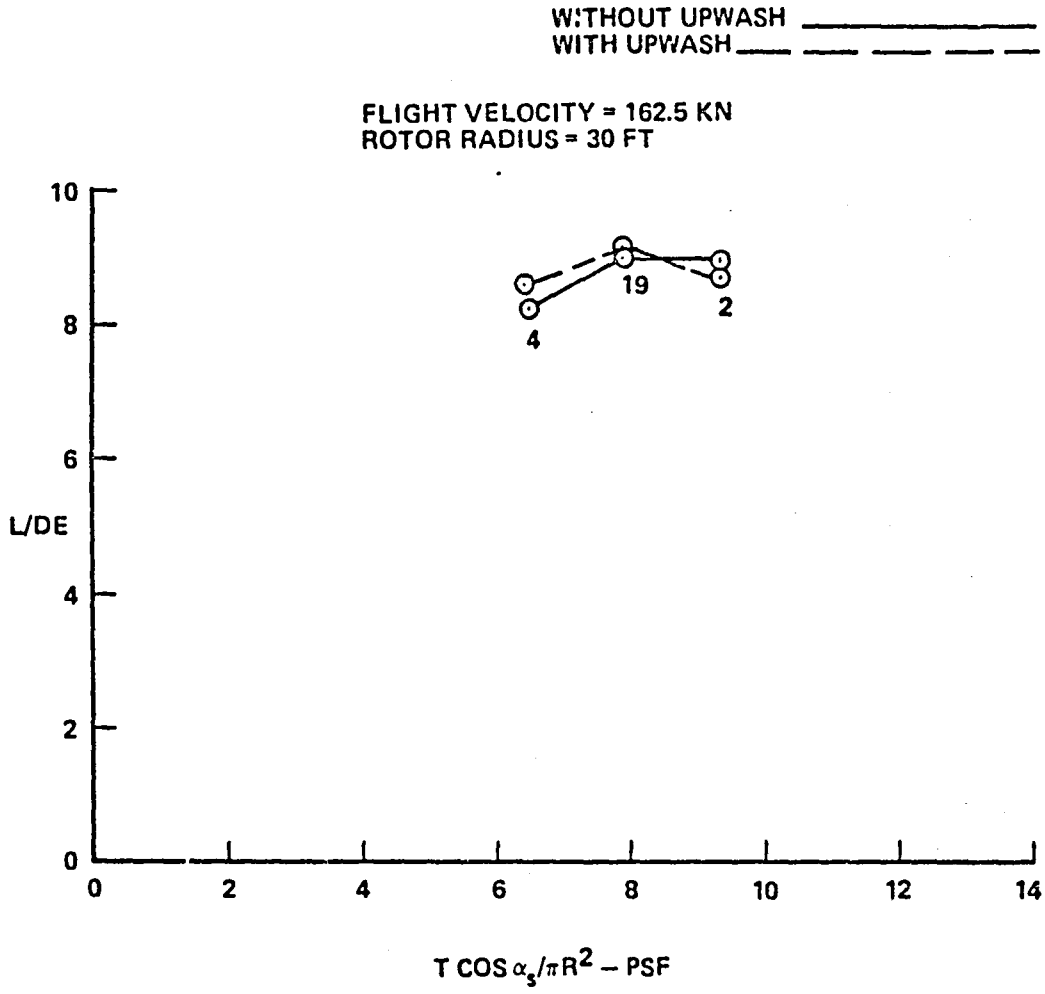

Figure 8–18. Variation of Equivalent Lift-to-Drag Ratio With Disk Loading From Loads Analysis. Flight Velocity and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

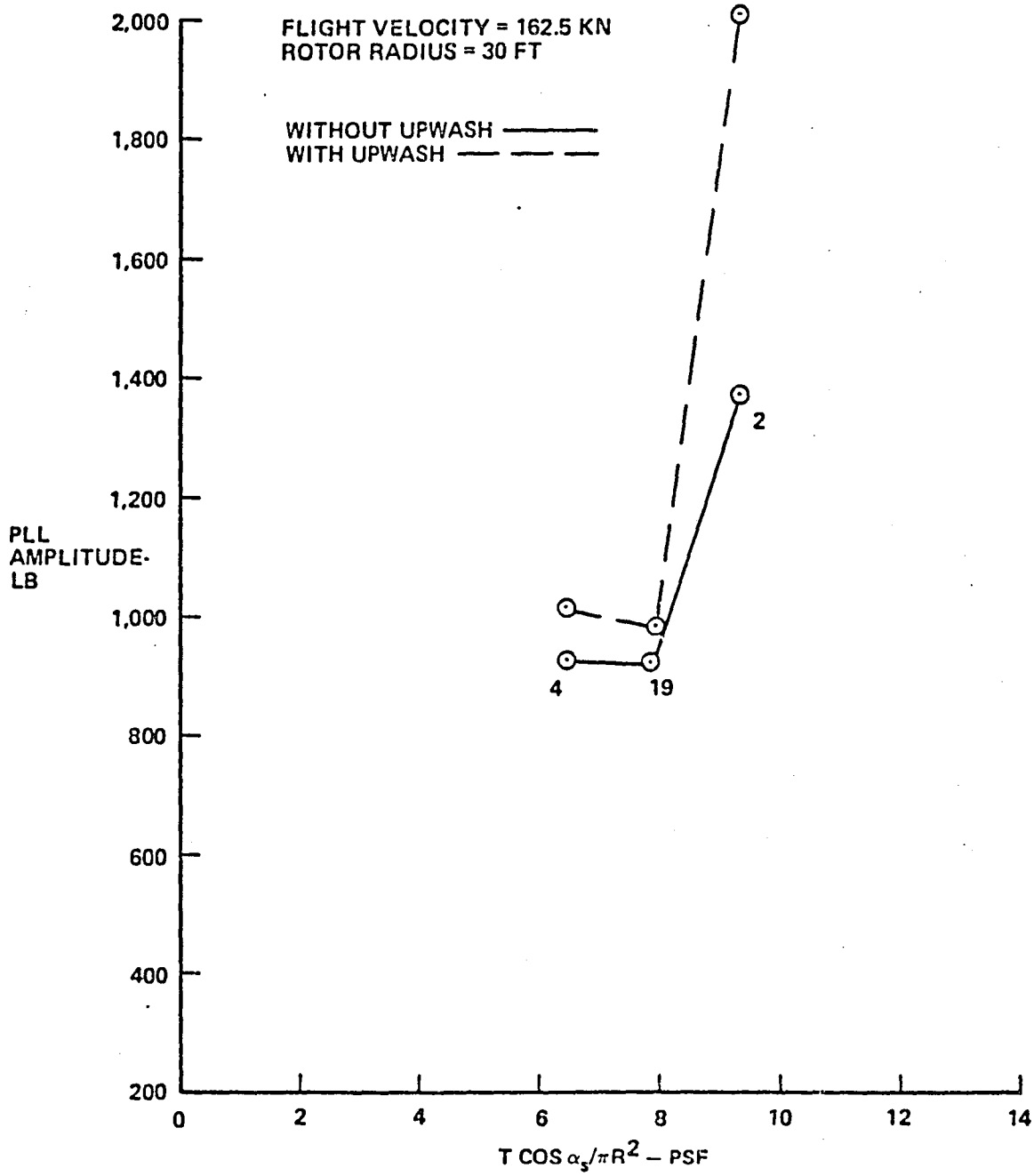

Figure 8-19. Variation of Pitch Link Load Vibratory Amplitude With Disk Loading From Loads Analysis. Flight Velocity and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

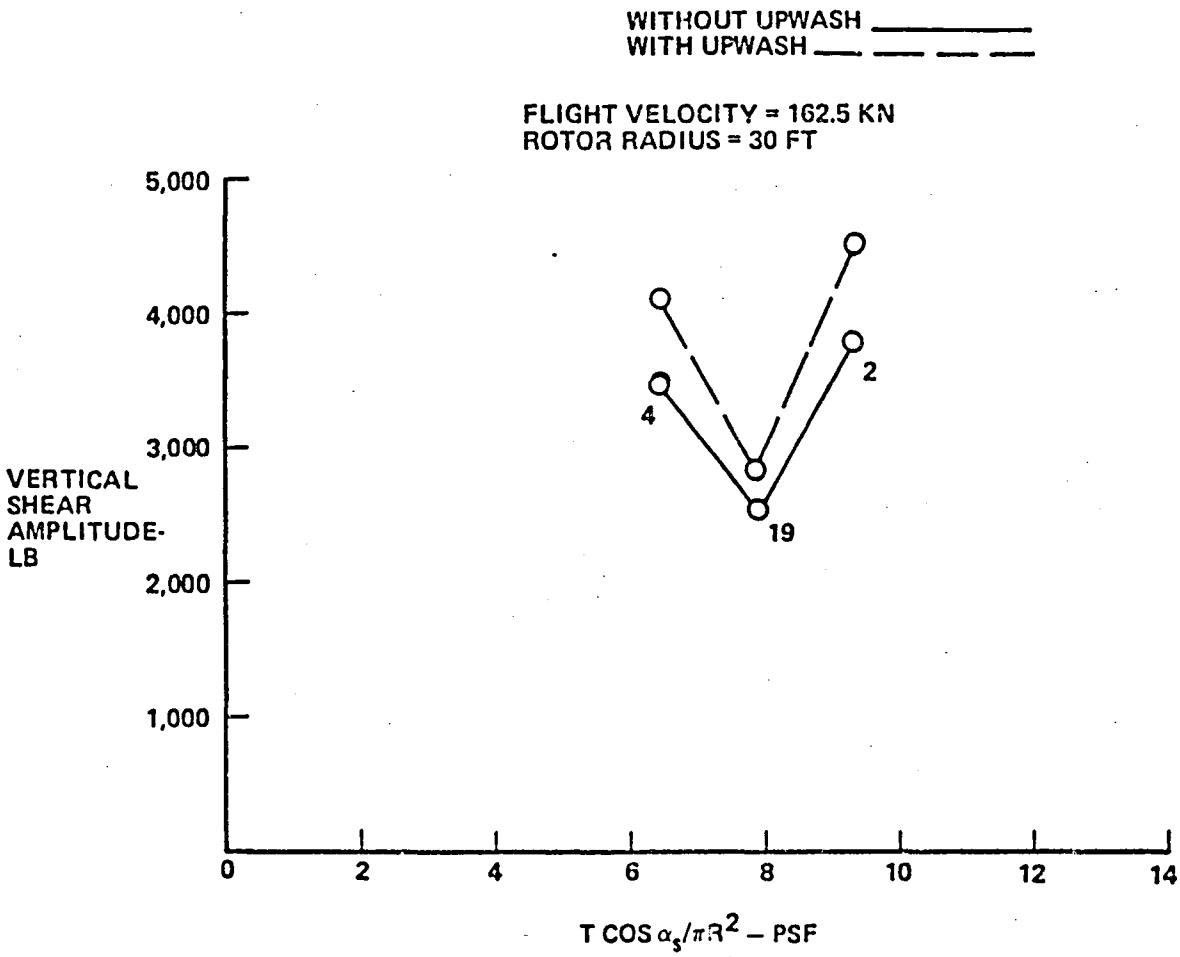

Figure 8-20. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Disk Loading From Loads Analysis. Flight Velocity and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

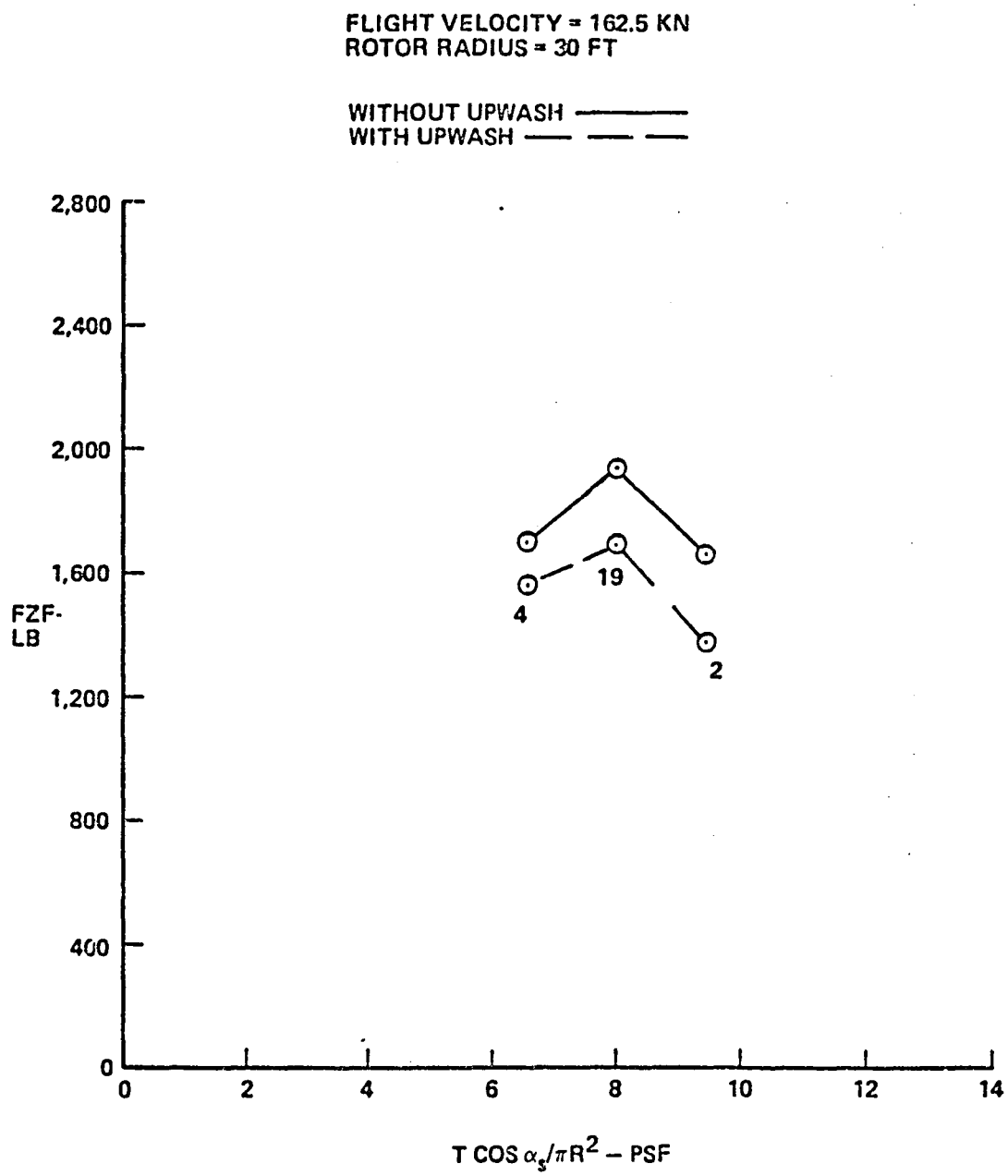

Figure 8–21. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Disk Loading From Loads Analysis. Flight Velocity and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

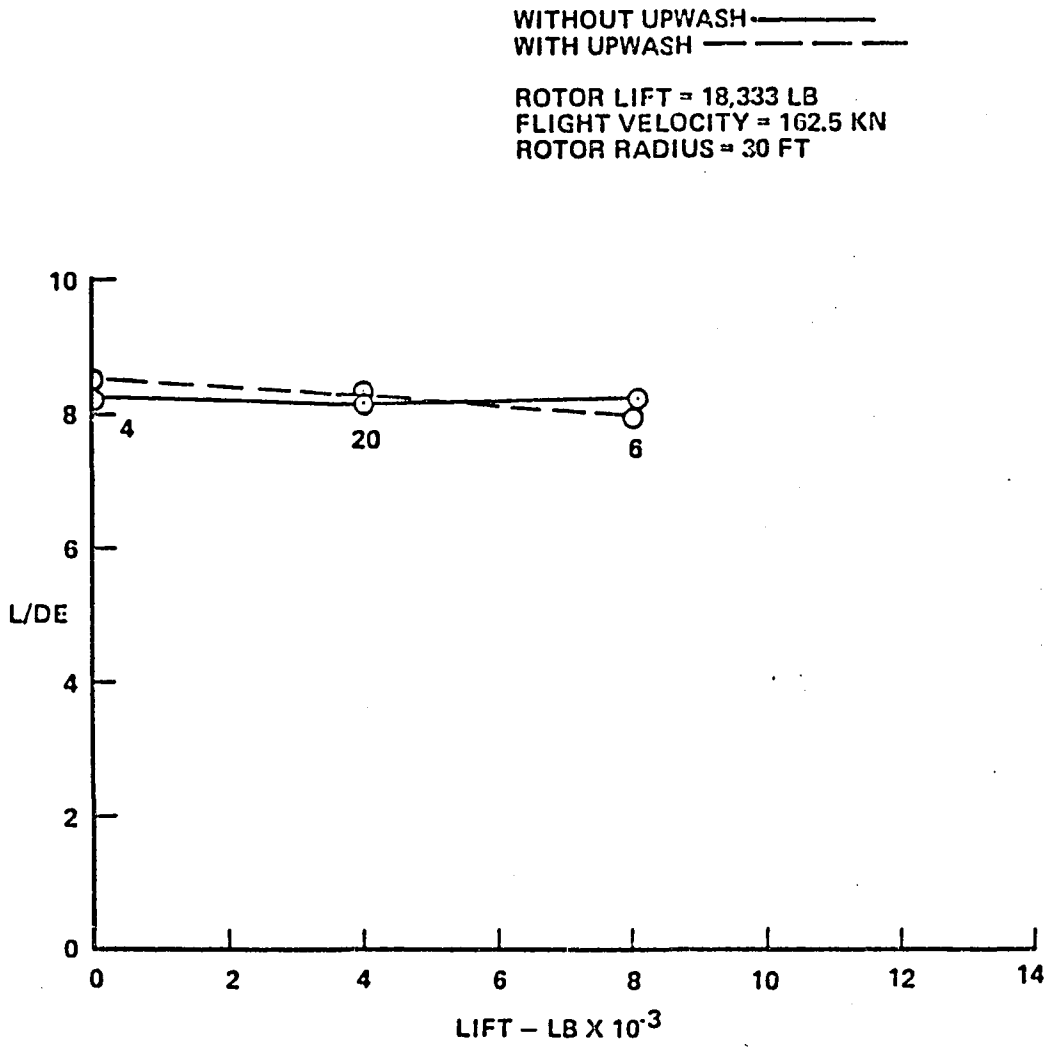

Figure 8–22. Variation of Equivalent Lift-to-Drag Ratio With Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

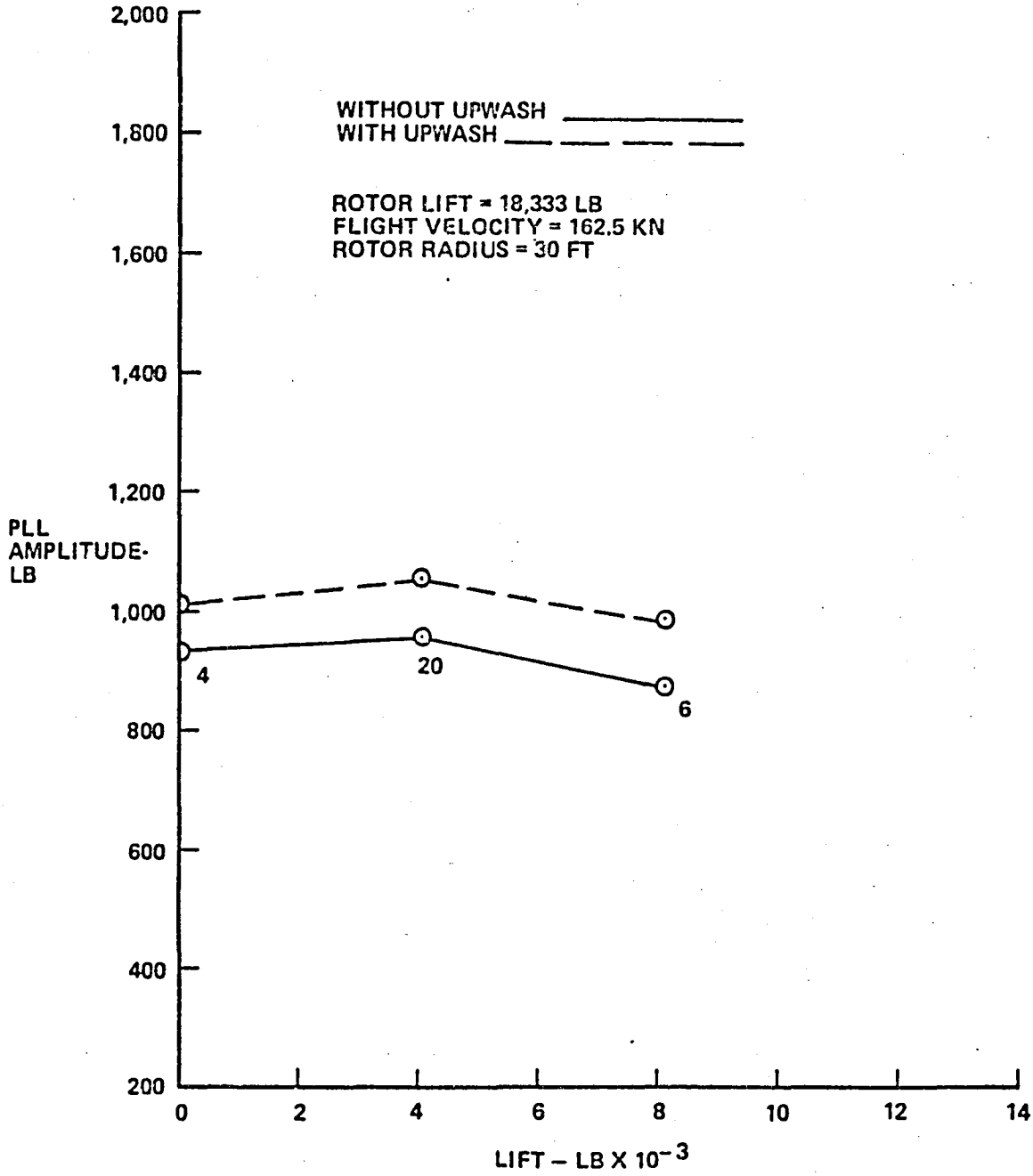

Figure 8-23. Variation of Pitch Link Load Vibratory Amplitude With Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

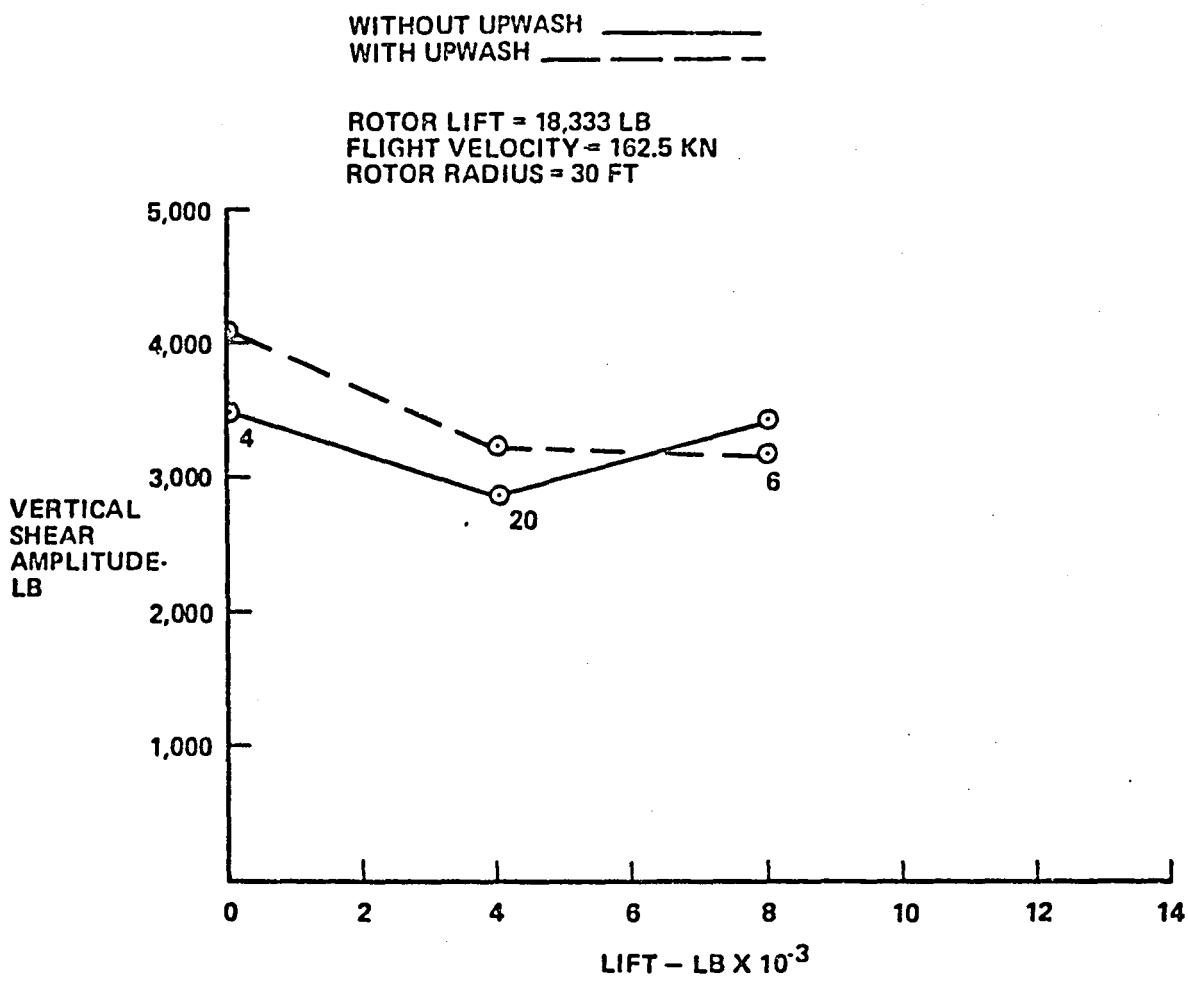

Figure 8-24. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

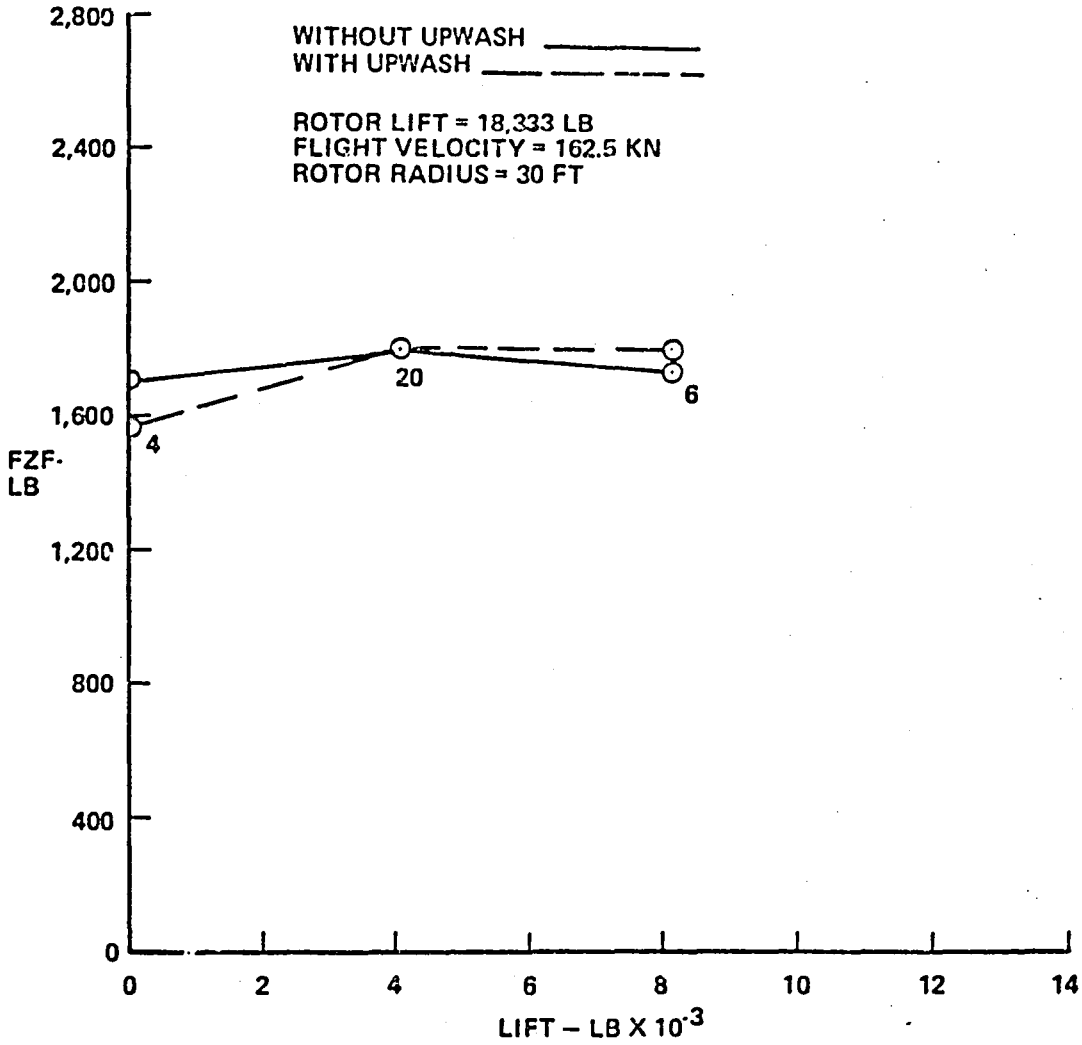

Figure 8–25. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

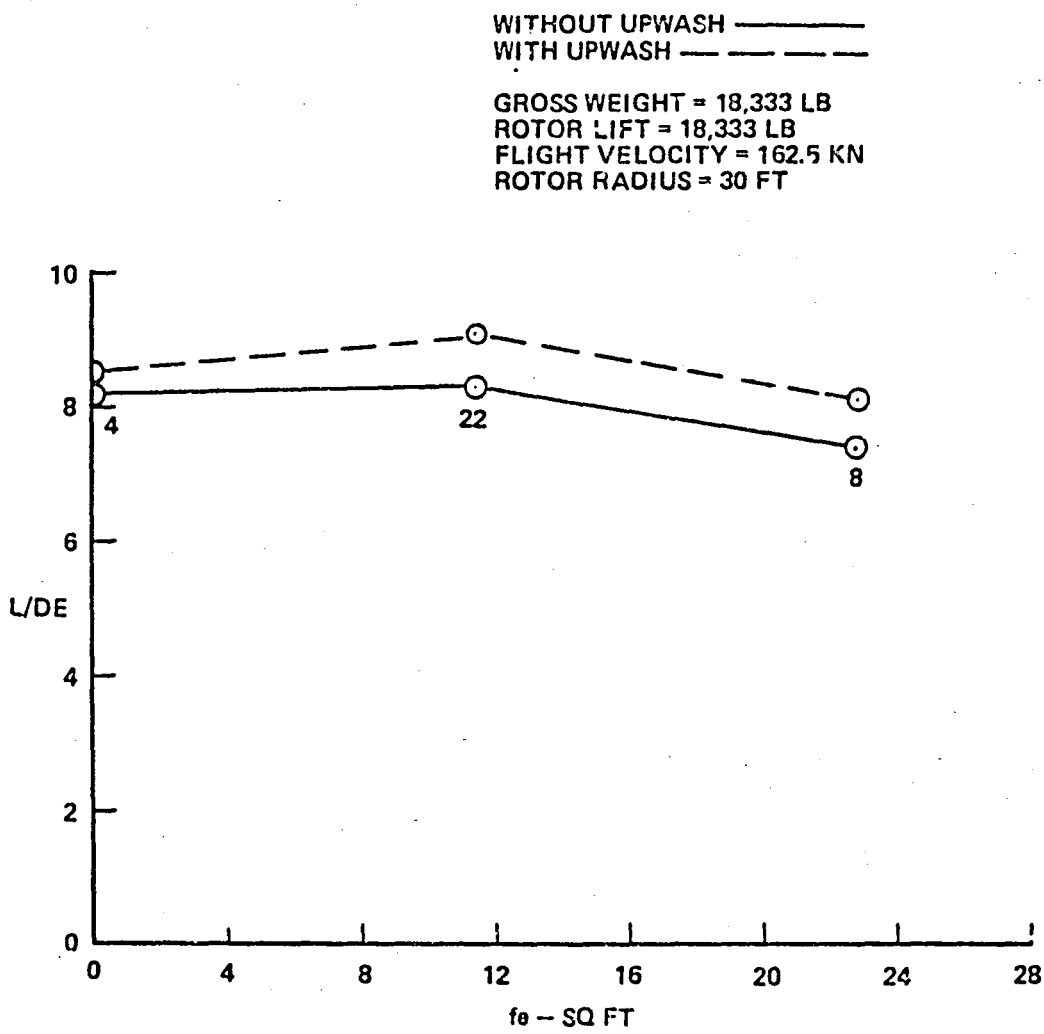

Figure 8–26. Variation of Equivalent Lift-to-Drag Ratio With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

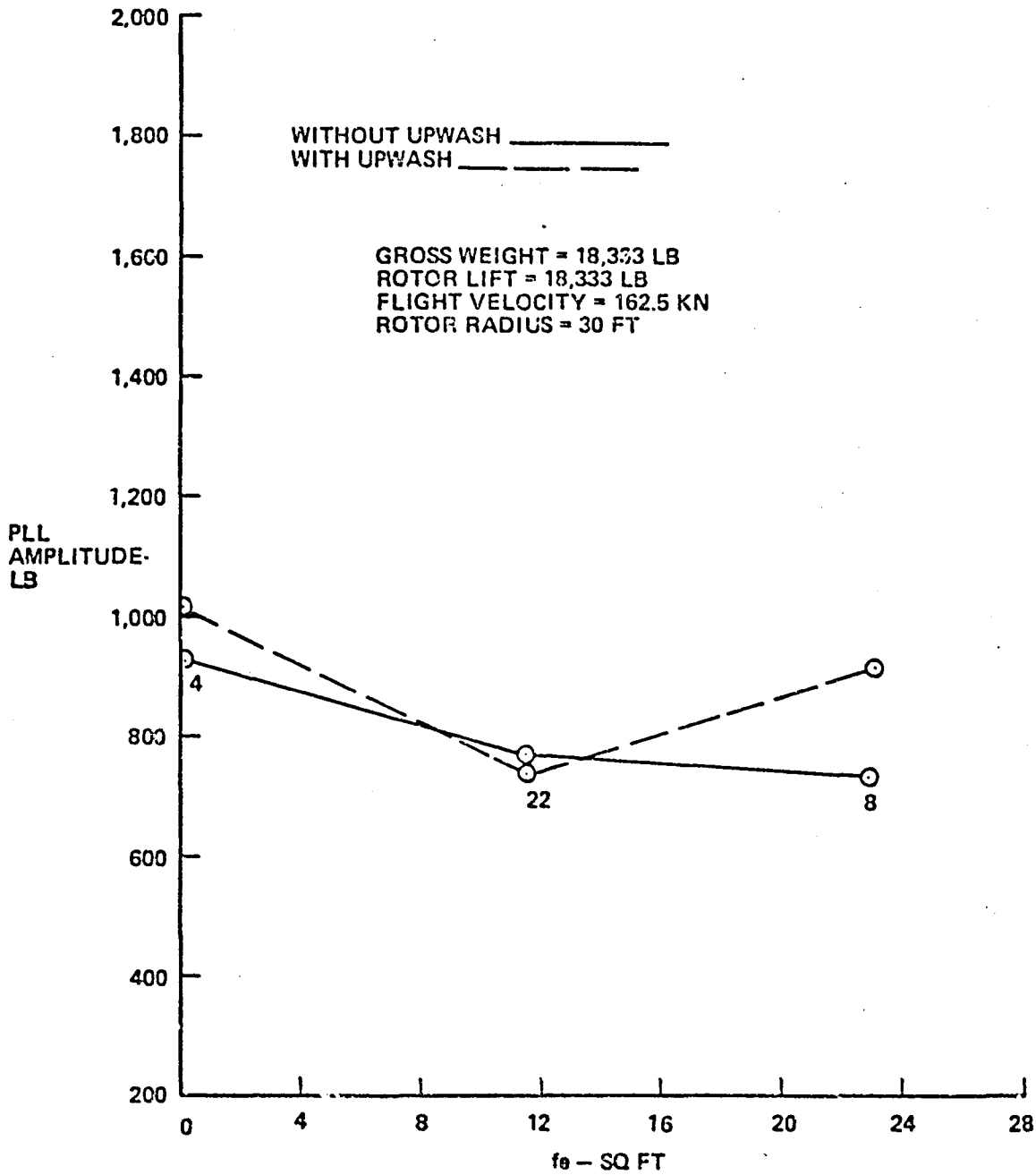

Figure 8-27. Variation of Pitch Link Load Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

