NASA Contractor Report 181916, Volume I

INVESTIGATION OF DIFFICULT COMPONENT EFFECTS ON FINITE ELEMENT MODEL VIBRATION PREDICTION FOR THE BELL AH-1G HELICOPTER

Volume I – Ground Vibration Test Results

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Space Administration

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FOREWORD

Bell Helicopter Textron Inc. (BHTI) has been conducting a study of finite element modeling of helicopter airframes to predict vibration. This work is being performed under U.S. Government Contract NAS1-17496. The contract is monitored by the NASA Langley Research Center, Structures Directorate.

This report summarizes a series of ground vibration tests performed on a Bell AH-1G helicopter airframe to isolate the effects of various components on overall airframe vibratory response. Key NASA and BHTI personnel are listed below:

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1. INTRODUCTION

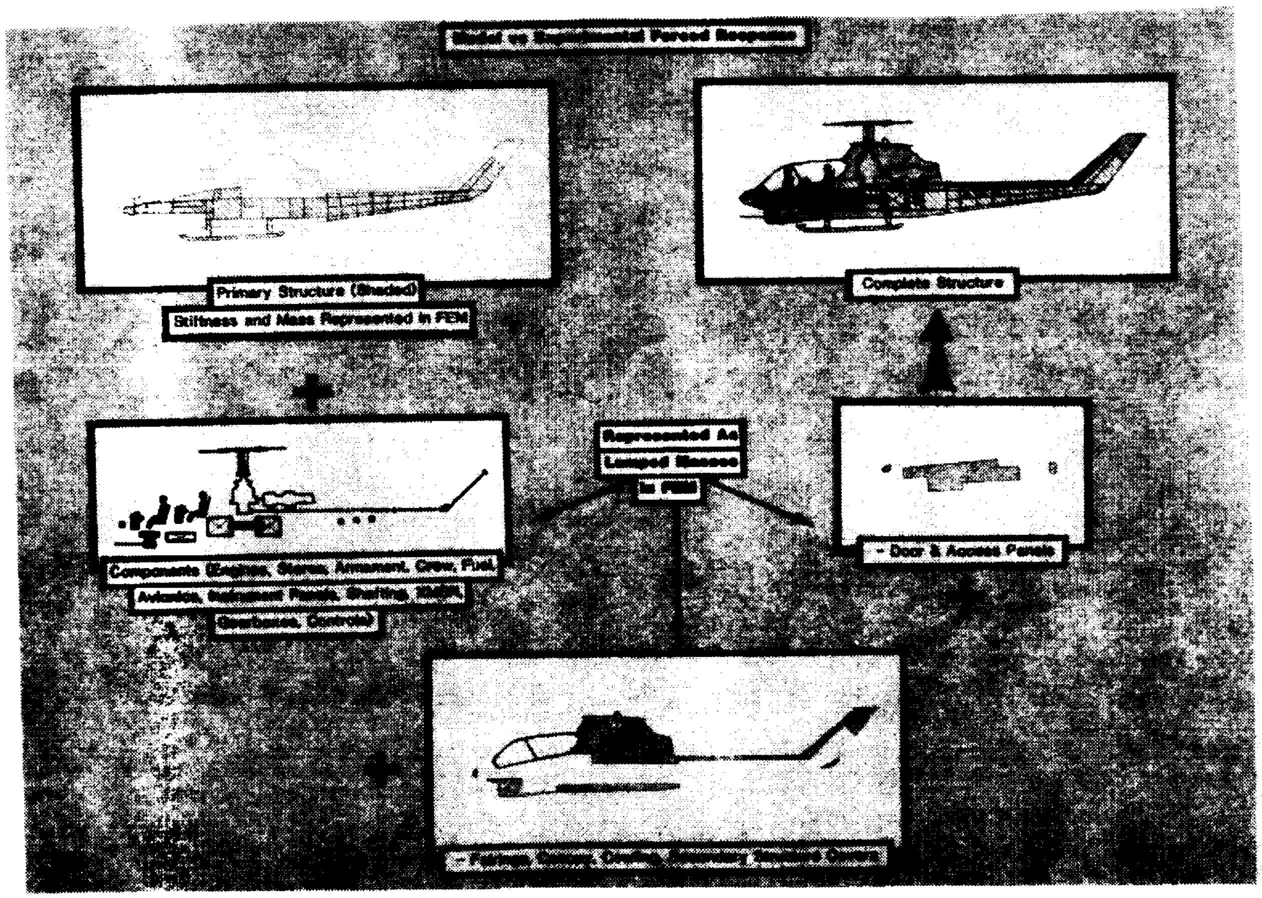
INTRODUCTION - DIFFICULT COMPONENTS INVESTIGATION

The NASA Langley Research Center is sponsoring a rotorcraft structural dynamics program with the overall objective to establish in the United States a superior capability to utilize finite element analysis models for calculations to support industrial design of helicopter airframe structures. Viewed as a whole, the program is planned to include efforts by NASA, universities, and the U.S. helicopter industry. In the initial phase of the program, teams from the major U.S. manufacturers of helicopter airframes will apply extant finite element analysis methods to calculate static internal loads and vibrations of helicopter airframes of both metal and composite construction, conduct laboratory measurements of the structural behavior of these airframes, and perform correlations between analysis and measurements to build up a basis upon which to evaluate the results of the applications. To maintain the necessary scientific observation and control, emphasis throughout these activities will be on advanced planning, documentation of methods and procedures, and thorough discussion of results and experiences, all with industry-wide critique to allow maximum technology transfer between companies. The finite element models formed in this phase will then serve as the basis for the development, application, and evaluation of both improved modeling techniques and advanced analytical and computational techniques, all aimed at strengthening and enhancing the technology base which supports industrial design of helicopter airframe structures. Here again, procedures for mutual critique have been established, and these procedures call for a thorough discussion among the program participants of each method prior to the applications and of the results and experiences after the applications. The aforementioned rotorcraft structural dynamics program has been given the acronym DAMVIBS (Design Analysis Methods for VIBrationS).

Based on previous correlations of a NASTRAN finite element model (FEM) of the AH-1G helicopter airframe (Ref. 1), vibration response predictions in the 20-30 Hz frequency range encompassing 4p were identified as needing further investigation. The purpose of this task is to evaluate the effects of difficult components (e.g., transmission, engine, secondary structure, etc.) on airframe vibration response and on the aforementioned correlations. Under this task, Bell Helicopter Textron, Inc. performed the following: (a) conducted ground vibration tests on an AH-1G helicopter airframe and selected components to evaluate the effect of difficult components on the vibration response of the airframe; (b) performed correlations using an extant NASTRAN FEM of the AH-1G airframe; and (c) reformulated the FEM as necessary and, based on the results of the correlations, made recommendations for further R&T work to improve vibration modeling and prediction methodology.

Volume I of this report addresses item (a), i.e., testing conducted by Bell Helicopter Textron Inc. to isolate various component effects on the overall vibratory response of the Bell AH-1G helicopter airframe. In order to isolate the effects of each component, multiple ground vibration tests were conducted with each test representing a progressive removal of an individual component until only the primary airframe structure remained.