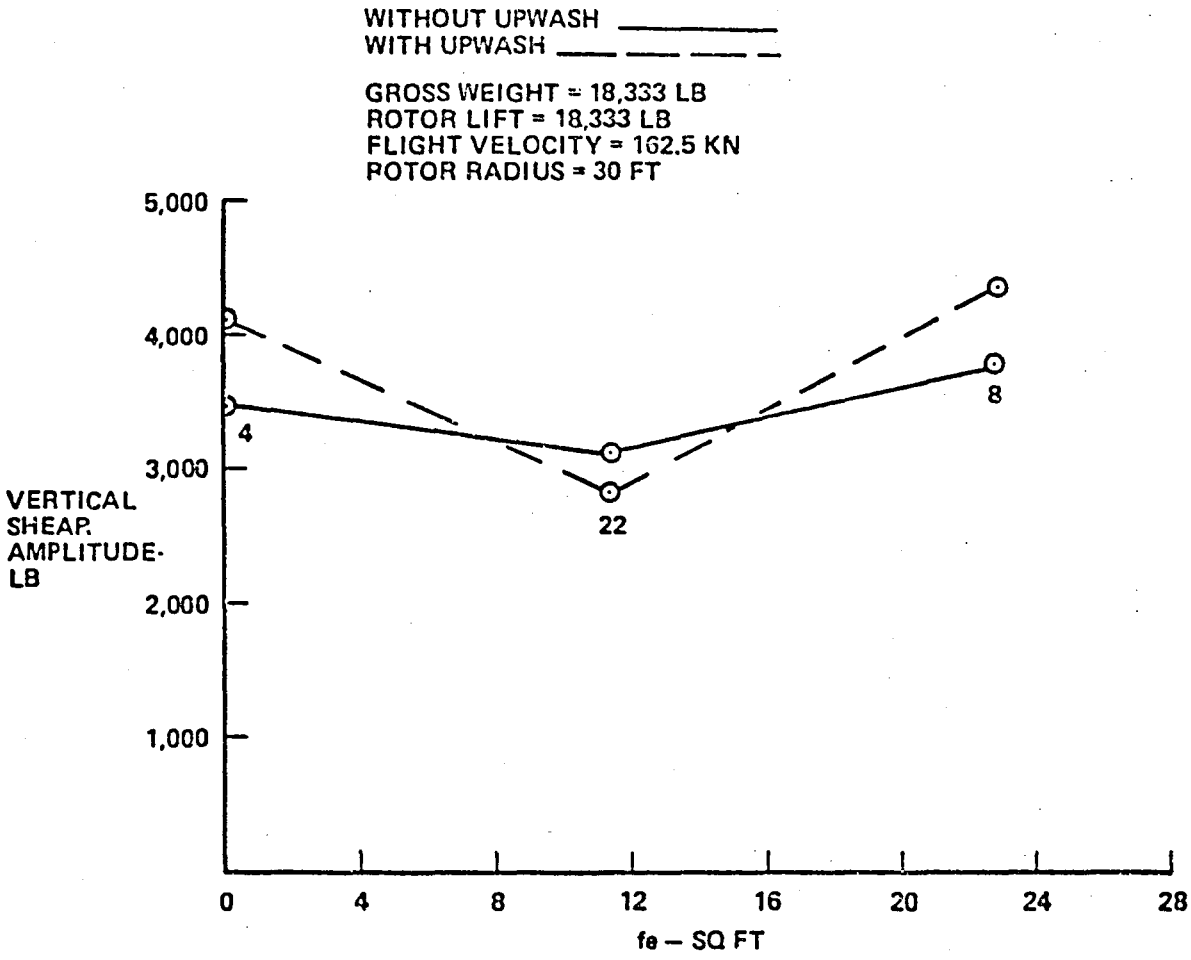

Figure 8-28. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

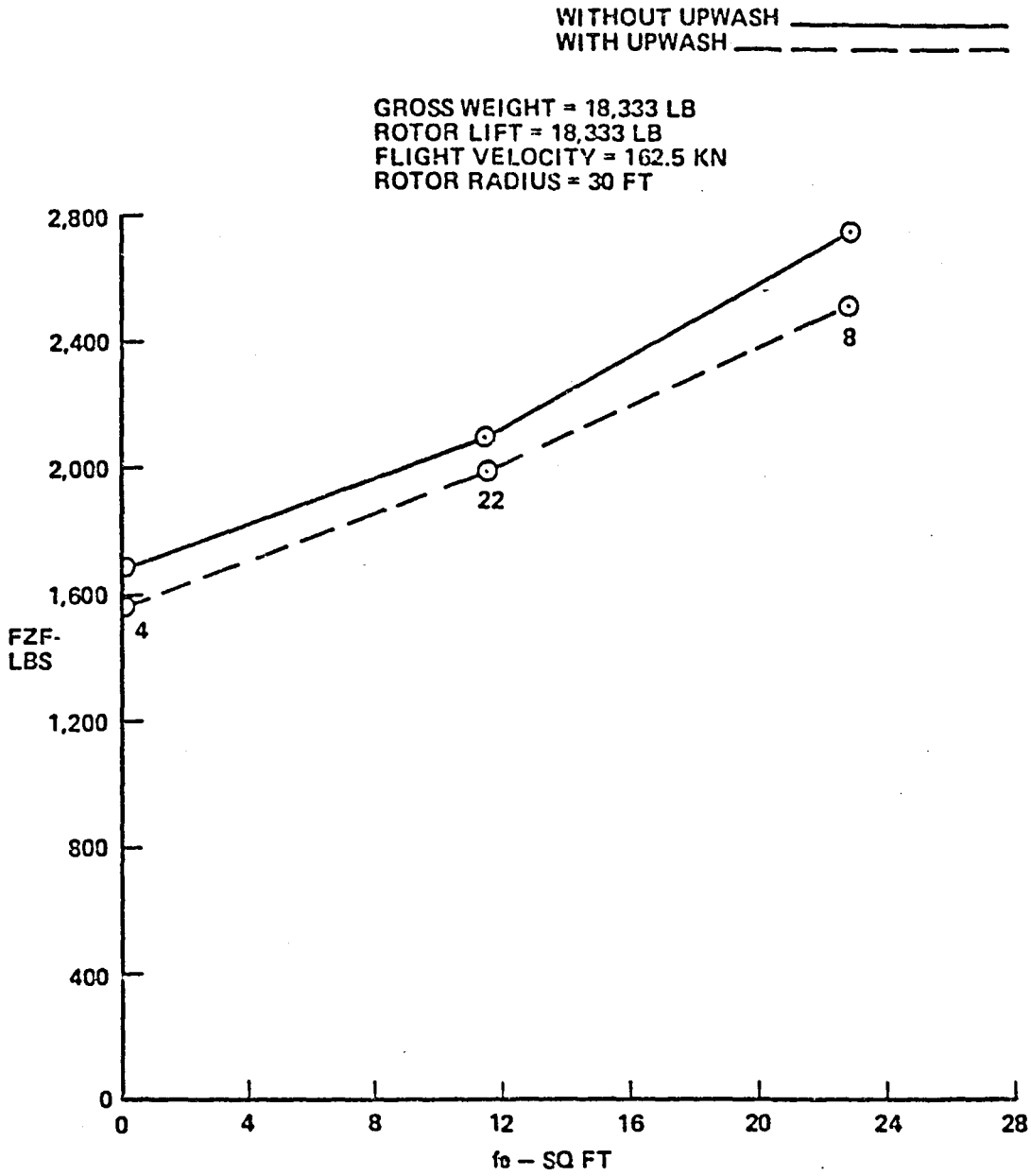

Figure 8–29. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

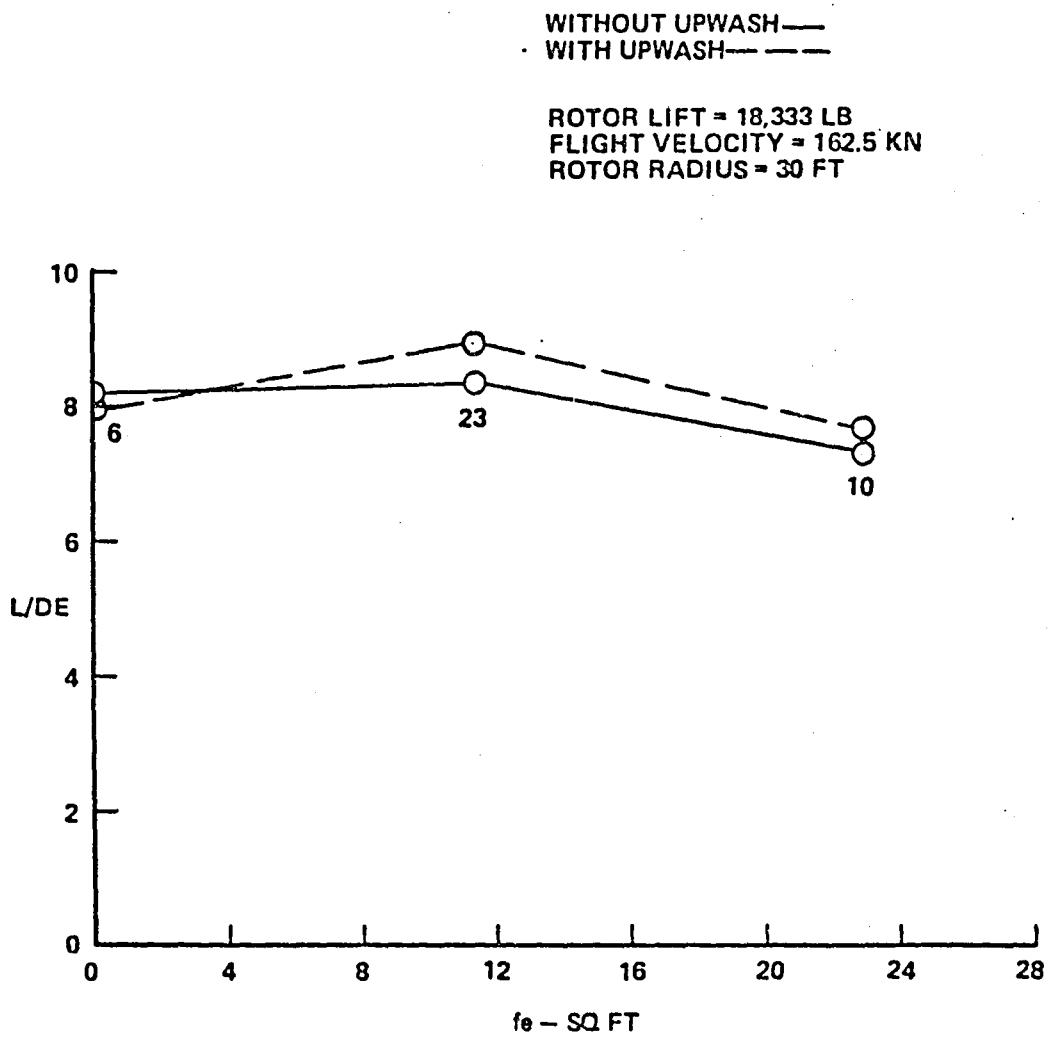

Figure 8–30. Variation of Equivalent Lift-to-Drag Ratio With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

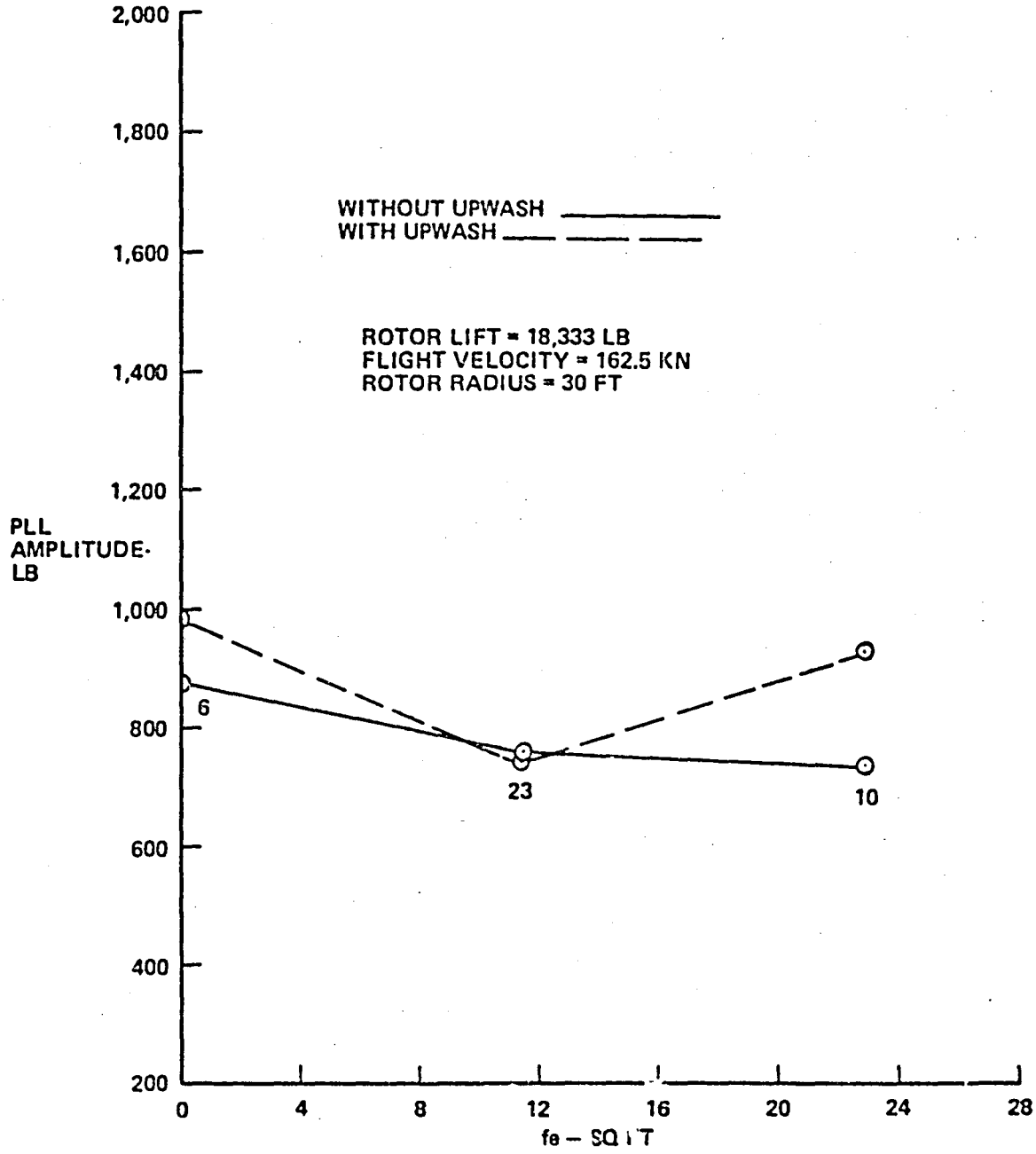

Figure 8-31. Variation of Pitch Link Load Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

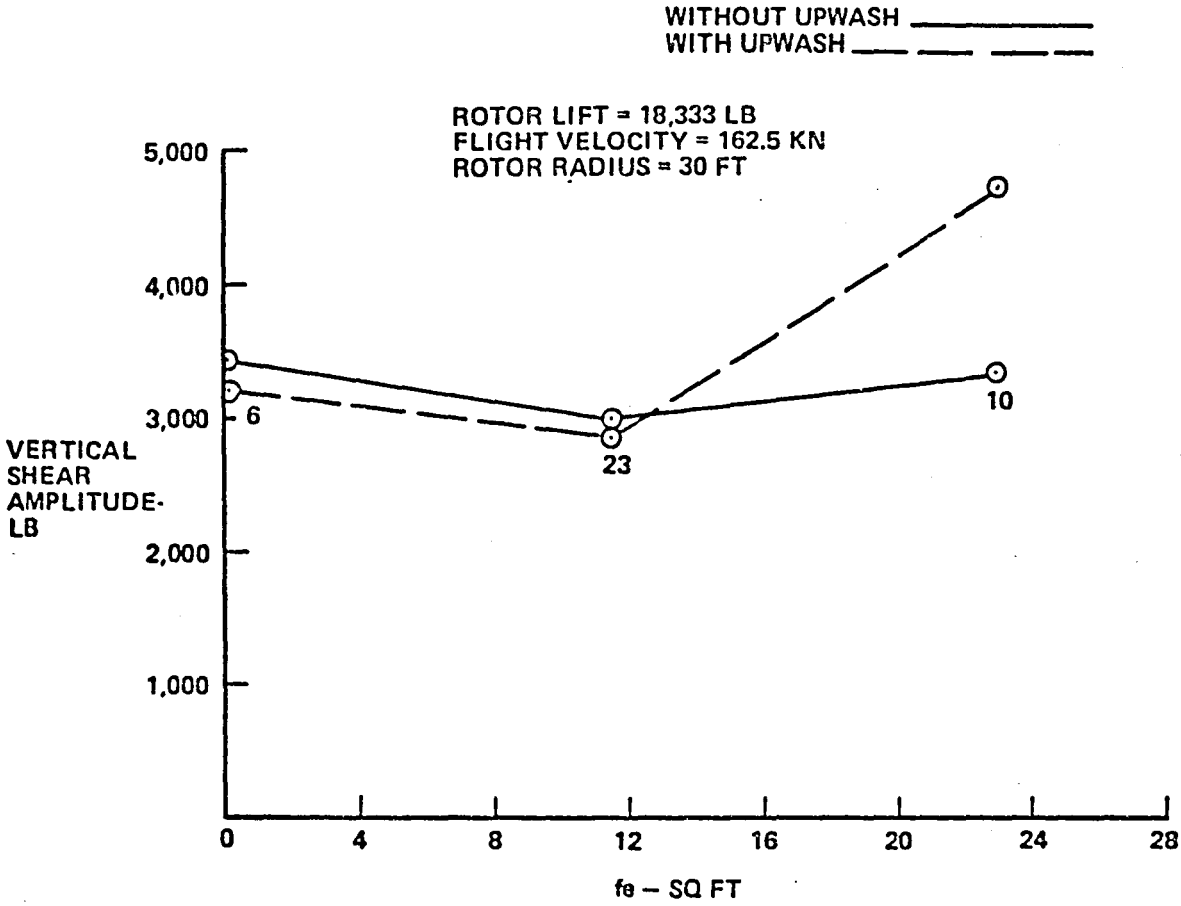

Figure 8-32. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

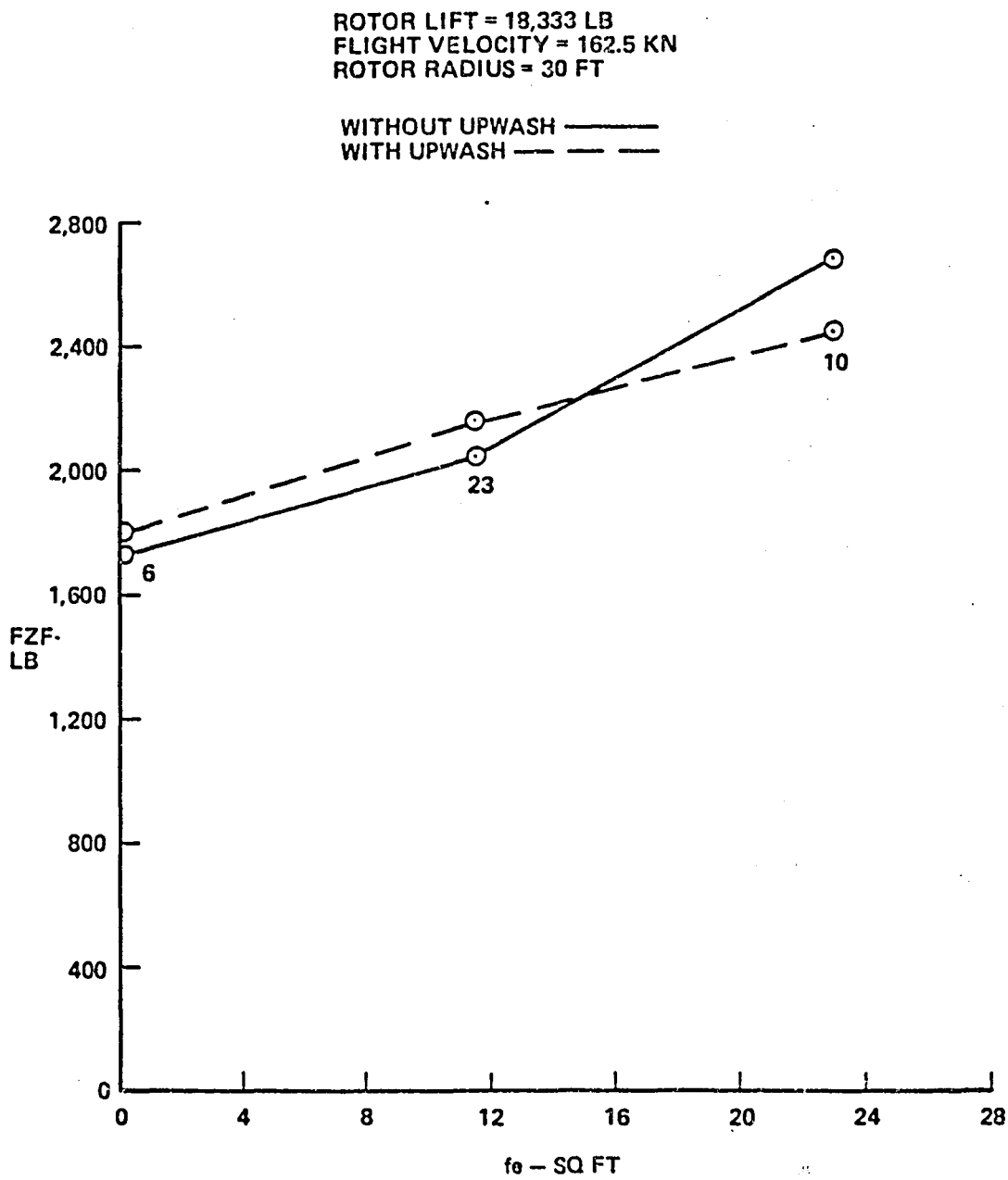

Figure 8–33. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flat Plate Area for Auxiliary Thrust From Loads Analysis. Rotor Radius, Rotor Lift, and Flight Velocity Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

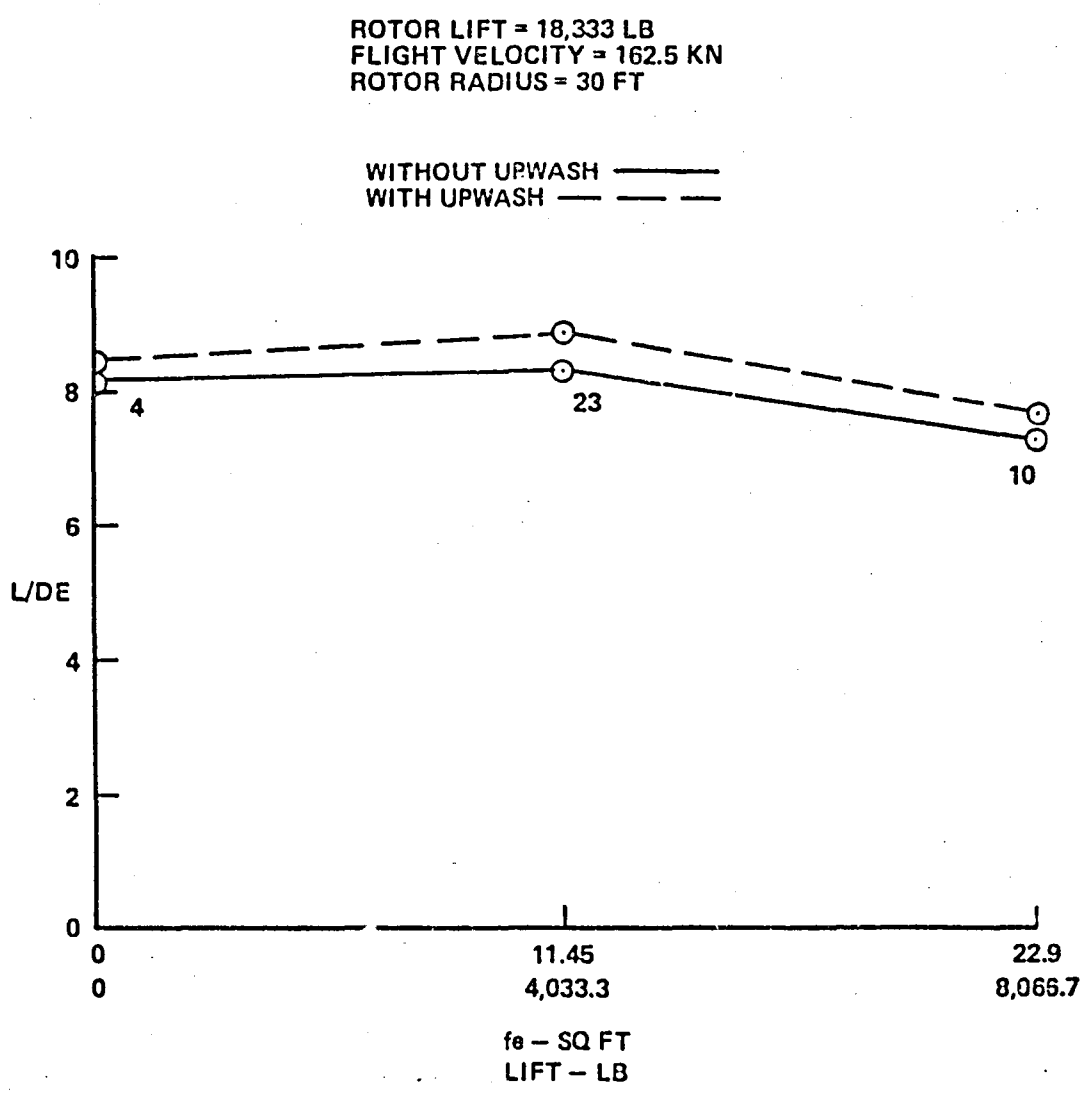

Figure 8–34. Variation of Equivalent Lift-to-Drag Ratio With Flat Plate Area for Auxiliary Thrust and Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

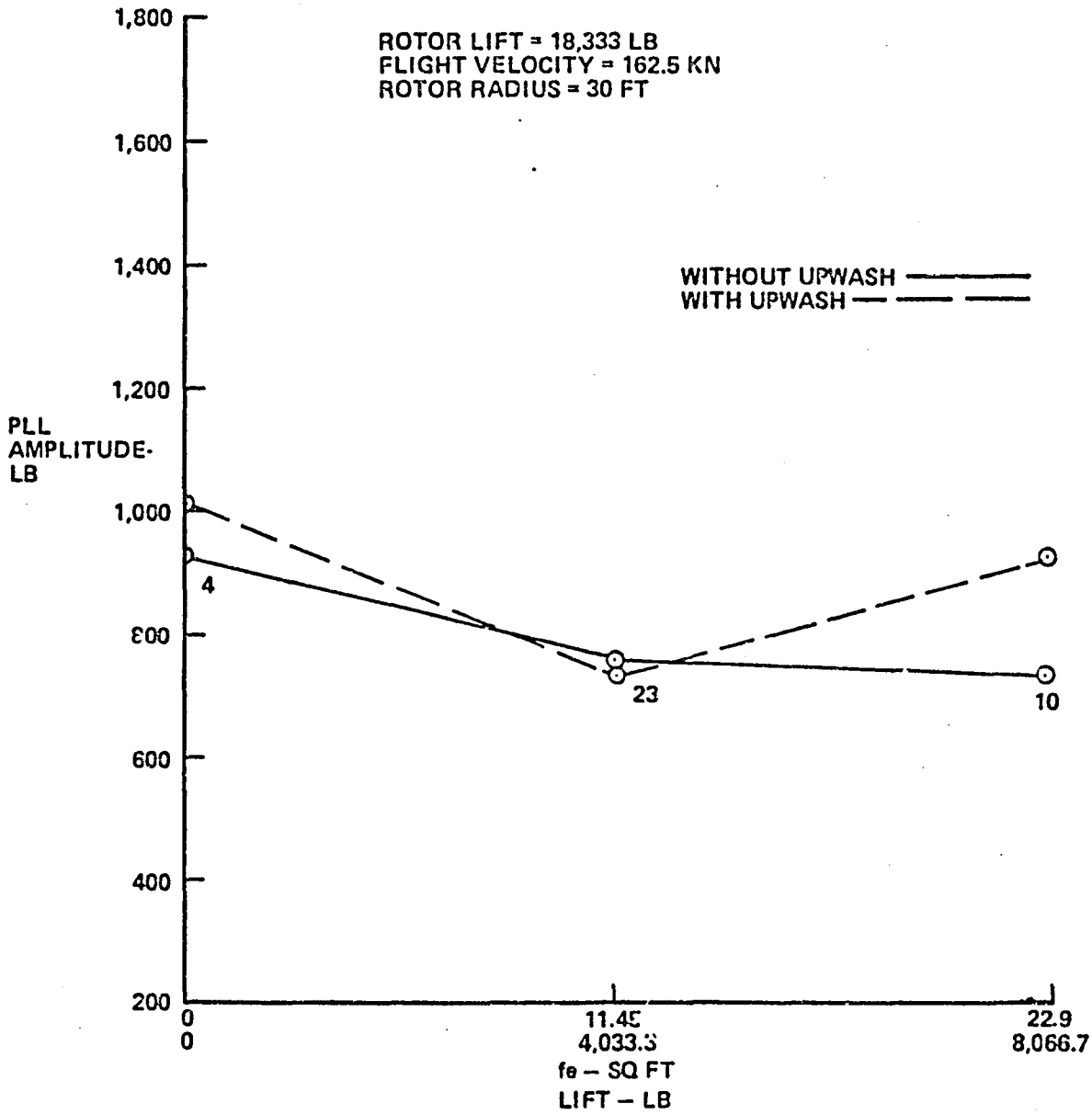

Figure 8-35. Variation of Pitch Link Load Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust and Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

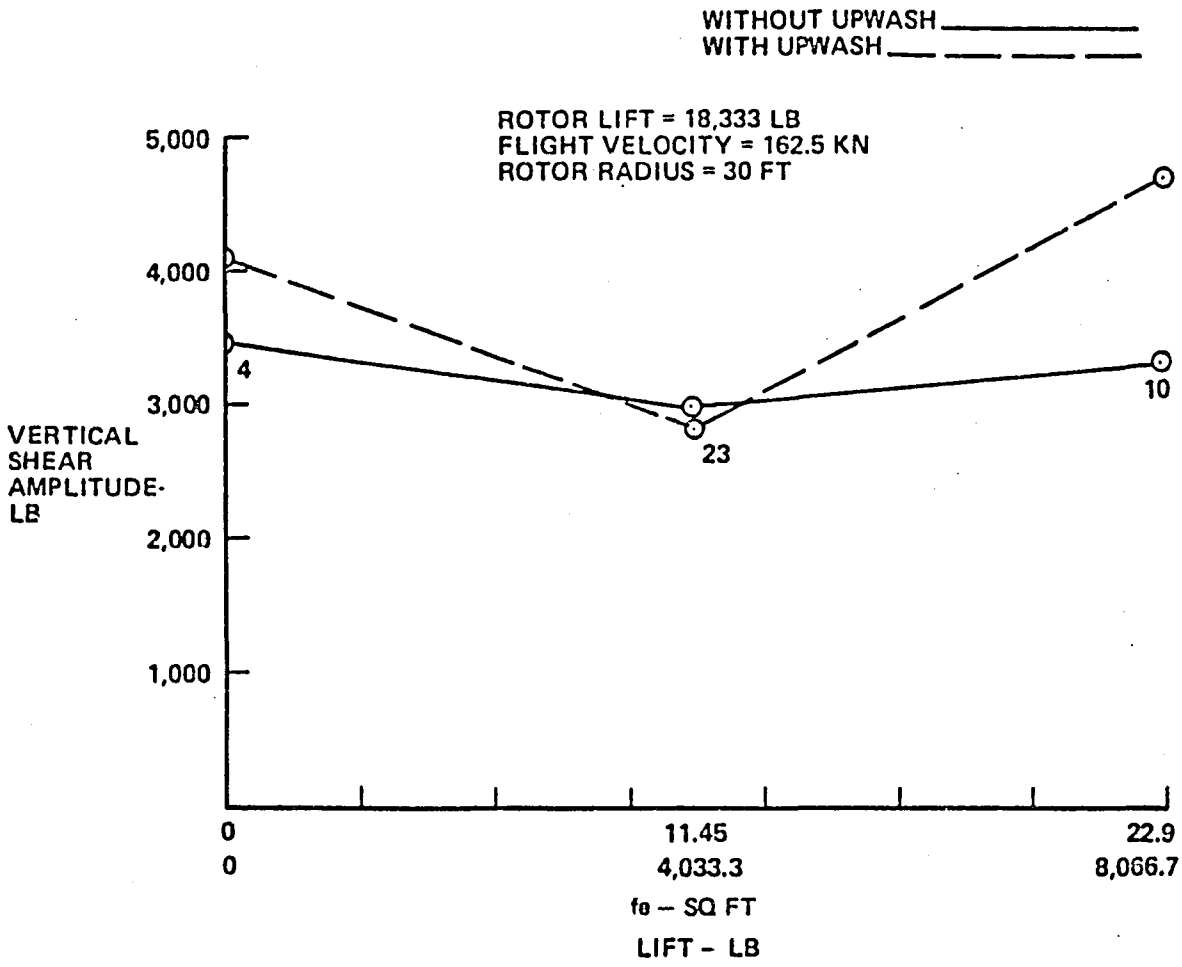

Figure 8-36. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Flat Plate Area for Auxiliary Thrust and Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

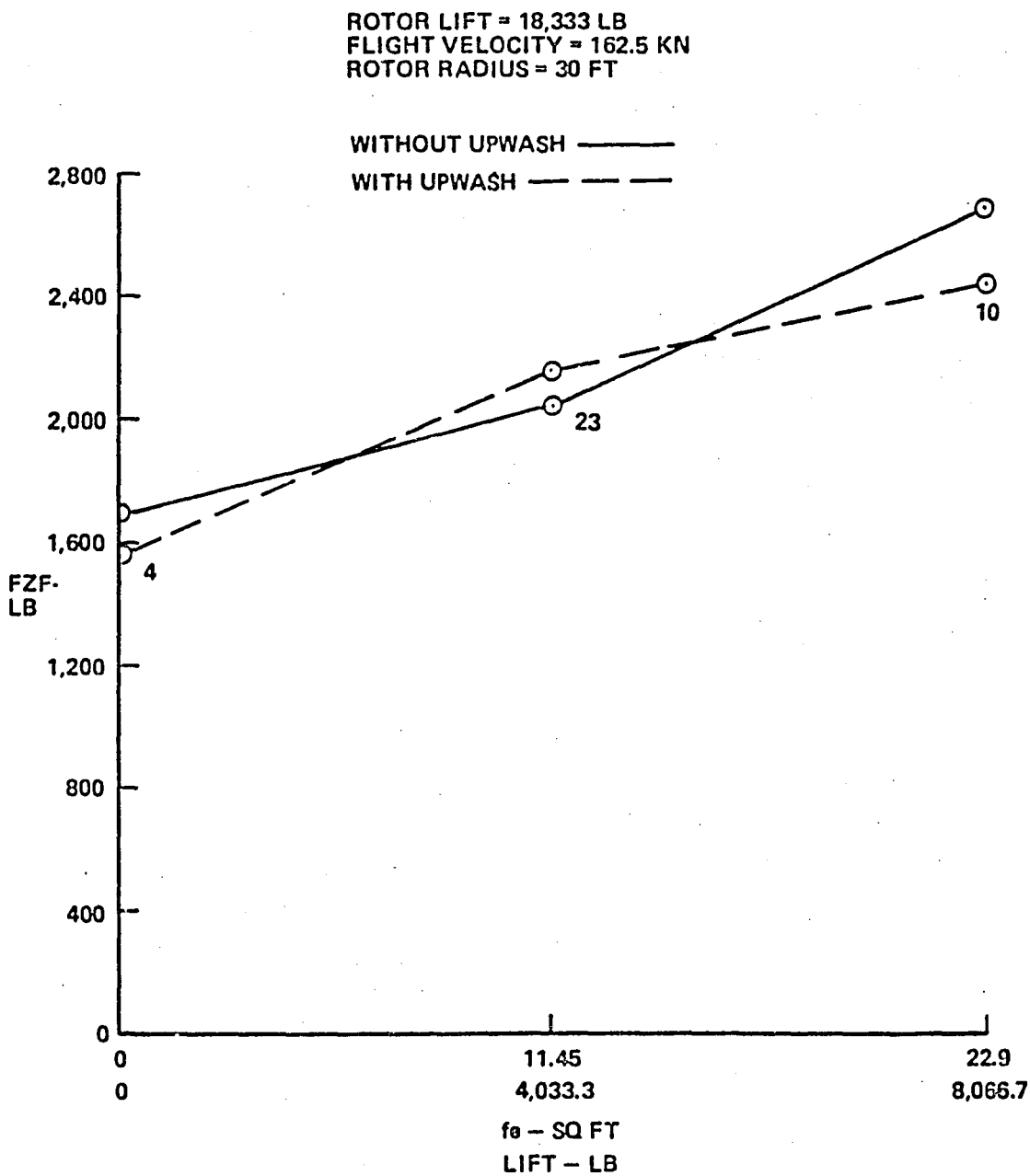

Figure 8–37. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Flat Plate Area for Auxiliary Thrust and Wing Lift From Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

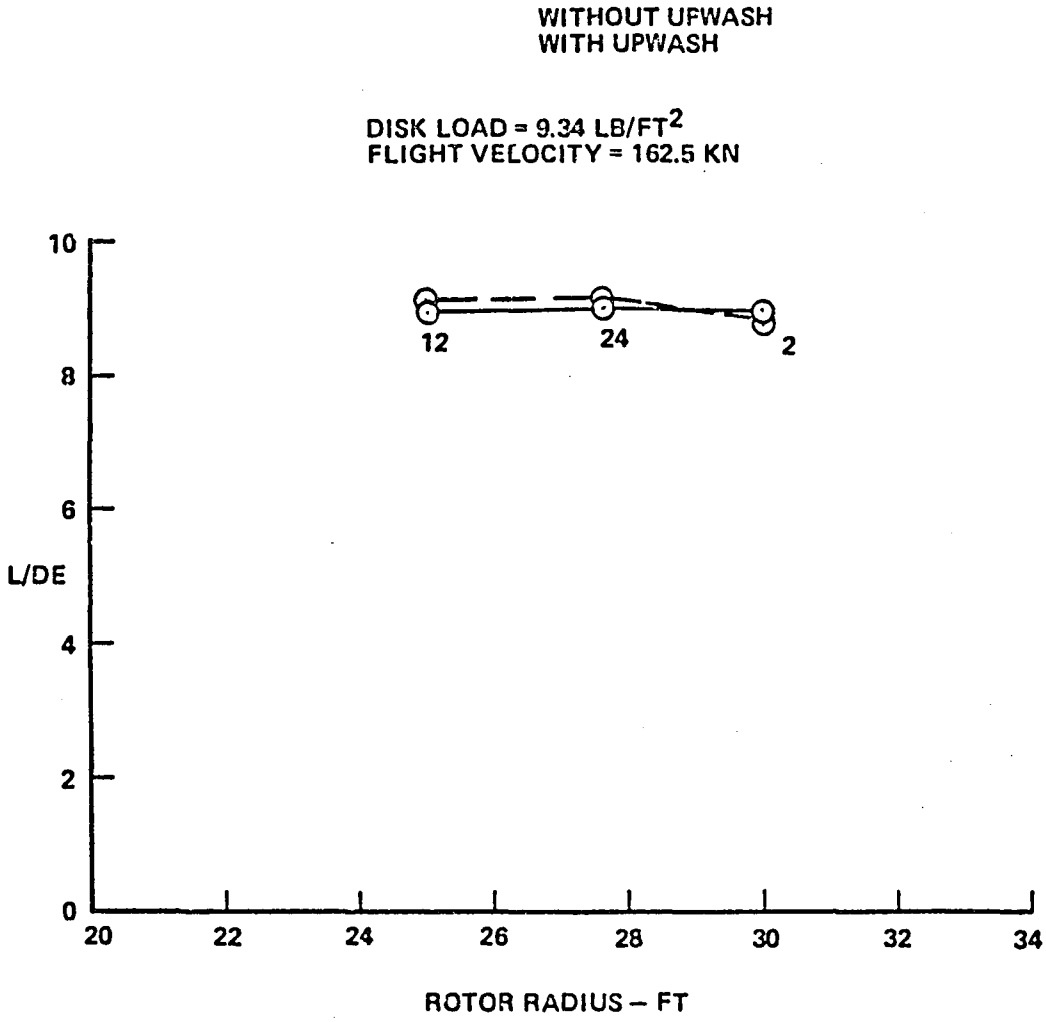

Figure 8–38. Variation of Equivalent Lift-to-Drag Ratio With Rotor Radius From Loads Analysis. Flight Velocity and Disk Loading Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

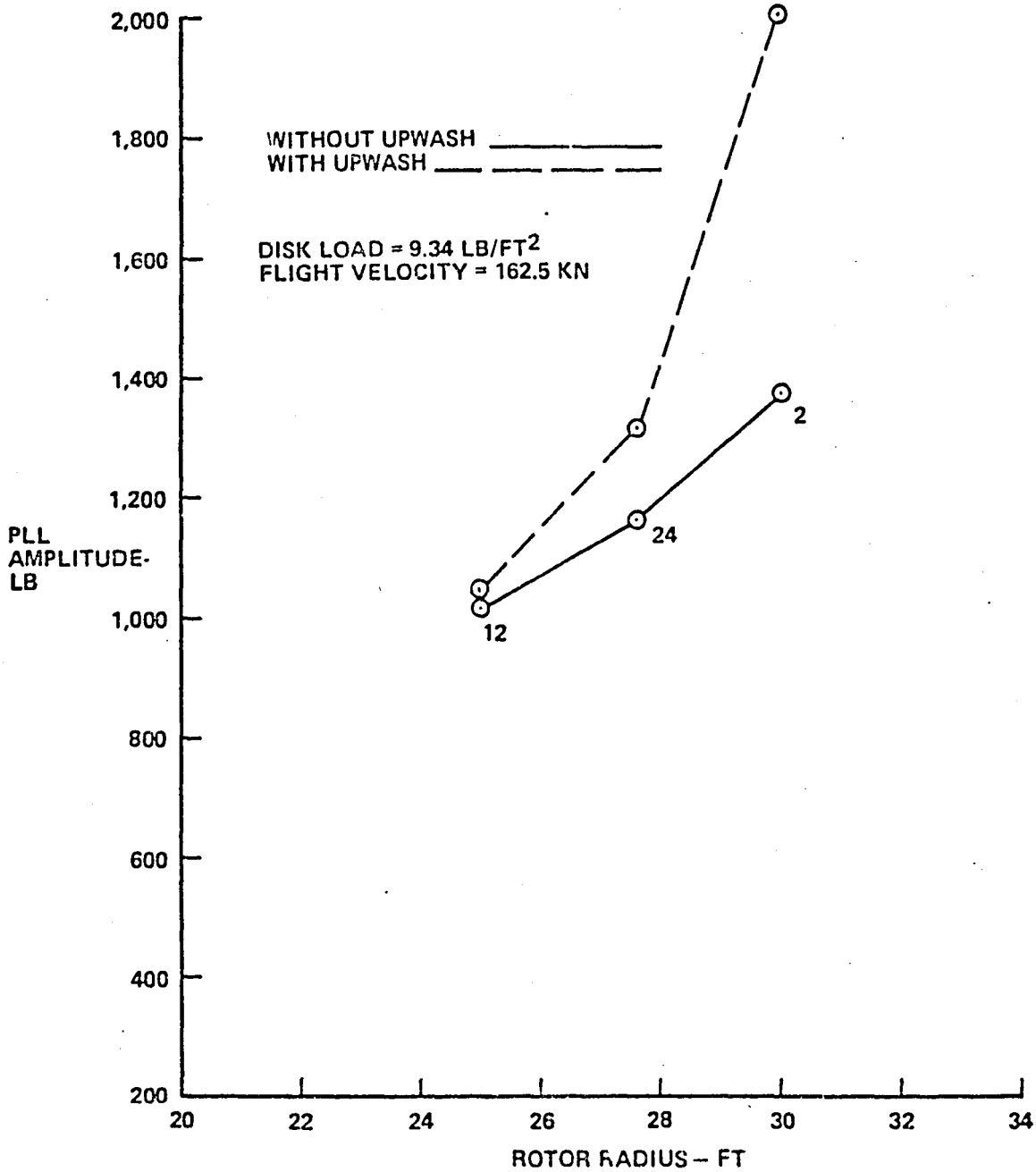

Figure 8–39. Variation of Pitch Link Load Vibratory Amplitude With Rotor Radius From Loads Analysis. Flight Velocity and Disk Loading Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

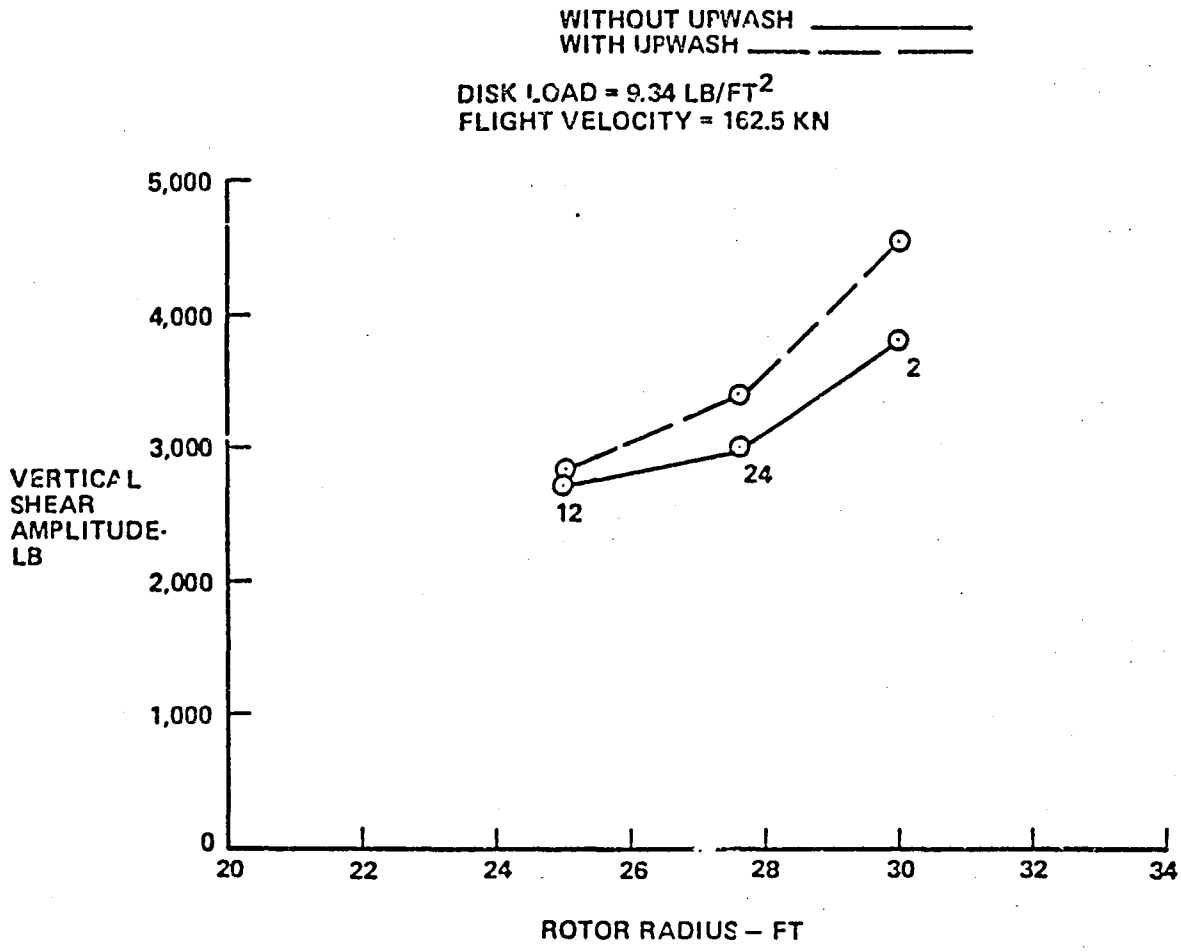

Figure 8-40. Variation of Flap Hinge Vertical Shear Vibratory Amplitude With Rotor Radius From Loads Analysis. Flight Velocity and Disk Loading Are Held Constant. Numerals Near Symbols Indicate Flight Condition.