INTRODUCTION - DIFFICULT COMPONENTS INVESTIGATION



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2. AIRCRAFT GROUND VIBRATION TEST DESCRIPTION

TEST OBJECTIVES AND APPROACH

As a result of previous efforts (Ref. 1), several components on the AH-1G (e.g., transmission, engine, secondary structure, etc.), were identified as candidates for investigation under this task. These components represent areas of the analytic model which are suspected as requiring more rigorous mathematical representation to account for their effects. Particular attention will be paid to these areas in defining test conditions to isolate each of the components listed below and their effect on the overall vibratory response of the airframe. These "difficult components" will be investigated through a series of aircraft and component ground tests and correlations with the AH-1G NASTRAN FEM.

TEST OBJECTIVES AND APPROACH

OBJECTIVE

- ACQUIRE FREQUENCY DOMAIN DATA FROM 0 - 35 HZ
- EXCITE MODES FROM SEVERAL LOCATIONS (NOT SIMULTANEOUSLY)
- IDENTIFY DIFFICULT COMPONENT EFFECTS
  - MAIN ROTOR PYLON
  - SECONDARY STRUCTURE
  - LANDING GEAR
  - ENGINE
  - FUEL
  - SUSPENSION SYSTEM

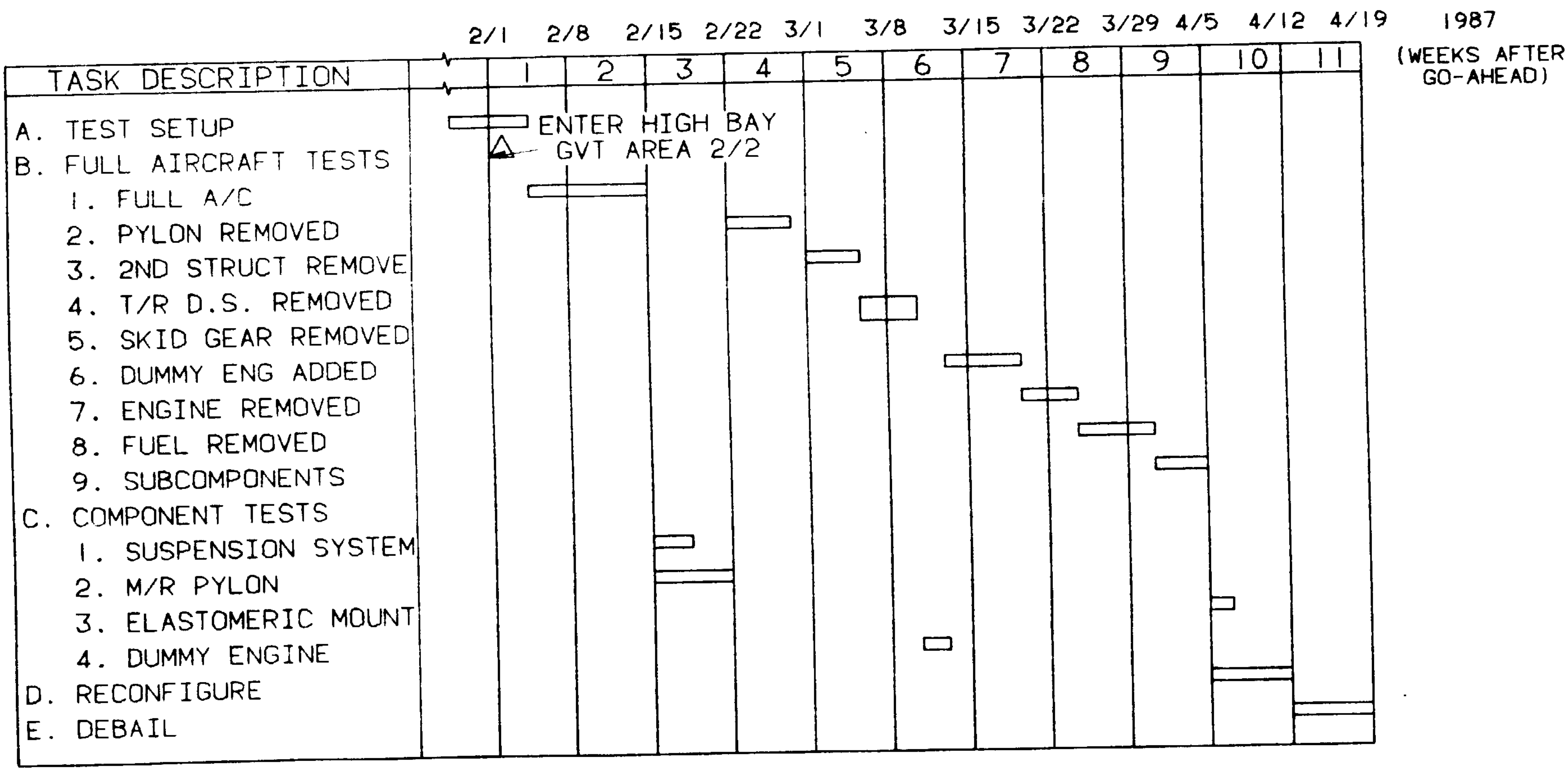
APPROACH

- OBTAIN FREQUENCY RESPONSE FUNCTIONS AND FORCED RESPONSE MODE SHAPES FROM 0 - 35 HZ
- SYSTEMATIC REMOVAL OF DIFFICULT COMPONENTS
- ISOLATED COMPONENT TESTS
  - MAIN ROTOR PYLON
  - SUSPENSION SYSTEM

GROUND VIBRATION TEST SCHEDULE - DIFFICULT COMPONENT INVESTIGATION

The schedule for the AH-1G airframe and component ground vibration testing is shown.