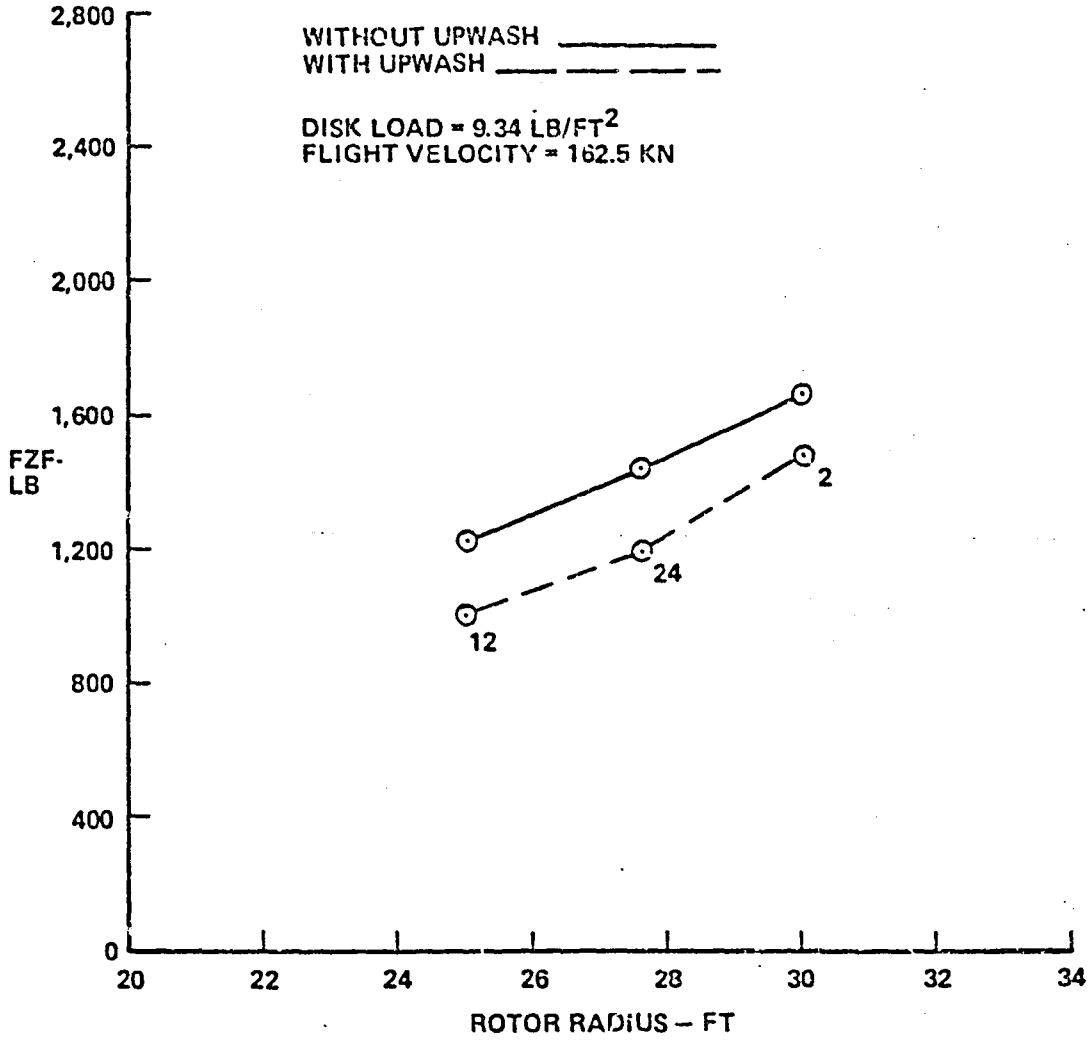

Figure 8–41. Variation of Vertical Hub Force Fourth Harmonic Amplitude With Rotor Radius From Loads Analysis. Flight Velocity and Disk Loading Are Held Constant. Numerals Near Symbols indicate Flight Condition.

9.0 CONCLUSIONS AND RECOMMENDATIONS

It is obvious from the discussion and figures in Section 8.0 that the effects of upwash on the fuselage, wings, and/or engines of the RSRA reflect complicated flow interactions, not always lending themselves to simple or straightforward interpretation.

At any rate some generalizations can be stated. Upwash from the fuselage and auxiliary engines decreases the required rotor power and increases L/DE and the flap hinge vertical shear vibratory amplitude. The tip elastic twist deflection is most influenced by fuselage/wing/engine upwash at high as opposed to low flight velocities. Wing upwash decreases T_4/T_0 and Q_4/Q_0. Fuselage/wing/engine upwash changes T_8/T_0 mainly at high flight velocities and decreases Q_8/Q_0 mainly at low flight velocities. The PLL amplitude is increased by fuselage/wing/engine upwash. Fuselage/wing upwash increases FZF, while fuselage or fuselage/engine upwash decreases it.

It is recommended that follow-on work focus on the interpretation of these effects.

10.0 REFERENCES

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2. Bain, L., and A. Landgrebe, "Investigation of Compound Helicopter Aerodynamic Interference Effects," USAAVLABS Technical Report 67-44, November 1967.

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4. Sewell, R., S. Lee, and T. Fukushima, "Rotor Airloads and Performance Analysis with Non-Uniform Induced Inflow." Boeing Doc. D8-0312 - Original Release December 1967.

5. Tarzanin, F., and J. Ranieri, "Aeroelastic Rotor Analysis Program C-60," Boeing Report D210-10371, Philadelphia, Pa. Revised 1978.

6. Dadone, L., "U.S. Army Helicopter Design Datcom, Volume I, Airfoils," USAAMRDL CR 76-2 (NASA CR-153247), September 1976.

11.0 APPENDICES

APPENDIX A

Potential Flow Model Coordinates

This appendix contains the point coordinates which define the fuselage, wings, engines, fuselage wake, and engine exhausts as they occur in the six potential flow models used in this study. The point coordinates are contained in the input data sets used by the potential flow program, TEA-230, to determine the velocities induced by the fuselage/wings/engines at the rotor blade locations. The six input data sets, one for each potential flow model, are reproduced in this appendix.

The title in the second line of each data set identifies the potential flow model involved. Those models involving wings will have a wing incidence of 0° unless another incidence is indicated in this line.

The first line of each data set contains the word "CASE." The ninth line contains the first of the sets of point coordinates. These coordinates are, in order, station, buttline, waterline. They are all in inches and they define, for purposes of the potential flow program, the corners of quadrilaterals from which source panels are made. The product of the first two numbers in the eighth line indicates the number of sets of coordinate points that follow before another line similar to the eighth line is encountered. The number of groups indicated by lines similar to the eighth line is designated by the number in the seventh line. The totality of point coordinates defining the corners of quadrilaterals from which source panels are made is followed by another word, either "END" or "MULT." Most data following either of these words refer to vortices or reference dimensions.

```
CASE
RSRA FUSELAGE ONLY
J D COWAN  BOEING VERTOL  ORG 7440  X7834  M/S P32-74
GEOM
   3.0000  288.0     1.          -1.
SOUR
       6.0
      7.00        4.00
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  58.79999    0.0        110.20000
  58.79999   16.89999     108.09999
  58.79999   22.50000     106.00000
  58.79999   22.50000      96.20000
  58.79999   22.50000      86.39999
  58.79999   16.89999      82.29999
  58.79999    0.0          82.29999
  81.50000    0.0        119.89999
  81.50000   22.09999     116.39999
  81.50000   29.50000     113.00000
  81.50000   29.50000      99.00000
  81.50000   29.50000      85.00000
  81.50000   22.09999      78.09999
  81.50000    0.0          78.09999
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 120.89999   28.39999     136.70000
 120.89999   37.79999     125.89999
 120.89999   37.79999     108.00000
 120.89999   37.79999      90.70000
 120.89999   28.39999      74.79999
 120.89999    0.0          74.79999
      7.00       13.00
 120.89999    0.0        147.59999
 120.89999   28.39999     136.70000
 120.89999   37.79999     125.89999
 120.89999   37.79999     108.00000
 120.89999   37.79999      90.70000
 120.89999   28.39999      74.79999
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 133.00000   29.20000     148.89999
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 133.00000   38.89999     110.79999
 133.00000   38.89999      91.79999
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 133.00000    0.0          72.79999
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 175.29999   38.89999      91.79999
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209.29999	38.89999	110.79999
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222.29999	38.89999	110.79999
222.29999	38.89999	91.79999
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222.29999	0.0	72.79999
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271.00000	29.20000	148.89999
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271.00000	38.89999	110.79999
271.00000	38.89999	91.79999
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271.00000	0.0	72.79999
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7.00	10.00	
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348.59985	19.59109	174.59999

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376.59985  17.79999 161.00000
376.59985  17.79999 148.89999
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```

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175.29999	-12.10000	148.89999
209.29999	0.0	72.79999
209.29999	-29.20000	72.79999
209.29999	-38.89999	91.79999
209.29999	-38.89999	110.79999
209.29999	-38.89999	129.89999
209.29999	-29.20000	148.89999
209.29999	-21.89999	148.89999
222.29999	0.0	72.79999
222.29999	-29.20000	72.79999
222.29999	-38.89999	91.79999
222.29999	-38.89999	110.79999
222.29999	-38.89999	129.89999
222.29999	-29.20000	148.89999
222.29999	-22.70000	148.89999
271.00000	0.0	72.79999
271.00000	-29.20000	72.79999
271.00000	-38.89999	91.79999
271.00000	-38.89999	110.79999
271.00000	-38.89999	129.89999
271.00000	-29.20000	148.89999
271.00000	-22.70000	148.89999
300.00000	0.0	72.79999
300.00000	-29.20000	72.79999
300.00000	-38.89999	91.79999
300.00000	-38.89999	110.79999
300.00000	-38.89999	129.89999
300.00000	-29.20000	148.89999
300.00000	-22.70000	148.89999
376.60010	0.0	72.79999
376.60010	-29.20000	72.79999
376.60010	-38.89999	91.79999
376.60010	-38.89999	110.79999
376.60010	-38.89999	129.89999
376.60010	-29.20000	148.89999
376.60010	-17.79999	148.89999
391.69995	0.0	74.39999
391.69995	-28.00000	74.39999
391.69995	-37.29999	92.59999
391.69995	-37.29999	110.79999
391.69995	-37.29999	129.00000
391.69995	-28.00000	147.29999
391.69995	-15.70000	147.29999
445.69995	0.0	77.79999
445.69995	-24.50000	77.79999
445.69995	-32.70000	94.39999
445.69995	-32.70000	110.79999

```
445.69995 -32.70000 127.20000
445.69995 -24.50000 143.45999
445.69995  -7.87174 143.45999
500.00000   0.0      81.29999
500.00000 -21.00000  81.29999
500.00000 -28.00000  96.20000
500.00000 -28.00000 110.79999
500.00000 -28.00000 125.39999
500.00000 -21.00000 139.59999
500.00000   0.0     139.59999
600.00000   0.0      89.89999
600.00000 -13.50000  89.89999
600.00000 -18.00000 100.39999
600.00000 -18.00000 110.79999
600.00000 -18.00000 120.89999
600.00000 -13.50000 131.00000
600.00000   0.0     131.00000
1000.00000  0.0      89.89999
1000.00000 -13.50000 89.89999
1000.00000 -18.00000 100.39999
1000.00000 -18.00000 110.79999
1000.00000 -18.00000 120.89999
1000.00000 -13.50000 131.00000
1000.00000  0.0     131.00000
      7.00     10.00
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 175.29999 -12.10000 148.89999
 175.29999 -12.10000 153.79999
 175.29999 -12.10000 157.39999
 175.29999 -12.10000 161.39999
 175.29999 -11.70000 163.59999
 175.29999  -8.10000 165.89999
 175.29999   0.0     165.89999
 209.29999 -21.89999 148.89999
 209.29999 -20.20000 157.79999
 209.29999 -22.00000 164.29999
 209.29999 -22.00000 171.59999
 209.29999 -21.09999 175.50000
 209.29999 -14.60000 179.70000
 209.29999   0.0     179.70000
 222.29999 -22.70000 148.89999
 222.29999 -22.70000 158.89999
 222.29999 -22.70000 166.39999
 222.29999 -22.70000 174.79999
 222.29999 -22.70000 181.29999
 222.29999 -19.59999 181.29999
 222.29999   0.0     181.29999
 271.00000 -22.70000 148.89999
 271.00000 -22.70000 161.39999
 271.00000 -22.70000 170.70000
 271.00000 -22.70000 181.09999
 271.00000 -22.70000 189.20000
 271.00000 -19.59999 189.20000
 271.00000   0.0     189.20000
```

```
 300.00000 -22.70000 148.89999
 300.00000 -22.70000 163.00000
 300.00000 -22.70000 173.29999
 300.00000 -22.70000 184.79999
 300.00000 -22.70000 193.79999
 300.00000 -19.59999 193.79999
 300.00000   0.0     193.79999
 348.60010 -19.59109 148.89999
 348.60010 -19.59109 163.59999
 348.60010 -19.59109 174.59999
 348.60010 -19.59109 186.89999
 348.60010 -19.59109 196.39999
 348.60010 -16.89999 196.39999
 348.60010   0.0     196.39999
 376.60010 -17.79999 148.89999
 376.60010 -17.79999 161.00000
 376.60010 -17.79999 170.09999
 376.60010 -17.79999 180.29999
 376.60010 -17.79999 188.09999
 376.60010 -15.30000 188.09999
 376.60010   0.0     188.09999
 391.69995 -15.70000 147.29999
 391.69995 -15.70000 158.29999
 391.69995 -15.70000 166.50000
 391.69995 -15.70000 175.79999
 391.69995 -15.70000 182.89999
 391.69995 -13.50000 182.89999
 391.69995   0.0     182.89999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
 500.00000   0.0     139.59999
END
AERO
     0.          0.          0.
FORC
307.5      0.          75.52      52112.     98.1       331.2      0.
END
```

```
CASE
RSRA FUSELAGE AND WINGS
J D COWAN    AERO RESEARCH  ORGN 7440  EXT 3871
GEOM
3.          634.        1.          -1.
SOUR
16.
7.          4.
  36.       0.          95.9
  36.       0.          95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  58.8      0.0         110.2
  58.8      16.9        108.1
  58.8      22.5        106.
  58.8      22.5        96.2
  58.8      22.5        86.4
  58.8      16.9        82.3
  58.8      0.0         82.3
  81.5      0.0         119.9
  81.5      22.1        116.4
  81.5      29.5        113.
  81.5      29.5        99.
  81.5      29.5        85.
  81.5      22.1        78.1
  81.5      0.0         78.1
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9     0.          74.8
  7.        6.
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9                 74.8
  133.                  148.9
  133.      [illegible].2 148.9
  133.      [illegible]  129.9
  133.      [illegible]  110.8
  133.      [illegible]  91.8
  133.      [illegible]  72.8
  133.      [illegible]  72.8
  175.3     12.1        148.9
  175.3     29.2        148.9
  175.3     38.9        129.9
  175.3     38.9        110.8
  175.3     38.9        91.8
```

175.3	29.2	72.8
175.3	0.	72.8
209.3	21.9	148.9
209.3	29.2	148.9
209.3	38.9	129.9
209.3	38.9	110.8
209.3	38.9	91.8
209.3	29.2	72.8
209.3	0.	72.8
222.3	22.7	148.9
222.3	29.2	148.9
222.3	38.9	129.9
222.3	38.9	110.8
222.3	38.9	91.8
222.3	29.2	72.8
222.3	0.	72.8
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
271.	0.	72.8
6.	4.	
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
300.	22.7	148.9
300.	29.2	148.9
300.	38.9	129.9
300.	38.9	110.8
300.	38.9	91.8
300.	38.9	85.
376.6	27.8	148.9
376.6	29.2	148.9
376.6	38.9	129.9
376.6	38.9	110.8
376.6	38.9	91.8
376.6	38.9	85.
391.7	15.7	147.3
391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
391.7	28.	74.4
7	5.	
391.7	15.7	147.3
391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
391.7	28.	74.4
391.7	0.	74.4
445.7	7.871745	143.46
445.7	24.5	143.46
445.7	32.7	121.2
445.7	32.7	110.8

445.7	32.7	94.4
445.7	24.5	77.8
445.7	0.	77.8
500.	0.	139.6
500.	21.	139.6
500.	28.	125.4
500.	28.	110.8
500.	28.	96.2
500.	21.	81.3
500.	0.	81.3
600.	0.	131.
600.	13.5	131.
600.	18.	120.9
600.	18.	110.8
600.	18.	100.4
600.	13.5	89.9
600.	0.	89.9
1000.	0.	131.
1000.	13.5	131.
1000.	18.	120.9
1000.	18.	110.8
1000.	18.	100.4
1000.	13.5	89.9
1000.	0.	89.9
7.	10.	
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
175.3	0.	165.9
175.3	8.1	165.9
175.3	11.7	163.6
175.3	12.1	161.4
175.3	12.1	157.4
175.3	12.1	153.8
175.3	12.1	148.9
209.3	0.	179.7
209.3	14.6	179.7
209.3	21.1	175.5
209.3	22.	171.6
209.3	22.	164.3
209.3	20.2	157.8
209.3	21.9	148.9
222.3	0.	181.3
222.3	19.6	181.3
222.3	22.7	181.3
222.3	22.7	174.8
222.3	22.7	166.4
222.3	22.7	158.9
222.3	22.7	148.9
271.	0.	189.2
271.	19.6	189.2
271.	22.7	189.2
271.	22.7	181.1
271.	22.7	170.7
271.	22.7	161.4
271.	22.7	148.9

```
300.        0.          193.8
300.        19.6        193.8
300.        22.7        193.8
300.        22.7        184.8
300.        22.7        173.3
300.        22.7        163.
300.        22.7        148.9
348.6       0.          196.4
348.6       16.9        196.4
348.6       19.5911     196.4
348.6       19.5911     186.9
348.6       19.5911     174.6
348.6       19.5911     163.6
348.6       19.5911     148.9
376.6       0.          188.1
376.6       15.3        188.1
376.6       17.8        188.1
376.6       17.8        180.3
376.6       17.8        170.1
376.6       17.8        161.0
376.6       17.8        148.9
391.7       0.          182.9
391.7       13.5        182.9
391.7       15.7        182.9
391.7       15.7        175.8
391.7       15.7        166.5
391.7       15.7        158.3
391.7       15.7        147.3
500.        0.          139.6
500.        0.          139.6
500.        0.          139.6
500.        0.          139.6
500.        0.          139.6
500.        0.          139.6
500.        0.          139.6
        7.0         4.0
   36.          0.          95.9
   36.          0.          95.9
   36.0000     -0.0000      95.9000
   36.0000     -0.0000      95.9000
   36.0000     -0.0000      95.9000
   36.0000     -0.0000      95.9000
   36.0000     -0.0000      95.9000
   58.8000     -0.0000      82.3000
   58.8       -16.9         82.3
   58.8000    -22.5000      86.4000
   58.8000    -22.5000      96.2000
   58.8000    -22.5000     106.0000
   58.8       -16.9        108.1
   58.8000     -0.0000     110.2000
   81.5000     -0.0000      78.1000
   81.5       -22.1         78.1
   81.5000    -29.5000      85.0000
   81.5000    -29.5000      99.0000
   81.5000    -29.5000     113.0000
   81.5       -22.1        116.4
   81.5000     -0.0000     119.9000
  120.9000     -0.0000      74.8000
  120.9       -28.4         74.8
  120.9000    -37.8000      90.7000
```

```
120.9000   -37.8000   108.
120.9000   -37.8000   125.9000
120.9      -28.4      136.7
120.9000    -0.0000   147.6000
     7.0        6.
120.9000    -0.0000    74.8000
120.9000   -28.4000    74.8000
120.9000   -37.8000    90.7000
120.9000   -37.8000   108.
120.9000   -37.8000   125.9000
120.9000   -28.4000   136.7000
120.9000    -0.0000   147.6000
133.0000    -0.0000    72.8000
133.0000   -29.2000    72.8000
133.0000   -35.9000    91.8000
133.0000   -38.9000   110.8000
133.0000   -38.9000   129.9000
133.0000   -29.2000   148.9000
133.0000    -0.0000   148.9000
175.3000    -0.0000    72.8000
175.3000   -29.2000    72.8000
175.3000   -38.9000    91.8000
175.3000   -38.9000   110.8000
175.3000   -38.9000   129.9000
175.3000   -29.2000   148.9000
175.3000   -12.1000   148.9000
209.3000    -0.0000    72.8000
209.3000   -29.2000    72.8000
209.3000   -38.9000    91.8000
209.3000   -38.9000   110.8000
209.3000   -38.9000   129.9000
209.3000   -29.2000   148.9000
209.3000   -21.9000   148.9000
222.3000    -0.0000    72.8000
222.3000   -29.2000    72.8000
222.3000   -38.9000    91.8000
222.3000   -38.9000   110.8000
222.3000   -38.9000   129.9000
222.3000   -29.2000   148.9000
222.3000   -22.7000   148.9000
271.0000    -0.0000    72.8000
271.0000   -29.2000    72.8000
271.0000   -38.9000    91.8000
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.       -22.7      148.9000
6.         4.
271.0000   -29.2000   72.8
271.0000   -38.9000   91.8
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.0000   -22.7000   148.9000
300.       -38.9      85.
300.       -38.9      91.8
300.       -38.9      110.8
300.       -38.9      129.9
300.       -29.2      148.9
300.       -22.7      148.9
```

```
 376.6      -38.9      85.
 376.6      -38.9      91.8
 376.6      -38.9      110.8
 376.6      -38.9      129.9
 376.6      -29.2      148.9
 376.6      -17.8      148.9
 391.7      -28.       74.4
 391.7      -37.3      92.6
 391.7      -37.3      110.8
 391.7      -37.3      129.
 391.7      -28.       147.3
 391.7      -15.7      147.3
 7.         5.
 391.7000     -0.0000    74.4000
 391.7000    -28.0000    74.4000
 391.7000    -37.3000    92.6000
 391.7000    -37.3000   110.8000
 391.7000    -37.3000   129.0000
 391.7000    -28.0000   147.3000
 391.7000    -15.7000   147.3000
 445.7000     -0.0000    77.8000
 445.7000    -24.5000    77.8000
 445.7000    -32.7000    94.4000
 445.7000    -32.7000   110.8000
 445.7000    -32.7000   127.2000
 445.7000    -24.5000   143.4600
 445.7000-7.871745      143.4600
 500.0000     -0.0000    81.3000
 500.0000    -21.0000    81.3000
 500.0000    -28.0000    96.2000
 500.0000    -28.0000   110.8000
 500.0000    -28.0000   125.4000
 500.0000    -21.0000   139.6000
 500.0000     -0.0000   139.6000
 600.0000     -0.0000    89.9000
 600.0000    -13.5000    89.9000
 600.0000    -18.0000   100.4000
 600.0000    -18.0000   110.8000
 600.0000    -18.0000   120.9000
 600.0000    -13.5000   131.0000
 600.0000     -0.0000   131.0000
1000.0000     -0.0000    89.9000
1000.0000    -13.5000    89.9000
1000.0000    -18.0000   100.4000
1000.0000    -18.0000   110.8000
1000.0000    -18.0000   120.9000
1000.0000    -13.5000   131.0000
1000.0000     -0.0000   131.0000
       7.0         10.0
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 133.0000     -0.0000   148.9000
 175.3000    -12.1000   148.9000
 175.3000    -12.1000   153.8000
 175.3000    -12.1000   157.4000
 175.3000    -12.1000   161.4000
```

```
  175.3000  -11.7000  163.6000
  175.3000   -8.1000  165.9000
  175.3000   -0.0000  165.9000
  209.3000  -21.9000  148.9000
  209.3000  -20.2000  157.8000
  209.3000  -22.0000  164.3000
  209.3000  -22.0000  171.6000
  209.3000  -21.1000  175.5000
  209.3000  -14.6000  179.7000
  209.3000   -0.0000  179.7000
  222.3000  -22.7000  148.3000
  222.3000  -22.7000  158.9000
  222.3000  -22.7000  166.4000
  222.3000  -22.7000  174.8000
  222.3000  -22.7000  181.3000
  222.3000  -19.6000  181.3000
  222.3000   -0.0000  181.3000
  271.0000  -22.7000  148.9000
  271.0000  -22.7000  161.4000
  271.0000  -22.7000  170.7000
  271.0000  -22.7000  181.1000
  271.0000  -22.7000  189.2000
  271.0000  -19.6000  189.2000
  271.0000   -0.0000  189.2000
  300.0000  -22.7000  148.9000
  300.0000  -22.7000  163.0000
  300.0000  -22.7000  173.3000
  300.0000  -22.7000  184.8000
  300.0000  -22.7000  193.8000
  300.0000  -19.6000  193.8000
  300.0000   -0.0000  193.8000
  348.6001  -19.5911  148.9000
  348.6001  -19.5911  163.6000
  348.6001  -19.5911  174.6000
  348.6001  -19.5911  186.9000
  348.6001  -19.5911  196.4000
  348.6001  -16.9000  196.4000
  348.6001   -0.0000  196.4000
  376.6001  -17.8000  148.9000
  376.6001  -17.8000  161.0000
  376.6001  -17.8000  170.1000
  376.6001  -17.8000  180.3000
  376.6001  -17.8000  188.1000
  376.6001  -15.3000  188.1000
  376.6001   -0.0000  188.1000
  391.7000  -15.7000  147.3000
  391.7000  -15.7000  158.3000
  391.7000  -15.7000  166.5000
  391.7000  -15.7000  175.8000
  391.7000  -15.7000  182.9000
  391.7000  -13.5000  182.9000
  391.7000   -0.0000  182.9000
  500.       -0.0000  139.6000
  500.       -0.0000  139.6000
  500.       -0.0000  139.6000
  500.       -0.0000  139.6
  500.       -0.0000  139.6
  500.       -0.0000  139.6000
  500.       -0.0000  139.6000
17.       10.
```

391.36	56.65	71.07
369.4	56.17	75.35
347.29	55.71	79.4
325.04	55.47	81.52
308.31	55.55	80.88
297.19	55.74	79.13
288.89	56.	76.84
283.43	56.29	74.32
280.98	56.64	71.21
284.09	56.93	68.64
289.67	56.1	67.16
297.92	57.23	65.97
308.87	57.32	65.2
325.25	57.3	65.32
347.14	57.06	67.44
369.18	56.74	70.29
391.36	56.65	71.07
389.72	79.71	73.68
368.48	79.24	77.81
347.11	78.8	81.73
325.59	78.57	83.78
309.41	78.64	83.16
298.65	78.83	81.47
290.63	79.08	79.26
285.35	79.35	76.82
282.98	79.69	73.81
285.99	79.97	71.32
291.38	80.13	69.9
299.36	80.26	68.74
309.95	80.35	67.99
325.79	80.33	68.12
346.96	80.1	70.17
368.27	79.79	72.92
389.72	79.71	73.68
388.08	102.76	76.28
367.57	102.31	80.28
346.92	101.88	84.06
326.13	101.66	86.04
310.51	101.73	85.44
300.12	101.91	83.81
292.37	102.15	81.67
287.27	102.42	79.32
284.98	102.75	76.41
287.89	103.02	74.01
293.09	103.17	72.63
300.8	103.3	71.51
311.03	103.38	70.79
326.33	103.37	70.91
346.78	103.14	72.89
367.36	102.84	75.55
388.08	102.76	76.28
386.44	125.81	78.89
366.65	125.38	82.74
346.73	124.97	86.39
326.68	124.75	88.3
311.61	124.82	87.72
301.59	124.99	86.15
294.11	125.23	84.09
289.19	125.48	81.82
286.98	125.8	79.01

289.79	126.06	76.69
294.81	126.21	75.36
302.25	126.33	74.29
312.11	126.41	73.59
326.87	126.4	73.71
346.59	126.18	75.62
366.45	125.89	78.18
386.44	125.81	78.89
384.8	148.87	81.49
365.74	148.45	85.2
346.55	148.05	88.72
327.23	147.84	90.56
312.71	147.91	90.
303.05	148.08	88.49
295.85	148.3	86.5
291.11	148.55	84.31
288.98	148.85	81.61
291.68	149.11	79.38
296.52	149.25	78.1
303.69	149.37	77.06
313.19	149.44	76.39
327.41	149.43	76.5
346.41	149.22	78.34
365.54	148.94	80.81
384.8	148.87	81.49
383.16	171.92	84.1
364.82	171.52	87.67
346.36	171.13	91.05
327.78	170.93	92.82
313.81	171.	92.28
304.52	171.16	90.82
297.59	171.38	88.91
293.03	171.61	86.81
290.99	171.91	84.21
293.58	172.15	82.06
298.24	172.29	80.83
305.13	172.4	79.83
314.27	172.47	79.19
327.95	172.46	79.29
346.23	172.26	81.06
364.63	171.99	83.44
383.16	171.92	84.1
381.52	194.97	86.7
363.91	194.59	90.13
346.17	194.22	93.38
328.32	194.03	95.08
314.91	194.09	94.56
305.98	194.24	93.16
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294.95	194.68	89.31
292.99	194.96	86.81
295.48	195.19	84.75
299.95	195.33	83.56
306.57	195.44	82.6
315.35	195.51	81.88
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363.73	195.04	86.07
381.52	194.97	86.7
379.88	218.03	89.3

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301.07    217.53    93.74
296.87    217.74    91.8
294.99    218.02    89.41
297.38    218.24    87.43
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316.43    218.54    84.78
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  325.25     0.        65.32
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  284.09    29.2       68.64
  289.67    29.2       67.16
  297.92    29.2       65.97
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347.29        38.9       85.
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347.14        29.2       67.44
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325.25        57.3       65.32
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314.91	194.79	88.29
328.32	194.76	88.58
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362.07	240.93	93.2
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367.57      -102.58     77.92
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289.19      -125.74     79.5
294.11      -125.71     79.82
301.59      -125.66     80.26
311.61      -125.61     80.67
326.68      -125.57     81.
346.73      -125.57     81.01
366.65      -125.64     80.46
386.44      -125.81     78.89
406.54      -125.81     77.31
446.81      -125.81     75.2
9000.       -125.81     -160.15
291.11      -148.8      82.08
295.85      -148.77     82.39
303.05      -148.72     82.82
312.71      -148.67     83.21
327.23      -148.64     83.53
346.55      -148.64     83.54
365.74      -148.7      83.01
384.8       -148.87     81.49
404.17      -148.87     79.97
```

```
442.96     -148.87    77.94
9000.      -148.87    -157.41
293.03     -171.86    84.67
297.59     -171.82    84.96
304.52     -171.78    85.37
313.81     -171.73    85.75
327.78     -171.7     86.06
346.36     -171.7     86.07
364.82     -171.76    85.56
383.16     -171.92    84.1
401.79     -171.92    82.63
439.11     -171.92    80.68
9000.      -171.92    -154.67
294.95     -194.91    87.25
299.33     -194.88    87.53
305.98     -194.84    87.93
314.91     -194.79    88.29
328.32     -194.76    88.58
346.17     -194.76    88.59
363.91     -194.82    88.1
381.52     -194.97    86.7
399.41     -194.97    85.29
435.26     -194.97    83.41
9000.      -194.97    -151.93
296.87     -217.97    89.83
301.07     -217.94    90.1
307.45     -217.89    90.48
316.01     -217.85    90.83
328.87     -217.82    91.11
345.99     -217.82    91.12
362.99     -217.87    90.65
379.88     -218.03    89.3
397.04     -218.03    87.95
431.41     -218.03    86.15
9000.      -218.03    -149.19
298.79     -241.02    92.41
302.81     -240.99    92.67
308.92     -240.95    93.03
317.11     -240.92    93.37
329.42     -240.89    93.64
345.8      -240.88    93.64
362.07     -240.93    93.2
378.24     -241.08    91.91
394.66     -241.08    90.62
427.56     -241.08    88.89
9000.      -241.08    -146.45
300.51     -261.77    94.73
304.37     -261.75    94.98
310.24     -261.71    95.33
318.1      -261.67    95.65
329.91     -261.64    95.91
345.63     -261.64    95.92
361.25     -261.69    95.49
376.76     -261.83    94.25
392.52     -261.83    93.01
424.1      -261.83    91.36
9000.      -261.83    -143.98
.050192    .085453    .120618    .172921    .242018    .219928
.10887
388.93     -91.17     74.97      .07889     .10636     .99119
```

```
387.29      -114.22     77.58       .07889      .10636    .99119
385.64      -137.27     80.18       .07889      .10636    .99119
334.        -160.32     82.78       .07889      .10636    .99119
382.36      -183.37     85.39       .07889      .10636    .99119
380.72      -206.42     87.99       .07889      .10636    .99119
379.08      -229.47     90.59       .07889      .10636    .99119
377.44      -252.52     93.2        .07889      .10636    .99119
B-MU
2.
11.         3.          7.          1.          10.       0.
283.43      0.          71.76
288.89      0.          72.11
297.19      0.          72.6
308.31      0.          73.06
325.04      0.          73.42
347.29      0.          73.43
369.4       0.          76.
392.0323    0.          77.65445
413.67      0.          100.
458.36      0.          120.
9000.       0.          -115.3426
283.43      56.58       71.76
288.89      56.54       72.11
297.19      56.48       72.6
308.31      56.43       73.06
325.04      56.39       73.42
347.29      56.39       73.43
369.4       56.46       72.62
391.36      56.65       71.07
413.67      56.65       69.32
458.36      56.65       66.98
9000.       56.65       -168.36
285.35      79.63       74.34
290.63      79.59       74.68
298.65      79.54       75.16
309.41      79.49       75.6
325.59      79.45       75.95
347.11      79.45       75.96
368.48      79.52       75.37
389.72      79.71       73.68
411.29      79.71       71.98
454.51      79.71       69.72
9000.       79.71       -165.62
.050192     .085453     .120618     .172921     .242018   .219928
.10387
390.57      68.12       72.37       .07889      -.10636   .99119
11.         3.          7.          1.          10.       0.
283.43      0.          71.76
288.89      0.          72.11
297.19      0.          72.6
308.31      0.          73.06
325.04      0.          73.42
347.29      0.          73.43
369.4       0.          76.
392.0323    0.          77.65445
413.67      0.          100.
458.36      0.          120.
9000.       0.          -115.3426
283.43      -56.58      71.76
288.89      -56.54      72.11
```

```
297.19     -56.48     72.6
308.31     -56.43     73.06
325.04     -56.39     73.42
347.29     -56.39     73.43
369.4      -56.46     72.82
391.36     -56.65     71.07
413.67     -56.65     69.32
458.36     -56.65     66.98
9000.      -56.65     -168.36
285.35     -79.63     74.34
290.63     -79.59     74.68
298.65     -79.54     75.16
309.41     -79.49     75.6
325.59     -79.45     75.95
347.11     -79.45     75.96
368.48     -79.52     75.37
389.72     -79.71     73.68
411.29     -79.71     71.98
454.51     -79.71     69.72
9000.      -79.71     -165.62
.050192    .085453    .120618    .172921    .242018    .219928
.10887
390.57     -68.12     72.37      .07889      .10636    .99119
END
AERO
5.         0.         0.
FORC
307.5      0.         75.52      52112.     98.1       531.2      0.
END
```

```
CASE
RSRA FUSELAGE AND ENGINES
J D COWAN  BOEING VERTOL  ORG 7440  X7834  M/S P32-74
GEOM
   3.00000 400.      1.          -1.                  0.
SOUR
        8.0
       7.00        4.00
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  36.00000    0.0         95.89999
  58.79999    0.0        110.20000
  58.79999   16.89999    108.09999
  58.79999   22.50000    106.00000
  58.79999   22.50000     96.20000
  58.79999   22.50000     86.39999
  58.79999   16.89999     82.29999
  58.79999    0.0         82.29999
  81.50000    0.0        119.89999
  81.50000   22.09999    116.39999
  81.50000   29.50000    113.00000
  81.50000   29.50000     99.00000
  81.50000   29.50000     85.00000
  81.50000   22.09999     78.09999
  81.50000    0.0         78.09999
 120.89999    0.0        147.59999
 120.89999   28.39999    136.70000
 120.89999   37.79999    125.89999
 120.89999   37.79999    108.00000
 120.89999   37.79999     90.70000
 120.89999   28.39999     74.79999
 120.89999    0.0         74.79999
       7.00       13.00
 120.89999    0.0        147.59999
 120.89999   28.39999    136.70000
 120.89999   37.79999    125.89999
 120.89999   37.79999    108.00000
 120.89999   37.79999     90.70000
 120.89999   28.39999     74.79999
 120.89999    0.0         74.79999
 133.00000    0.0        148.89999
 133.00000   29.20000    148.89999
 133.00000   38.89999    129.89999
 133.00000   38.89999    110.79999
 133.00000   38.89999     91.79999
 133.00000   29.20000     72.79999
 133.00000    0.0         72.79999
 175.29999   12.10000    148.89999
 175.29999   29.20000    148.89999
 175.29999   38.89999    129.89999
 175.29999   38.89999    110.79999
 175.29999   38.89999     91.79999
```