GROUND VIBRATION TEST SCHEDULE - DIFFICULT COMPONENT INVESTIGATION

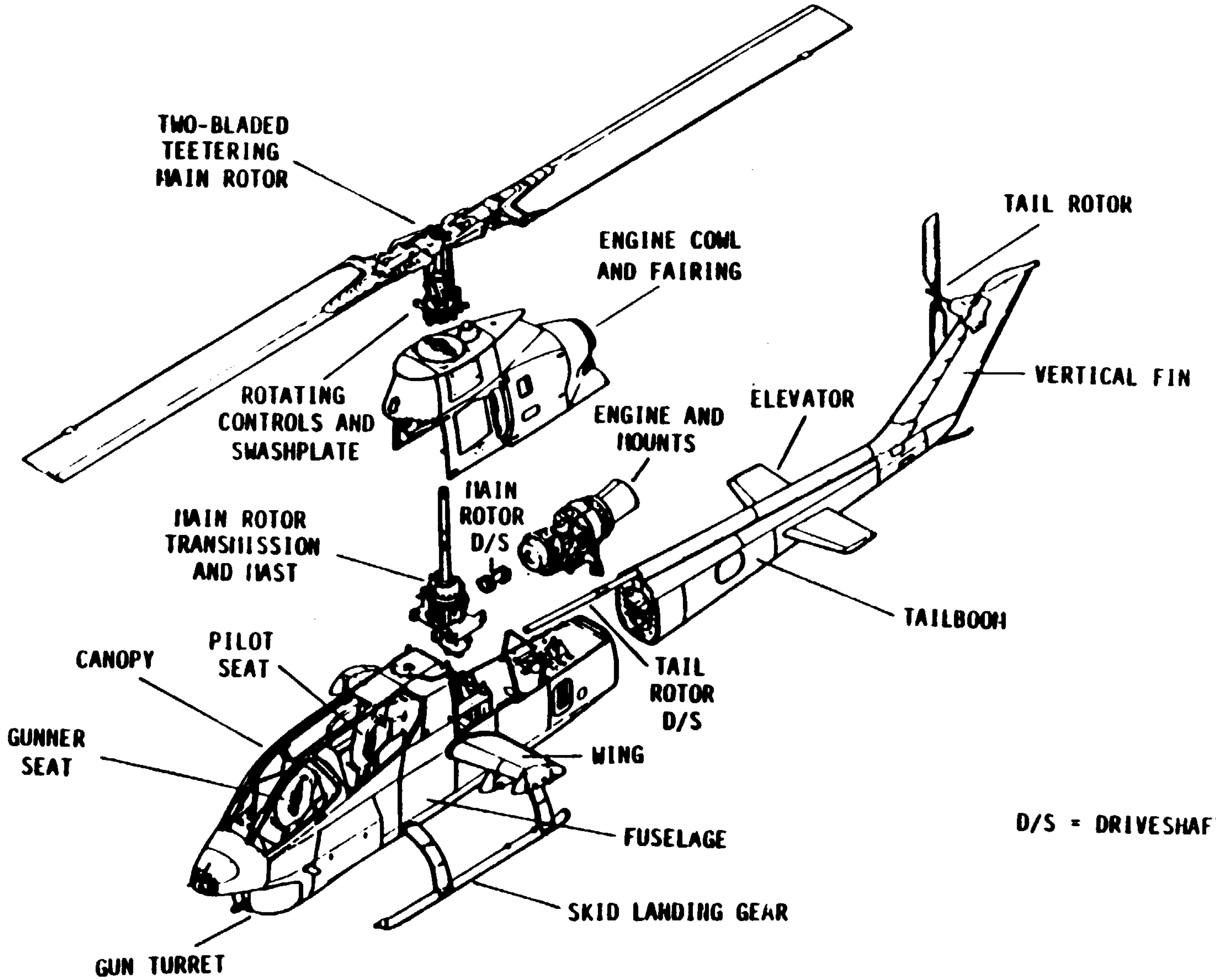


TEST ARTICLE DESCRIPTION - AH-1G HELICOPTER

BHTI began development of the AH-1G (Model 209) in March 1965 as a company-funded development of the UH-1B/C Iroquois intended specifically for armed helicopter missions. The original design combined the basic rotor system, transmission and power plant of the UH-1C with a new, streamlined fuselage designed for increased speed, armament load, and crew efficiency. Tandem seating is provided for the crew of two with the copilot/gunner forward and the pilot aft.

The original version for the U.S. Army was powered by a single 1400 shp Avco Lycoming T53-L-13 turboshaft engine derated to 1100 shp for take off and maximum continuous rating. The AH-1G uses a Model 540 two-bladed wide-chord 'door hinge' 44 ft diameter main rotor system similar to that of the UH-1C. The interchangeable blades are built-up of extruded aluminum spars and laminates. The main rotor rpm is 294 to 324. The two-bladed tail rotor is an all metal, flex-beam, tractor design located on the starboard side and is of honeycomb construction. The 44.5 ft long AH-1G fuselage is a conventional all-metal semi-monocoque structure with low silhouette and narrow profile. The small mid-mounted stub wings carry armament and off-load the rotor in flight. The landing gear is a nonretractable tubular skid-type gear.

TEST ARTICLE DESCRIPTION - AH-1G HELICOPTER



AH-1G AIRFRAME STRUCTURE DESCRIPTION

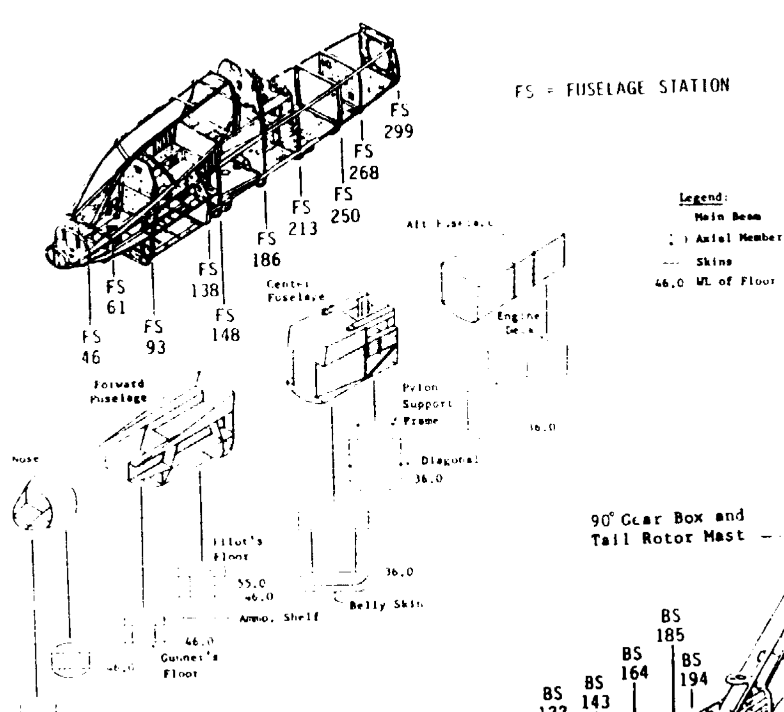
A brief structural description of three major divisions of the AH-1G is presented: the fuselage structure, the main rotor pylon, and the tailboom and vertical fin structures with panels removed. These are illustrated below.

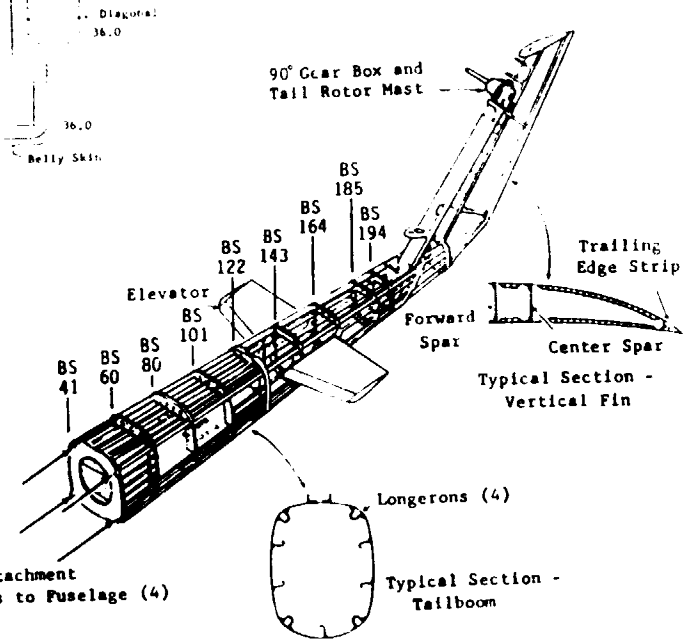
The fuselage structure is built around the two main beams running the length of the fuselage (FS 61 to FS 300). The main beams provide the primary vertical bending stiffness in the fuselage structure and differential bending of the main beams provides torsional stiffness in the open sections of the forward fuselage. The main beams are tied together by the lower horizontal floors to give the fuselage lateral stiffness. The cross-sectional areas in the figure detail the fuselage structure.

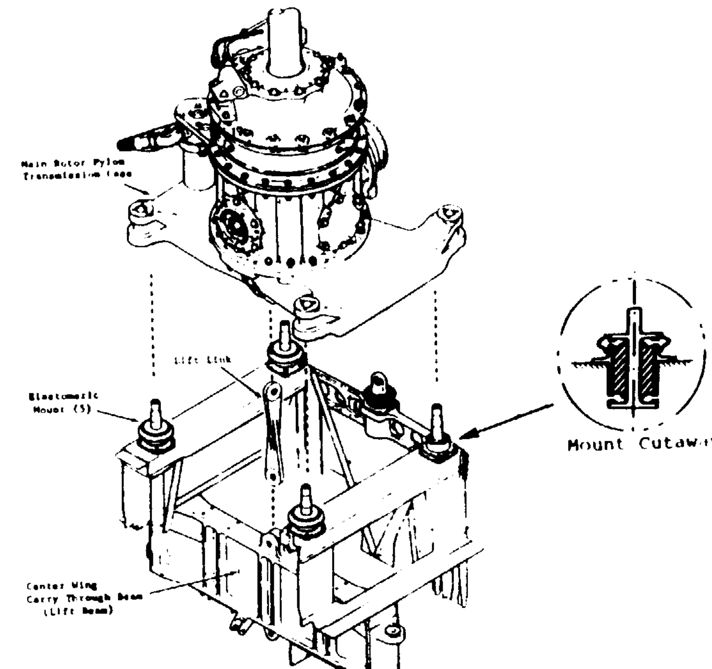
The main rotor pylon located at FS 200 above WL 65 provides the structural tie between the main rotor and the fuselage. It is attached to the fuselage through five elastomeric mounts and a lift link. The lift link is the primary vertical load path and is pinned to the center wing carry-through beam or "lift beam." The elastomeric mounts are designed to produce low pylon rocking frequencies to isolate the main rotor in-plane vibratory loads from the fuselage and to react the main rotor torque. The carry-through consists of three beams that are attached to the spars by pinned connections at the fuselage contour.

The tailboom is of semi-monocoque construction having aluminum skins, stringers, and longerons. The longerons and stringers are supported by bulkhead frames spaced down the length of the boom. The tailboom is bolted to the fuselage at FS 299 by means of four attachment fittings located at the four main longeron locations.

AH-1G AIRFRAME STRUCTURE DESCRIPTION







TEST ARTICLE WEIGHT AND BALANCE CALCULATIONS

The test article used for the ground vibration tests was a bailed Bell AH-1G Cobra (Model 209).

Ship No. 69-16444 was received at BHTI on December 16, 1986. This ship was released from Bell in an 876 configuration. Since its release, the ship has been extensively modified to convert it to an 880 configuration. A total of 188 lbs was added to the initial 876 configuration over the history of this particular ship (see table below) to convert it to an 880 configuraton. Configuration 876 has a basic empty weight (BEW) of 5571. Therefore, the BEW for the test article is 5571 + 188 = 5759 lb. Useful loads on the ship, when received, totaled 163 lbs, as shown in the accompanying table. Hence, the bailed aircraft total weight on 12/18/86 was 5759 + 163 = 5922 lbs.

AH-1G SIGNIFICANT WEIGHT MODIFICATIONS (876→880)

Action		Weight (lb)
1.	Install Pilot and Gunner Instrument Light Circuits	+3.3
2.	Install Cowl Latch Indicator	+0.8
3.	Install Shock Mounted Instrumentation Panels	+3.5
4.	Install Complete provisions for KY-28 Voice Security System	+0.4
5.	Install Canopy pyrotechnic removal system	+7.0
6.	Install Fire Detection System	+8.0
7.	Install Improved T/R System	+13.3
8.	Install Hangar Support Braces/Rocket Electric Provisions	+18.2
9.	Eliminate Engine Air Inlet Screens	-2.8
10.	Install Aircraft Electric Ignition Security Device	+0.5
11.	Install Provisions for IR Suppressor	+2.2
12.	Install Crashworthy Fuel system	+102.6
13.	Modify Engine Deck panel	-6.0
14.	Install door lock devices	+3.3
15.	Install Toggle Circuit Breakers for Armament System	+3.7
16.	Install Improved Closed-Circuit Refueling Receptacle	+18.0
17.	Modify Structure/Misc Changes	+12.0
	TOTAL	188.0 lbs

TEST ARTICLE WEIGHT AND BALANCE CALCULATIONS

ADDITIONAL USEFUL WEIGHT ON AH-1G AT BAILMENT

Item	Weight (lb)
Trapped fuel	8.5
Transmission oil	22.5
Engine oil	23.4
42° and 90° gearbox fluids	0.7
Wing pylons - inboard	68.0
Wing pylons - outboard	40.0

Total = 163 lb

AH-1G WEIGHT AND BALANCE CALCULATION

MODEL: AH-1G
WEIGH DATE: 18 DECEMBER 1986

SERIAL NO: 20880
DATE: 14 JANUARY 1987

ITEM	WEIGHT (LB)	LONGITUDINAL		LATERAL	
		ARM (IN)	MOMENT (IN·LB)	ARM (IN)	MOMENT (IN·LB)
JACK POINT	2800.0	200.35	560980.0	60.90	170520.0
JACK POINT	2714.0	200.35	543750.0	-60.90	-165280.0
JACK POINT	408.0	299.09	122030.0	-10.00	-4080.0
AS WEIGHED	5922.0	207.16	1226800.0	0.20	1160.0
PILOT	0.0	125.0	0.0	0.00	0.0
TOTAL	5922.0	107.16	1226800.0	0.20	1160.0