175.29999	29.20000	72.79999
175.29999	0.0	72.79999
209.29999	21.89999	148.89999
209.29999	29.20000	148.89999
209.29999	38.89999	129.89999
209.29999	38.89999	110.79999
209.29999	38.89999	91.79999
209.29999	29.20000	72.79999
209.29999	0.0	72.79999
222.29999	22.70000	148.89999
222.29999	29.20000	148.89999
222.29999	38.89999	129.89999
222.29999	38.89999	110.79999
222.29999	38.89999	91.79999
222.29999	29.20000	72.79999
222.29999	0.0	72.79999
271.00000	22.70000	148.89999
271.00000	29.20000	148.89999
271.00000	38.89999	129.89999
271.00000	38.89999	110.79999
271.00000	38.89999	91.79999
271.00000	29.20000	72.79999
271.00000	0.0	72.79999
300.00000	22.70000	148.89999
300.00000	29.20000	148.89999
300.00000	38.89999	129.89999
300.00000	38.89999	110.79999
300.00000	38.89999	91.79999
300.00000	29.20000	72.79999
300.00000	0.0	72.79999
376.59985	17.79999	148.89999
376.59985	29.20000	148.89999
376.59985	38.89999	129.89999
376.59985	38.89999	110.79999
376.59985	38.89999	91.79999
376.59985	29.20000	72.79999
376.59985	0.0	72.79999
391.69995	13.70000	147.29999
391.69995	28.00000	147.29999
391.69995	37.29999	129.00000
391.69995	37.29999	110.79999
391.69995	37.29999	92.59999
391.69995	28.00000	74.39999
391.69995	0.0	74.39999
445.69995	7.87174	143.45999
445.69995	24.50000	143.45999
445.69995	32.70000	127.20000
445.69995	32.70000	110.79999
445.69995	32.70000	94.39999
445.69995	24.50000	77.79999
445.69995	0.0	77.79999
500.00000	0.0	139.59999
500.00000	21.00000	139.59999
500.00000	28.00000	125.39999
500.00000	28.00000	110.79999
500.00000	28.00000	96.20000
500.00000	21.00000	81.29999
500.00000	0.0	81.29999
600.00000	0.0	131.00000
600.00000	13.50000	131.00000

600.00000	18.00000	120.89999
600.00000	18.00000	110.79999
600.00000	18.00000	100.39999
600.00000	13.50000	89.89999
600.00000	0.0	89.89999
1000.00000	0.0	131.00000
1000.00000	13.50000	131.00000
1000.00000	18.00000	120.89999
1000.00000	18.00000	110.79999
1000.00000	18.00000	100.39999
1000.00000	13.50000	89.89999
1000.00000	0.0	89.89999
7.00	10.00	
133.00000	0.0	148.89999
133.00000	0.0	148.89999
133.00000	0.0	148.89999
133.00000	0.0	148.89999
133.00000	0.0	148.89999
133.00000	0.0	148.89999
133.00000	0.0	148.89999
175.29999	0.0	165.89999
175.29999	8.10000	165.89999
175.29999	11.70000	163.59999
175.29999	12.10000	161.39999
175.29999	12.10000	157.39999
175.29999	12.10000	153.79999
175.29999	12.10000	148.89999
209.29999	0.0	179.70000
209.29999	14.60000	179.70000
209.29999	21.09999	175.50000
209.29999	22.00000	171.59999
209.29999	22.00000	164.29999
209.29999	20.20000	157.79999
209.29999	21.89999	148.89999
222.29999	0.0	181.29999
222.29999	19.59999	181.29999
222.29999	22.70000	181.29999
222.29999	22.70000	174.79999
222.29999	22.70000	166.39999
222.29999	22.70000	158.89999
222.29999	22.70000	148.89999
271.00000	0.0	189.20000
271.00000	19.59999	189.20000
271.00000	22.70000	189.20000
271.00000	22.70000	181.09999
271.00000	22.70000	170.70000
271.00000	22.70000	161.39999
271.00000	22.70000	148.89999
300.00000	0.0	193.79999
300.00000	19.59999	193.79999
300.00000	22.70000	193.79999
300.00000	22.70000	184.79999
300.00000	22.70000	173.29999
300.00000	22.70000	163.00000
300.00000	22.70000	148.89999
348.59985	0.0	196.39999
348.59985	16.89999	196.39999
348.59985	19.59109	196.39999
348.59985	19.59109	186.89999
348.59985	19.59109	174.59999

```
348.59985   19.59109 163.59999
348.59985   19.59109 148.89999
376.59985    0.0     188.09999
376.59985   15.30000 188.09999
376.59985   17.79999 188.09999
376.59985   17.79999 180.29999
376.59985   17.79999 170.09999
376.59985   17.79999 161.00000
376.59985   17.79999 148.89999
391.69995    0.0     182.89999
391.69995   13.50000 182.89999
391.69995   15.70000 182.89999
391.69995   15.70000 175.79999
391.69995   15.70000 166.50000
391.69995   15.70000 158.29999
391.69995   15.70000 147.29999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
500.00000    0.0     139.59999
      7.00        4.00
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 36.00000    0.0      95.89999
 58.79999    0.0      82.29999
 58.79999  -16.89999  82.29999
 58.79999  -22.50000  86.39999
 58.79999  -22.50000  96.20000
 58.79999  -22.50000 106.00000
 58.79999  -16.89999 108.09999
 58.79999    0.0     110.20000
 81.50000    0.0      78.09999
 81.50000  -22.09999  78.09999
 81.50000  -29.50000  85.00000
 81.50000  -29.50000  99.00000
 81.50000  -29.50000 113.00000
 81.50000  -22.09999 116.39999
 81.50000    0.0     119.89999
120.89999    0.0      74.79999
120.89999  -28.39999  74.79999
120.89999  -37.79999  90.70000
120.89999  -37.79999 108.00000
120.89999  -37.79999 125.89999
120.89999  -28.39999 136.70000
120.89999    0.0     147.59999
      7.00       13.00
120.89999    0.0      74.79999
120.89999  -28.39999  74.79999
120.89999  -37.79999  90.70000
120.89999  -37.79999 108.00000
120.89999  -37.79999 125.89999
120.89999  -28.39999 136.70000
120.89999    0.0     147.59999
```

133.00000	0.0	72.79999
133.00000	-29.20000	72.79999
133.00000	-38.89999	91.79999
133.00000	-38.89999	110.79999
133.00000	-38.89999	129.89999
133.00000	-29.20000	148.89999
133.00000	0.0	148.89999
175.29999	0.0	72.79999
175.29999	-29.20000	72.79999
175.29999	-38.89999	91.79999
175.29999	-38.89999	110.79999
175.29999	-38.89999	129.89999
175.29999	-29.20000	148.89999
175.29999	-12.10000	148.89999
209.29999	0.0	72.79999
209.29999	-29.20000	72.79999
209.29999	-38.89999	91.79999
209.29999	-38.89999	110.79999
209.29999	-38.89999	129.89999
209.29999	-29.20000	148.89999
209.29999	-21.89999	148.89999
222.29999	0.0	72.79999
222.29999	-29.20000	72.79999
222.29999	-38.89999	91.79999
222.29999	-38.89999	110.79999
222.29999	-38.89999	129.89999
222.29999	-29.20000	148.89999
222.29999	-22.70000	148.89999
271.00000	0.0	72.79999
271.00000	-29.20000	72.79999
271.00000	-38.89999	91.79999
271.00000	-38.89999	110.79999
271.00000	-38.89999	129.89999
271.00000	-29.20000	148.89999
271.00000	-22.70000	148.89999
300.00000	0.0	72.79999
300.00000	-29.20000	72.79999
300.00000	-38.89999	91.79999
300.00000	-38.89999	110.79999
300.00000	-38.89999	129.89999
300.00000	-29.20000	148.89999
300.00000	-22.70000	148.89999
376.60010	0.0	72.79999
376.60010	-29.20000	72.79999
376.60010	-38.89999	91.79999
376.60010	-38.89999	110.79999
376.60010	-38.89999	129.89999
376.60010	-29.20000	148.89999
376.60010	-17.79999	148.89999
391.69995	0.0	74.39999
391.69995	-28.00000	74.39999
391.69995	-37.29999	92.59999
391.69995	-37.29999	110.79999
391.69995	-37.29999	129.00000
391.69995	-23.00000	147.29999
391.69995	-15.70000	147.29999
445.69995	0.0	77.79999
445.69995	-24.50000	77.79999
445.69995	-32.70000	94.39999
445.69995	-32.70000	110.79999

```
445.69995 -32.70000 127.20000
445.69995 -24.50000 143.45999
445.69995  -7.87174 143.45999
500.00000   0.0      81.29999
500.00000 -21.00000  81.29999
500.00000 -28.00000  96.20000
500.00000 -28.00000 110.79999
500.00000 -28.00000 125.39999
500.00000 -21.00000 139.59999
500.00000   0.0     139.59999
600.00000   0.0      89.89999
600.00000 -13.50000  89.89999
600.00000 -18.00000 100.39999
600.00000 -18.00000 110.79999
600.00000 -18.00000 120.89999
600.00000 -13.50000 131.00000
600.00000   0.0     131.00000
1000.00000  0.0      89.89999
1000.00000 -13.50000  89.89999
1000.00000 -18.00000 100.39999
1000.00000 -18.00000 110.79999
1000.00000 -18.00000 120.89999
1000.00000 -13.50000 131.00000
1000.00000  0.0     131.00000
      7.00     10.00
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 133.00000   0.0     148.89999
 175.29999 -12.10000 148.89999
 175.29999 -12.10000 153.79999
 175.29999 -12.10000 157.39999
 175.29999 -12.10000 161.39999
 175.29999 -11.70000 163.59999
 175.29999  -8.10000 165.89999
 175.29999   0.0     165.89999
 209.29999 -21.89999 148.89999
 209.29999 -20.20000 157.79999
 209.29999 -22.00000 164.29999
 209.29999 -22.00000 171.59999
 209.29999 -21.09999 175.50000
 209.29999 -14.60000 179.70000
 209.29999   0.0     179.70000
 222.29999 -22.70000 148.89999
 222.29999 -22.70000 158.89999
 222.29999 -22.70000 166.39999
 222.29999 -22.70000 174.79999
 222.29999 -22.70000 181.29999
 222.29999 -19.59999 181.29999
 222.29999   0.0     181.29999
 271.00000 -22.70000 148.89999
 271.00000 -22.70000 161.39999
 271.00000 -22.70000 170.70000
 271.00000 -22.70000 181.09999
 271.00000 -22.70000 189.20000
 271.00000 -19.59999 189.20000
 271.00000   0.0     189.20000
```

```
300.00000 -22.70000 148.89999
300.00000 -22.70000 163.00000
300.00000 -22.70000 173.29999
300.00000 -22.70000 184.79999
300.00000 -22.70000 193.79999
300.00000 -19.59999 193.79999
300.00000   0.0     193.79999
348.60010 -19.59109 148.89999
348.60010 -19.59109 163.59999
348.60010 -19.59109 174.59999
348.60010 -19.59109 186.89999
348.60010 -19.59109 196.39999
348.60010 -16.89999 196.39999
348.60010   0.0     196.39999
376.60010 -17.79999 148.89999
376.60010 -17.79999 161.00000
376.60010 -17.79999 170.09999
376.60010 -17.79999 180.29999
376.60010 -17.79999 188.09999
376.60010 -15.30000 188.09999
376.60010   0.0     188.09999
391.69995 -15.70000 147.29999
391.69995 -15.70000 158.29999
391.69995 -15.70000 166.50000
391.69995 -15.70000 175.79999
391.69995 -15.70000 182.89999
391.69995 -13.50000 182.89999
391.69995   0.0     182.89999
500.00000   0.0     139.59999
500.00000   0.0     139.59999
500.00000   0.0     139.59999
500.00000   0.0     139.59999
500.00000   0.0     139.59999
500.00000   0.0     139.59199
500.00000   0.0     139.59999
9.          8.
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     175.6       79.9      120.3
     211.9       79.9      101.5
     211.5       64.8      107.7
     210.4       58.6      122.8
     209.3       64.8      137.8
     208.9       79.9      144.0
     209.3       95.0      137.8
     210.4      101.2      122.8
     211.5       95.0      107.7
     211.9       79.9      101.5
     225.9       79.9       98.3
     225.3       61.9      105.7
     224.0       54.4      123.7
     222.8       61.9      141.7
     222.2       79.9      149.2
     222.8       97.9      141.7
```

224.0	105.4	123.7
225.3	97.9	105.7
225.9	79.9	98.3
248.4	79.9	99.4
247.9	61.5	107.0
246.6	53.9	125.3
245.3	61.5	143.7
244.7	79.9	151.3
245.3	98.3	143.7
246.6	105.9	125.3
247.9	98.3	107.0
248.4	79.9	99.4
267.1	79.9	102.4
266.6	62.6	109.5
265.3	55.5	126.7
264.1	62.6	143.9
263.6	79.9	151.0
264.1	97.2	143.9
265.3	104.3	126.7
266.6	97.2	109.5
267.1	79.9	102.4
299.3	79.9	104.7
298.8	62.6	111.8
297.6	55.5	129.0
296.3	62.6	146.2
295.8	79.9	153.3
296.3	97.2	146.2
297.6	104.3	129.0
298.8	97.2	111.8
299.3	79.9	104.7
700.7	79.9	133.4
700.2	62.6	140.6
699.0	55.5	157.8
697.7	62.6	175.0
697.2	79.9	182.1
697.7	97.2	175.0
699.0	104.3	157.8
700.2	97.2	140.6
700.7	79.9	133.4
1000.	79.9	133.4
1000.	62.6	140.6
1000.	55.5	157.8
1000.	62.6	175.0
1000.	79.9	182.1
1000.	97.2	175.0
1000.	104.3	157.8
1000.	97.2	140.6
1000.	79.9	133.4
9.	8.	
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
175.60	-79.90	120.30
211.90	-79.90	101.50
211.50	-95.00	107.70

210.40	-101.20	122.80
209.30	-95.00	137.80
208.90	-79.90	144.00
209.30	-64.80	137.80
210.40	-58.60	122.80
211.50	-64.80	107.70
211.90	-79.90	101.50
225.90	-79.90	98.30
225.30	-97.90	105.70
224.00	-105.40	123.70
222.80	-97.90	141.70
222.20	-79.90	149.20
222.80	-61.90	141.70
224.00	-54.40	123.70
225.30	-61.90	105.70
225.90	-79.90	98.30
248.40	-79.90	99.40
247.90	-98.30	107.00
246.60	-105.90	125.30
245.30	-98.30	143.70
244.70	-79.90	151.30
245.30	-61.50	143.70
246.60	-53.90	125.30
247.90	-61.50	107.00
248.40	-79.90	99.40
267.10	-79.90	102.40
266.60	-97.20	109.50
265.30	-104.30	126.70
264.10	-97.20	143.90
263.60	-79.90	151.00
264.10	-62.60	143.90
265.30	-55.50	126.70
266.60	-62.60	109.50
267.10	-79.90	102.40
299.30	-79.90	194.70
298.80	-97.20	111.80
297.60	-104.30	129.00
296.30	-97.20	146.20
295.80	-79.90	153.30
296.30	-62.60	146.20
297.60	-55.50	129.00
298.80	-62.60	111.80
299.30	-79.90	104.70
700.70	-79.90	133.40
700.20	-97.20	140.60
699.00	-104.30	157.80
697.70	-97.20	175.00
697.20	-79.90	182.10
697.70	-62.60	175.00
699.00	-55.50	157.80
700.20	-62.60	140.60
700.70	-79.90	133.40
1000.00	-79.90	133.40
1000.00	-97.20	140.60
1000.00	-104.30	157.80
1000.00	-97.20	175.00
1000.00	-79.90	182.10
1000.00	-62.60	175.00
1000.00	-55.50	157.80
1000.00	-62.60	140.60

```
   1000.00     -79.90     133.40
END
AERO
      0.          0.0        0.0
FORC
307.5      0.          75.52      52112.     98.1       531.2      0.
END
```

```
CASE
RSRA FUSELAGE, WINGS AND ENGINES
J D COWAN   AERO RESEARCH  ORGN 7440  EXT 7834
GEOM
3.          746.        1.          -1.
SOUR
18.
7.          4.
  36.       0.          95.9
  36.       0.          95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  58.8      0.0         110.2
  58.8      16.9        108.1
  58.8      22.5        106.
  58.8      22.5        96.2
  58.8      22.5        86.4
  58.8      16.9        82.3
  58.8      0.0         82.3
  81.5      0.0         119.9
  81.5      22.1        116.4
  81.5      29.5        113.
  81.5      29.5        99.
  81.5      29.5        85.
  81.5      22.1        78.1
  81.5      0.0         78.1
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9     0.          74.8
  7.        6.
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9     0.          74.8
  133.      0.          148.9
  133.      29.2        148.9
  133.      38.9        129.9
  133.      38.9        110.8
  133.      38.9        91.8
  133.      29.2        72.8
  133.      0.          72.8
  175.3     12.1        148.9
  175.3     29.2        148.9
  175.3     38.9        129.9
  175.3     38.9        110.8
  175.3     38.9        91.8
```

175.3	29.2	72.8
175.3	0.	72.8
209.3	21.9	148.9
209.3	29.2	148.9
209.3	38.9	129.9
209.3	38.9	110.8
209.3	38.9	91.8
209.3	29.2	72.8
209.3	0.	72.8
222.3	22.7	148.9
222.3	29.2	148.9
222.3	38.9	129.9
222.3	38.9	110.8
222.3	38.9	91.8
222.3	29.2	72.8
222.3	0.	72.8
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
271.	0.	72.8
6.	4.	
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
300.	22.7	148.9
300.	29.2	148.9
300.	38.9	129.9
300.	38.9	110.8
300.	38.9	91.8
300.	38.9	85.
376.6	17.8	148.9
376.6	29.2	148.9
376.6	38.9	129.9
376.6	38.9	110.8
376.6	38.9	91.8
376.6	38.9	85.
391.7	15.7	147.3
391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
391.7	28.	74.4
7.	5.	
391.7	15.7	147.3
391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
391.7	28.	74.4
391.7	0.	74.4
445.7	7.871745	143.46
445.7	24.5	143.46
445.7	32.7	127.2
445.7	32.7	110.8

445.7	32.7	94.4
445.7	24.5	77.8
445.7	0.	77.8
500.	0.	139.6
500.	21.	139.6
500.	28.	125.4
500.	28.	110.8
500.	28.	96.2
500.	21.	81.3
500.	0.	81.3
600.	0.	131.
600.	13.5	131.
600.	18.	120.9
600.	18.	110.8
600.	18.	100.4
600.	13.5	89.9
600.	0.	89.9
1000.	0.	131.
1000.	13.5	131.
1000.	18.	120.9
1000.	18.	110.8
1000.	18.	100.4
1000.	13.5	89.9
1000.	0.	89.9
7.	10.	
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
175.3	0.	165.9
175.3	8.1	165.9
175.3	11.7	163.6
175.3	12.1	161.4
175.3	12.1	157.4
175.3	12.1	153.8
175.3	12.1	148.9
209.3	0.	179.7
209.3	14.6	179.7
209.3	21.1	175.5
209.3	22.	171.6
209.3	22.	164.3
209.3	20.2	157.8
209.3	21.9	148.9
222.3	0.	181.3
222.3	19.6	181.3
222.3	22.7	181.3
222.3	22.7	174.8
222.3	22.7	166.4
222.3	22.7	158.9
222.3	22.7	148.9
271.	0.	189.2
271.	19.6	189.2
271.	22.7	189.2
271.	22.7	181.1
271.	22.7	170.7
271.	22.7	161.4
271.	22.7	148.9

300.	0.	193.8
300.	19.6	193.8
300.	22.7	193.8
300.	22.7	184.8
300.	22.7	173.3
300.	22.7	163.
300.	22.7	148.9
348.6	0.	196.4
348.6	16.9	196.4
348.6	19.5911	196.4
348.6	19.5911	186.9
348.6	19.5911	174.6
348.6	19.5911	163.6
348.6	19.5911	148.9
376.6	0.	188.1
376.6	15.3	188.1
376.6	17.8	188.1
376.6	17.8	180.3
376.6	17.8	170.1
376.6	17.8	161.0
376.6	17.8	148.9
391.7	0.	182.9
391.7	13.5	182.9
391.7	15.7	182.9
391.7	15.7	175.8
391.7	15.7	166.5
391.7	15.7	158.3
391.7	15.7	147.3
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6

7.0 4.0

36.	0.	95.9
36.	0.	95.9
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
58.8000	-0.0000	82.3000
58.8	-16.9	82.3
58.8000	-22.5000	86.4000
58.8000	-22.5000	96.2000
58.8000	-22.5000	106.0000
58.8	-16.9	108.1
58.8000	-0.0000	110.2000
81.5000	-0.0000	78.1000
81.5	-22.1	78.1
81.5000	-29.5000	85.0000
81.5000	-29.5000	99.0000
81.5000	-29.5000	113.0000
81.5	-22.1	116.4
81.5000	-0.0000	119.9000
120.9000	-0.0000	74.8000
120.9	-28.4	74.8
120.9000	-37.8000	90.7000

```
120.9000   -37.8000   108.
120.9000   -37.8000   125.9000
120.9      -28.4      136.7
120.9000    -0.0000   147.6000
     7.0         6.
120.9000    -0.0000    74.8000
120.9000   -28.4000    74.8000
120.9000   -37.8000    90.7000
120.9000   -37.8000   108.
120.9000   -37.8000   125.9000
120.9000   -28.4000   136.7000
120.9000    -0.0000   147.6000
133.0000    -0.0000    72.8000
133.0000   -29.2000    72.8000
133.0000   -38.9000    91.8000
133.0000   -38.9000   110.8000
133.0000   -38.9000   129.9000
133.0000   -29.2000   148.9000
133.0000    -0.0000   148.9000
175.3000    -0.0000    72.8000
175.3000   -29.2000    72.8000
175.3000   -38.9000    91.8000
175.3000   -38.9000   110.8000
175.3000   -38.9000   129.9000
175.3000   -29.2000   148.9000
175.3000   -12.1000   148.9000
209.3000    -0.0000    72.8000
209.3000   -29.2000    72.8000
209.3000   -38.9000    91.8000
209.3000   -38.9000   110.8000
209.3000   -38.9000   129.9000
209.3000   -29.2000   148.9000
209.3000   -21.9000   148.9000
222.3000    -0.0000    72.8000
222.3000   -29.2000    72.8000
222.3000   -38.9000    91.8000
222.3000   -38.9000   110.8000
222.3000   -38.9000   129.9000
222.3000   -29.2000   148.9000
222.3000   -22.7000   148.9000
271.0000    -0.0000    72.8000
271.0000   -29.2000    72.8000
271.0000   -38.9000    91.8000
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.       -22.7      148.9000
6.         4.
271.0000   -29.2000   72.8
271.0000   -38.9000   91.8
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.0000   -22.7000   148.9000
300.       -38.9      85.
300.       -38.9      91.8
300.       -38.9      110.8
300.       -38.9      129.9
300.       -29.2      148.9
300.       -22.7      148.9
```

```
376.6      -38.9      85.
376.6      -38.9      91.8
376.6      -38.9      110.8
376.6      -38.9      129.9
376.6      -29.2      148.9
376.6      -17.8      148.9
391.7      -28.       74.4
391.7      -37.3      92.6
391.7      -37.3      110.8
391.7      -37.3      129.
391.7      -28.       147.3
391.7      -15.7      147.3
7.         5.
391.7000    -0.0000    74.4000
391.7000   -28.0000    74.4000
391.7000   -37.3000    92.6000
391.7000   -37.3000   110.8000
391.7000   -37.3000   129.0000
391.7000   -28.0000   147.3000
391.7000   -15.7000   147.3000
445.7000    -0.0000    77.8000
445.7000   -24.5000    77.8000
445.7000   -32.7000    94.4000
445.7000   -32.7000   110.8000
445.7000   -32.7000   127.2000
445.7000   -24.5000   143.4600
445.7000-7.871745     143.4600
500.0000    -0.0000    81.3000
500.0000   -21.0000    81.3000
500.0000   -28.0000    96.2000
500.0000   -28.0000   110.8000
500.0000   -28.0000   125.4000
500.0000   -21.0000   139.6000
500.0000    -0.0000   139.6000
600.0000    -0.0000    89.9000
600.0000   -13.5000    89.9000
600.0000   -18.0000   100.4000
600.0000   -18.0000   110.8000
600.0000   -18.0000   120.9000
600.0000   -13.5000   131.0000
600.0000    -0.0000   131.0000
1000.0000   -0.0000    89.9000
1000.0000  -13.5000    89.9000
1000.0000  -18.0000   100.4000
1000.0000  -18.0000   110.8000
1000.0000  -18.0000   120.9000
1000.0000  -13.5000   131.0000
1000.0000   -0.0000   131.0000
      7.0        10.0
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 175.3000   -12.1000   148.9000
 175.3000   -12.1000   153.8000
 175.3000   -12.1000   157.4000
 175.3000   -12.1000   161.4000
```

```
 175.3000   -11.7000   163.6000
 175.3000    -8.1000   165.9000
 175.3000    -0.0000   165.9000
 209.3000   -21.9000   148.9000
 209.3000   -20.2000   157.8000
 209.3000   -22.0000   164.3000
 209.3000   -22.0000   171.6000
 209.3000   -21.1000   175.5000
 209.3000   -14.6000   179.7000
 209.3000    -0.0000   179.7000
 222.3000   -22.7000   148.9000
 222.3000   -22.7000   158.9000
 222.3000   -22.7000   166.4000
 222.3000   -22.7000   174.8000
 222.3000   -22.7000   181.3000
 222.3000   -19.6000   181.3000
 222.3000    -0.0000   181.3000
 271.0000   -22.7000   148.9000
 271.0000   -22.7000   161.4000
 271.0000   -22.7000   170.7000
 271.0000   -22.7000   181.1000
 271.0000   -22.7000   189.2000
 271.0000   -19.6000   189.2000
 271.0000    -0.0000   189.2000
 300.0000   -22.7000   148.9000
 300.0000   -22.7000   163.0000
 300.0000   -22.7000   173.3000
 300.0000   -22.7000   184.8000
 300.0000   -22.7000   193.8000
 300.0000   -19.6000   193.8000
 300.0000    -0.0000   193.8000
 348.6001   -19.5911   148.9000
 348.6001   -19.5911   163.6000
 348.6001   -19.5911   174.6000
 348.6001   -19.5911   186.9000
 348.6001   -19.5911   196.4000
 348.6001   -16.9000   196.4000
 348.6001    -0.0000   196.4000
 376.6001   -17.8000   148.9000
 376.6001   -17.8000   161.0000
 376.6001   -17.8000   170.1000
 376.6001   -17.8000   180.3000
 376.6001   -17.8000   188.1000
 376.6001   -15.3000   188.1000
 376.6001    -0.0000   188.1000
 391.7000   -15.7000   147.3000
 391.7000   -15.7000   158.3000
 391.7000   -15.7000   166.5000
 391.7000   -15.7000   175.8000
 391.7000   -15.7000   182.9000
 391.7000   -13.5000   182.9000
 391.7000    -0.0000   182.9000
 500.        -0.0000   139.6000
 500.        -0.0000   139.6000
 500.        -0.0000   139.6000
 500.        -0.0000   139.6
 500.        -0.0000   139.6
 500.        -0.0000   139.6000
 500.        -0.0000   139.6000
17.       10.
```

391.36	56.65	71.07
369.4	56.17	75.35
347.29	55.71	79.4
325.04	55.47	81.52
308.31	55.55	80.88
297.19	55.74	79.13
288.89	56.	76.84
283.43	56.29	74.32
280.98	56.64	71.21
284.09	56.93	68.64
289.67	56.1	67.16
297.92	57.23	65.97
308.87	57.32	65.2
325.25	57.3	65.32
347.14	57.06	67.44
369.18	56.74	70.29
391.36	56.65	71.07
389.72	79.71	73.68
368.48	79.24	77.81
347.11	78.8	81.73
325.59	78.57	83.78
309.41	78.64	83.16
298.65	78.83	81.47
290.63	79.08	79.26
285.35	79.35	76.82
282.98	79.69	73.81
285.99	79.97	71.32
291.38	80.13	69.9
299.36	80.26	68.74
309.95	80.35	67.99
325.79	80.33	68.12
346.96	80.1	70.17
368.27	79.79	72.92
389.72	79.71	73.68
388.08	102.76	76.28
367.57	102.31	80.28
346.92	101.88	84.06
326.13	101.66	86.04
310.51	101.73	85.44
300.12	101.91	83.81
292.37	102.15	81.67
287.27	102.42	79.32
284.98	102.75	76.41
287.89	103.02	74.01
293.09	103.17	72.63
300.8	103.3	71.51
311.03	103.38	70.79
326.33	103.37	70.91
346.78	103.14	72.89
367.36	102.84	75.55
388.08	102.76	76.28
386.44	125.81	78.89
366.65	125.38	82.74
346.73	124.97	86.39
326.68	124.75	88.3
311.61	124.82	87.72
301.59	124.99	86.15
294.11	125.23	84.09
289.19	125.48	81.82
286.98	125.8	79.01

289.79	126.06	76.69
294.81	126.21	75.36
302.25	126.33	74.29
312.11	126.41	73.59
326.87	126.4	73.71
346.59	126.18	75.62
366.45	125.89	78.18
386.44	125.81	78.89
384.8	148.87	81.49
365.74	148.45	85.2
346.55	148.05	88.72
327.23	147.84	90.56
312.71	147.91	90.
303.05	148.08	88.49
295.85	148.3	86.5
291.11	148.55	84.31
288.98	148.85	81.61
291.68	149.11	79.38
296.52	149.25	78.1
303.69	149.37	77.06
313.19	149.44	76.39
327.41	149.43	76.5
346.41	149.22	78.34
365.54	148.94	80.81
384.8	148.87	81.49
383.16	171.92	84.1
364.82	171.52	87.67
346.36	171.13	91.05
327.78	170.93	92.82
313.81	171.	92.28
304.52	171.16	90.82
297.59	171.38	88.91
293.03	171.61	86.81
290.99	171.91	84.21
293.58	172.15	82.06
298.24	172.29	80.83
305.13	172.4	79.83
314.27	172.47	79.19
327.95	172.46	79.29
346.23	172.26	81.06
364.63	171.99	83.44
383.16	171.92	84.1
381.52	194.97	86.7
363.91	194.59	90.13
346.17	194.22	93.38
328.32	194.03	95.08
314.91	194.09	94.56
305.98	194.24	93.16
299.33	194.45	91.33
294.95	194.68	89.31
292.99	194.96	86.81
295.48	195.19	84.75
299.95	195.33	83.56
306.57	195.44	82.6
315.35	195.51	81.98
328.49	195.49	82.09
346.05	195.3	83.79
363.73	195.04	86.07
381.52	194.97	86.7
379.88	218.03	89.3

362.99	217.66	92.59
345.99	217.3	95.71
328.87	217.12	97.34
316.01	217.18	96.84
307.45	217.33	95.5
301.07	217.53	93.74
296.87	217.74	91.8
294.99	218.02	89.41
297.38	218.24	87.43
301.67	218.37	86.3
308.01	218.47	85.38
316.43	218.54	84.78
329.03	218.53	84.88
345.87	218.34	86.51
362.82	218.10	88.7
379.88	218.03	89.3
378.24	241.08	91.91
362.07	240.72	95.06
345.8	240.39	98.04
329.42	240.21	99.6
317.11	240.27	99.13
308.92	240.41	97.84
302.81	240.6	96.15
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296.99	240.07	92.01
299.28	241.28	90.12
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309.45	241.5	88.15
317.51	241.57	87.58
329.57	241.56	87.68
345.69	241.38	89.23
361.91	241.15	91.33
378.24	241.08	91.91
376.6	264.13	94.51
361.16	263.79	97.52
345.61	263.47	100.37
329.97	263.3	101.86
318.21	263.35	101.41
310.38	263.49	100.18
304.55	263.68	98.57
300.71	263.88	96.8
298.99	264.12	94.61
301.17	264.33	92.8
305.09	264.44	91.76
310.9	264.54	90.92
318.59	264.6	90.38
330.11	264.59	90.47
345.51	264.42	91.96
361.	264.2	93.96
376.6	264.13	94.51

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289.6699	-56.1000	67.1600
284.0901	-56.9300	68.6400
280.9800	-56.6400	71.2100

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368.2700	-79.7900	72.9200
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290.6299	-79.0800	79.2600
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 391.7     0.         74.4
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 297.92    29.2       65.97
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 391.7     28.        74.4
      8.0          2 0
 391.7       -0.0000   74.4
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  284.0901   -0.0000   68.6400
  271.0000   -0.0000   72.8000
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  325.2500   -29.2000  65.3200
  308.8701   -29.2000  65.2000
  297.9199   -29.2000  65.9700
  289.6699   -29.2000  67.1600
  284.0901   -29.2000  68.6400
  271.0000   -29.2000  72.8000
17.         2.
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347.29      38.9      85.
325.04      38.9      85.
308.31      38.9      85.
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283.43      56.29     74.32
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325.25      57.3      65.32
347.14      57.06     67.44
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  325.2500  -29.2000  65.3200
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297.9199	-57.2300	65.9700
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9. 8.