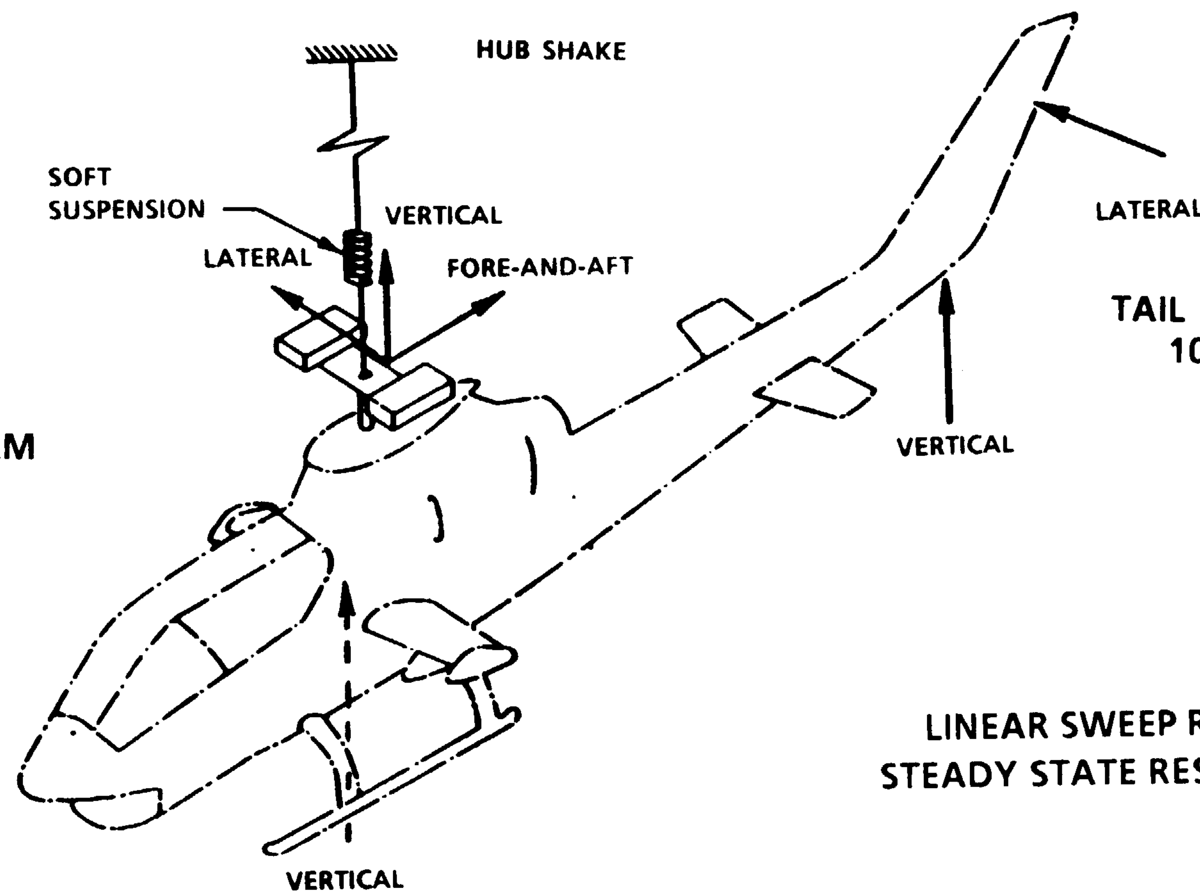
AIRFRAME SINUSOIDAL VIBRATION TEST

The airframe sinusoidal vibration test setup is depicted in the illustration. In configuration 1, the main rotor and hub were replaced by a dummy hub that is ballasted to represent the 948 pound weight. The dummy hub was aligned perpendicular to the flapping axis to remove local inertias since the NASTRAN model does not contain flapping inertias. The tail rotor blade was replaced with dummy weights. All aircraft configurations were clean wing. After removal of the main rotor pylon, all configurations were hoisted by a quad brace and excited vertically at the lift beam.

Swept sine excitation allows more energy input at each frequency than would be possible using random excitation. This is important in evaluating nonlinear systems. However, in order to prevent excessive response (and potentially damaging loads) while sweeping through natural frequencies, it was necessary to limit the amplitude of the excitation force. Therefore, the excitation forces used should not be considered representative of the rotor generated forces that occur in flight. Due to the nonlinearities, the response to rotor harmonics in flight may be different from those indicated by the frequency response functions obtained in these tests. Also, the nonlinear effects of simultaneous excitations at multiple frequencies and in multiple directions is not accounted for. Generally, .1 Hz frequency increments are used in the sine sweeps. This resolution provides sufficient data for accurate modal parameter representation. The data from each increment is recorded only after the transients have died-out and only steady state response remains.

The force levels used for each excitation were varied according to several basic needs. Firstly, the amplitudes must be of sufficient magnitude to obtain proper frequency response functions, but not so large to cause damaging vibrations. Secondly, two different force levels for frequency sweep from 2 - 30 Hz were used to determine effect of force level variation throughout the frequency range of interest. Finally, large amplitude forces, proximate to anticipated flight load levels, were used near main rotor 2p and 4p to obtain data points for nonlinear response. Generally, the flight level loads (400 - 1000 lb) were significantly greater than the frequency sweep load levels (20 - 200 lb).

AIRFRAME SINUSOIDAL VIBRATION TEST



M/R HUB-LIFT BEAM
EXCITATION
100 - 200 LBS

TAIL EXCITATION
10 - 40 LBS

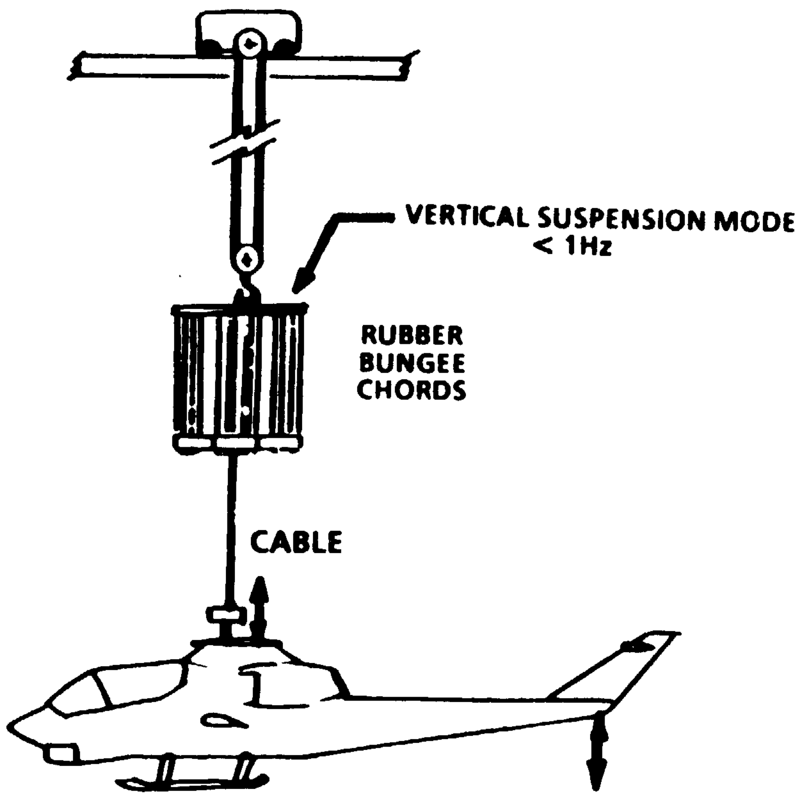
LINEAR SWEEP RATES -
STEADY STATE RESPONSE

SUSPENSION SYSTEM AND EXCITATION CONDITIONS

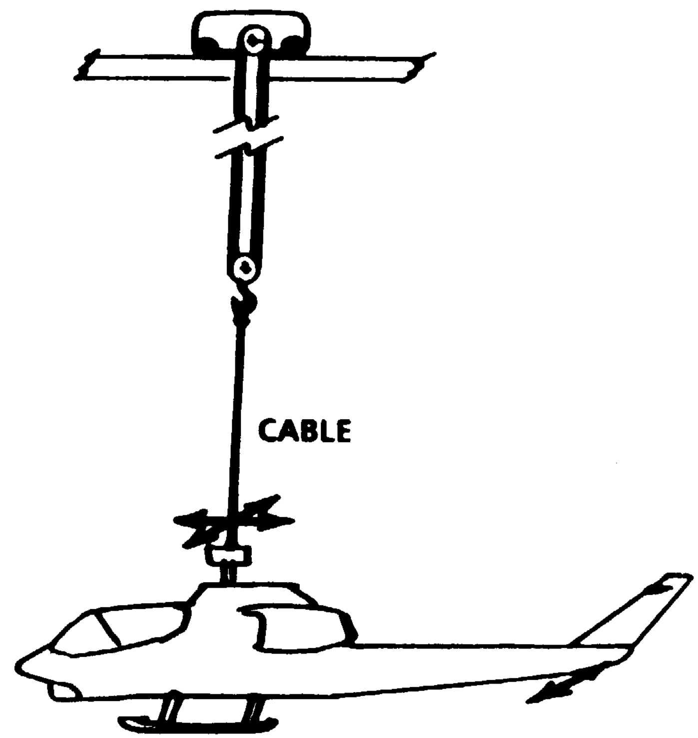
The AH-1G ground vibration test (GVT) vehicle was suspended at the main rotor hub by a long cable for in-plane excitations. During vertical excitation, 16 bungee chords were put between the hoist and hub. The bungee system is designed to place the vertical suspension rigid body mode at 1 Hz to isolate its effects from the flexible test vehicle modes between 2 - 30 Hz. Both suspension systems were instrumented to monitor cable/suspension modes and their relationship to any distortion of the frequency response.

Five excitation conditions were used for the initial configuration (full-up). Three hub shakes (vertical, lateral, F/A) and two tail shakes (vertical and lateral) were used as shown below. Once the main rotor pylon was removed, all additional configurations used the same cable suspension attached to a bridle assembly mounted to the M/R pylon attachment structure. The hub shakes were replaced with one vertical excitation condition into the lift beam and the tail shakes remained unchanged.

SUSPENSION SYSTEM AND EXCITATION CONDITIONS



VERTICAL EXCITATION



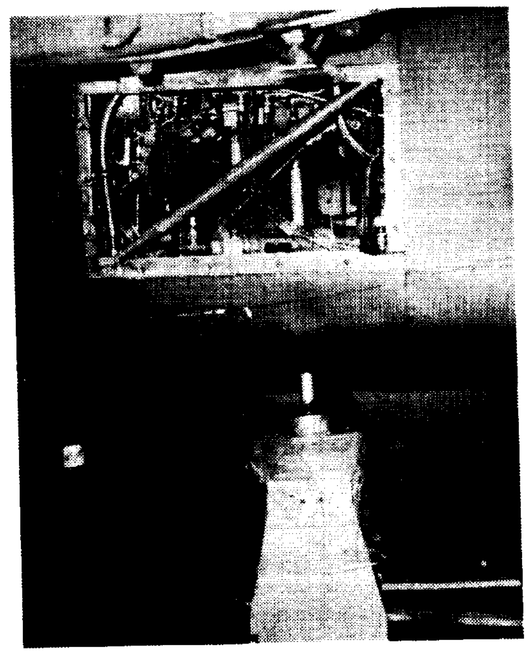
IN-PLANE EXCITATION

SHAKER INSTALLATION

Photographs of the servo-controlled shakers used for the test configurations are illustrated below. The initial configuration had three additional hub shakes performed at the main rotor mast location (not shown).

SHAKER INSTALLATION

VERTICAL-TAIL SKID



VERTICAL-LIFT BEAM
(PROXIMATE TO C.G.)

LATERAL-T/R HUB

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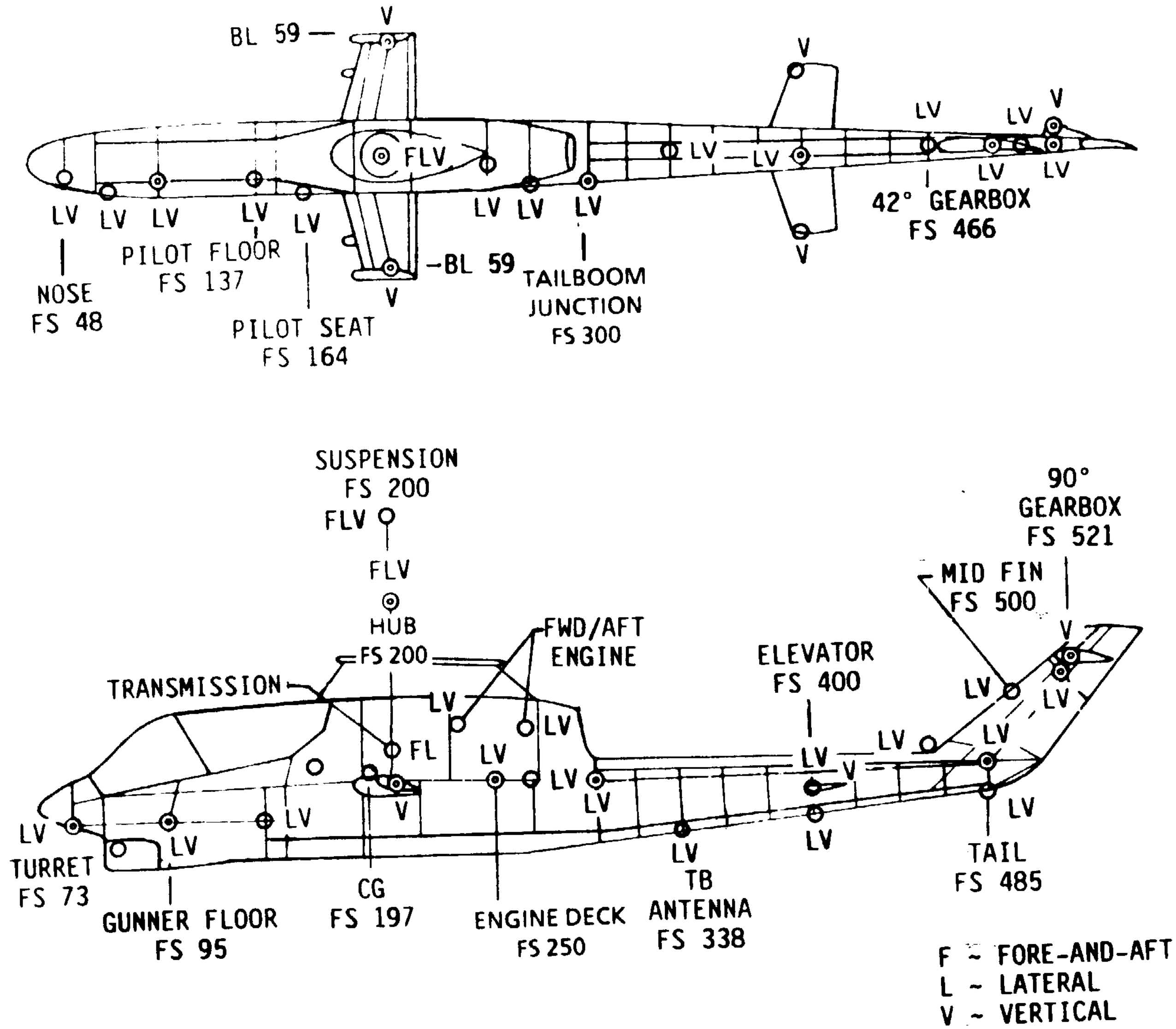
ACCELEROMETER LOCATIONS