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225.9	79.9	98.3
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225.9	79.9	98.3
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290.63      79.59       74.68
298.65      79.54       75.16
309.41      79.49       75.6
325.59      79.45       75.95
347.11      79.45       75.96
```

368.48	79.52	74.37
389.72	79.71	73.68
411.29	79.71	71.98
454.51	79.71	69.72
9000.	79.71	-165.62
287.27	102.69	76.92
292.37	102.65	77.25
300.12	102.6	77.71
310.51	102.55	78.13
326.13	102.51	78.48
346.92	102.51	78.49
367.57	102.58	77.92
388.08	102.76	76.28
408.92	102.76	74.64
450.66	102.76	72.46
9000.	102.76	-162.88
289.19	125.74	79.5
294.11	125.71	79.82
301.59	125.66	80.26
311.61	125.61	80.67
326.68	125.57	81.
346.73	125.57	81.01
366.65	125.64	80.46
386.44	125.81	78.89
406.54	125.81	77.31
446.81	125.81	75.2
9000.	125.81	-160.15
291.11	148.8	82.08
295.85	148.77	82.39
303.05	148.72	82.82
312.71	148.67	83.21
327.23	148.64	83.53
346.55	148.64	83.54
365.74	148.7	83.01
384.8	148.87	81.49
404.17	148.87	79.97
442.96	148.87	77.94
9000.	148.87	-157.41
293.03	171.86	84.67
297.59	171.82	84.96
304.52	171.78	85.37
313.81	171.73	85.75
327.78	171.7	86.06
346.36	171.7	86.07
364.82	171.76	85.56
383.16	171.92	84.1
401.79	171.92	82.63
439.11	171.92	80.68
9000.	171.92	-154.67
294.95	194.91	87.25
299.33	194.88	87.53
305.98	194.84	87.93
314.91	194.79	88.29
328.32	194.76	88.58
346.17	194.76	88.59
363.91	194.82	88.1
381.52	194.97	86.7
399.41	194.97	85.29
435.26	194.97	83.41
9000.	194.97	-151.93

296.87	217.97	89.83			
301.07	217.94	90.1			
307.45	217.89	90.48			
316.01	217.85	90.83			
328.87	217.82	91.11			
345.99	217.82	91.12			
362.99	217.87	90.65			
379.88	218.03	89.3			
397.04	218.03	87.95			
431.41	218.03	86.15			
9000.	218.03	-149.19			
298.79	241.02	92.41			
302.81	240.99	92.67			
308.92	240.95	93.03			
317.11	240.92	93.37			
329.42	240.89	93.64			
345.8	240.88	93.64			
362.07	240.93	93.2			
378.24	241.08	91.91			
394.66	241.08	90.62			
427.56	241.08	88.89			
9000.	241.08	-146.45			
300.51	261.77	94.73			
304.37	261.75	94.98			
310.24	261.71	95.33			
318.1	261.67	95.65			
329.91	261.64	95.91			
345.63	261.64	95.92			
361.25	261.69	95.49			
376.76	261.83	94.25			
392.52	261.83	93.01			
424.1	261.83	91.36			
9000.	261.83	-143.98			
.050192	.085453	.120618	.172921	.242018	.219928
.10887					
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387.29	114.22	77.58	.07889	-.10636	.99119
385.64	137.27	80.18	.07889	-.10636	.99119
384.	160.32	82.78	.07889	-.10636	.99119
382.36	183.37	85.39	.07889	-.10636	.99119
380.72	206.42	87.99	.07889	-.10636	.99119
379.08	229.47	90.59	.07889	-.10636	.99119
377.44	252.52	93.2	.07889	-.10636	.99119
11.	9.	7.	1.	10.	0.
285.35	-79.63	74.34			
290.63	-79.59	74.68			
298.65	-79.54	75.16			
309.41	-79.49	75.6			
325.59	-79.45	75.95			
347.11	-79.45	75.96			
368.48	-79.52	74.37			
389.72	-79.71	73.68			
411.29	-79.71	71.98			
454.51	-79.71	69.72			
9000.	-79.71	-165.62			
287.27	-102.69	76.92			
292.37	-102.65	77.25			
300.12	-102.6	77.71			
310.51	-102.55	78.13			
326.13	-102.51	78.48			

346.92	-102.51	78.49
367.57	-102.58	77.92
383.08	-102.76	76.28
408.92	-102.76	74.64
450.66	-102.76	72.46
9000.	-102.76	-162.88
289.19	-125.74	79.5
294.11	-125.71	79.82
301.59	-125.66	80.26
311.61	-125.61	80.67
326.68	-125.57	81.
346.73	-125.57	81.01
366.65	-125.64	80.46
386.44	-125.81	78.89
406.54	-125.81	77.31
446.81	-125.81	75.2
9000.	-125.81	-160.15
291.11	-148.8	82.08
295.85	-148.77	82.39
303.05	-148.72	82.82
312.71	-148.67	83.21
327.23	-148.64	83.53
346.55	-148.64	83.54
365.74	-148.7	83.01
384.8	-148.87	81.49
404.17	-148.87	79.97
442.96	-148.87	77.94
9000.	-148.87	-157.41
293.03	-171.86	84.67
297.59	-171.82	84.96
304.52	-171.78	85.37
313.81	-171.73	85.75
327.78	-171.7	86.06
346.36	-171.7	86.07
364.82	-171.76	85.56
383.16	-171.92	84.1
401.79	-171.92	82.63
439.11	-171.92	80.68
9000.	-171.92	-154.67
294.95	-194.91	87.25
299.33	-194.88	87.53
305.98	-194.84	87.93
314.91	-194.79	88.29
328.32	-194.76	88.58
346.17	-194.76	88.59
363.91	-194.82	88.1
381.52	-194.97	86.7
399.41	-194.97	85.29
435.26	-194.97	83.41
9000.	-194.97	-151.93
296.87	-217.97	89.83
301.07	-217.94	90.1
307.45	-217.89	90.48
316.01	-217.85	90.83
328.87	-217.82	91.11
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362.99	-217.87	90.65
379.88	-218.03	89.3
397.04	-218.03	87.95
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9000.       -218.03     -149.19
298.79      -241.02     92.41
302.81      -240.99     92.67
308.92      -240.95     93.02
317.11      -240.92     93.37
329.42      -240.89     93.64
345.8       -240.88     93.64
362.07      -240.93     93.2
378.24      -241.08     91.91
394.66      -241.08     90.62
427.56      -241.08     88.89
9000.       -241.08     -146.45
300.51      -261.77     94.73
304.37      -261.75     94.98
310.24      -261.71     95.33
318.1       -261.67     95.65
329.91      -261.64     95.91
345.63      -261.64     95.92
361.25      -261.69     95.49
376.76      -261.83     94.25
392.52      -261.83     93.01
424.1       -261.83     91.36
9000.       -261.83     -143.98
.050192     .085453     .120618     .172921     .242018     .219928
.10887
388.93      -91.17      74.97       .07889      .10636      .99119
387.29      -114.22     77.58       .07889      .10636      .99119
385.64      -137.27     80.18       .07889      .10636      .99119
384.        -160.32     82.78       .07889      .10636      .99119
382.36      -183.37     85.39       .07889      .10636      .99119
380.72      -206.42     87.99       .07889      .10636      .99119
379.08      -229.47     90.59       .07889      .10636      .99119
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B-MU
2.
11.         3.          7.          1.          10.         0.
283.43      0.          71.76
288.89      0.          72.11
297.19      0.          72.6
308.31      0.          73.06
325.04      0.          73.42
347.29      0.          73.43
369.4       0.          76.
392.0323    0.          77.65445
413.67      0.          100.
458.36      0.          120.
9000.       0.          -115.3426
283.43      56.58       71.76
288.89      56.54       72.11
297.19      56.48       72.6
308.31      56.43       73.06
325.04      56.39       73.42
347.29      56.39       73.43
369.4       56.46       72.82
391.36      56.65       71.07
413.67      56.65       69.32
458.36      56.65       66.98
9000.       56.65       -168.36
285.35      79.63       74.34
290.63      79.59       74.68
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298.65     79.54     75.16
309.41     79.49     75.6
325.59     79.45     75.95
347.11     79.45     75.96
368.48     79.52     75.37
389.72     79.71     73.68
411.29     79.71     71.98
454.51     79.71     69.72
9000.      79.71     -165.62
.050192    .085453   .120618   .172921   .242018   .219928
.10887
390.57     68.12     72.37     .07889    -.10636   .99119
11.        3.        7.        1.        10.       0.
283.43     0.        71.76
288.89     0.        72.11
297.19     0.        72.6
308.31     0.        73.06
325.04     0.        73.42
347.29     0.        73.43
369.4      0.        76.
392.0323   0.        77.65445
413.67     0.        100.
458.36     0.        120.
9000.      0.        -115.3426
283.43     -56.58    71.76
288.89     -56.54    72.11
297.19     -56.48    72.6
308.31     -56.43    73.06
325.04     -56.39    73.42
347.29     -56.39    73.43
369.4      -56.46    72.82
391.36     -56.65    71.07
413.67     -56.65    69.32
458.36     -56.65    66.98
9000.      -56.65    -168.36
285.35     -79.63    74.34
290.63     -79.59    74.68
298.65     -79.54    75.16
309.41     -79.49    75.6
325.59     -79.45    75.95
347.11     -79.45    75.96
368.48     -79.52    75.37
389.72     -79.71    73.68
411.29     -79.71    71.98
454.51     -79.71    69.72
9000.      -79.71    -165.62
.050192    .085453   .120618   .172921   .242018   .219928
.10887
390.57     -68.12    72.37     .07889     .10636   .99119
END
AERO
0.         0.        0.
FORC
307.5      0.        75.52     52112.    98.1      531.2     0.
END
```

```
CASE
RSRA FUSELAGE AND WINGS.  WING INCIDENCE  5.52 DEGREES
J D COWAN    AERO RESEARCH  ORGN 7440  EXT 7834
GEOM
3.          634.        1.          -1.
SOUR
16.
7.          4.
  36.       0.          95.9
  36.       0.          95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  36.       0.0         95.9
  58.8      0.0         110.2
  58.8      16.9        108.1
  58.8      22.5        106.
  58.8      22.5        96.2
  58.8      22.5        86.4
  58.8      16.9        82.3
  58.8      0.0         82.3
  81.5      0.0         119.9
  81.5      22.1        116.4
  81.5      29.5        113.
  81.5      29.5        99.
  81.5      29.5        85.
  81.5      22.1        78.1
  81.5      0.0         78.1
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9     0.          74.8
  7.        6.
  120.9     0.          147.6
  120.9     28.4        136.7
  120.9     37.8        125.9
  120.9     37.8        108.
  120.9     37.8        90.7
  120.9     28.4        74.8
  120.9     0.          74.8
  133.      0.          148.9
  133.      29.2        148.9
  133.      38.9        129.9
  133.      38.9        110.8
  133.      38.9        91.8
  133.      29.2        72.8
  133.      0.          72.8
  175.3     12.1        148.9
  175.3     29.2        148.9
  175.3     38.9        129.9
  175.3     38.9        110.8
  175.3     38.9        91.8
```

175.3	29.2	72.8
175.3	0.	72.8
209.3	21.9	148.9
209.3	29.2	148.9
209.3	38.9	129.9
209.3	38.9	110.8
209.3	38.9	91.8
209.3	29.2	72.8
209.3	0.	72.8
222.3	22.7	148.9
222.3	29.2	148.9
222.3	38.9	129.9
222.3	38.9	110.8
222.3	38.9	91.8
222.3	29.2	72.8
222.3	0.	72.8
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
271.	0.	72.8
6.	4.	
271.	22.7	148.9
271.	29.2	148.9
271.	38.9	129.9
271.	38.9	110.8
271.	38.9	91.8
271.	29.2	72.8
300.	22.7	148.9
300.	29.2	148.9
300.	38.9	129.9
300.	38.9	110.8
300.	38.9	91.8
300.	38.9	85.
376.6	17.8	148.9
376.6	29.2	148.9
376.6	38.9	129.9
376.6	38.9	110.8
376.6	38.9	91.8
376.6	38.9	85.
391.7	15.7	147.3
391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
391.7	28.	74.4
7.	5.	
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391.7	28.	147.3
391.7	37.3	129.
391.7	37.3	110.8
391.7	37.3	92.6
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391.7	0.	74.4
445.7	7.871745	143.46
445.7	24.5	143.46
445.7	32.7	127.2
445.7	32.7	110.8

445.7	32.7	94.4
445.7	24.5	77.8
445.7	0.	77.8
500.	0.	139.6
500.	21.	139.6
500.	28.	125.4
500.	28.	110.8
500.	28.	96.2
500.	21.	81.3
500.	0.	81.3
600.	0.	131.
600.	13.5	131.
600.	18.	120.9
600.	18.	110.8
600.	18.	100.4
600.	13.5	89.9
600.	0.	89.9
1000.	0.	131.
1000.	13.5	131.
1000.	18.	120.9
1000.	18.	110.8
1000.	18.	100.4
1000.	13.5	89.9
1000.	0.	89.9
7.	10.	
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
133.	0.	148.9
175.3	0.	165.9
175.3	8.1	165.9
175.3	11.7	163.6
175.3	12.1	161.4
175.3	12.1	157.4
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175.3	12.1	148.9
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209.3	21.1	175.5
209.3	22.	171.6
209.3	22.	164.3
209.3	20.2	157.8
209.3	21.9	148.9
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222.3	19.6	181.3
222.3	22.7	181.3
222.3	22.7	174.8
222.3	22.7	166.4
222.3	22.7	158.9
222.3	22.7	148.9
271.	0.	189.2
271.	19.6	189.2
271.	22.7	189.2
271.	22.7	181.1
271.	22.7	170.7
271.	22.7	161.4
271.	22.7	148.9

300.	0.	193.8
300.	19.6	193.8
300.	22.7	193.8
300.	22.7	184.8
300.	22.7	173.3
300.	22.7	163.
300.	22.7	148.9
348.6	0.	196.4
348.6	16.9	196.4
348.6	19.5911	196.4
348.6	19.5911	186.9
348.6	19.5911	174.6
348.6	19.5911	163.6
348.6	19.5911	148.9
376.6	0.	188.1
376.6	15.3	188.1
376.6	17.8	188.1
376.6	17.8	180.3
376.6	17.8	170.1
376.6	17.8	161.0
376.6	17.8	148.9
391.7	0.	182.9
391.7	13.5	182.9
391.7	15.7	182.9
391.7	15.7	175.8
391.7	15.7	166.5
391.7	15.7	158.3
391.7	15.7	147.3
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6
500.	0.	139.6

7.0	4.0	
36.	0.	95.9
36.	0.	95.9
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36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
36.0000	-0.0000	95.9000
58.8000	-0.0000	82.3000
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58.8000	-22.5000	86.4000
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58.8	-16.9	108.1
58.8000	-0.0000	110.2000
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120.9000	-37.8000	90.7000

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     7.0        6.
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120.9000   -37.8000   125.9000
120.9000   -28.4000   136.7000
120.9000    -0.0000   147.6000
133.0000    -0.0000    72.8000
133.0000   -29.2000    72.8000
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133.0000   -38.9000   110.8000
133.0000   -38.9000   129.9000
133.0000   -29.2000   148.9000
133.0000    -0.0000   148.9000
175.3000    -0.0000    72.8000
175.3000   -29.2000    72.8000
175.3000   -38.9000    91.8000
175.3000   -38.9000   110.8000
175.3000   -38.9000   129.9000
175.3000   -29.2000   148.9000
175.3000   -12.1000   148.9000
209.3000    -0.0000    72.8000
209.3000   -29.2000    72.8000
209.3000   -38.9000    91.8000
209.3000   -38.9000   110.8000
209.3000   -38.9000   129.9000
209.3000   -29.2000   148.9000
209.3000   -21.9000   148.9000
222.3000    -0.0000    72.8000
222.3000   -29.2000    72.8000
222.3000   -38.9000    91.8000
222.3000   -38.9000   110.8000
222.3000   -38.9000   129.9000
222.3000   -29.2000   148.9000
222.3000   -22.7000   148.9000
271.0000    -0.0000    72.8000
271.0000   -29.2000    72.8000
271.0000   -38.9000    91.8000
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.       -22.7      148.9000
6.         4.
271.0000   -29.2000   72.8
271.0000   -38.9000   91.8
271.0000   -38.9000   110.8000
271.0000   -38.9000   129.9000
271.0000   -29.2000   148.9000
271.0000   -22.7000   148.9000
300.       -38.9      85.
300.       -38.9      91.8
300.       -38.9      110.8
300.       -38.9      129.9
300.       -29.2      148.9
300.       -22.7      148.9
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 376.6      -38.9      85.
 376.6      -38.9      91.8
 376.6      -38.9      110.8
 376.6      -38.9      129.9
 376.6      -29.2      148.9
 376.6      -17.8      148.9
 391.7      -28.       74.4
 391.7      -37.3      92.6
 391.7      -37.3      110.8
 391.7      -37.3      129.
 391.7      -28.       147.3
 391.7      -15.7      147.3
 7.         5.
 391.7000    -0.0000    74.4000
 391.7000   -28.0000    74.4000
 391.7000   -37.3000    92.6000
 391.7000   -37.3000   110.8000
 391.7000   -37.3000   129.0000
 391.7000   -28.0000   147.3000
 391.7000   -15.7000   147.3000
 445.7000    -0.0000    77.8000
 445.7000   -24.5000    77.8000
 445.7000   -32.7000    94.4000
 445.7000   -32.7000   110.8000
 445.7000   -32.7000   127.2000
 445.7000   -24.5000   143.4600
 445.7000-7.871745     143.4600
 500.0000    -0.0000    81.3000
 500.0000   -21.0000    81.3000
 500.0000   -28.0000    96.2000
 500.0000   -28.0000   110.8000
 500.0000   -28.0000   125.4000
 500.0000   -21.0000   139.6000
 500.0000    -0.0000   139.6000
 600.0000    -0.0000    89.9000
 600.0000   -13.5000    89.9000
 600.0000   -18.0000   100.4000
 600.0000   -18.0000   110.8000
 600.0000   -18.0000   120.9000
 600.0000   -13.5000   131.0000
 600.0000    -0.0000   131.0000
1000.0000    -0.0000    89.9000
1000.0000   -13.5000    89.9000
1000.0000   -18.0000   100.4000
1000.0000   -18.0000   110.8000
1000.0000   -18.0000   120.9000
1000.0000   -13.5000   131.0000
1000.0000    -0.0000   131.0000
       7.0        10.0
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 133.0000    -0.0000   148.9000
 175.3000   -12.1000   148.9000
 175.3000   -12.1000   153.8000
 175.3000   -12.1000   157.4000
 175.3000   -12.1000   161.4000
```

175.3000	-11.7000	163.6000
175.3000	-8.1000	165.9000
175.3000	-0.0000	165.9000
209.3000	-21.9000	148.9000
209.3000	-20.2000	157.8000
209.3000	-22.0000	164.3000
209.3000	-22.0000	171.6000
209.3000	-21.1000	175.5000
209.3000	-14.6000	179.7000
209.3000	-0.0000	179.7000
222.3000	-22.7000	148.9000
222.3000	-22.7000	158.9000
222.3000	-22.7000	166.4000
222.3000	-22.7000	174.8000
222.3000	-22.7000	181.3000
222.3000	-19.6000	181.3000
222.3000	-0.0000	181.3000
271.0000	-22.7000	148.9000
271.0000	-22.7000	161.4000
271.0000	-22.7000	170.7000
271.0000	-22.7000	181.1000
271.0000	-22.7000	189.2000
271.0000	-19.6000	189.2000
271.0000	-0.0000	189.2000
300.0000	-22.7000	148.9000
300.0000	-22.7000	163.0000
300.0000	-22.7000	173.3000
300.0000	-22.7000	184.8000
300.0000	-22.7000	193.8000
300.0000	-19.6000	193.8000
300.0000	-0.0000	193.8000
348.6001	-19.5911	148.9000
348.6001	-19.5911	163.6000
348.6001	-19.5911	174.6000
348.6001	-19.5911	186.9000
348.6001	-19.5911	196.4000
348.6001	-16.9000	196.4000
348.6001	-0.0000	196.4000
376.6001	-17.8000	148.9000
376.6001	-17.8000	161.0000
376.6001	-17.8000	170.1000
376.6001	-17.8000	180.3000
376.6001	-17.8000	188.1000
376.6001	-15.3000	188.1000
376.6001	-0.0000	188.1000
391.7000	-15.7000	147.3000
391.7000	-15.7000	158.3000
391.7000	-15.7000	166.5000
391.7000	-15.7000	175.8000
391.7000	-15.7000	182.9000
391.7000	-13.5000	182.9000
391.7000	-0.0000	182.9000
500.	-0.0000	139.6000
500.	-0.0000	139.6000
500.	-0.0000	139.6000
500.	-0.0000	139.6
500.	-0.0000	139.6
500.	-0.0000	139.6000
500.	-0.0000	139.6000

17. 10.

391.17400	57.08647	67.24026
369.73042	56.36848	73.59626
348.11788	55.67416	79.74264
326.17208	55.19565	83.97866
309.46237	55.08731	84.93768
298.21946	55.16361	84.26228
289.73513	55.33131	82.77772
284.05489	55.55556	80.79251
281.32157	55.87912	77.92827
284.16805	56.20197	75.07025
289.57370	56.42800	73.06931
297.67233	56.65164	71.08961
308.49333	56.85676	69.27374
324.81283	57.01911	67.83657
346.80632	57.01725	67.85307
369.01630	56.93522	68.57924
391.17400	57.08647	67.24026
389.54160	80.12214	70.00121
368.80529	79.42783	76.14757
347.90560	78.75641	82.09122
326.68364	78.29368	86.18752
310.52507	78.18892	87.11492
299.65298	78.26270	86.46179
291.44849	78.42487	85.02619
285.95560	78.64173	83.10646
283.31244	78.95461	80.33670
286.06502	79.26681	77.57294
291.29238	79.48539	75.63800
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309.58799	79.90001	71.96761
325.36922	80.05700	70.57785
346.63730	80.05520	70.59381
368.11473	79.97587	71.29602
389.54160	80.12214	70.00121
387.90921	103.15781	72.76215
367.88017	102.48718	78.69888
347.69332	101.83866	84.43980
327.19520	101.39171	88.39638
311.58777	101.29053	89.29215
301.08651	101.36179	88.66130
293.16185	101.51843	87.27467
287.85631	101.72789	85.42042
285.30330	102.03010	82.74512
287.96200	102.33165	80.07563
293.01107	102.54278	78.20669
300.57546	102.75166	76.35757
310.68265	102.94325	74.66149
325.92561	103.09489	73.31912
346.46829	103.09315	73.33454
367.21316	103.01653	74.01280
387.90921	103.15781	72.76215
386.27681	126.19348	75.52310
366.95505	125.54653	81.25018
347.48105	124.92092	86.78838
327.70676	124.48975	90.60525
312.65046	124.39213	91.46938
302.52003	124.46088	90.86081
294.87521	124.61199	89.52314
289.75702	124.81405	87.73437
287.29416	125.10559	85.15354

289.85898	125.39650	82.57832
294.72975	125.60016	80.77537
302.02703	125.80167	78.99155
311.77731	125.98650	77.35536
326.46201	126.13278	76.06040
346.29927	126.13110	76.07527
366.31159	126.05719	76.72958
386.27681	126.19348	75.52310
384.64442	149.22915	78.28404
366.02993	148.60588	83.80149
347.26877	148.00317	89.13696
328.21833	147.58778	92.81411
313.71316	147.49374	93.64661
303.95355	147.55997	93.06032
296.58857	147.70555	91.77162
291.65773	147.90022	90.04832
289.28503	148.18108	87.56196
291.75596	148.46134	85.08101
296.44843	148.65755	83.34406
303.47860	148.85168	81.62554
312.87197	149.02975	80.04924
327.03840	149.17067	78.80168
346.13025	149.16906	78.81601
365.41002	149.09785	79.44636
384.64442	149.22915	78.28404
383.01202	172.26482	81.04499
365.10481	171.66523	86.35279
347.05650	171.08542	91.48554
328.72989	170.68582	95.02297
314.77586	170.59535	95.82384
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291.27589	171.25657	89.97039
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304.93017	171.90169	84.25952
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383.01202	172.26482	81.04499
381.37963	195.30049	83.80593
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329.24145	193.78385	97.23184
315.83855	193.69696	98.00108
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300.01529	193.89267	96.26856
295.45916	194.07254	94.67622
293.26676	194.33207	92.37881
295.54992	194.59103	90.08639
299.88580	194.77233	88.48143
306.38173	194.95171	86.89350
315.06128	195.11624	85.43699
328.15119	195.24646	84.28423
345.79222	195.24496	84.29747
363.60689	195.17917	84.87993
381.37963	195.30049	83.80593
379.74723	218.33616	86.56688

363.25456	217.78393	91.45540
346.63194	217.24992	96.18270
329.75301	216.88189	99.44070
316.90125	216.79856	100.17831
308.25411	216.85724	99.65885
301.72865	216.98623	98.51704
297.35987	217.15871	96.99018
295.25762	217.40756	94.78723
297.44690	217.65587	92.58908
301.60449	217.82972	91.05012
307.83330	218.00172	89.52748
316.15594	218.15948	88.13086
328.70758	218.28435	87.02551
345.62320	218.28291	87.03820
362.70532	218.21982	87.59671
379.74723	218.33616	86.56688
378.11484	241.37183	89.32783
362.32944	240.84328	94.00671
346.41967	240.33217	98.53128
330.26457	239.97992	101.64957
317.96395	239.90017	102.35554
309.68763	239.95634	101.85835
303.44201	240.07979	100.76551
299.26058	240.24487	99.30413
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299.34388	240.72071	95.09177
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317.25060	241.20273	90.82474
329.26397	241.32224	89.76679
345.45418	241.32087	89.77894
361.80375	241.26048	90.31349
378.11484	241.37183	89.32783
376.48244	264.40750	92.08877
361.40432	263.90263	96.55802
346.20739	263.41443	100.87986
330.77613	263.07796	103.85843
319.02664	263.00178	104.53277
311.12115	263.05543	104.05786
305.15537	263.17335	103.01399
301.16129	263.33103	101.61808
299.23935	263.55854	99.60408
301.24085	263.78555	97.59446
305.04186	263.94449	96.18749
310.73643	264.10174	94.79545
318.34526	264.24598	93.51862
329.82037	264.36013	92.50807
345.28517	264.35882	92.51967
360.90218	264.30114	93.03028
376.48244	264.40750	92.08877
17.0	10.0	
391.17	-57.09	67.24
369.02	-56.94	68.58
346.81	-57.02	67.85
324.81	-57.02	67.84
308.49	-56.86	69.27
297.67	-56.65	71.09
289.57	-56.43	73.07
284.17	-56.20	75.07
281.32	-55.88	77.93

284.05	-55.56	80.79
289.74	-55.33	82.78
298.22	-55.16	84.26
309.46	-55.09	84.94
326.17	-55.20	83.98
348.12	-55.67	79.74
369.73	-56.37	73.60
391.17	-57.09	67.24
389.54	-80.12	70.00
368.11	-79.98	71.30
346.64	-80.06	70.59
325.37	-80.06	70.58
309.59	-79.90	71.97
299.12	-79.70	73.72
291.29	-79.49	75.64
286.06	-79.27	77.57
283.31	-78.95	80.34
285.96	-78.64	83.11
291.45	-78.42	85.03
299.65	-78.26	86.46
310.53	-78.19	87.11
326.68	-78.29	86.19
347.91	-78.76	82.09
368.81	-79.43	76.15
389.54	-80.12	70.00
387.91	-103.16	72.76
367.21	-103.02	74.01
346.47	-103.09	73.33
325.93	-103.09	73.32
310.68	-102.94	74.66
300.58	-102.75	76.36
293.01	-102.54	78.21
287.96	-102.33	80.08
285.30	-102.03	82.75
287.86	-101.73	85.42
293.16	-101.52	87.27
301.09	-101.36	88.66
311.59	-101.29	89.29
327.20	-101.39	88.40
347.69	-101.84	84.44
367.88	-102.49	78.70
387.91	-103.16	72.76
386.28	-126.19	75.52
366.31	-126.06	76.73
346.30	-126.13	76.08
326.48	-126.13	76.06
311.78	-125.99	77.36
302.03	-125.80	78.99
294.73	-125.60	80.78
289.86	-125.40	82.58
287.29	-125.11	85.15
289.76	-124.81	87.73
294.88	-124.61	89.52
302.52	-124.46	90.86
312.65	-124.39	91.47
327.71	-124.49	90.61
347.48	-124.92	86.79
366.96	-125.55	81.25
386.28	-126.19	75.52
384.64	-149.23	78.28

365.41	-149.10	79.45
346.13	-149.17	78.82
327.04	-149.17	78.80
312.87	-149.03	80.05
303.48	-148.85	81.63
296.45	-148.66	83.34
291.76	-148.46	85.08
289.28	-148.18	87.56
291.66	-147.90	90.05
296.59	-147.71	91.77
303.95	-147.56	93.06
313.71	-147.49	93.65
328.22	-147.59	92.81
347.27	-148.00	89.14
366.03	-148.61	83.80
384.64	-149.23	78.28
383.01	-172.26	81.04
364.51	-172.14	82.16
345.96	-172.21	81.56
327.59	-172.21	81.54
313.97	-172.07	82.74
304.93	-171.90	84.26
298.17	-171.71	85.91
293.65	-171.53	87.58
291.28	-171.26	89.97
293.56	-170.99	92.36
298.30	-170.80	94.02
305.39	-170.66	95.26
314.78	-170.60	95.82
328.73	-170.69	95.02
347.06	-171.09	91.49
365.10	-171.67	86.35
383.01	-172.26	81.04
381.38	-195.30	83.81
363.61	-195.18	84.88
345.79	-195.24	84.30
328.15	-195.25	84.28
315.06	-195.12	85.44
306.38	-194.95	86.89
299.89	-194.77	88.48
295.55	-194.59	90.09
293.27	-194.33	92.38
295.46	-194.07	94.68
300.02	-193.89	96.27
306.82	-193.76	97.46
315.84	-193.70	98.00
329.24	-193.78	97.23
346.84	-194.17	93.83
364.18	-194.72	88.90
381.38	-195.30	83.81
379.75	-218.34	86.57
362.71	-218.22	87.60
345.62	-218.28	87.04
328.71	-218.28	87.03
316.16	-218.16	88.13
307.63	-218.00	89.53
301.60	-217.83	91.05
297.45	-217.66	92.59
295.26	-217.41	94.79
297.36	-217.16	96.99

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   301.73   -216.99     98.52
   308.25   -216.86     99.66
   316.90   -216.80    100.18
   329.75   -216.88     99.44
   346.63   -217.25     96.18
   363.25   -217.78     91.46
   379.75   -218.34     86.57
   378.11   -241.37     89.33
   361.80   -241.26     90.31
   345.45   -241.32     89.78
   329.26   -241.32     89.77
   317.25   -241.20     90.82
   309.28   -241.05     92.16
   303.32   -240.89     93.62
   299.34   -240.72     95.09
   297.25   -240.48     97.20
   299.26   -240.24     99.30
   303.44   -240.08    100.77
   309.69   -239.96    101.86
   317.96   -239.90    102.36
   330.26   -239.98    101.65
   346.42   -240.33     98.53
   362.33   -240.84     94.01
   378.11   -241.37     89.33
   376.48   -264.41     92.09
   360.90   -264.30     93.03
   345.29   -264.36     92.52
   329.82   -264.36     92.51
   318.35   -264.25     93.52
   310.74   -264.10     94.80
   305.04   -263.94     96.19
   301.24   -263.79     97.59
   299.24   -263.56     99.60
   301.16   -263.33    101.62
   305.16   -263.17    103.01
   311.12   -263.06    104.06
   319.03   -263.00    104.53
   330.78   -263.08    103.86
   346.21   -263.41    100.88
   361.40   -263.90     96.56
   376.48   -264.41     92.09
8.          2.
  271.        0.         72.8
  284.09      0.         68.64
  289.67      0.         67.16
  297.92      0.         65.97
  308.87      0.         65.2
  325.25      0.         65.32
  347.14      0.         67.44
  391.7       0.         74.4
  271.       29.2        72.8
  284.09     29.2        68.64
  289.67     29.2        67.16
  297.92     29.2        65.97
  308.87     29.2        65.2
  325.25     29.2        65.32
  347.14     29.2        67.44
  391.7      28.         74.4
      8.0          2.0
  391.7        -0.0000   74.4
```

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
PSI													
0.0	-0.04081	-0.03393	-0.02836	-0.02423	-0.02120	-0.01892	-0.01720	-0.01581	-0.01461	-0.01354	-0.01255	-0.01167	-0.01092
15.0	-0.03256	-0.02803	-0.02448	-0.02168	-0.01949	-0.01770	-0.01622	-0.01495	-0.01382	-0.01282	-0.01190	-0.01108	-0.01036
30.0	-0.02175	-0.02057	-0.01925	-0.01790	-0.01657	-0.01525	-0.01399	-0.01280	-0.01166	-0.01061	-0.00959	-0.00863	-0.00772
45.0	-0.01580	-0.01577	-0.01544	-0.01480	-0.01392	-0.01285	-0.01163	-0.01033	-0.00897	-0.00762	-0.00627	-0.00498	-0.00378
60.0	-0.01135	-0.01164	-0.01173	-0.01154	-0.01104	-0.01020	-0.00905	-0.00765	-0.00609	-0.00452	-0.00303	-0.00174	-0.00070
75.0	-0.00711	-0.00718	-0.00719	-0.00706	-0.00674	-0.00615	-0.00526	-0.00415	-0.00287	-0.00162	-0.00054	0.00028	0.00084
90.0	-0.00304	-0.00259	-0.00216	-0.00171	-0.00122	-0.00068	-0.00011	0.00046	0.00095	0.00132	0.00156	0.00168	0.00170
105.0	0.00042	0.00118	0.00178	0.00225	0.00259	0.00281	0.00291	0.00288	0.00276	0.00257	0.00236	0.00214	0.00194
120.0	0.00314	0.00380	0.00413	0.00422	0.00414	0.00393	0.00364	0.00331	0.00297	0.00265	0.00235	0.00209	0.00185
135.0	0.00584	0.00621	0.00611	0.00580	0.00538	0.00488	0.00434	0.00382	0.00332	0.00298	0.00251	0.00219	0.00191
150.0	0.01093	0.01089	0.01002	0.00924	0.00859	0.00781	0.00685	0.00585	0.00489	0.00407	0.00337	0.00281	0.00235
165.0	0.02484	0.02395	0.02021	0.01825	0.01778	0.01673	0.01453	0.01187	0.00935	0.00725	0.00556	0.00429	0.00335
180.0	0.03485	0.03666	0.03091	0.02749	0.02702	0.02569	0.02211	0.01770	0.01353	0.01010	0.00742	0.00546	0.00408
195.0	0.02450	0.02356	0.01958	0.01803	0.01743	0.01628	0.01412	0.01155	0.00912	0.00710	0.00548	0.00424	0.00332
210.0	0.01135	0.01109	0.01016	0.00935	0.00861	0.00777	0.00680	0.00580	0.00485	0.00405	0.00336	0.00280	0.00235
225.0	0.00618	0.00638	0.00620	0.00583	0.00537	0.00485	0.00438	0.00378	0.00329	0.00286	0.00249	0.00217	0.00189
240.0	0.00332	0.00385	0.00408	0.00410	0.00398	0.00376	0.00347	0.00315	0.00283	0.00253	0.00226	0.00201	0.00179
255.0	0.00051	0.00117	0.00167	0.00206	0.00234	0.00251	0.00258	0.00255	0.00245	0.00231	0.00213	0.00195	0.00178
270.0	-0.00297	-0.00253	-0.00219	-0.00166	-0.00119	-0.00069	-0.00017	0.00033	0.00076	0.00109	0.00131	0.00143	0.00147
285.0	-0.00703	-0.00697	-0.00685	-0.00659	-0.00615	-0.00550	-0.00463	-0.00359	-0.00248	-0.00144	-0.00055	0.00014	0.00062
300.0	-0.01127	-0.01136	-0.01126	-0.01090	-0.01028	-0.00939	-0.00825	-0.00693	-0.00551	-0.00414	-0.00284	-0.00174	-0.00084
315.0	-0.01574	-0.01559	-0.01501	-0.01424	-0.01331	-0.01220	-0.01099	-0.00971	-0.00841	-0.00714	-0.00589	-0.00471	-0.00363
330.0	-0.02165	-0.02032	-0.01891	-0.01749	-0.01613	-0.01480	-0.01354	-0.01235	-0.01122	-0.01018	-0.00919	-0.00825	-0.00737
345.0	-0.03214	-0.02767	-0.02415	-0.02138	-0.01920	-0.01742	-0.01595	-0.01468	-0.01356	-0.01256	-0.01165	-0.01084	-0.01012

Flight Condition 5

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04619	-0.03786	-0.03365	-0.02518	-0.02172	-0.01832	-0.01620	-0.01456	-0.01316	-0.01189	-0.01070	-0.00964	-0.00875
15.0	-0.03624	-0.03056	-0.02592	-0.02238	-0.01954	-0.01735	-0.01560	-0.01413	-0.01283	-0.01168	-0.01062	-0.00970	-0.00890
30.0	-0.02251	-0.02108	-0.01951	-0.01791	-0.01635	-0.01485	-0.01343	-0.01218	-0.01088	-0.00977	-0.00873	-0.00778	-0.00690
45.0	-0.01528	-0.01531	-0.01502	-0.01436	-0.01364	-0.01231	-0.01107	-0.00977	-0.00846	-0.00719	-0.00596	-0.00476	-0.00368
60.0	-0.01018	-0.01059	-0.01080	-0.01071	-0.01031	-0.00968	-0.00868	-0.00737	-0.00599	-0.00468	-0.00325	-0.00210	-0.00116
75.0	-0.00555	-0.00571	-0.00582	-0.00581	-0.00564	-0.00527	-0.00468	-0.00387	-0.00290	-0.00191	-0.00102	-0.00031	0.00018
90.0	-0.00130	-0.00100	-0.00069	-0.00036	-0.00001	0.00034	0.00066	0.00091	0.00109	0.00118	0.00121	0.00119	0.00116
105.0	0.00221	0.00261	0.00293	0.00316	0.00328	0.00326	0.00315	0.00291	0.00261	0.00229	0.00199	0.00171	0.00149
120.0	0.00515	0.00519	0.00503	0.00475	0.00439	0.00397	0.00352	0.00307	0.00266	0.00230	0.00198	0.00171	0.00148
135.0	0.00884	0.00834	0.00751	0.00666	0.00588	0.00513	0.00441	0.00376	0.00318	0.00270	0.00228	0.00193	0.00165
150.0	0.01729	0.01610	0.01403	0.01233	0.01105	0.00975	0.00831	0.00688	0.00557	0.00449	0.00360	0.00289	0.00236
165.0	0.04277	0.03915	0.03232	0.02868	0.02741	0.02519	0.02128	0.01685	0.01280	0.00954	0.00701	0.00517	0.00386
180.0	0.06210	0.06269	0.05168	0.04542	0.04422	0.04120	0.03460	0.02691	0.01989	0.01429	0.01003	0.00704	0.00501
195.0	0.06176	0.05809	0.05171	0.04812	0.04653	0.04413	0.04034	0.03616	0.03235	0.02927	0.02688	0.02512	0.02385
210.0	0.01814	0.01659	0.01644	0.01266	0.01125	0.00984	0.00835	0.00690	0.00560	0.00453	0.00364	0.00294	0.00239
225.0	0.00952	0.00878	0.00786	0.00690	0.00605	0.00525	0.00458	0.00383	0.00324	0.00274	0.00232	0.00197	0.00169
240.0	0.00546	0.00531	0.00503	0.00466	0.00425	0.00381	0.00336	0.00294	0.00255	0.00221	0.00191	0.00166	0.00144
255.0	0.00226	0.00251	0.00269	0.00279	0.00282	0.00276	0.00262	0.00242	0.00219	0.00195	0.00171	0.00151	0.00133
270.0	-0.00135	-0.00100	-0.00081	-0.00052	-0.00022	0.00006	0.00032	0.00054	0.00071	0.00082	0.00088	0.00091	0.00091
285.0	-0.00559	-0.00555	-0.00546	-0.00526	-0.00492	-0.00444	-0.00382	-0.00309	-0.00231	-0.00157	-0.00092	-0.00039	-0.00001
300.0	-0.01019	-0.01022	-0.01008	-0.00971	-0.00912	-0.00838	-0.00752	-0.00621	-0.00505	-0.00393	-0.00298	-0.00220	-0.00157
315.0	-0.01528	-0.01438	-0.01425	-0.01337	-0.01234	-0.01118	-0.00996	-0.00873	-0.00753	-0.00639	-0.00538	-0.00451	-0.00381
330.0	-0.02214	-0.02057	-0.01879	-0.01706	-0.01546	-0.01396	-0.01253	-0.01125	-0.01007	-0.00901	-0.00802	-0.00712	-0.00638
345.0	-0.03512	-0.02963	-0.02512	-0.02159	-0.01889	-0.01674	-0.01501	-0.01355	-0.01228	-0.01115	-0.01013	-0.00924	-0.00847

Flight Condition 6

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.03406	-0.02565	-0.01931	-0.01483	-0.01172	-0.00967	-0.00784	-0.00658	-0.00550	-0.00454	-0.00366	-0.00291	-0.00229
15.0	-0.02382	-0.01803	-0.01371	-0.01043	-0.00793	-0.00593	-0.00430	-0.00294	-0.00178	-0.00082	-0.00003	0.00054	0.00086
30.0	-0.01099	-0.00821	-0.00567	-0.00362	-0.00221	-0.00136	-0.00096	-0.00082	-0.00077	-0.00075	-0.00073	-0.00069	-0.00065
45.0	-0.00442	-0.00252	-0.00137	-0.00108	-0.00103	-0.00112	-0.00115	-0.00110	-0.00101	-0.00098	-0.00078	-0.00068	-0.00058
60.0	-0.00084	0.00002	-0.00009	-0.00047	-0.00074	-0.00082	-0.00081	-0.00073	-0.00064	-0.00056	-0.00048	-0.00041	-0.00035
75.0	0.00118	0.00118	0.00054	0.00002	-0.00025	-0.00034	-0.00035	-0.00033	-0.00029	-0.00026	-0.00022	-0.00019	-0.00016
90.0	0.00263	0.00219	0.00136	0.00076	0.00043	0.00024	0.00014	0.00008	0.00005	0.00003	0.00001	0.00000	-0.00000
105.0	0.00438	0.00388	0.00298	0.00218	0.00159	0.00115	0.00085	0.00063	0.00048	0.00037	0.00028	0.00023	0.00018
120.0	0.00694	0.00728	0.00656	0.00522	0.00388	0.00280	0.00202	0.00149	0.00112	0.00084	0.00067	0.00053	0.00042
135.0	0.01068	0.01224	0.01188	0.00977	0.00730	0.00525	0.00388	0.00288	0.00211	0.00162	0.00126	0.00098	0.00078
150.0	0.01588	0.01707	0.01601	0.01358	0.01096	0.00863	0.00672	0.00519	0.00399	0.00307	0.00235	0.00182	0.00140
165.0	0.02256	0.02238	0.02041	0.02036	0.01861	0.01657	0.01382	0.01091	0.00829	0.00620	0.00455	0.00334	0.00246
180.0	0.03557	0.03771	0.03191	0.02783	0.02653	0.02451	0.02067	0.01625	0.01217	0.00888	0.00632	0.00448	0.00319
195.0	0.02716	0.02686	0.02305	0.02005	0.01822	0.01613	0.01343	0.01062	0.00810	0.00608	0.00449	0.00330	0.00245
210.0	0.01598	0.01679	0.01557	0.01319	0.01070	0.00847	0.00663	0.00515	0.00397	0.00307	0.00237	0.00183	0.00142
225.0	0.01072	0.01181	0.01119	0.00919	0.00697	0.00511	0.00376	0.00288	0.00213	0.00165	0.00128	0.00101	0.00081
240.0	0.00694	0.00707	0.00628	0.00508	0.00376	0.00275	0.00202	0.00150	0.00114	0.00088	0.00069	0.00055	0.00044
255.0	0.00423	0.00379	0.00295	0.00219	0.00161	0.00118	0.00088	0.00066	0.00050	0.00039	0.00030	0.00024	0.00020
270.0	0.00246	0.00205	0.00133	0.00079	0.00047	0.00028	0.00017	0.00011	0.00007	0.00004	0.00003	0.00001	0.00001
285.0	0.00096	0.00096	0.00044	0.00001	-0.00022	-0.00031	-0.00033	-0.00031	-0.00027	-0.00024	-0.00021	-0.00018	-0.00016
300.0	-0.00104	-0.00025	-0.00028	-0.00055	-0.00074	-0.00079	-0.00077	-0.00070	-0.00062	-0.00054	-0.00046	-0.00040	-0.00036
315.0	-0.00453	-0.00272	-0.00162	-0.00123	-0.00112	-0.00113	-0.00112	-0.00105	-0.00096	-0.00085	-0.00074	-0.00065	-0.00056
330.0	-0.01096	-0.00815	-0.00568	-0.00372	-0.00238	-0.00155	-0.00111	-0.00090	-0.00081	-0.00075	-0.00069	-0.00065	-0.00060
345.0	-0.02340	-0.01769	-0.01343	-0.01021	-0.00776	-0.00580	-0.00423	-0.00292	-0.00182	-0.00092	-0.00018	0.00034	0.00063