Accelerometer locations were selected to correspond as closely as possible to grid point locations in the NASTRAN model and were located on hard-point structure to facilitate correlation. Accelerometer placement locations for each test configuration are described in the table and illustrated in the figure. Appendix A contains photographic documentation of all instrumentation locations used in test.

TRANSDUCER DESCRIPTION	FS	BL	WL	CONFIG 1		CONFIG 2-4		CONFIG 5		CONFIG 6		CONFIG 7-8	
				VERT	LAT	VERT	LAT	VERT	LAT	VERT	LAT	VERT	LAT
Gunner Heel Rest	48.0	-9.1	46.0	V(2)	L(2)	V(2)	L(2)	V(2)	L(2)	V(2)	L(2)	V(2)	L(2)
Gunner Floor	95.0	-10.0	46.0	V(3)	L(3)	V(3)	L(3)	V(3)	L(3)	V(3)	L(3)	V(3)	L(3)
Pilot Floor	136.7	-10.0	46.0	V(6)	L(6)	V(6)	L(6)	V(6)	L(6)	V(6)	L(6)	V(6)	L(6)
Pilot Seat Top Aft	164.0	-17.6	77.5	-	-	-	-	-	-	V(4)	L(4)	V(4)	L(4)
Center-of-Gravity	196.9	-9.0	64.6	V(7)	L(7)	V(7)	L(7)	V(7)	L(7)	V(7)	L(7)	V(7)	L(7)
Transmission	200.0	-8.0	86.3	F(25)	L(25)	-	-	-	-	-	-	-	-
Main Rotor Hub	200.0	3.0	154.9	V(11) L(12) F(13)	V(11) L(12) F(13)	-	-	-	-	-	-	-	-
Suspension Cable	200.0	0.0	184.0	V(8) L(9) F(10)	L(10)	V(8) L(9) F(10)	L(10)	V(8) L(9) F(10)	L(10)	V(8) L(9) F(10)	L(10)	V(8) L(9) F(10)	L(10)
Left Wing Tip	204.0	-59.0	63.9	V(15)	V(15)	V(15)	V(15)	V(15)	V(15)	V(15)	V(15)	V(15)	V(15)
Right Wing Tip	204.0	59.0	63.9	V(14)	V(14)	V(14)	V(14)	V(14)	V(14)	V(14)	V(14)	V(14)	V(14)
Forward Engine Deck	250.0	-2.3	64.5	V(18)	L(18)	V(18)	L(18)	V(18)	L(18)	V(18)	L(18)	V(18)	L(18)
Aft Engine Deck	268.2	-14.0	63.6	-	-	-	-	-	-	V(11)	L(11)	V(11)	L(11)
Forward Engine	232.3	0.0	95.6	V(16)	L(16)	V(16)	L(16)	V(16)	L(16)	V(16)	L(16)	-	-
Aft Engine	252.8	0.0	97.5	V(17)	L(17)	V(17)	L(17)	V(17)	L(17)	V(17)	L(17)	-	-
Tailboom Junction	296.3	-14.3	63.5	V(19)	L(19)	V(19)	L(19)	V(19)	L(19)	V(19)	L(19)	V(19)	L(19)
Tailboom Antennae	338.0	0.0	36.0	-	-	-	-	-	-	V(5)	L(5)	V(5)	L(5)
Elevator Centerline	402.4	-1.0	42.0	V(20)	L(20)	V(20)	L(20)	V(20)	L(20)	V(20)	L(20)	V(20)	L(20)
Left Elevator Tip	398.0	-32.8	57.0	-	-	-	V(8)	-	V(8)	-	V(8)	-	V(8)
Right Elevator Tip	398.0	33.3	57.0	-	-	-	V(9)	-	V(9)	-	V(9)	-	V(9)
42° Gearbox	466.0	0.0	74.0	-	-	V(13)	L(13)	V(13)	L(13)	V(13)	L(13)	V(13)	L(13)
Tail Skid Tube	485.3	0.0	54.7	V(21)	L(21)	V(21)	L(21)	V(21)	L(21)	V(21)	L(21)	V(21)	L(21)
Mid Vertical Tailfin	506.6	0.0	101.0	-	-	-	-	-	-	V(12)	L(12)	V(12)	L(12)
90° Gearbox	521.5	7.6	120.7	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)	V(22) L(23)
Tail Rotor Hub	520.7	19.6	119.7	V(24)	V(24)	V(24) F(25)	V(24) F(25)	V(24) F(25)	V(24) F(25)	V(24) F(25)	V(24) F(25)	V(24) F(25)	V(24) F(25)
Left Fwd Skid Gear	110.2	-40.0	11.0	V(4)	L(4)	V(4)	L(4)	-	-	-	-	-	-
Right Fwd Skid Gear	110.2	40.0	11.0	V(5)	L(5)	V(5)	L(5)	-	-	-	-	-	-
Left Aft Skid Gear	232.0	-38.0	7.4	-	L(9)	V(11)	L(11)	-	-	-	-	-	-
Right Aft Skid Gear	232.0	42.0	7.4	-	L(8)	V(12)	L(12)	-	-	-	-	-	-
Turret	73.0	-11.0	39.0	-	-	-	-	-	-	-	-	V(16)	L(16)

ACCELEROMETER LOCATIONS

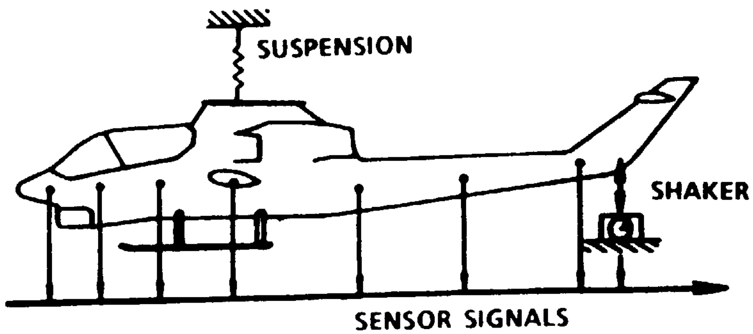


DATA ANALYSIS

BHTI's Interactive Test Data Analyses (INACT) program (Ref. 2) is part of the Vibration Analysis and Test Control System (VIBRATEC) which was used to acquire, store, and analyze data. Significant frequency, natural mode shape, critical damping estimate, and forced response mode shape information was determined for each test configuration using swept sine excitation with frequency sweeps from 2-30 Hz at two different force levels.