Flight Condition 7

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04853	-0.03654	-0.02751	-0.02113	-0.01669	-0.01348	-0.01114	-0.00933	-0.00778	-0.00640	-0.00516	-0.00409	-0.00322
15.0	-0.03632	-0.02597	-0.01976	-0.01582	-0.01342	-0.00853	-0.00628	-0.00425	-0.00258	-0.00128	-0.00008	0.00074	0.00119
30.0	-0.01588	-0.01186	-0.00819	-0.00523	-0.00319	-0.00197	-0.00139	-0.00118	-0.00112	-0.00109	-0.00105	-0.00100	-0.00093
45.0	-0.00639	-0.00365	-0.00208	-0.00146	-0.00149	-0.00161	-0.00165	-0.00159	-0.00145	-0.00129	-0.00113	-0.00098	-0.00086
60.0	-0.00126	-0.00001	-0.00016	-0.00078	-0.00106	-0.00119	-0.00116	-0.00105	-0.00093	-0.00088	-0.00069	-0.00059	-0.00050
75.0	0.00167	0.00167	0.00077	0.00002	-0.00035	-0.00049	-0.00051	-0.00047	-0.00042	-0.00037	-0.00032	-0.00027	-0.00023
90.0	0.00377	0.00315	0.00197	0.00111	0.00062	0.00035	0.00028	0.00012	0.00007	0.00004	0.00002	0.00001	-0.00000
105.0	0.00622	0.00560	0.00431	0.00316	0.00230	0.00167	0.00122	0.00091	0.00069	0.00053	0.00041	0.00032	0.00026
120.0	0.01002	0.01057	0.00956	0.00759	0.00563	0.00405	0.00292	0.00214	0.00160	0.00123	0.00095	0.00075	0.00060
135.0	0.01539	0.01795	0.01761	0.01449	0.01075	0.00758	0.00551	0.00404	0.00302	0.00232	0.00179	0.00140	0.00111
150.0	0.02277	0.02495	0.02363	0.02005	0.01611	0.01262	0.00978	0.00753	0.00577	0.00442	0.00338	0.00259	0.00200
165.0	0.04066	0.04075	0.03660	0.03087	0.02779	0.02499	0.02088	0.01644	0.01244	0.00923	0.00672	0.00488	0.00357
180.0	0.05306	0.05753	0.04837	0.04203	0.04062	0.03808	0.03213	0.02517	0.01875	0.01355	0.00953	0.00667	0.00470
195.0	0.03986	0.03965	0.03388	0.02947	0.02697	0.02403	0.02004	0.01582	0.01202	0.00897	0.00659	0.00482	0.00355
210.0	0.02304	0.02460	0.02271	0.01925	0.01559	0.01232	0.00962	0.00746	0.00574	0.00443	0.00341	0.00264	0.00205
225.0	0.01568	0.01708	0.01621	0.01332	0.01089	0.00739	0.00543	0.00405	0.00307	0.00238	0.00185	0.00146	0.00116
240.0	0.01002	0.01018	0.00902	0.00719	0.00541	0.00397	0.00292	0.00218	0.00165	0.00128	0.00100	0.00080	0.00064
255.0	0.00609	0.00544	0.00425	0.00317	0.00234	0.00172	0.00127	0.00096	0.00073	0.00057	0.00044	0.00035	0.00028
270.0	0.00347	0.00289	0.00198	0.00115	0.00069	0.00042	0.00026	0.00016	0.00011	0.00007	0.00004	0.00003	0.00001
285.0	0.00125	0.00126	0.00058	-0.00008	-0.00031	-0.00043	-0.00045	-0.00043	-0.00038	-0.00034	-0.00030	-0.00026	-0.00023
300.0	-0.00165	-0.00056	-0.00053	-0.00086	-0.00106	-0.00113	-0.00109	-0.00096	-0.00087	-0.00076	-0.00065	-0.00056	-0.00048
315.0	-0.00663	-0.00407	-0.00251	-0.00187	-0.00170	-0.00166	-0.00160	-0.00149	-0.00135	-0.00120	-0.00105	-0.00091	-0.00078
330.0	-0.01578	-0.01172	-0.00821	-0.00546	-0.00357	-0.00238	-0.00172	-0.00138	-0.00120	-0.00108	-0.00099	-0.00090	-0.00083
345.0	-0.03329	-0.02516	-0.01908	-0.01448	-0.01198	-0.00823	-0.00602	-0.00420	-0.00267	-0.00143	-0.00043	0.00029	0.00068

Flight Condition 8

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04644	-0.03818	-0.03213	-0.02774	-0.02451	-0.02201	-0.02005	-0.01843	-0.01701	-0.01578	-0.01466	-0.01378	-0.01291
15.0	-0.03728	-0.03165	-0.02748	-0.02430	-0.02126	-0.01892	-0.01693	-0.01520	-0.01367	-0.01234	-0.01119	-0.01024	-0.00953
30.0	-0.02404	-0.02173	-0.01931	-0.01704	-0.01509	-0.01349	-0.01221	-0.01115	-0.01023	-0.00946	-0.00858	-0.00779	-0.00702
45.0	-0.01576	-0.01442	-0.01338	-0.01253	-0.01191	-0.01120	-0.01032	-0.00927	-0.00809	-0.00685	-0.00558	-0.00434	-0.00316
60.0	-0.00971	-0.00907	-0.00917	-0.00942	-0.00937	-0.00887	-0.00795	-0.00678	-0.00526	-0.00373	-0.00229	-0.00104	-0.00005
75.0	-0.00483	-0.00443	-0.00478	-0.00518	-0.00525	-0.00495	-0.00426	-0.00326	-0.00207	-0.00090	0.00012	0.00087	0.00136
90.0	-0.00395	-0.00016	0.00006	0.00012	0.00026	0.00050	0.00084	0.00126	0.00164	0.00193	0.00210	0.00216	0.00213
105.0	0.00215	0.00358	0.00436	0.00467	0.00466	0.00449	0.00425	0.00396	0.00364	0.00331	0.00298	0.00267	0.00238
120.0	0.00542	0.00746	0.00868	0.00865	0.00782	0.00676	0.00577	0.00493	0.00421	0.00363	0.00313	0.00272	0.00238
135.0	0.00959	0.01272	0.01417	0.01328	0.01119	0.00905	0.00729	0.00596	0.00489	0.00409	0.00344	0.00292	0.00250
150.0	0.01445	0.01745	0.01789	0.01642	0.01418	0.01186	0.00978	0.00799	0.00650	0.00531	0.00435	0.00358	0.00298
165.0	0.02353	0.02626	0.02305	0.02065	0.01994	0.01879	0.01639	0.01369	0.01072	0.00840	0.00658	0.00506	0.00398
180.0	0.02869	0.03582	0.03083	0.02695	0.02712	0.02668	0.02350	0.01916	0.01491	0.01132	0.00862	0.00627	0.00474
195.0	0.02335	0.02585	0.02282	0.02048	0.01963	0.01837	0.01600	0.01318	0.01050	0.00825	0.00642	0.00501	0.00395
210.0	0.01466	0.01725	0.01744	0.01594	0.01380	0.01159	0.00958	0.00785	0.00641	0.00525	0.00431	0.00356	0.00297
225.0	0.00985	0.01248	0.01348	0.01251	0.01063	0.00868	0.00706	0.00579	0.00479	0.00401	0.00339	0.00289	0.00248
240.0	0.00575	0.00748	0.00836	0.00818	0.00737	0.00639	0.00547	0.00469	0.00402	0.00348	0.00301	0.00262	0.00230
255.0	0.00237	0.00352	0.00416	0.00437	0.00429	0.00410	0.00385	0.00358	0.00329	0.00301	0.00272	0.00245	0.00221
270.0	-0.00093	-0.00022	-0.00068	0.00009	0.00023	0.00047	0.00078	0.00111	0.00142	0.00166	0.00181	0.00187	0.00185
285.0	-0.00492	-0.00448	-0.00462	-0.00476	-0.00466	-0.00425	-0.00355	-0.00266	-0.00167	-0.00074	0.00005	0.00065	0.00106
300.0	-0.00976	-0.00905	-0.00891	-0.00884	-0.00853	-0.00796	-0.00702	-0.00586	-0.00458	-0.00332	-0.00213	-0.00111	-0.00038
315.0	-0.01571	-0.01627	-0.01309	-0.01218	-0.01139	-0.01055	-0.00960	-0.00856	-0.00741	-0.00627	-0.00512	-0.00403	-0.00302
330.0	-0.02382	-0.02133	-0.01690	-0.01667	-0.01479	-0.01321	-0.01191	-0.01052	-0.00905	-0.00798	-0.00715	-0.00736	-0.00661
345.0	-0.03656	-0.03102	-0.02681	-0.02346	-0.02076	-0.01847	-0.01653	-0.01485	-0.01338	-0.01212	-0.01102	-0.01012	-0.00944

Flight Condition 9

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.06029	-0.04837	-0.03936	-0.03282	-0.02814	-0.02469	-0.02216	-0.02014	-0.01839	-0.01679	-0.01528	-0.01393	-0.01279
15.0	-0.04448	-0.03673	-0.03083	-0.02605	-0.02213	-0.01876	-0.01579	-0.01314	-0.01076	-0.00868	-0.00689	-0.00552	-0.00465
30.0	-0.02427	-0.02119	-0.01773	-0.01458	-0.01203	-0.01043	-0.00957	-0.00910	-0.00874	-0.00833	-0.00782	-0.00723	-0.00657
45.0	-0.01303	-0.01107	-0.01002	-0.00997	-0.01024	-0.01023	-0.00976	-0.00892	-0.00787	-0.00671	-0.00551	-0.00432	-0.00321
60.0	-0.00549	-0.00513	-0.00633	-0.00769	-0.00835	-0.00827	-0.00761	-0.00655	-0.00527	-0.00393	-0.00263	-0.00158	-0.00061
75.0	-0.00004	-0.00052	-0.00209	-0.00334	-0.00392	-0.00397	-0.00362	-0.00296	-0.00212	-0.00124	-0.00044	0.00017	0.00059
90.0	0.00419	0.00383	0.00288	0.00208	0.00176	0.00166	0.00168	0.00172	0.00174	0.00173	0.00167	0.00159	0.00149
105.0	0.00789	0.00798	0.00735	0.00660	0.00590	0.00526	0.00463	0.00404	0.00350	0.00301	0.00257	0.00220	0.00189
120.0	0.01227	0.01335	0.01292	0.01132	0.00937	0.00758	0.00613	0.00499	0.00409	0.00340	0.00284	0.00239	0.00203
135.0	0.01793	0.02050	0.02034	0.01748	0.01384	0.01063	0.00821	0.00644	0.00512	0.00415	0.00340	0.00281	0.00235
150.0	0.02534	0.02737	0.02601	0.02253	0.01863	0.01503	0.01201	0.00956	0.00755	0.00601	0.00479	0.00384	0.00311
165.0	0.04114	0.04158	0.03505	0.03142	0.02838	0.02589	0.02182	0.01748	0.01354	0.01036	0.00783	0.00594	0.00456
180.0	0.05159	0.05542	0.04732	0.04141	0.03954	0.03670	0.03123	0.02485	0.01892	0.01409	0.01038	0.00753	0.00557
195.0	0.04044	0.04048	0.03513	0.03000	0.02608	0.02499	0.02102	0.01687	0.01313	0.01010	0.00768	0.00586	0.00452
210.0	0.02550	0.02679	0.02508	0.02168	0.01801	0.01462	0.01173	0.00937	0.00745	0.00596	0.00477	0.00384	0.00313
225.0	0.01800	0.01968	0.01896	0.01624	0.01302	0.01017	0.00796	0.00638	0.00505	0.00412	0.00338	0.00281	0.00235
240.0	0.01229	0.01298	0.01228	0.01061	0.00881	0.00717	0.00583	0.00477	0.00393	0.00328	0.00275	0.00233	0.00199
255.0	0.00772	0.00765	0.00697	0.00618	0.00544	0.00477	0.00417	0.00363	0.00315	0.00272	0.00234	0.00202	0.00176
270.0	0.00375	0.00338	0.00252	0.00189	0.00157	0.00144	0.00142	0.00143	0.00145	0.00144	0.00141	0.00136	0.00129
285.0	-0.00062	-0.00100	-0.00215	-0.00303	-0.00339	-0.00333	-0.00295	-0.00237	-0.00168	-0.00108	-0.00059	-0.00028	-0.00041
300.0	-0.00601	-0.00562	-0.00636	-0.00717	-0.00748	-0.00726	-0.00657	-0.00562	-0.00452	-0.00342	-0.00238	-0.00148	-0.00076
315.0	-0.01325	-0.01137	-0.01028	-0.00992	-0.00979	-0.00947	-0.00837	-0.00703	-0.00704	-0.00600	-0.00495	-0.00394	-0.00300
330.0	-0.02414	-0.02084	-0.01748	-0.01456	-0.01222	-0.01063	-0.00960	-0.00889	-0.00831	-0.00776	-0.00718	-0.00658	-0.00596
345.0	-0.04326	-0.03575	-0.02993	-0.02523	-0.02141	-0.01815	-0.01536	-0.01291	-0.01075	-0.00889	-0.00732	-0.00612	-0.00535

Flight Condition 10

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
PSI													
0.0	-0.03481	-0.02858	-0.02243	-0.01751	-0.01385	-0.01106	-0.00898	-0.00741	-0.00628	-0.00524	-0.00442	-0.00368	-0.00303
15.0	-0.02613	-0.02092	-0.01660	-0.01324	-0.01068	-0.00868	-0.00712	-0.00591	-0.00495	-0.00417	-0.00358	-0.00292	-0.00241
30.0	-0.01308	-0.01099	-0.00912	-0.00753	-0.00622	-0.00513	-0.00425	-0.00354	-0.00295	-0.00247	-0.00207	-0.00173	-0.00145
45.0	-0.00732	-0.00611	-0.00510	-0.00423	-0.00352	-0.00292	-0.00242	-0.00201	-0.00168	-0.00141	-0.00118	-0.00100	-0.00084
60.0	-0.00446	-0.00361	-0.00297	-0.00245	-0.00203	-0.00168	-0.00139	-0.00116	-0.00097	-0.00082	-0.00069	-0.00059	-0.00050
75.0	-0.00274	-0.00214	-0.00172	-0.00140	-0.00115	-0.00095	-0.00078	-0.00065	-0.00054	-0.00046	-0.00039	-0.00033	-0.00028
90.0	-0.00151	-0.00111	-0.00085	-0.00067	-0.00053	-0.00042	-0.00034	-0.00028	-0.00023	-0.00018	-0.00015	-0.00013	-0.00011
105.0	-0.00039	-0.00017	-0.00005	0.00002	0.00006	0.00009	0.00010	0.00010	0.00010	0.00009	0.00009	0.00008	0.00007
120.0	0.00099	0.00105	0.00103	0.00097	0.00090	0.00083	0.00075	0.00067	0.00060	0.00053	0.00046	0.00040	0.00035
135.0	0.00338	0.00329	0.00309	0.00282	0.00257	0.00233	0.00210	0.00187	0.00165	0.00143	0.00123	0.00105	0.00089
150.0	0.00905	0.00868	0.00809	0.00725	0.00658	0.00587	0.00559	0.00503	0.00440	0.00377	0.00316	0.00261	0.00214
165.0	0.02160	0.02162	0.02018	0.01741	0.01568	0.01475	0.01404	0.01293	0.01117	0.00935	0.00758	0.00602	0.00472
180.0	0.02874	0.03096	0.03022	0.02662	0.02330	0.02209	0.02122	0.01946	0.01684	0.01396	0.01115	0.00870	0.00667
195.0	0.02124	0.02112	0.01961	0.01786	0.01531	0.01439	0.01359	0.01236	0.01074	0.00901	0.00732	0.00584	0.00468
210.0	0.00945	0.00894	0.00826	0.00740	0.00670	0.00614	0.00560	0.00508	0.00457	0.00374	0.00314	0.00268	0.00214
225.0	0.00386	0.00365	0.00337	0.00305	0.00276	0.00248	0.00222	0.00197	0.00172	0.00149	0.00128	0.00109	0.00093
240.0	0.00131	0.00130	0.00123	0.00113	0.00104	0.00094	0.00084	0.00075	0.00066	0.00058	0.00050	0.00044	0.00038
255.0	-0.00020	-0.00003	0.00006	0.00012	0.00014	0.00015	0.00015	0.00014	0.00014	0.00013	0.00012	0.00010	0.00009
270.0	-0.00162	-0.00104	-0.00086	-0.00062	-0.00049	-0.00039	-0.00032	-0.00026	-0.00021	-0.00017	-0.00014	-0.00012	-0.00010
285.0	-0.00273	-0.00213	-0.00171	-0.00139	-0.00114	-0.00093	-0.00077	-0.00064	-0.00054	-0.00045	-0.00038	-0.00033	-0.00028
300.0	-0.00451	-0.00364	-0.00298	-0.00245	-0.00202	-0.00167	-0.00139	-0.00116	-0.00097	-0.00082	-0.00069	-0.00059	-0.00050
315.0	-0.00739	-0.00614	-0.00509	-0.00421	-0.00349	-0.00289	-0.00240	-0.00200	-0.00167	-0.00140	-0.00118	-0.00099	-0.00084
330.0	-0.01305	-0.01089	-0.00900	-0.00739	-0.00609	-0.00502	-0.00415	-0.00345	-0.00288	-0.00242	-0.00203	-0.00170	-0.00142
345.0	-0.02538	-0.02037	-0.01618	-0.01298	-0.01040	-0.00844	-0.00694	-0.00575	-0.00481	-0.00405	-0.00339	-0.00283	-0.00234

Flight Condition 11

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
PSI													
0.0	-0.04182	-0.03547	-0.02818	-0.02199	-0.01727	-0.01366	-0.01097	-0.00898	-0.00748	-0.00631	-0.00531	-0.00448	-0.00358
15.0	-0.03239	-0.02655	-0.02127	-0.01708	-0.01373	-0.01116	-0.00920	-0.00769	-0.00650	-0.00554	-0.00470	-0.00396	-0.00338
30.0	-0.01667	-0.01424	-0.01203	-0.01010	-0.00849	-0.00715	-0.00604	-0.00512	-0.00435	-0.00371	-0.00316	-0.00269	-0.00228
45.0	-0.00963	-0.00826	-0.00712	-0.00611	-0.00522	-0.00445	-0.00378	-0.00321	-0.00273	-0.00233	-0.00199	-0.00170	-0.00146
60.0	-0.00611	-0.00521	-0.00449	-0.00387	-0.00332	-0.00283	-0.00241	-0.00205	-0.00174	-0.00149	-0.00128	-0.00110	-0.00095
75.0	-0.00392	-0.00334	-0.00289	-0.00249	-0.00214	-0.00182	-0.00155	-0.00132	-0.00113	-0.00097	-0.00083	-0.00072	-0.00062
90.0	-0.00224	-0.00194	-0.00170	-0.00145	-0.00128	-0.00109	-0.00093	-0.00079	-0.00067	-0.00058	-0.00050	-0.00043	-0.00037
105.0	-0.00057	-0.00055	-0.00053	-0.00048	-0.00043	-0.00037	-0.00031	-0.00026	-0.00022	-0.00018	-0.00016	-0.00013	-0.00012
120.0	0.00167	0.00140	0.00115	0.00095	0.00081	0.00070	0.00061	0.00054	0.00047	0.00041	0.00035	0.00030	0.00025
135.0	0.00565	0.00509	0.00448	0.00387	0.00337	0.00296	0.00260	0.00228	0.00197	0.00169	0.00143	0.00120	0.00100
150.0	0.01543	0.01416	0.01286	0.01126	0.00997	0.00900	0.00812	0.00720	0.00621	0.00524	0.00432	0.00351	0.00283
165.0	0.03956	0.03782	0.03428	0.02929	0.02601	0.02439	0.02299	0.02077	0.01779	0.01465	0.01165	0.00907	0.00696
180.0	0.05345	0.05567	0.05328	0.04563	0.04027	0.03800	0.03630	0.03295	0.02812	0.02293	0.01798	0.01373	0.01029
195.0	0.03845	0.03656	0.03309	0.02845	0.02530	0.02352	0.02192	0.01967	0.01683	0.01393	0.01111	0.00870	0.00673
210.0	0.01644	0.01484	0.01332	0.01167	0.01032	0.00924	0.00827	0.00726	0.00624	0.00526	0.00435	0.00356	0.00289
225.0	0.00670	0.00588	0.00514	0.00445	0.00387	0.00337	0.00294	0.00256	0.00220	0.00188	0.00159	0.00134	0.00112
240.0	0.00234	0.00194	0.00162	0.00136	0.00116	0.00100	0.00087	0.00075	0.00065	0.00056	0.00048	0.00041	0.00035
255.0	-0.00018	-0.00021	-0.00023	-0.00022	-0.00020	-0.00017	-0.00015	-0.00012	-0.00010	-0.00009	-0.00007	-0.00006	-0.00005
270.0	-0.00207	-0.00177	-0.00153	-0.00132	-0.00113	-0.00096	-0.00082	-0.00070	-0.00060	-0.00051	-0.00044	-0.00038	-0.00033
285.0	-0.00390	-0.00329	-0.00280	-0.00239	-0.00204	-0.00173	-0.00147	-0.00126	-0.00107	-0.00092	-0.00079	-0.00069	-0.00059
300.0	-0.00621	-0.00523	-0.00445	-0.00379	-0.00322	-0.00273	-0.00232	-0.00197	-0.00168	-0.00144	-0.00124	-0.00107	-0.00093
315.0	-0.00975	-0.00838	-0.00705	-0.00597	-0.00507	-0.00429	-0.00363	-0.00308	-0.00262	-0.00223	-0.00191	-0.00166	-0.00140
330.0	-0.01647	-0.01400	-0.01169	-0.00974	-0.00814	-0.00682	-0.00573	-0.00485	-0.00411	-0.00350	-0.00298	-0.00253	-0.00215
345.0	-0.03057	-0.02527	-0.02026	-0.01620	-0.01308	-0.01064	-0.00877	-0.00731	-0.00617	-0.00524	-0.00443	-0.00373	-0.00311

Flight Condition 12

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04077	-0.03295	-0.02589	-0.02048	-0.01651	-0.01348	-0.01119	-0.00944	-0.00806	-0.00696	-0.00596	-0.00509	-0.00431
15.0	-0.03038	-0.02397	-0.01905	-0.01527	-0.01235	-0.00999	-0.00810	-0.00657	-0.00530	-0.00423	-0.00329	-0.00249	-0.00180
30.0	-0.01462	-0.01204	-0.00964	-0.00748	-0.00568	-0.00420	-0.00307	-0.00225	-0.00169	-0.00138	-0.00162	-0.00083	-0.00068
45.0	-0.00740	-0.00556	-0.00395	-0.00273	-0.00194	-0.00147	-0.00120	-0.00106	-0.00091	-0.00088	-0.00070	-0.00061	-0.00053
60.0	-0.00346	-0.00198	-0.00105	-0.00063	-0.00052	-0.00050	-0.00049	-0.00047	-0.00043	-0.00039	-0.00034	-0.00030	-0.00025
75.0	-0.00054	0.00009	0.00047	0.00044	0.00029	0.00016	0.00008	0.00003	0.00000	-0.00001	-0.00001	-0.00001	-0.00001
90.0	0.00089	0.00156	0.00162	0.00140	0.00113	0.00090	0.00072	0.00058	0.00047	0.00039	0.00032	0.00027	0.00023
105.0	0.00264	0.00322	0.00323	0.00295	0.00255	0.00213	0.00175	0.00142	0.00116	0.00095	0.00078	0.00065	0.00054
120.0	0.00489	0.00588	0.00632	0.00614	0.00546	0.00455	0.00365	0.00289	0.00229	0.00183	0.00148	0.00120	0.00099
135.0	0.00801	0.00974	0.01087	0.01086	0.00976	0.00839	.00644	0.00507	0.00399	0.00319	0.00255	0.00207	0.00169
150.0	0.01289	0.01473	0.01552	0.01492	0.01343	0.01159	0.00978	0.00814	0.00671	0.00552	0.00449	0.00365	0.00297
165.0	0.02167	0.02412	0.02395	0.02141	0.01908	0.01753	0.01620	0.01454	0.01254	0.01049	0.00852	0.00682	0.00548
180.0	0.02632	0.03045	0.03130	0.02776	0.02468	0.02304	0.02196	0.02013	0.01749	0.01459	0.01177	0.00929	0.00722
195.0	0.02147	0.02366	0.02339	0.02096	0.01871	0.01712	0.01573	0.01406	0.01211	0.01013	0.00826	0.00663	0.00527
210.0	0.01319	0.01469	0.01517	0.01441	0.01294	0.01118	0.00966	0.00790	0.00654	0.00540	0.00441	0.00360	0.00294
225.0	0.00836	0.00972	0.01043	0.01017	0.00907	0.00757	0.00611	0.00487	0.00389	0.00313	0.00253	0.00207	0.00170
240.0	0.00516	0.00593	0.00616	0.00585	0.00516	0.00431	0.00349	0.00280	0.00224	0.00182	0.00148	0.00121	0.00100
255.0	0.00280	0.00324	0.00326	0.00290	0.00251	0.00210	0.00173	0.00141	0.00115	0.00095	0.00078	0.00065	0.00055
270.0	0.00092	0.00147	0.00152	0.00133	0.00109	0.00088	0.00071	0.00058	0.00047	0.00039	0.00032	0.00027	0.00023
285.0	-0.00099	-0.00008	0.00027	0.00028	0.00020	0.00011	0.00005	0.00001	-0.00001	-0.00002	-0.00002	-0.00002	-0.00002
300.0	-0.00356	-0.00216	-0.00129	-0.00086	-0.00068	-0.00062	-0.00055	-0.00050	-0.00045	-0.00040	-0.00035	-0.00030	-0.00026
315.0	-0.00768	-0.00564	-0.00409	-0.00292	-0.00215	-0.00165	-0.00133	-0.00112	-0.00096	-0.00083	-0.00072	-0.00062	-0.00053
330.0	-0.01459	-0.01191	-0.00948	-0.00737	-0.00564	-0.00424	-0.00318	-0.00239	-0.00183	-0.00142	-0.00113	-0.00090	-0.00073
345.0	-0.02942	-0.02332	-0.01852	-0.01482	-0.01197	-0.00967	-0.00784	-0.00635	-0.00515	-0.00412	-0.00323	-0.00247	-0.00183

Flight Condition 13

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.05984	-0.04848	-0.03803	-0.03008	-0.02424	-0.01980	-0.01644	-0.01388	-0.01186	-0.01023	-0.00880	-0.00752	-0.00638
15.0	-0.04452	-0.03517	-0.02797	-0.02243	-0.01816	-0.01471	-0.01193	-0.00967	-0.00779	-0.00621	-0.00481	-0.00360	-0.00256
30.0	-0.02110	-0.01744	-0.01399	-0.01086	-0.00821	-0.00602	-0.00436	-0.00317	-0.00235	-0.00181	-0.00142	-0.00115	-0.00095
45.0	-0.01066	-0.00801	-0.00566	-0.00387	-0.00273	-0.00206	-0.00170	-0.00147	-0.00130	-0.00115	-0.00101	-0.00088	-0.00076
60.0	-0.00498	-0.00282	-0.00147	-0.00087	-0.00072	-0.00071	-0.00070	-0.00067	-0.00062	-0.00056	-0.00049	-0.00042	-0.00037
75.0	-0.00136	0.00015	0.00070	0.00065	0.00043	0.00024	0.00011	0.00004	0.00000	-0.00001	-0.00002	-0.00002	-0.00002
90.0	0.00128	0.00227	0.00236	0.00203	0.00164	0.00130	0.00104	0.00084	0.00068	0.00054	0.00047	0.00039	0.00033
105.0	0.00377	0.00463	0.00468	0.00426	0.00369	0.00309	0.00253	0.00206	0.00167	0.00137	0.00112	0.00093	0.00078
120.0	0.00692	0.00846	0.00920	0.00900	0.00804	0.00668	0.00535	0.00421	0.00332	0.00265	0.00213	0.00173	0.00142
135.0	0.01123	0.01405	0.01606	0.01630	0.01472	0.01215	0.00959	0.00747	0.00584	0.00463	0.00369	0.00298	0.00243
150.0	0.01809	0.02125	0.02285	0.02223	0.02010	0.01738	0.01453	0.01204	0.00989	0.00810	0.00658	0.00532	0.00431
165.0	0.03179	0.03604	0.03609	0.03205	0.02846	0.02633	0.02465	0.02231	0.01928	0.01609	0.01303	0.01035	0.00814
180.0	0.03894	0.04607	0.04824	0.04252	0.03746	0.03536	0.03420	0.03165	0.02754	0.02293	0.01841	0.01442	0.01111
195.0	0.03132	0.03489	0.03467	0.03097	0.02761	0.02537	0.02346	0.02107	0.01817	0.01519	0.01235	0.00987	0.00781
210.0	0.01894	0.02125	0.02205	0.02101	0.01888	0.01630	0.01379	0.01151	0.00952	0.00785	0.00641	0.00522	0.00426
225.0	0.01209	0.01403	0.01506	0.01467	0.01308	0.01092	0.00881	0.00703	0.00561	0.00452	0.00366	0.00299	0.00246
240.0	0.00752	0.00856	0.00885	0.00838	0.00739	0.00617	0.00501	0.00402	0.00323	0.00261	0.00213	0.00175	0.00145
255.0	0.00410	0.00468	0.00461	0.00417	0.00360	0.00301	0.00248	0.00203	0.00166	0.00137	0.00113	0.00094	0.00079
270.0	0.00136	0.00209	0.00215	0.00188	0.00156	0.00127	0.00102	0.00083	0.00068	0.00056	0.00047	0.00039	0.00033
285.0	-0.00146	-0.00019	0.00030	0.00035	0.00024	0.00013	0.00006	0.00001	-0.00002	-0.00003	-0.00003	-0.00003	-0.00003
300.0	-0.00514	-0.00319	-0.00196	-0.00133	-0.00105	-0.00092	-0.00082	-0.00074	-0.00066	-0.00058	-0.00051	-0.00044	-0.00038
315.0	-0.01082	-0.00818	-0.00596	-0.00429	-0.00317	-0.00245	-0.00197	-0.00165	-0.00140	-0.00121	-0.00104	-0.00090	-0.00077
330.0	-0.02106	-0.01716	-0.01365	-0.01061	-0.00814	-0.00614	-0.00462	-0.00349	-0.00267	-0.00209	-0.00165	-0.00133	-0.00108
345.0	-0.04253	-0.03371	-0.02677	-0.02142	-0.01730	-0.01399	-0.01134	-0.00919	-0.00742	-0.00595	-0.00467	-0.00357	-0.00264

Flight Condition 14

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04268	-0.03756	-0.03224	-0.02786	-0.02445	-0.02174	-0.01961	-0.01792	-0.01656	-0.01543	-0.01443	-0.01351	-0.01266
15.0	-0.03638	-0.03084	-0.02726	-0.02431	-0.02194	-0.01996	-0.01828	-0.01688	-0.01568	-0.01464	-0.01368	-0.01281	-0.01201
30.0	-0.02245	-0.02143	-0.02038	-0.01913	-0.01797	-0.01679	-0.01566	-0.01457	-0.01352	-0.01254	-0.01159	-0.01069	-0.00983
45.0	-0.01589	-0.01574	-0.01557	-0.01520	-0.01466	-0.01395	-0.01310	-0.01215	-0.01113	-0.01008	-0.00899	-0.00789	-0.00680
60.0	-0.01120	-0.01134	-0.01146	-0.01144	-0.01125	-0.01086	-0.01026	-0.00947	-0.00849	-0.00749	-0.00619	-0.00496	-0.00377
75.0	-0.00713	-0.00706	-0.00705	-0.00708	-0.00685	-3.00659	-0.00617	-0.00559	-0.00484	-0.00397	-0.00308	-0.00203	-0.00115
90.0	-0.00338	-0.00292	-0.00255	-0.00228	-0.00184	-0.00145	-0.00103	-0.00059	-0.00014	0.00029	0.00069	0.00102	0.00127
105.0	-0.00010	0.00061	0.00117	0.00163	0.00199	0.00228	0.00249	0.00262	0.00268	0.00267	0.00259	0.00248	0.00233
120.0	0.00270	0.00340	0.00383	0.00406	0.00414	0.00409	0.00395	0.00375	0.00351	0.00325	0.00298	0.00271	0.00246
135.0	0.00571	0.00622	0.00637	0.00623	0.00596	0.00561	0.00520	0.00475	0.00430	0.00387	0.00345	0.00307	0.00273
150.0	0.01128	0.01147	0.01113	0.01036	0.00961	0.00898	0.00833	0.00759	0.00677	0.00594	0.00514	0.00442	0.00378
165.0	0.02336	0.02407	0.02285	0.02006	0.01814	0.01725	0.01653	0.01527	0.01346	0.01147	0.00951	0.00777	0.00630
180.0	0.03017	0.03318	0.03305	0.02992	0.02588	0.02457	0.02379	0.02204	0.01929	0.01621	0.01319	0.01051	0.00829
195.0	0.02305	0.02357	0.02238	0.01969	0.01783	0.01685	0.01601	0.01470	0.01295	0.01105	0.00919	0.00754	0.00614
210.0	0.01182	0.01179	0.01131	0.01046	0.00968	0.00898	0.00827	0.00749	0.00666	0.00584	0.00506	0.00435	0.00374
225.0	0.00630	0.00658	0.00657	0.00634	0.00609	0.00559	0.00516	0.00470	0.00424	0.00380	0.00339	0.00302	0.00268
240.0	0.00309	0.00360	0.00389	0.00402	0.00401	0.00392	0.00375	0.00354	0.00330	0.00305	0.00280	0.00255	0.00232
255.0	0.00012	0.00071	0.00116	0.00152	0.00160	0.00202	0.00218	0.00227	0.00230	0.00229	0.00223	0.00214	0.00203
270.0	-0.00326	-0.00282	-0.00245	-0.00211	-0.00175	-0.00138	-0.00099	-0.00059	-0.00020	0.00017	0.00051	0.00078	0.00100
285.0	-0.00709	-0.00690	-0.00676	-0.00657	-0.00630	-0.00582	-0.00543	-0.00482	-0.00410	-0.00332	-0.00251	-0.00173	-0.00103
300.0	-0.01122	-0.01116	-0.01107	-0.01086	-0.01051	-0.00998	-0.00931	-0.00848	-0.00754	-0.00653	-0.00546	-0.00440	-0.00341
315.0	-0.01585	-0.01558	-0.01520	-0.01467	-0.01400	-0.01320	-0.01231	-0.01134	-0.01033	-0.00932	-0.00828	-0.00726	-0.00627
330.0	-0.02239	-0.02121	-0.01994	-0.01847	-0.01745	-0.01624	-0.01509	-0.01399	-0.01296	-0.01197	-0.01103	-0.01015	-0.00931
345.0	-0.03618	-0.03028	-0.02677	-0.02387	-0.02152	-0.01955	-0.01791	-0.01652	-0.01533	-0.01429	-0.01334	-0.01248	-0.01169

Flight Condition 15

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04616	-0.04113	-0.03665	-0.02889	-0.02434	-0.02074	-0.01798	-0.01588	-0.01427	-0.01297	-0.01183	-0.01079	-0.00982
15.0	-0.03702	-0.03256	-0.02810	-0.02432	-0.02128	-0.01878	-0.01677	-0.01514	-0.01378	-0.01263	-0.01158	-0.01062	-0.00975
30.0	-0.02167	-0.02051	-0.01923	-0.01791	-0.01660	-0.01531	-0.01407	-0.01289	-0.01178	-0.01076	-0.00988	-0.00911	-0.00849
45.0	-0.01393	-0.01335	-0.01274	-0.01163	-0.01291	-0.01221	-0.01139	-0.01048	-0.00953	-0.00858	-0.00762	-0.00668	-0.00577
60.0	-0.00891	-0.00908	-0.00927	-0.00934	-0.00926	-0.00896	-0.00852	-0.00792	-0.00717	-0.00633	-0.00541	-0.00446	-0.00354
75.0	-0.00469	-0.00471	-0.00479	-0.00481	-0.00477	-0.00465	-0.00444	-0.00412	-0.00370	-0.00319	-0.00260	-0.00199	-0.00141
90.0	-0.00094	-0.00073	-0.00055	-0.00037	-0.00017	0.00004	0.00024	0.00043	0.00058	0.00070	0.00077	0.00081	0.00083
105.0	0.00236	0.00256	0.00271	0.00282	0.00289	0.00292	0.00288	0.00278	0.00263	0.00243	0.00220	0.00196	0.00173
120.0	0.00554	0.00544	0.00521	0.00491	0.00459	0.00423	0.00385	0.00347	0.00310	0.00275	0.00242	0.00212	0.00186
135.0	0.00987	0.00933	0.00858	0.00771	0.00687	0.00618	0.00548	0.00474	0.00414	0.00368	0.00311	0.00269	0.00232
150.0	0.01962	0.01823	0.01667	0.01473	0.01308	0.01173	0.01053	0.00930	0.00804	0.00686	0.00574	0.00477	0.00395
165.0	0.04337	0.04148	0.03768	0.03239	0.02878	0.02681	0.02508	0.02258	0.01937	0.01605	0.01289	0.01017	0.00795
180.0	0.05703	0.05900	0.05631	0.04843	0.04279	0.04020	0.03817	0.03456	0.02953	0.02419	0.01910	0.01474	0.01121
195.0	0.04225	0.04018	0.03643	0.03149	0.02841	0.02589	0.02397	0.02144	0.01838	0.01526	0.01232	0.00979	0.00771
210.0	0.02057	0.01881	0.01701	0.01501	0.01331	0.01187	0.01057	0.00928	0.00801	0.00682	0.00573	0.00478	0.00397
225.0	0.01080	0.00993	0.00900	0.00803	0.00713	0.00630	0.00555	0.00486	0.00423	0.00368	0.00318	0.00274	0.00237
240.0	0.00603	0.00570	0.00533	0.00494	0.00456	0.00413	0.00373	0.00335	0.00298	0.00264	0.00233	0.00204	0.00178
255.0	0.00252	0.00258	0.00260	0.00261	0.00259	0.00254	0.00246	0.00234	0.00219	0.00202	0.00183	0.00165	0.00147
270.0	-0.00098	-0.00080	-0.00065	-0.00050	-0.00033	-0.00017	-0.00000	0.00015	0.00028	0.00039	0.00047	0.00053	0.00057
285.0	-0.00484	-0.00473	-0.00466	-0.00455	-0.00438	-0.00414	-0.00384	-0.00347	-0.00305	-0.00259	-0.00210	-0.00163	-0.00120
300.0	-0.00911	-0.00902	-0.00892	-0.00873	-0.00842	-0.00799	-0.00744	-0.00688	-0.00608	-0.00533	-0.00455	-0.00378	-0.00307
315.0	-0.01413	-0.01375	-0.01330	-0.01271	-0.01201	-0.01121	-0.01033	-0.00942	-0.00851	-0.00762	-0.00674	-0.00591	-0.00511
330.0	-0.02156	-0.02020	-0.01867	-0.01718	-0.01576	-0.01442	-0.01316	-0.01199	-0.01091	-0.00993	-0.00903	-0.00816	-0.00738
345.0	-0.03547	-0.03135	-0.02708	-0.02343	-0.02058	-0.01808	-0.01612	-0.01452	-0.01318	-0.01205	-0.01102	-0.01009	-0.00925

Flight Condition 16

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.302	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04934	-0.04224	-0.03603	-0.03123	-0.02759	-0.02469	-0.02237	-0.02058	-0.01894	-0.01762	-0.01644	-0.01537	-0.01442
15.0	-0.04038	-0.03483	-0.03042	-0.02698	-0.02405	-0.02161	-0.01956	-0.01775	-0.01619	-0.01484	-0.01341	-0.01251	-0.01154
30.0	-0.02539	-0.02336	-0.02128	-0.01925	-0.01737	-0.01567	-0.01420	-0.01295	-0.01189	-0.01099	-0.01016	-0.00948	-0.00868
45.0	-0.01664	-0.01546	-0.01429	-0.01330	-0.01253	-0.01187	-0.01123	-0.01033	-0.00974	-0.00888	-0.00794	-0.00697	-0.00593
60.0	-0.01057	-0.00957	-0.00906	-0.00898	-0.00904	-0.00898	-0.00867	-0.00818	-0.00739	-0.00634	-0.00524	-0.00410	-0.00299
75.0	-0.00575	-0.00474	-0.00447	-0.00464	-0.00487	-0.00494	-0.00479	-0.00448	-0.00380	-0.00305	-0.00218	-0.00129	-0.00047
90.0	-0.00192	-0.00075	-0.00019	0.00000	0.00007	0.00016	0.00031	0.00053	0.00081	0.00111	0.00140	0.00166	0.00184
105.0	0.00116	0.00253	0.00352	0.00416	0.00446	0.00458	0.00461	0.00423	0.00403	0.00388	0.00355	0.00329	0.00303
120.0	0.00416	0.00597	0.00749	0.00842	0.00854	0.00882	0.00722	0.00638	0.00562	0.00492	0.00433	0.00381	0.00337
135.0	0.00760	0.01032	0.01259	0.01369	0.01329	0.01185	0.01018	0.00849	0.00713	0.00604	0.00514	0.00441	0.00381
150.0	0.01197	0.01527	0.01728	0.01759	0.01661	0.01493	0.01305	0.01124	0.00958	0.00814	0.00687	0.00580	0.00490
165.0	0.01925	0.02417	0.02547	0.02510	0.02088	0.01976	0.01908	0.01765	0.01563	0.01338	0.01114	0.00915	0.00745
180.0	0.02281	0.02981	0.03346	0.02995	0.02647	0.02539	0.02534	0.02410	0.02146	0.01827	0.01583	0.01210	0.00960
195.0	0.01927	0.02375	0.02487	0.02268	0.02056	0.01937	0.01866	0.01784	0.01506	0.01291	0.01078	0.00838	0.00727
210.0	0.01256	0.01539	0.01695	0.01697	0.01593	0.01432	0.01257	0.01035	0.00928	0.00791	0.00671	0.00558	0.00482
225.0	0.00823	0.01051	0.01222	0.01285	0.01238	0.01099	0.00966	0.00884	0.00681	0.00581	0.00497	0.00428	0.00371
240.0	0.00472	0.00628	0.00746	0.00804	0.00797	0.00743	0.00669	0.00593	0.00522	0.00451	0.00406	0.00359	0.00319
255.0	0.00153	0.00272	0.00352	0.00398	0.00414	0.00412	0.00393	0.00379	0.00359	0.00337	0.00315	0.00293	0.00271
270.0	-0.00178	-0.00076	-0.00026	-0.00006	0.00004	0.00014	0.00029	0.00049	0.00073	0.00058	0.00121	0.00141	0.00156
285.0	-0.00574	-0.00482	-0.00448	-0.00448	-0.00452	-0.00444	-0.00418	-0.00374	-0.00316	-0.00249	-0.00176	-0.00106	-0.00041
300.0	-0.01061	-0.00958	-0.00900	-0.00874	-0.00859	-0.00833	-0.00790	-0.00727	-0.00648	-0.00559	-0.00462	-0.00364	-0.00271
315.0	-0.01666	-0.01535	-0.01411	-0.01306	-0.01221	-0.01165	-0.01071	-0.00993	-0.00911	-0.00825	-0.00735	-0.00643	-0.00552
330.0	-0.02527	-0.02307	-0.02090	-0.01885	-0.01700	-0.01533	-0.01389	-0.01266	-0.01159	-0.01067	-0.00982	-0.00905	-0.00832
345.0	-0.03952	-0.03419	-0.02905	-0.02637	-0.02355	-0.02115	-0.01912	-0.01737	-0.01584	-0.01452	-0.01333	-0.01227	-0.01134

Flight Condition 17

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.06542	-0.05588	-0.04657	-0.03921	-0.03364	-0.02929	-0.02594	-0.02336	-0.02133	-0.01966	-0.01817	-0.01679	-0.01549
15.0	-0.04986	-0.04216	-0.03603	-0.03108	-0.02702	-0.02358	-0.02047	-0.01782	-0.01548	-0.01340	-0.01147	-0.00974	-0.00821
30.0	-0.02608	-0.02371	-0.02106	-0.01818	-0.01551	-0.01328	-0.01147	-0.01031	-0.00958	-0.00911	-0.00873	-0.00836	-0.00794
45.0	-0.01448	-0.01273	-0.01116	-0.01021	-0.00995	-0.01004	-0.01018	-0.00953	-0.00847	-0.00797	-0.00765	-0.00809	
60.0	-0.00686	-0.00546	-0.00531	-0.00614	-0.00717	-0.00728	-0.00808	-0.00784	-0.00726	-0.00642	-0.00544	-0.00637	-0.00532
75.0	-0.00115	-0.00020	-0.00072	-0.00198	-0.00292	-0.00354	-0.00377	-0.00368	-0.00335	-0.00285	-0.00221	-0.00153	-0.00088
90.0	0.00325	0.00405	0.00363	0.00283	0.00219	0.00180	0.00161	0.00156	0.00176	0.00159	0.00161	0.00161	0.00159
105.0	0.00701	0.00791	0.00782	0.00738	0.00667	0.00604	0.00545	0.00491	0.00441	0.00395	0.00358	0.00389	0.00272
120.0	0.01188	0.01256	0.01312	0.01272	0.01156	0.01081	0.00846	0.00718	0.00596	0.00504	0.00428	0.00365	0.00314
135.0	0.01592	0.01847	0.02068	0.01974	0.01720	0.01499	0.01222	0.00989	0.00803	0.00661	0.00547	0.00457	0.00385
150.0	0.02345	0.02395	0.02687	0.02563	0.02304	0.01991	0.01686	0.01412	0.01175	0.00974	0.00807	0.00666	0.00552
165.0	0.03739	0.04065	0.03968	0.03542	0.03156	0.02883	0.02651	0.02378	0.02041	0.01718	0.01398	0.01127	0.00902
180.0	0.04469	0.05818	0.05068	0.04498	0.03980	0.03766	0.03585	0.03194	0.02767	0.02311	0.01878	0.01464	0.01165
195.0	0.03684	0.03929	0.03828	0.03429	0.03058	0.02761	0.02533	0.02251	0.01937	0.01625	0.01332	0.01081	0.00871
210.0	0.02408	0.02578	0.02595	0.02436	0.02188	0.01837	0.01686	0.01352	0.01131	0.00945	0.00784	0.00652	0.00542
225.0	0.01642	0.01825	0.01895	0.01803	0.01610	0.01367	0.01135	0.00931	0.00767	0.00638	0.00532	0.00448	0.00368
240.0	0.01141	0.01236	0.01245	0.01177	0.01056	0.00914	0.00777	0.00656	0.00555	0.00472	0.00403	0.00346	0.00298
255.0	0.00786	0.00759	0.00735	0.00676	0.00610	0.00544	0.00464	0.00431	0.00384	0.00342	0.00303	0.00269	0.00238
270.0	0.00295	0.00344	0.00306	0.00243	0.00191	0.00157	0.00138	0.00129	0.00126	0.00126	0.00127	0.00127	0.00126
285.0	-0.00165	-0.00093	-0.00138	-0.00204	-0.00266	-0.00320	-0.00365	-0.00289	-0.00256	-0.00214	-0.00165	-0.00115	-0.00069
300.0	-0.00732	-0.00612	-0.00587	-0.00625	-0.00672	-0.00698	-0.00692	-0.00656	-0.00597	-0.00526	-0.00444	-0.00362	-0.00282
315.0	-0.01479	-0.01298	-0.01148	-0.01059	-0.00995	-0.00967	-0.00937	-0.00894	-0.00837	-0.00768	-0.00691	-0.00609	-0.00527
330.0	-0.02648	-0.02338	-0.02054	-0.01776	-0.01533	-0.01325	-0.01164	-0.01046	-0.00956	-0.00887	-0.00829	-0.00775	-0.00723
345.0	-0.04791	-0.04067	-0.03471	-0.02967	-0.02591	-0.02258	-0.01961	-0.01711	-0.01493	-0.01303	-0.01132	-0.00988	-0.00847

Flight Condition 18

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.249	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04699	-0.03588	-0.02605	-0.01968	-0.01526	-0.01207	-0.00975	-0.00797	-0.00648	-0.00529	-0.00407	-0.00313	-0.00238
15.0	-0.03396	-0.02564	-0.01955	-0.01518	-0.01187	-0.00944	-0.00760	-0.00615	-0.00495	-0.00396	-0.00312	-0.00243	-0.00189
30.0	-0.01707	-0.01368	-0.01082	-0.00853	-0.00677	-0.00538	-0.00429	-0.00344	-0.00275	-0.00221	-0.00177	-0.00142	-0.00114
45.0	-0.00933	-0.00745	-0.00598	-0.00466	-0.00369	-0.00293	-0.00234	-0.00187	-0.00151	-0.00122	-0.00099	-0.00081	-0.00066
60.0	-0.00565	-0.00421	-0.00329	-0.00258	-0.00204	-0.00162	-0.00129	-0.00104	-0.00084	-0.00069	-0.00056	-0.00047	-0.00039
75.0	-0.00318	-0.00236	-0.00179	-0.00138	-0.00108	-0.00085	-0.00067	-0.00054	-0.00044	-0.00035	-0.00029	-0.00024	-0.00020
90.0	-0.00163	-0.00110	-0.00077	-0.00054	-0.00040	-0.00029	-0.00022	-0.00016	-0.00012	-0.00010	-0.00006	-0.00006	-0.00005
105.0	-0.00030	0.00001	0.00017	0.00023	0.00026	0.00026	0.00024	0.00022	0.00020	0.00018	0.00016	0.00013	0.00012
120.0	0.00129	0.00142	0.00140	0.00131	0.00120	0.00107	0.00094	0.00081	0.00069	0.00059	0.00049	0.00042	0.00035
135.0	0.00408	0.00403	0.00373	0.00341	0.00310	0.00276	0.00240	0.00203	0.00170	0.00141	0.00115	0.00094	0.00077
150.0	0.01112	0.01069	0.00951	0.00867	0.00812	0.00740	0.00643	0.00536	0.00432	0.00343	0.00269	0.00209	0.00163
165.0	0.03115	0.02978	0.02660	0.02212	0.02188	0.02064	0.01792	0.01432	0.01093	0.00821	0.00601	0.00438	0.00328
180.0	0.06559	0.06816	0.05996	0.05532	0.05505	0.05335	0.04859	0.04260	0.03694	0.03238	0.02869	0.02618	0.02436
195.0	0.03032	0.02883	0.02411	0.02148	0.02103	0.01964	0.01691	0.01362	0.01049	0.00791	0.00584	0.00430	0.00317
210.0	0.01188	0.01119	0.00993	0.00899	0.00828	0.00744	0.00641	0.00533	0.00431	0.00344	0.00271	0.00213	0.00167
225.0	0.00480	0.00456	0.00416	0.00375	0.00335	0.00294	0.00254	0.00214	0.00179	0.00148	0.00122	0.00100	0.00082
240.0	0.00175	0.00176	0.00166	0.00152	0.00136	0.00119	0.00104	0.00089	0.00075	0.00064	0.00054	0.00046	0.00039
255.0	-0.00005	0.00020	0.00030	0.00034	0.00034	0.00032	0.00030	0.00026	0.00023	0.00020	0.00018	0.00015	0.00013
270.0	-0.00152	-0.00102	-0.00071	-0.00058	-0.00036	-0.00027	-0.00020	-0.00015	-0.00011	-0.00009	-0.00007	-0.00005	-0.00004
285.0	-0.00318	-0.00235	-0.00179	-0.00138	-0.00108	-0.00085	-0.00068	-0.00055	-0.00044	-0.00036	-0.00030	-0.00025	-0.00021
300.0	-0.00552	-0.00425	-0.00331	-0.00260	-0.00205	-0.00163	-0.00131	-0.00106	-0.00086	-0.00071	-0.00058	-0.00048	-0.00040
315.0	-0.00943	-0.00745	-0.00587	-0.00462	-0.00367	-0.00292	-0.00233	-0.00188	-0.00151	-0.00123	-0.00101	-0.00083	-0.00068
330.0	-0.01696	-0.01342	-0.01055	-0.00829	-0.00657	-0.00523	-0.00418	-0.00335	-0.00269	-0.00217	-0.00175	-0.00141	-0.00114
345.0	-0.03266	-0.02467	-0.01879	-0.01450	-0.01140	-0.00906	-0.00728	-0.00589	-0.00474	-0.00388	-0.00308	-0.00236	-0.00184

Flight Condition 19

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.248	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04135	-0.03356	-0.02641	-0.02093	-0.01699	-0.01416	-0.01218	-0.01078	-0.00964	-0.00828	-0.00715	-0.00614	-0.00538
15.0	-0.03131	-0.02594	-0.02148	-0.01803	-0.01541	-0.01342	-0.01186	-0.01056	-0.00941	-0.00839	-0.00746	-0.00664	-0.00595
30.0	-0.01813	-0.01681	-0.01540	-0.01398	-0.01261	-0.01128	-0.01004	-0.00891	-0.00788	-0.00697	-0.00615	-0.00541	-0.00474
45.0	-0.01157	-0.01159	-0.01136	-0.01080	-0.01003	-0.00910	-0.00811	-0.00711	-0.00612	-0.00528	-0.00432	-0.00350	-0.00277
60.0	-0.00713	-0.00749	-0.00768	-0.00763	-0.00737	-0.00688	-0.00621	-0.00538	-0.00446	-0.00354	-0.00266	-0.00189	-0.00122
75.0	-0.00325	-0.00342	-0.00354	-0.00358	-0.00353	-0.00338	-0.00310	-0.00269	-0.00218	-0.00164	-0.00111	-0.00068	-0.00035
90.0	0.00019	0.00030	0.00045	0.00063	0.00078	0.00090	0.00096	0.00094	0.00086	0.00074	0.00063	0.00054	0.00048
105.0	0.00299	0.00301	0.00303	0.00302	0.00293	0.00276	0.00251	0.00219	0.00185	0.00152	0.00123	0.00100	0.00082
120.0	0.00553	0.00508	0.00457	0.00407	0.00358	0.00309	0.00264	0.00222	0.00185	0.00154	0.00127	0.00106	0.00089
135.0	0.00932	0.00824	0.00703	0.00595	0.00506	0.00426	0.00356	0.00295	0.00243	0.00200	0.00165	0.00136	0.00113
150.0	0.01856	0.01661	0.01418	0.01208	0.01055	0.00908	0.00758	0.00615	0.00488	0.00384	0.00301	0.00236	0.00186
165.0	0.04472	0.03995	0.03301	0.02905	0.02708	0.02430	0.02020	0.01581	0.01187	0.00875	0.00635	0.00460	0.00337
180.0	0.06446	0.06248	0.05160	0.04530	0.04313	0.03931	0.03260	0.02515	0.01845	0.01317	0.00917	0.00638	0.00448
195.0	0.04373	0.03898	0.03238	0.02846	0.02627	0.02339	0.01943	0.01525	0.01151	0.00856	0.00626	0.00456	0.00336
210.0	0.01919	0.01696	0.01441	0.01233	0.01072	0.00917	0.00763	0.00619	0.00493	0.00390	0.00307	0.00242	0.00192
225.0	0.00985	0.00861	0.00732	0.00620	0.00525	0.00442	0.00369	0.00305	0.00252	0.00208	0.00172	0.00142	0.00118
240.0	0.00575	0.00518	0.00460	0.00405	0.00353	0.00304	0.00259	0.00218	0.00182	0.00152	0.00127	0.00106	0.00090
255.0	0.00298	0.00291	0.00284	0.00275	0.00261	0.00242	0.00217	0.00189	0.00160	0.00134	0.00111	0.00091	0.00076
270.0	0.00007	0.00016	0.00027	0.00039	0.00050	0.00059	0.00063	0.00062	0.00058	0.00052	0.00047	0.00042	0.00039
285.0	-0.00337	-0.00342	-0.00343	-0.00336	-0.00321	-0.00299	-0.00267	-0.00228	-0.00184	-0.00140	-0.00099	-0.00065	-0.00038
300.0	-0.00723	-0.00733	-0.00729	-0.00707	-0.00668	-0.00614	-0.00546	-0.00470	-0.00390	-0.00313	-0.00241	-0.00178	-0.00127
315.0	-0.01164	-0.01136	-0.01088	-0.01018	-0.00935	-0.00841	-0.00745	-0.00650	-0.00558	-0.00474	-0.00395	-0.00323	-0.00260
330.0	-0.01805	-0.01649	-0.01492	-0.01340	-0.01199	-0.01067	-0.00947	-0.00837	-0.00738	-0.00652	-0.00573	-0.00503	-0.00441
345.0	-0.03041	-0.02522	-0.02088	-0.01751	-0.01497	-0.01299	-0.01144	-0.01016	-0.00903	-0.00804	-0.00713	-0.00635	-0.00568

Flight Condition 20

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.248	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.05829	-0.04573	-0.03639	-0.02969	-0.02491	-0.02136	-0.01869	-0.01655	-0.01472	-0.01318	-0.01162	-0.01036	-0.00932
15.0	-0.04313	-0.03475	-0.02845	-0.02351	-0.01958	-0.01638	-0.01355	-0.01117	-0.00918	-0.00732	-0.00579	-0.00460	-0.00388
30.0	-0.02323	-0.01976	-0.01618	-0.01291	-0.01029	-0.00836	-0.00705	-0.00616	-0.00558	-0.00495	-0.00443	-0.00395	-0.00348
45.0	-0.01220	-0.01001	-0.00836	-0.00749	-0.00703	-0.00668	-0.00603	-0.00534	-0.00459	-0.00382	-0.00307	-0.00237	-0.00173
60.0	-0.00510	-0.00401	-0.00417	-0.00471	-0.00499	-0.00489	-0.00446	-0.00383	-0.00307	-0.00229	-0.00155	-0.00091	-0.00041
75.0	0.00003	0.00042	-0.00026	-0.00101	-0.00146	-0.00163	-0.00159	-0.00137	-0.00101	-0.00061	-0.00022	0.00010	0.00032
90.0	0.00383	0.00418	0.00376	0.00338	0.00295	0.00267	0.00243	0.00218	0.00193	0.00168	0.00145	0.00125	0.00110
105.0	0.00780	0.00759	0.00742	0.00686	0.00614	0.00537	0.00462	0.00391	0.00327	0.00278	0.00222	0.00183	0.00152
120.0	0.01088	0.01234	0.01238	0.01186	0.00919	0.00738	0.00588	0.00478	0.00377	0.00307	0.00258	0.00206	0.00172
135.0	0.01622	0.01928	0.01970	0.01717	0.01361	0.01038	0.00793	0.00614	0.00482	0.00386	0.00311	0.00253	0.00208
150.0	0.02317	0.02587	0.02509	0.02195	0.01821	0.01469	0.01171	0.00926	0.00729	0.00575	0.00454	0.00361	0.00289
165.0	0.03023	0.03971	0.03422	0.03006	0.02619	0.02561	0.02175	0.01745	0.01358	0.01027	0.00770	0.00578	0.00436
180.0	0.04766	0.05391	0.04592	0.04018	0.03903	0.03695	0.03171	0.02529	0.01924	0.01425	0.01033	0.00746	0.00545
195.0	0.03756	0.03855	0.03367	0.02964	0.02722	0.02456	0.02081	0.01673	0.01308	0.00996	0.00753	0.00569	0.00434
210.0	0.02342	0.02524	0.02408	0.02093	0.01746	0.01419	0.01138	0.00906	0.00717	0.00569	0.00452	0.00361	0.00290
225.0	0.01640	0.01841	0.01818	0.01548	0.01261	0.00982	0.00763	0.00599	0.00475	0.00383	0.00310	0.00256	0.00210
240.0	0.01105	0.01196	0.01166	0.01024	0.00853	0.00690	0.00554	0.00446	0.00362	0.00296	0.00243	0.00202	0.00169
255.0	0.00696	0.00731	0.00698	0.00633	0.00558	0.00482	0.00411	0.00347	0.00291	0.00243	0.00202	0.00169	0.00142
270.0	0.00350	0.00374	0.00336	0.00292	0.00256	0.00227	0.00202	0.00180	0.00158	0.00139	0.00123	0.00108	0.00096
285.0	-0.00062	-0.00006	-0.00069	-0.00097	-0.00125	-0.00132	-0.00123	-0.00101	-0.00073	-0.00043	-0.00015	0.00008	0.00025
300.0	-0.00566	-0.00442	-0.00431	-0.00448	-0.00451	-0.00428	-0.00383	-0.00325	-0.00261	-0.00193	-0.00140	-0.00089	-0.00049
315.0	-0.01241	-0.01017	-0.00853	-0.00752	-0.00685	-0.00623	-0.00558	-0.00488	-0.00417	-0.00348	-0.00281	-0.00220	-0.00167
330.0	-0.02203	-0.01935	-0.01583	-0.01275	-0.01033	-0.00848	-0.00715	-0.00616	-0.00540	-0.00477	-0.00422	-0.00372	-0.00327
345.0	-0.04188	-0.03370	-0.02753	-0.02269	-0.01887	-0.01571	-0.01309	-0.01087	-0.00895	-0.00733	-0.00596	-0.00490	-0.00418

Flight Condition 21

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04014	-0.03624	-0.02728	-0.02095	-0.01655	-0.01335	-0.01103	-0.00922	-0.00768	-0.00632	-0.00508	-0.00403	-0.00317
15.0	-0.03419	-0.02586	-0.01966	-0.01495	-0.01136	-0.00849	-0.00618	-0.00424	-0.00260	-0.00124	-0.00013	0.00067	0.00111
30.0	-0.01537	-0.01185	-0.00829	-0.00525	-0.00322	-0.00208	-0.00141	-0.00119	-0.00112	-0.00109	-0.00105	-0.00099	-0.00092
45.0	-0.00640	-0.00366	-0.00202	-0.00148	-0.00153	-0.00162	-0.00165	-0.00158	-0.00145	-0.00129	-0.00113	-0.00097	-0.00083
60.0	-0.00124	-0.00002	-0.00017	-0.00078	-0.00106	-0.00119	-0.00115	-0.00105	-0.00092	-0.00080	-0.00069	-0.00059	-0.00050
75.0	0.00166	0.00166	0.00076	0.00002	-0.00035	-0.00049	-0.00051	-0.00047	-0.00042	-0.00037	-0.00032	-0.00028	-0.00023
90.0	0.00377	0.00316	0.00197	0.00118	0.00062	0.00035	0.00021	0.00012	0.00007	0.00004	0.00002	0.00001	-0.00000
105.0	0.00422	0.00568	0.00431	0.00315	0.00238	0.00187	0.00122	0.00091	0.00069	0.00053	0.00041	0.00032	0.00026
120.0	0.01002	0.01059	0.00956	0.00761	0.00564	0.00405	0.00292	0.00214	0.00168	0.00123	0.00095	0.00075	0.00068
135.0	0.01533	0.01803	0.01774	0.01468	0.01082	0.00770	0.00552	0.00404	0.00302	0.00231	0.00173	0.00140	0.00110
150.0	0.02270	0.02504	0.02379	0.02019	0.01620	0.01266	0.00988	0.00754	0.00576	0.00441	0.00337	0.00258	0.00199
165.0	0.04097	0.04118	0.03487	0.03029	0.02818	0.02536	0.02121	0.01669	0.01268	0.00932	0.00677	0.00490	0.00357
180.0	0.05381	0.05897	0.04943	0.04287	0.04178	0.03924	0.03320	0.02598	0.01938	0.01339	0.00972	0.00676	0.00473
195.0	0.04023	0.04816	0.03422	0.02976	0.02735	0.02447	0.02043	0.01611	0.01221	0.00929	0.00665	0.00485	0.00356
210.0	0.02295	0.02456	0.02293	0.01943	0.01571	0.01239	0.00967	0.00748	0.00575	0.00443	0.00341	0.00263	0.00204
225.0	0.01547	0.01721	0.01640	0.01348	0.01018	0.00743	0.00545	0.00405	0.00307	0.00237	0.00185	0.00145	0.00116
240.0	0.01002	0.01022	0.00906	0.00722	0.00543	0.00398	0.00292	0.00218	0.00165	0.00128	0.00100	0.00079	0.00064
255.0	0.00618	0.00565	0.00426	0.00317	0.00234	0.00171	0.00127	0.00096	0.00073	0.00057	0.00045	0.00035	0.00028
270.0	0.00348	0.00298	0.00198	0.00116	0.00069	0.00042	0.00026	0.00017	0.00011	0.00007	0.00004	0.00003	0.00001
285.0	0.00126	0.00125	0.00057	-0.00000	-0.00031	-0.00043	-0.00045	-0.00043	-0.00039	-0.00034	-0.00030	-0.00026	-0.00022
300.0	-0.00167	-0.00057	-0.00035	-0.00085	-0.00106	-0.00113	-0.00108	-0.00098	-0.00087	-0.00076	-0.00066	-0.00056	-0.00048
315.0	-0.00664	-0.00409	-0.00254	-0.00189	-0.00171	-0.00166	-0.00160	-0.00148	-0.00134	-0.00119	-0.00104	-0.00090	-0.00078
330.0	-0.01576	-0.01178	-0.00821	-0.00547	-0.00369	-0.00241	-0.00175	-0.00140	-0.00128	-0.00108	-0.00098	-0.00099	-0.00082
345.0	-0.03311	-0.02581	-0.01896	-0.01438	-0.01092	-0.00818	-0.00599	-0.00419	-0.00269	-0.00147	-0.00049	0.00022	0.00068

Flight Condition 22

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04943	-0.03326	-0.03132	-0.02550	-0.02132	-0.01823	-0.01595	-0.01413	-0.01256	-0.01114	-0.00982	-0.00866	-0.00769
15.0	-0.03674	-0.02970	-0.02413	-0.01962	-0.01597	-0.01287	-0.01024	-0.00796	-0.00598	-0.00431	-0.00295	-0.00195	-0.00138
30.0	-0.01895	-0.01568	-0.01230	-0.00937	-0.00730	-0.00608	-0.00552	-0.00530	-0.00516	-0.00497	-0.00470	-0.00437	-0.00398
45.0	-0.00839	-0.00645	-0.00564	-0.00589	-0.00641	-0.00665	-0.00647	-0.00596	-0.00527	-0.00453	-0.00376	-0.00303	-0.00237
60.0	-0.00153	-0.00144	-0.00294	-0.00451	-0.00536	-0.00550	-0.00516	-0.00452	-0.00374	-0.00294	-0.00217	-0.00151	-0.00097
75.0	0.00322	0.00224	0.00024	-0.00125	-0.00200	-0.00225	-0.00220	-0.00195	-0.00157	-0.00115	-0.00073	-0.00038	-0.00012
90.0	0.00688	0.00579	0.00412	0.00301	0.00242	0.00211	0.00188	0.00167	0.00144	0.00121	0.00101	0.00085	0.00073
105.0	0.01021	0.00944	0.00795	0.00663	0.00561	0.00475	0.00401	0.00334	0.00274	0.00222	0.00179	0.00144	0.00118
120.0	0.01435	0.01475	0.01341	0.01107	0.00870	0.00671	0.00519	0.00405	0.00319	0.00255	0.00205	0.00167	0.00137
135.0	0.01975	0.02212	0.02136	0.01765	0.01335	0.00970	0.00724	0.00547	0.00421	0.00331	0.00263	0.00211	0.00172
150.0	0.02711	0.02900	0.02718	0.02296	0.01842	0.01444	0.01123	0.00871	0.00673	0.00522	0.00406	0.00317	0.00258
165.0	0.04621	0.04564	0.03864	0.03346	0.03074	0.02748	0.02287	0.01797	0.01359	0.01011	0.00741	0.00544	0.00403
180.0	0.05985	0.06424	0.05385	0.04669	0.04501	0.04197	0.03532	0.02757	0.02048	0.01477	0.01040	0.00730	0.00519
195.0	0.04532	0.04447	0.03787	0.03282	0.02987	0.02647	0.02199	0.01732	0.01317	0.00986	0.00728	0.00539	0.00402
210.0	0.02736	0.02836	0.02614	0.02207	0.01785	0.01411	0.01107	0.00863	0.00671	0.00524	0.00409	0.00322	0.00255
225.0	0.01971	0.02103	0.01970	0.01627	0.01252	0.00960	0.00755	0.00542	0.00422	0.00336	0.00267	0.00216	0.00176
240.0	0.01413	0.01406	0.01257	0.01036	0.00821	0.00639	0.00499	0.00392	0.00312	0.00251	0.00203	0.00166	0.00137
255.0	0.00978	0.00892	0.00750	0.00622	0.00519	0.00435	0.00362	0.00308	0.00246	0.00202	0.00164	0.00134	0.00111
270.0	0.00619	0.00515	0.00374	0.00273	0.00216	0.00180	0.00155	0.00134	0.00115	0.00098	0.00084	0.00073	0.00064
285.0	0.00241	0.00156	0.00003	-0.00111	-0.00164	-0.00186	-0.00179	-0.00156	-0.00125	-0.00093	-0.00061	-0.00035	-0.00014
300.0	-0.00224	-0.00214	-0.00317	-0.00421	-0.00474	-0.00476	-0.00441	-0.00386	-0.00321	-0.00256	-0.00196	-0.00141	-0.00097
315.0	-0.00872	-0.00694	-0.00611	-0.00634	-0.00616	-0.00612	-0.00582	-0.00531	-0.00468	-0.00403	-0.00337	-0.00276	-0.00220
330.0	-0.01878	-0.01543	-0.01222	-0.00956	-0.00766	-0.00643	-0.00570	-0.00525	-0.00491	-0.00468	-0.00426	-0.00391	-0.00356
345.0	-0.03562	-0.02875	-0.02330	-0.01891	-0.01539	-0.01244	-0.00998	-0.00789	-0.00610	-0.00463	-0.00343	-0.00256	-0.00204

Flight Condition 23

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.260	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.06259	-0.03373	-0.02578	-0.01959	-0.01518	-0.01193	-0.00959	-0.00787	-0.00652	-0.00539	-0.00436	-0.00344	-0.00264
15.0	-0.03195	-0.02508	-0.01953	-0.01531	-0.01219	-0.00982	-0.00803	-0.00665	-0.00553	-0.00460	-0.00378	-0.00307	-0.00246
30.0	-0.01635	-0.01358	-0.01116	-0.00913	-0.00752	-0.00619	-0.00512	-0.00425	-0.00354	-0.00295	-0.00244	-0.00203	-0.00169
45.0	-0.00928	-0.00779	-0.00652	-0.00542	-0.00451	-0.00373	-0.00310	-0.00257	-0.00214	-0.00179	-0.00150	-0.00126	-0.00106
60.0	-0.00576	-0.00478	-0.00400	-0.00333	-0.00278	-0.00231	-0.00191	-0.00160	-0.00133	-0.00112	-0.00095	-0.00080	-0.00068
75.0	-0.00363	-0.00299	-0.00249	-0.00207	-0.00173	-0.00143	-0.00119	-0.00099	-0.00083	-0.00070	-0.00059	-0.00050	-0.00043
90.0	-0.00206	-0.00169	-0.00140	-0.00116	-0.00096	-0.00079	-0.00066	-0.00055	-0.00046	-0.00038	-0.00032	-0.00028	-0.00024
105.0	-0.00054	-0.00043	-0.00035	-0.00029	-0.00022	-0.00017	-0.00013	-0.00010	-0.00008	-0.00006	-0.00005	-0.00004	-0.00003
120.0	0.00148	0.00131	0.00113	0.00098	0.00086	0.00076	0.00067	0.00059	0.00053	0.00043	0.00036	0.00030	0.00026
135.0	0.00512	0.00466	0.00409	0.00356	0.00313	0.00275	0.00239	0.00205	0.00173	0.00145	0.00120	0.00099	0.00081
150.0	0.01396	0.01302	0.01148	0.01004	0.00903	0.00816	0.00719	0.00613	0.00508	0.00412	0.00328	0.00260	0.00204
165.0	0.03620	0.03467	0.02971	0.02555	0.02367	0.02236	0.02013	0.01699	0.01364	0.01062	0.00804	0.00602	0.00448
180.0	0.05031	0.05267	0.04681	0.03924	0.03640	0.03481	0.03147	0.02641	0.02094	0.01602	0.01187	0.00864	0.00625
195.0	0.03514	0.03334	0.02873	0.02436	0.02283	0.02128	0.01899	0.01601	0.01289	0.01010	0.00771	0.00582	0.00437
210.0	0.01487	0.01356	0.01191	0.01041	0.00929	0.00827	0.00722	0.00613	0.00507	0.00413	0.00331	0.00264	0.00209
225.0	0.00609	0.00549	0.00478	0.00407	0.00355	0.00309	0.00266	0.00226	0.00190	0.00159	0.00132	0.00109	0.00090
240.0	0.00213	0.00194	0.00167	0.00135	0.00117	0.00101	0.00088	0.00075	0.00064	0.00054	0.00046	0.00039	0.00032
255.0	-0.00015	-0.00011	-0.00007	-0.00005	-0.00003	-0.00001	0.00000	0.00001	0.00001	0.00002	0.00002	0.00001	0.00001
270.0	-0.00187	-0.00151	-0.00124	-0.00102	-0.00084	-0.00069	-0.00057	-0.00048	-0.00040	-0.00034	-0.00029	-0.00025	-0.00021
285.0	-0.00361	-0.00293	-0.00240	-0.00198	-0.00164	-0.00136	-0.00113	-0.00094	-0.00080	-0.00067	-0.00057	-0.00049	-0.00042
300.0	-0.00585	-0.00479	-0.00395	-0.00326	-0.00270	-0.00224	-0.00186	-0.00155	-0.00130	-0.00110	-0.00093	-0.00079	-0.00067
315.0	-0.00941	-0.00778	-0.00642	-0.00528	-0.00437	-0.00361	-0.00299	-0.00248	-0.00207	-0.00174	-0.00146	-0.00123	-0.00104
330.0	-0.01618	-0.01328	-0.01079	-0.00876	-0.00717	-0.00588	-0.00485	-0.00402	-0.00334	-0.00279	-0.00232	-0.00193	-0.00161
345.0	-0.03029	-0.02383	-0.01856	-0.01455	-0.01158	-0.00932	-0.00761	-0.00629	-0.00522	-0.00433	-0.00355	-0.00289	-0.00233

Flight Condition 24

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.03714	-0.02786	-0.02078	-0.01568	-0.01205	-0.00951	-0.00766	-0.00625	-0.00507	-0.00406	-0.00317	-0.00241	-0.00181
15.0	-0.02769	-0.02053	-0.01567	-0.01218	-0.00952	-0.00758	-0.00613	-0.00497	-0.00402	-0.00323	-0.00255	-0.00200	-0.00156
30.0	-0.01312	-0.01118	-0.00889	-0.00705	-0.00564	-0.00452	-0.00364	-0.00296	-0.00237	-0.00192	-0.00155	-0.00125	-0.00102
45.0	-0.00773	-0.00624	-0.00508	-0.00408	-0.00321	-0.00257	-0.00207	-0.00167	-0.00136	-0.00111	-0.00091	-0.00075	-0.00062
60.0	-0.00440	-0.00364	-0.00289	-0.00231	-0.00185	-0.00149	-0.00120	-0.00097	-0.00080	-0.00066	-0.00054	-0.00045	-0.00038
75.0	-0.00276	-0.00212	-0.00166	-0.00131	-0.00105	-0.00084	-0.00067	-0.00055	-0.00045	-0.00037	-0.00031	-0.00026	-0.00021
90.0	-0.00146	-0.00107	-0.00080	-0.00061	-0.00047	-0.00037	-0.00029	-0.00023	-0.00018	-0.00015	-0.00012	-0.00010	-0.00008
105.0	-0.00029	-0.00009	0.00001	0.00006	0.00009	0.00010	0.00011	0.00010	0.00009	0.00009	0.00007	0.00007	0.00006
120.0	0.00121	0.00120	0.00112	0.00102	0.00092	0.00081	0.00070	0.00060	0.00051	0.00044	0.00036	0.00031	0.00025
135.0	0.00312	0.00367	0.00330	0.00294	0.00262	0.00230	0.00198	0.00166	0.00138	0.00114	0.00093	0.00076	0.00062
150.0	0.61052	0.00979	0.00868	0.00778	0.00704	0.00638	0.00560	0.00446	0.00358	0.00286	0.00222	0.00173	0.00135
165.0	0.02715	0.02533	0.02121	0.01898	0.01811	0.01667	0.01422	0.01139	0.00874	0.00657	0.00484	0.00355	0.00261
180.0	0.03846	0.03079	0.03252	0.02854	0.02776	0.02572	0.02188	0.01722	0.01296	0.00958	0.00688	0.00486	0.00346
195.0	0.02641	0.02452	0.02078	0.01850	0.01744	0.01586	0.01351	0.01054	0.00837	0.00633	0.00470	0.00348	0.00253
210.0	0.01106	0.01011	0.00886	0.00789	0.00712	0.00629	0.00536	0.00442	0.00356	0.00284	0.00223	0.00176	0.00133
225.0	0.00451	0.00412	0.00365	0.00322	0.00283	0.00246	0.00210	0.00176	0.00144	0.00121	0.00099	0.00081	0.00065
240.0	0.00160	0.00150	0.00136	0.00121	0.00107	0.00093	0.00080	0.00068	0.000 *	0.00049	0.00041	0.00034	0.00029
255.0	-0.00036	0.00008	0.00015	0.00017	0.00018	0.00017	0.00016	0.00015	0.00013	0.00012	0.00010	0.00009	0.00007
270.0	-0.00136	-0.00098	-0.00074	-0.00056	-0.00043	-0.00033	-0.00026	-0.00021	-0.00017	-0.00014	-0.00011	-0.00009	-0.00008
285.0	-0.00275	-0.00218	-0.00164	-0.00129	-0.00103	-0.00083	-0.00067	-0.00054	-0.00045	-0.00037	-0.00031	-0.00026	-0.00022
300.0	-0.00465	-0.00365	-0.00289	-0.00230	-0.00184	-0.00148	-0.00120	-0.00098	-0.00080	-0.00066	-0.00055	-0.00046	-0.00039
315.0	-0.00779	-0.00623	-0.00496	-0.00395	-0.00316	-0.00254	-0.00205	-0.00166	-0.00135	-0.00111	-0.00091	-0.00075	-0.00063
330.0	-0.01381	-0.01099	-0.00868	-0.00687	-0.00548	-0.00439	-0.00353	-0.00285	-0.00231	-0.00187	-0.00152	-0.00123	-0.00100
345.0	-0.02628	-0.01987	-0.01515	-0.01169	-0.00920	-0.00732	-0.00591	-0.00479	-0.00387	-0.00311	-0.00247	-0.00194	-0.00152

Flight Condition 25

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

PSI \ X/R	0.248	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
0.0	-0.04436	-0.03652	-0.02989	-0.02489	-0.02127	-0.01860	-0.01667	-0.01515	-0.01385	-0.01266	-0.01155	-0.01055	-0.00971
15.0	-0.03459	-0.02932	-0.02519	-0.02196	-0.01963	-0.01749	-0.01588	-0.01453	-0.01332	-0.01224	-0.01126	-0.01038	-0.00962
30.0	-0.02173	-0.02054	-0.01919	-0.01777	-0.01637	-0.01499	-0.01367	-0.01242	-0.01126	-0.01019	-0.00917	-0.00822	-0.00733
45.0	-0.01517	-0.01527	-0.01503	-0.01445	-0.01360	-0.01253	-0.01133	-0.01005	-0.00873	-0.00742	-0.00612	-0.00487	-0.00371
60.0	-0.01017	-0.01088	-0.01108	-0.01099	-0.01059	-0.00986	-0.00883	-0.00753	-0.00606	-0.00457	-0.00314	-0.00190	-0.00090
75.0	-0.00610	-0.00624	-0.00633	-0.00628	-0.00606	-0.00562	-0.00493	-0.00398	-0.00288	-0.00177	-0.00079	-0.00006	0.00049
90.0	-0.00202	-0.00167	-0.00131	-0.00093	-0.00054	-0.00011	0.00031	0.00069	0.00108	0.00121	0.00134	0.00138	0.00137
105.0	0.00148	0.00193	0.00235	0.00267	0.00287	0.00296	0.00293	0.00279	0.00258	0.00233	0.00208	0.00184	0.00163
120.0	0.00423	0.00458	0.00453	0.00440	0.00415	0.00383	0.00346	0.00308	0.00271	0.00238	0.00208	0.00182	0.00160
135.0	0.00756	0.00737	0.00684	0.00621	0.00558	0.00494	0.00431	0.00371	0.00319	0.00273	0.00234	0.00201	0.00173
150.0	0.01462	0.01376	0.01220	0.01089	0.00985	0.00874	0.00751	0.00629	0.00517	0.00423	0.00344	0.00281	0.00231
165.0	0.03325	0.03083	0.02588	0.02308	0.02189	0.02085	0.01706	0.01371	0.01061	0.00809	0.00618	0.00462	0.00354
180.0	0.04678	0.04687	0.03919	0.03564	0.03334	0.03087	0.02611	0.02062	0.01554	0.01145	0.00829	0.00601	0.00442
195.0	0.03266	0.03019	0.02548	0.02271	0.02134	0.01941	0.01650	0.01328	0.01032	0.00791	0.00600	0.00457	0.00351
210.0	0.01508	0.01400	0.01239	0.01103	0.00990	0.00873	0.00748	0.00626	0.00515	0.00422	0.00344	0.00282	0.00233
225.0	0.00801	0.00764	0.00701	0.00632	0.00564	0.00496	0.00432	0.00372	0.00318	0.00273	0.00234	0.00201	0.00174
240.0	0.00446	0.00458	0.00451	0.00430	0.00402	0.00368	0.00331	0.00294	0.00259	0.00228	0.00200	0.00176	0.00155
255.0	0.00147	0.00188	0.00219	0.00241	0.00254	0.00258	0.00253	0.00241	0.00224	0.00204	0.00186	0.00165	0.00148
270.0	-0.00201	-0.00167	-0.00133	-0.00098	-0.00062	-0.00026	0.00012	0.00045	0.00072	0.00092	0.00105	0.00112	0.00113
285.0	-0.00608	-0.00605	-0.00596	-0.00575	-0.00539	-0.00485	-0.00414	-0.00328	-0.00237	-0.00158	-0.00095	-0.00054	-0.00027
300.0	-0.01844	-0.01854	-0.01846	-0.01814	-0.00957	-0.00875	-0.00772	-0.00652	-0.00525	-0.00401	-0.00286	-0.00186	-0.00105
315.0	-0.01516	-0.01492	-0.01442	-0.01365	-0.01270	-0.01159	-0.01040	-0.00916	-0.00792	-0.00673	-0.00556	-0.00447	-0.00348
330.0	-0.02163	-0.02017	-0.01865	-0.01712	-0.01567	-0.01427	-0.01295	-0.01173	-0.01059	-0.00954	-0.00856	-0.00765	-0.00680
345.0	-0.03378	-0.02866	-0.02661	-0.02444	-0.01898	-0.01702	-0.01542	-0.01407	-0.01288	-0.01182	-0.01085	-0.01000	-0.00926

Flight Condition 26

UP VALUES FROM ROOT TO TIP AT ALL AZIMUTH STATIONS

X/R	0.240	0.301	0.362	0.423	0.483	0.544	0.605	0.666	0.727	0.787	0.848	0.909	0.970
PSI													
0.0	-0.04947	-0.03741	-0.02812	-0.02159	-0.01710	-0.01396	-0.01180	-0.01019	-0.00879	-0.00748	-0.00628	-0.00504	-0.00407
15.0	-0.03165	-0.02405	-0.01849	-0.01421	-0.01088	-0.00812	-0.00578	-0.00368	-0.00174	-0.00001	0.00149	0.00263	0.00328
30.0	-0.01341	-0.01016	-0.00685	-0.00399	-0.00200	-0.00093	-0.00063	-0.00072	-0.00091	-0.00105	-0.00110	-0.00107	-0.00100
45.0	-0.00517	-0.00265	-0.00112	-0.00079	-0.00106	-0.00136	-0.00149	-0.00147	-0.00135	-0.00120	-0.00104	-0.00089	-0.00076
60.0	-0.00070	0.00047	0.00020	-0.00048	-0.00091	-0.00107	-0.00105	-0.00095	-0.00083	-0.00072	-0.00061	-0.00051	-0.00044
75.0	0.00173	0.00174	0.00079	0.00002	-0.00035	-0.00047	-0.00046	-0.00046	-0.00038	-0.00033	-0.00028	-0.00024	-0.00021
90.0	0.00348	0.00256	0.00178	0.00098	0.00047	0.00025	0.00013	0.00007	0.00003	0.00001	0.00000	-0.00001	-0.00001
105.0	0.00533	0.00481	0.00365	0.00264	0.00191	0.00137	0.00100	0.00074	0.00055	0.00043	0.00033	0.00026	0.00021
120.0	0.00846	0.00909	0.00827	0.00658	0.00484	0.00345	0.00247	0.00179	0.00133	0.00102	0.00078	0.00062	0.00049
135.0	0.01299	0.01541	0.01528	0.01258	0.00928	0.00656	0.00468	0.00341	0.00254	0.00194	0.00150	0.00117	0.00092
150.0	0.01919	0.02121	0.02017	0.01712	0.01373	0.01073	0.00830	0.00638	0.00488	0.00373	0.00285	0.00218	0.00168
165.0	0.03470	0.03689	0.02954	0.02565	0.02381	0.02150	0.01798	0.01415	0.01068	0.00798	0.00573	0.00415	0.00302
180.0	0.04604	0.05092	0.04256	0.03685	0.03603	0.03408	0.02886	0.02255	0.01671	0.01199	0.00835	0.00578	0.00403
195.0	0.03470	0.03689	0.02954	0.02565	0.02381	0.02150	0.01798	0.01415	0.01068	0.00798	0.00573	0.00415	0.00302
210.0	0.01919	0.02121	0.02017	0.01712	0.01373	0.01073	0.00830	0.00638	0.00488	0.00373	0.00285	0.00218	0.00168
225.0	0.01299	0.01541	0.01528	0.01258	0.00928	0.00656	0.00468	0.00341	0.00254	0.00194	0.00150	0.00117	0.00092
240.0	0.00846	0.00909	0.00827	0.00658	0.00484	0.00345	0.00247	0.00179	0.00133	0.00102	0.00078	0.00062	0.00049
255.0	0.00533	0.00481	0.00365	0.00264	0.00191	0.00137	0.00100	0.00074	0.00055	0.00043	0.00033	0.00026	0.00021
270.0	0.00348	0.00256	0.00178	0.00098	0.00047	0.00025	0.00013	0.00007	0.00003	0.00001	0.00000	-0.00001	-0.00001
285.0	0.00173	0.00174	0.00079	0.00002	-0.00035	-0.00047	-0.00048	-0.00046	-0.00038	-0.00033	-0.00028	-0.00024	-0.00021
300.0	-0.00070	0.00047	0.00020	-0.00048	-0.00091	-0.00107	-0.00105	-0.00095	-0.00083	-0.00072	-0.00061	-0.00051	-0.00044
315.0	-0.00517	-0.00265	-0.00112	-0.00079	-0.00106	-0.00136	-0.00149	-0.00147	-0.00135	-0.00120	-0.00104	-0.00089	-0.00076
330.0	-0.01341	-0.01016	-0.00685	-0.00399	-0.00200	-0.00093	-0.00063	-0.00072	-0.00091	-0.00105	-0.00110	-0.00107	-0.00100
345.0	-0.03165	-0.02405	-0.01849	-0.01421	-0.01088	-0.00812	-0.00578	-0.00368	-0.00174	-0.00001	0.00149	0.00263	0.00328

Flight Condition 27

APPENDIX C

Supplementary Loads Analysis Comparisons

To supplement the loads analysis results shown in Figures 8-6 through 8-41, this appendix contains several additional comparisons in tabular form.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	7.80	8.21
L/DE (with upwash)	7.91	8.53
PLL Amplitude-lbs (without upwash)	305	929
PLL Amplitude-lbs (with upwash)	435	1014
Vertical Shear Amplitude-lbs (without upwash)	1897	3476
Vertical Shear Amplitude-lbs (with upwash)	1410	4106
FZF-lbs (without upwash)	1182	1686
FZF-lbs (with upwash)	1219	1557
Flight Condition	3	4

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	7.45	7.29
L/DE (with upwash)	7.26	7.65
PLL Amplitude-lbs (without upwash)	407	735
PLL Amplitude-lbs (with upwash)	546	927
Vertical Shear Amplitude-lbs (without upwash)	5386	3306
Vertical Shear Amplitude-lbs (with upwash)	5220	4694
FZF-lbs (without upwash)	1733	2685
FZF-lbs (with upwash)	1594	2444
Flight Condition	9	10

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Wing Lift, Gross Weight, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	6.96	8.94
L/DE (with upwash)	7.10	9.06
PLL Amplitude-lbs (without upwash)	551	1019
PLL Amplitude-lbs (with upwash)	519	1044
Vertical Shear Amplitude-lbs (without upwash)	1102	2270
Vertical Shear Amplitude-lbs (with upwash)	1288	2815
FZF-lbs (without upwash)	682	1223
FZF-lbs (with upwash)	706	1005
Flight Condition	11	12

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Gross Weight, and Rotor Radius Are Held Constant.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	7.23	8.06
L/DE (with upwash)	7.66	8.99
PLL Amplitude-lbs (without upwash)	321	825
PLL Amplitude-lbs (with upwash)	485	1154
Vertical Shear Amplitude-lbs (without upwash)	1449	2598
Vertical Shear Amplitude-lbs (with upwash)	1912	3449
FZF-lbs (without upwash)	754	1446
FZF-lbs (with upwash)	682	1503
Flight Condition	13	14

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Gross Weight, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	7.09	8.93
L/DE (with upwash)	6.63	8.72
PLL Amplitude-lbs (without upwash)	483	1025
PLL Amplitude-lbs (with upwash)	532	1052
Vertical Shear Amplitude-lbs (without upwash)	897	2556
Vertical Shear Amplitude-lbs (with upwash)	1431	3436
FZF-lbs (without upwash)	720	1362
FZF-lbs (with upwash)	795	1194
Flight Condition	15	16

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Wing Lift, Gross Weight, and Rotor Radius Are Held Constant.

Flight Velocity - Knots	112.5	162.5
L/DE (without upwash)	7.27	8.04
L/DE (with upwash)	7.18	8.57
PLL Amplitude-lbs (without upwash)	261	869
PLL Amplitude-lbs (with upwash)	429	905
Vertical Shear Amplitude-lbs (without upwash)	3124	3234
Vertical Shear Amplitude-lbs (with upwash)	3138	4630
FZF-lbs (without upwash)	765	1559
FZF-lbs (with upwash)	655	1521
Flight Condition	17	18

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flight Velocity from Loads Analysis. Rotor Lift, Wing Lift, Gross Weight, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

$T\cos\alpha_s/\pi R^2$-psf	6.48	9.34
L/DE (without upwash)	7.80	7.21
L/DE (with upwash)	7.91	7.38
PLL Amplitude-lbs (without upwash)	305	756
PLL Amplitude-lbs (with upwash)	435	776
Vertical Shear Amplitude-lbs (without upwash)	1897	2270
Vertical Shear Amplitude-lbs (with upwash)	1410	2360
FZF-lbs (without upwash)	1182	1253
FZF-lbs (with upwash)	1219	1344
Flight Condition	3	1

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Vertical Component of Disk Loading from Loads Analysis. Flight Velocity and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	7.80	7.83
L/DE (with upwash)	7.91	7.30
PLL Amplitude-lbs (without upwash)	305	293
PLL Amplitude-lbs (with upwash)	435	493
Vertical Shear Amplitude-lbs (without upwash)	1897	2336
Vertical Shear Amplitude-lbs (with upwash)	1410	1820
FZF-lbs (without upwash)	1182	1173
FZF-lbs (with upwash)	1219	1386
Flight Condition	3	5

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	6.96	7.09
L/DE (with upwash)	7.10	6.63
PLL Amplitude-lbs (without upwash)	551	483
PLL Amplitude-lbs (with upwash)	519	532
Vertical Shear Amplitude-lbs (without upwash)	1102	897
Vertical Shear Amplitude-lbs (with upwash)	1288	1431
FZF-lbs (without upwash)	682	720
FZF-lbs (with upwash)	706	795
Flight Condition	11	15

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	8.94	8.93
L/DE (with upwash)	9.06	8.72
PLL Amplitude-lbs (without upwash)	1019	1025
PLL Amplitude-lbs (with upwash)	1044	1052
Vertical Shear Amplitude-lbs (without upwash)	2270	2556
Vertical Shear Amplitude-lbs (with upwash)	2815	3436
FZF-lbs (without upwash)	1223	1362
FZF-lbs (with upwash)	1005	1194
Flight Condition	12	16

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	7.44	7.45
L/DE (with upwash)	7.85	7.26
PLL Amplitude-lbs (without upwash)	419	407
PLL Amplitude-lbs (with upwash)	460	546
Vertical Shear Amplitude-lbs (without upwash)	2905	5386
Vertical Shear Amplitude-lbs (with upwash)	2877	5220
FZF-lbs (without upwash)	1629	1733
FZF-lbs (with upwash)	1561	1594
Flight Condition	7	9

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

Lift-lbs	0	4033.3	8066.7
L/DE (without upwash)	7.40	7.34	7.29
L/DE (with upwash)	8.14	7.80	7.65
PLL Amplitude-lbs (without upwash)	734	688	735
PLL Amplitude-lbs (with upwash)	916	882	927
Vertical Shear Amplitude-lbs (without upwash)	3766	3873	3306
Vertical Shear Amplitude-lbs (with upwash)	4359	4830	4694
FZF-lbs (without upwash)	2736	2693	2685
FZF-lbs (with upwash)	2507	2402	2444
Flight Condition	8	21	10

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	7.23	7.27
L/DE (with upwash)	7.66	7.18
PLL Amplitude-lbs (without upwash)	321	261
PLL Amplitude-lbs (with upwash)	485	429
Vertical Shear Amplitude-lbs (without upwash)	1449	3124
Vertical Shear Amplitude-lbs (with upwash)	1912	3138
FZF-lbs (without upwash)	754	765
FZF-lbs (with upwash)	682	655
Flight Condition	13	17

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

Lift-lbs	0	8066.7
L/DE (without upwash)	8.06	8.04
L/DE (with upwash)	8.99	8.57
PLL Amplitude-lbs (without upwash)	825	869
PLL Amplitude-lbs (with upwash)	1154	905
Vertical Shear Amplitude-lbs (without upwash)	2598	3234
Vertical Shear Amplitude-lbs (with upwash)	3449	4630
FZF-lbs (without upwash)	1446	1559
FZF-lbs (with upwash)	1503	1521
Flight Condition	14	18

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, Flat Plate Area for Auxiliary Thrust, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	7.80	7.44
L/DE (with upwash)	7.91	7.85
PLL Amplitude-lbs (without upwash)	305	419
PLL Amplitude-lbs (with upwash)	435	460
Vertical Shear Amplitude-lbs (without upwash)	1897	2905
Vertical Shear Amplitude-lbs (with upwash)	1410	2877
FZF-lbs (without upwash)	1182	1629
FZF-lbs (with upwash)	1219	1561
Flight Condition	3	7

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	6.96	7.23
L/DE (with upwash)	7.10	7.66
PLL Amplitude-lbs (without upwash)	551	321
PLL Amplitude-lbs (with upwash)	519	485
Vertical Shear Amplitude-lbs (without upwash)	1102	1449
Vertical Shear Amplitude-lbs (with upwash)	1288	1912
FZF-lbs (without upwash)	682	754
FZF-lbs (with upwash)	706	682
Flight Condition	11	13

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Radius, Rotor Lift, Gross Weight, and Flight Velocity Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	8.94	8.06
L/DE (with upwash)	9.06	8.99
PLL Amplitude-lbs (without upwash)	1019	825
PLL Amplitude-lbs (with upwash)	1044	1154
Vertical Shear Amplitude-lbs (without upwash)	2270	2598
Vertical Shear Amplitude-lbs (with upwash)	2815	3449
FZF-lbs (without upwash)	1223	1446
FZF-lbs (with upwash)	1005	1503
Flight Condition	12	14

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Gross Weight, Flight Velocity, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	7.83	7.45
L/DE (with upwash)	7.30	7.26
PLL Amplitude-lbs (without upwash)	293	407
PLL Amplitude-lbs (with upwash)	493	546
Vertical Shear Amplitude-lbs (without upwash)	2336	5386
Vertical Shear Amplitude-lbs (with upwash)	1820	5220
FZF-lbs (without upwash)	1173	1733
FZF-lbs (with upwash)	1386	1594
Flight Condition	5	9

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Gross Weight, Flight Velocity, Wing Lift, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	7.09	7.27
L/DE (with upwash)	6.63	7.18
PLL Amplitude-lbs (without upwash)	483	261
PLL Amplitude-lbs (with upwash)	532	429
Vertical Shear Amplitude-lbs (without upwash)	897	3124
Vertical Shear Amplitude-lbs (with upwash)	1431	3138
FZF-lbs (without upwash)	720	765
FZF-lbs (with upwash)	795	655
Flight Condition	15	17

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Gross Weight, Flight Velocity, Wing Lift, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
L/DE (without upwash)	8.93	8.04
L/DE (with upwash)	8.72	8.57
PLL Amplitude-lbs (without upwash)	1025	869
PLL Amplitude-lbs (with upwash)	1052	905
Vertical Shear Amplitude-lbs (without upwash)	2556	3234
Vertical Shear Amplitude-lbs (with upwash)	3436	4630
FZF-lbs (without upwash)	1362	1559
FZF-lbs (with upwash)	1194	1521
Flight Condition	16	18

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Gross Weight, Flight Velocity, Wing Lift, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
Lift-lbs	0	8066.7
L/DE (without upwash)	7.80	7.45
L/DE (with upwash)	7.91	7.26
PLL Amplitude-lbs (without upwash)	305	407
PLL Amplitude-lbs (with upwash)	435	546
Vertical Shear Amplitude-lbs (without upwash)	1897	5386
Vertical Shear Amplitude-lbs (with upwash)	1410	5220
FZF-lbs (without upwash)	1182	1733
FZF-lbs (with upwash)	1219	1594
Flight Condition	3	9

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust and Wing Lift from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
Lift-lbs	0	8066.7
L/DE (without upwash)	6.96	7.27
L/DE (with upwash)	7.10	7.18
PLL Amplitude-lbs (without upwash)	551	261
PLL Amplitude-lbs (with upwash)	519	429
Vertical Shear Amplitude-lbs (without upwash)	1102	3124
Vertical Shear Amplitude-lbs (with upwash)	1288	3138
FZF-lbs (without upwash)	682	765
FZF-lbs (with upwash)	706	655
Flight Condition	11	17

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

fe-sq ft	0	22.9
Lift-lbs	0	8066.7
L/DE (without upwash)	8.94	8.04
L/DE (with upwash)	9.06	8.57
PLL Amplitude-lbs (without upwash)	1019	869
PLL Amplitude-lbs (with upwash)	1044	905
Vertical Shear Amplitude-lbs (without upwash)	2270	3234
Vertical Shear Amplitude-lbs (with upwash)	2815	4630
FZF-lbs (without upwash)	1223	1559
FZF-lbs (with upwash)	1005	1521
Flight Condition	12	18

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Flat Plate Area for Auxiliary Thrust from Loads Analysis. Rotor Lift, Flight Velocity, and Rotor Radius Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	6.96	7.21
L/DE (with upwash)	7.10	7.38
PLL Amplitude-lbs (without upwash)	551	756
PLL Amplitude-lbs (with upwash)	519	776
Vertical Shear Amplitude-lbs (without upwash)	1102	2270
Vertical Shear Amplitude-lbs (with upwash)	1288	2360
FZF-lbs (without upwash)	682	1253
FZF-lbs (with upwash)	706	1344
Flight Condition	11	1

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity and Disk Loading Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	6.96	7.80
L/DE (with upwash)	7.10	7.91
PLL Amplitude-lbs (without upwash)	551	305
PLL Amplitude-lbs (with upwash)	519	435
Vertical Shear Amplitude-lbs (without upwash)	1102	1897
Vertical Shear Amplitude-lbs (with upwash)	1288	1410
FZF-lbs (without upwash)	682	1182
FZF-lbs (with upwash)	706	1219
Flight Condition	11	3

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, and Gross Weight Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	8.94	8.21
L/DE (with upwash)	9.06	8.53
PLL Amplitude-lbs (without upwash)	1019	929
PLL Amplitude-lbs (with upwash)	1044	1014
Vertical Shear Amplitude-lbs (without upwash)	2270	3476
Vertical Shear Amplitude-lbs (with upwash)	2815	4106
FZF-lbs (without upwash)	1223	1686
FZF-lbs (with upwash)	1005	1557
Flight Condition	12	4

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, and Gross Weight Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	7.23	7.44
L/DE (with upwash)	7.66	7.85
PLL Amplitude-lbs (without upwash)	321	419
PLL Amplitude-lbs (with upwash)	485	460
Vertical Shear Amplitude-lbs (without upwash)	1449	2905
Vertical Shear Amplitude-lbs (with upwash)	1912	2877
FZF-lbs (without upwash)	754	1629
FZF-lbs (with upwash)	682	1561
Flight Condition	13	7

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Gross Weight, and Flat Plate Area for Auxiliary Thrust Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	8.06	7.40
L/DE (with upwash)	8.99	8.14
PLL Amplitude-lbs (without upwash)	825	734
PLL Amplitude-lbs (with upwash)	1154	916
Vertical Shear Amplitude-lbs (without upwash)	2598	3766
Vertical Shear Amplitude-lbs (with upwash)	3449	4359
FZF-lbs (without upwash)	1446	2736
FZF-lbs (with upwash)	1503	2507
Flight Condition	14	8

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Gross Weight, and Flat Plate Area for Auxiliary Thrust Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	7.09	7.83
L/DE (with upwash)	6.63	7.30
PLL Amplitude-lbs (without upwash)	483	293
PLL Amplitude-lbs (with upwash)	532	493
Vertical Shear Amplitude-lbs (without upwash)	897	2336
Vertical Shear Amplitude-lbs (with upwash)	1431	1820
FZF-lbs (without upwash)	720	1173
FZF-lbs (with upwash)	795	1386
Flight Condition	15	5

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Wing Lift, and Gross Weight Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	8.93	8.21
L/DE (with upwash)	8.72	8.01
PLL Amplitude-lbs (without upwash)	1025	873
PLL Amplitude-lbs (with upwash)	1052	987
Vertical Shear Amplitude-lbs (without upwash)	2556	3431
Vertical Shear Amplitude-lbs (with upwash)	3436	3188
FZF-lbs (without upwash)	1362	1730
FZF-lbs (with upwash)	1194	1795
Flight Condition	16	6

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Wing Lift, and Gross Weight Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	7.27	7.45
L/DE (with upwash)	7.18	7.26
PLL Amplitude-lbs (without upwash)	261	407
PLL Amplitude-lbs (with upwash)	429	546
Vertical Shear Amplitude-lbs (without upwash)	3124	5386
Vertical Shear Amplitude-lbs (with upwash)	3138	5220
FZF-lbs (without upwash)	765	1733
FZF-lbs (with upwash)	655	1594
Flight Condition	17	9

Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Wing Lift, Gross Weight, and Flat Plate Area for Auxiliary Thrust Are Held Constant.

Rotor Radius-ft	25	30
L/DE (without upwash)	8.04	7.29
L/DE (with upwash)	8.57	7.65
PLL Amplitude-lbs (without upwash)	869	735
PLL Amplitude-lbs (with upwash)	905	927
Vertical Shear Amplitude-lbs (without upwash)	3234	3306
Vertical Shear Amplitude-lbs (with upwash)	4630	4694
FZF-lbs (without upwash)	1559	2685
FZF-lbs (with upwash)	1521	2444
Flight Condition	18	10

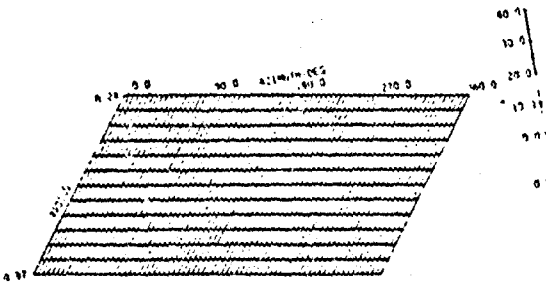
Variation of Equivalent Lift-to-Drag Ratio, Flap Hinge Vertical Shear Vibratory Amplitude, Pitch Link Load Vibratory Amplitude, and Vertical Hub Force Fourth Harmonic Amplitude with Rotor Radius from Loads Analysis. Flight Velocity, Rotor Lift, Wing Lift, Gross Weight, and Flat Plate Area for Auxiliary Thrust Are Held Constant.

APPENDIX D

Surface Plots

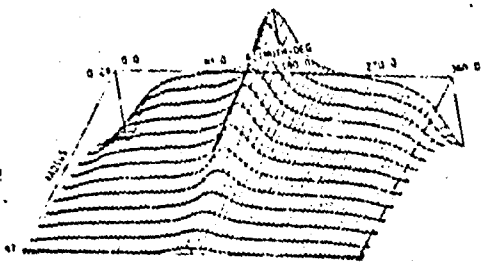
This appendix contains a few surface plots of upwash values, UP, the steady value and first ten harmonics of the blade loading, and the same blade loading with the steady value and first two harmonics removed. The blade loading is from B-65. The upwash values in this appendix are not nondimensionalized by rotor tip speed. They have units of ft/sec. The blade loading is in lb/in. These surface plots are examples only. They show that the effects of fuselage/wing/engine upwash on blade loading distribution is not dramatic.

ISOLATED ROTOR

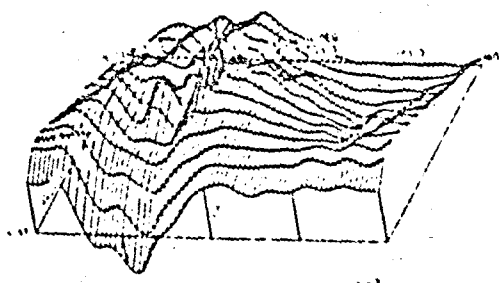


UPWASH VELOCITY, NORMAL COMPONENT,
Δu_p FUSELAGE (ft/sec)

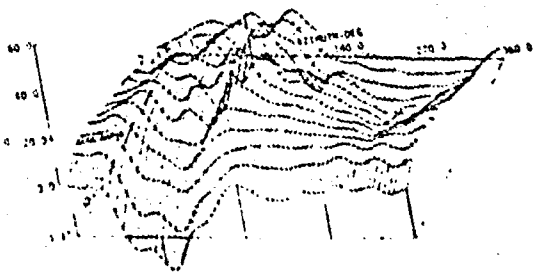
FUSELAGE UPWASH



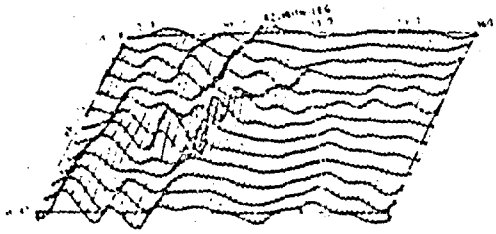
UPWASH VELOCITY, NORMAL COMPONENT,
Δu_p FUSELAGE (ft/sec)



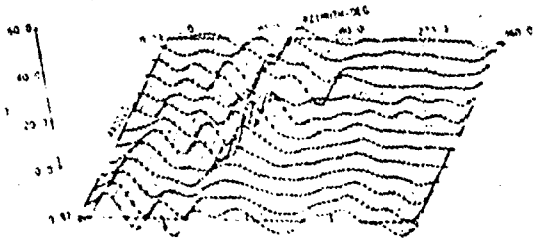
BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 3 TO 10

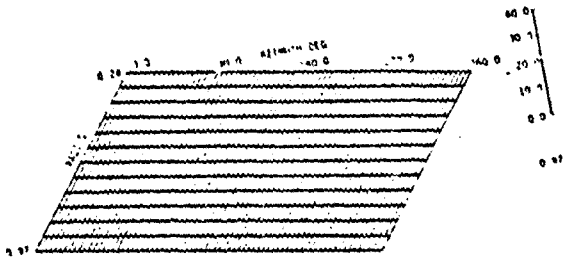


BLADE LOADING (lb/in)
HARMONICS 3 TO 10

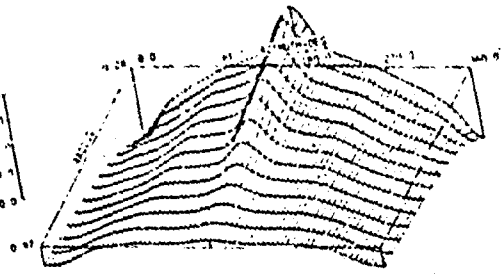
Flight Condition 3

ISOLATED ROTOR

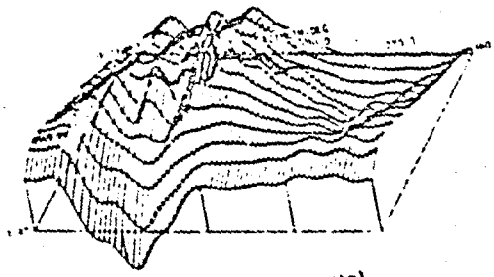
FUSELAGE UPWASH



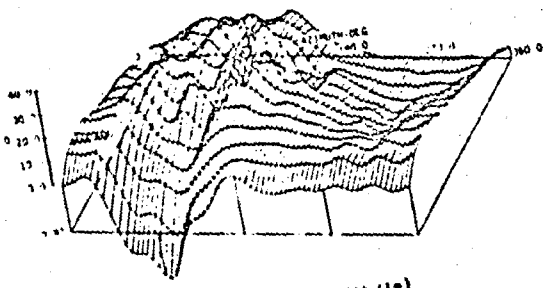
UPWASH VELOCITY, NORMAL COMPONENT,
$\Delta U_{FUSELAGE}$ (ft/sec)



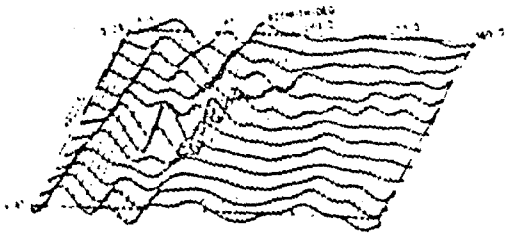
UPWASH VELOCITY, NORMAL COMPONENT,
$\Delta U_{FUSELAGE}$ (ft/sec)



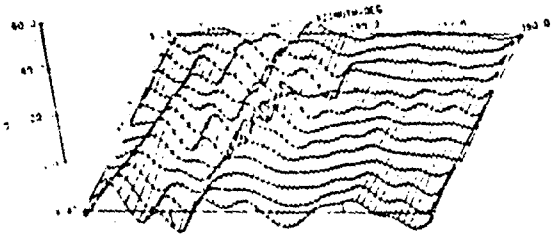
BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 3 TO 10

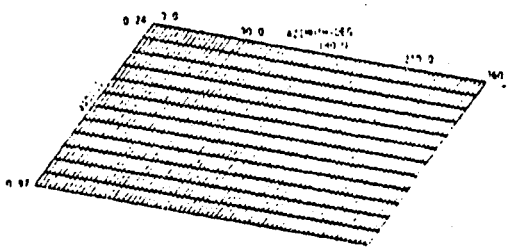


BLADE LOADING (lb/in)
HARMONICS 3 TO 10

Flight Condition 5

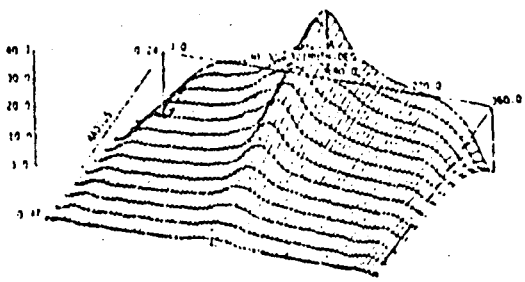
ISOLATED ROTOR

FUSELAGE UPWASH



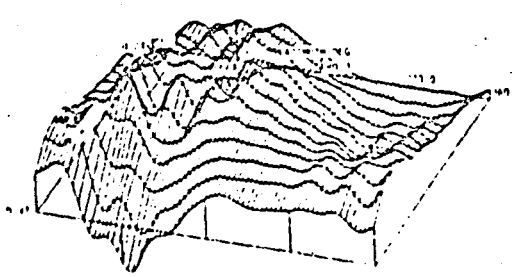
UPWASH VELOCITY, NORMAL COMPONENT,

$\Delta Up_{FUSELAGE}$ (ft/sec)



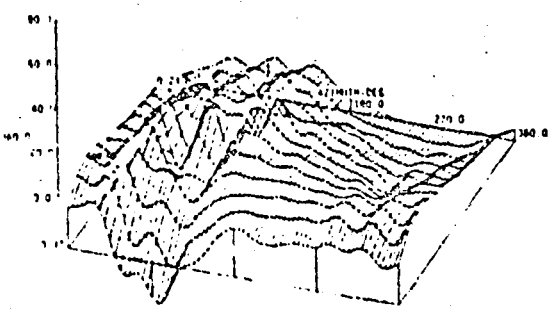
UPWASH VELOCITY, NORMAL COMPONENT,

$\Delta Up_{FUSELAGE}$ (ft/sec)



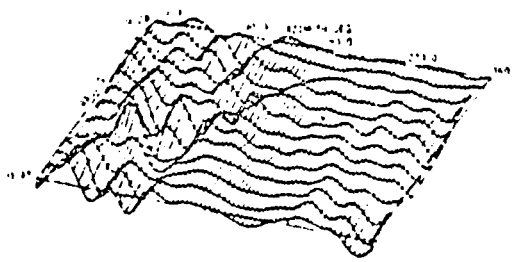
BLADE LOADING (lb/in)

HARMONICS 0 TO 10



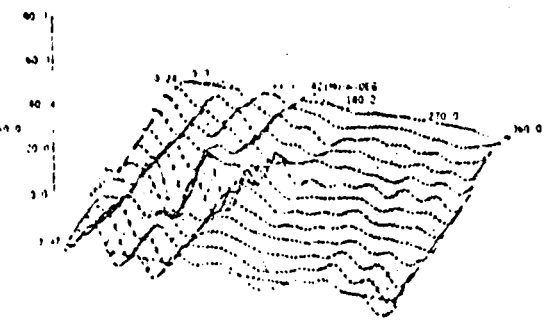
BLADE LOADING (lb/in)

HARMONICS 0 TO 10



BLADE LOADING (lb/in)

HARMONICS 3 TO 10

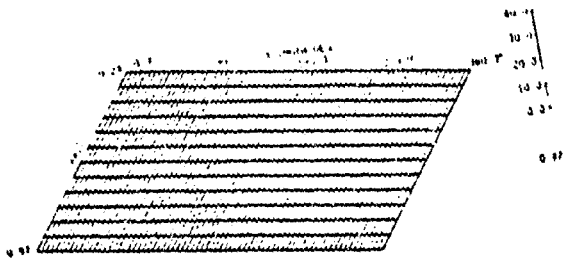


BLADE LOADING (lb/in)

HARMONICS 3 TO 10

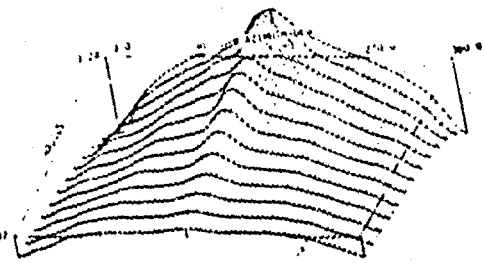
Flight Condition 7

ISOLATED ROTOR

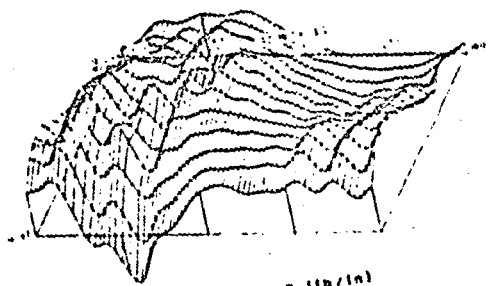


UPWASH VELOCITY, NORMAL COMPONENT,
Δu_p FUSELAGE (ft/sec)

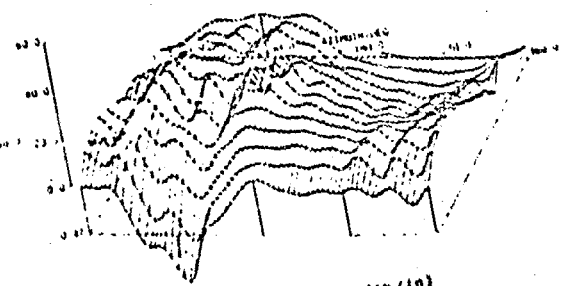
FUSELAGE UPWASH



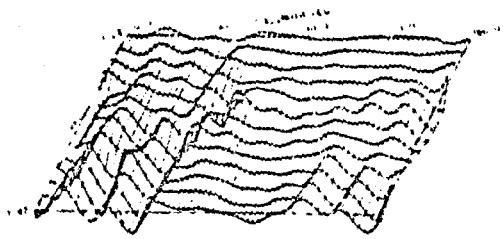
UPWASH VELOCITY, NORMAL COMPONENT,
Δu_p FUSELAGE (ft/sec)



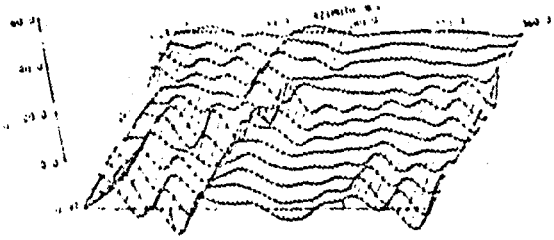
BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 0 TO 10



BLADE LOADING (lb/in)
HARMONICS 0 TO 10

Flight Condition 9

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15. Supplementary Notes

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16. Abstract

The effects of RSRA fuselage configurations on rotor performance and loads have been quantified analytically be means of currently available potential flow and rotor analysis.

Four configurations of the Rotor Systems Research Aircraft (RSRA) were considered in this study. They were:

(1) Fuselage alone (conventional helicopter)
(2) Fuselage with auxiliary propulsion
(3) Fuselage with wings (auxiliary lift)
(4) Fuselage with both auxiliary lift and propulsion

The rotor system investigated was identical to a CH-47D front rotor except that it had four instead of three blades. Two scaled-down versions of the same rotor were also analyzed to determine the effect of rotor scale on the fuselage upwash effects.

The flight conditions considered for the upwash study are discussed. The potential flow models for the RSRA configuration, with and without the wings and the auxiliary propulsion system, are presented. The results of fuselage/wing/propulsion system upwash on performance and loads are also presented.

The plethora of data resulting from this study reflected the existence of complicated flow interactions and did not lend itself to straightforward interpretation in all cases. More often than not though, neglecting fuselage upwash causes an underestimation of performance and an underestimation of loads.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
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