At the completion of each frequency sweep, the frequency response functions were copied from the computer disk to magnetic tape for permanent storage. In addition, mini-sweeps from 9-13 Hz (proximate to 2p, 10.8 Hz) and 18-25 Hz (proximate to 4p, 21.6 Hz) were performed at larger force amplitudes to obtain some measure of nonlinear response with respect to force magnitude. The results of these mini-sweeps were also saved on tape. Using the techniques described in Reference 3, the natural mode shapes and associated modal damping are derived at selected frequencies. Forced response mode shapes were also obtained by dwelling at certain frequencies. The forced response mode shapes include all residual modal response represented in a test and will be used to evaluate NASTRAN's compatibility with GVT response.

DATA ANALYSIS



DATA ACQUISITION AND VALIDATION:
- HARMONIC ANALYSIS
- FORCED RESPONSE ANIMATION
- TRANSFER FUNCTIONS

FREQUENCY RESPONSE OVER FREQUENCY RANGE - SWEEP

↓

SELECT RESPONSE PEAKS (UP TO 15)

↓

ESTIMATED MODAL FREQUENCIES AND DAMPING

↓

CIRCLE FIT TO ESTIMATE RESIDUES (SDOF)

↓

MULTI-DEGREE-OF-FREEDOM CURVE FIT TO REFINE MODAL PARAMETERS

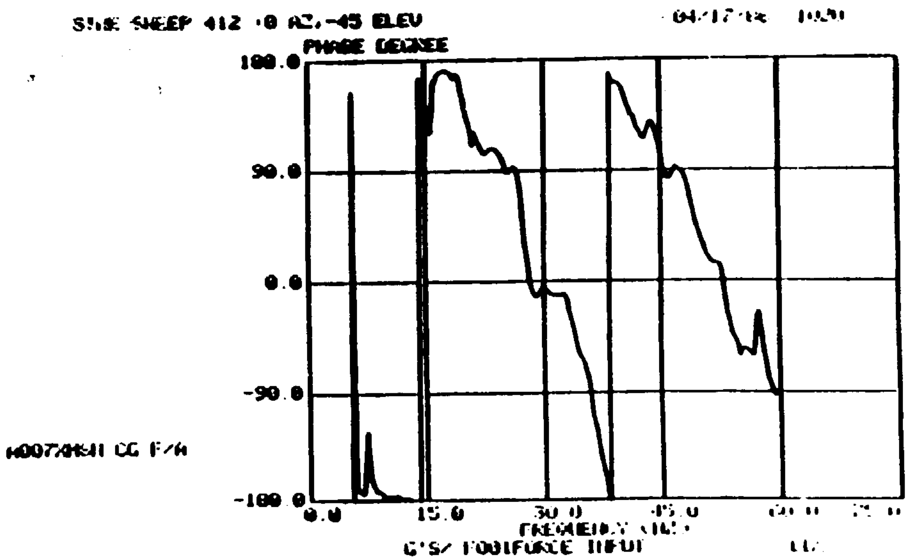
↓

DISPLAY MODAL FREQUENCIES, DAMPING, AND MODE SHAPES

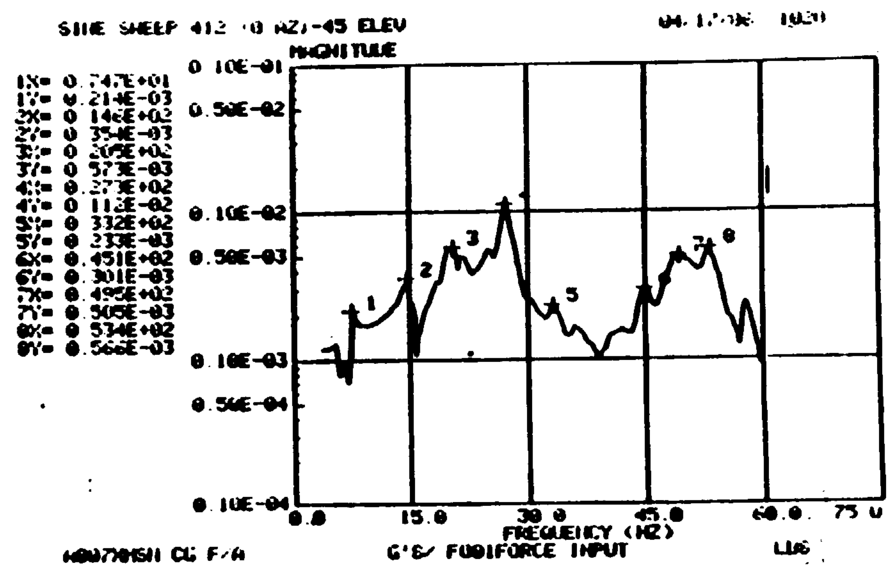
MEASURED FREQUENCY RESPONSE FUNCTIONS - A SAMPLE

VIBRATEC was utilized to obtain frequency response functions, as shown, for each transducer using a discrete Fourier analysis technique. For swept sinusoidal forcing functions, the time required to excite all frequencies of interest typically requires a substantial amount of time. Using a sampling rate of 512 samples/second results in approximately 180,000 samples per function. Due to limitations on computer disk memory size, an algorithm for frequency response function calculation is used which is computationally efficient and reasonably modest in computer memory requirements. The algorithm adapted in INACT/VIBRATEC requires storage of time history data in the frequency range of interest for all 26 channels. Functions x(t) and y(t) are defined as the forcing and response functions, respectively. The analog time history data signals are converted to integer (digital) values proportional to voltage. A low pass analog filter is used to frequency band limit the data before analog to digital (A/D) conversion. For harmonic analyses or transfer function data, the A/D conversion sampling rate should be chosen so that there are 8 to 10 (or more) samples per cycle of the highest frequency in the data. Calibration of the A/D conversion to engineering units is accomplished at this time. After computing x(t) and y(t), cross-power spectral density (CPSD) and power spectral density (PSD) values are determined at discrete frequencies and averaged to improve their estimates. The CPSD and PSD are used to compute the frequency response functions X(t) and Y(t) which contain all of the frequency magnitude and phase information of the vibration test data. Further, due to linearity of the Fourier transform (and discrete Fourier transform) the process of summing the sequence of functions in the time domain is equivalent to summing (or averaging) on a frequency-to-frequency basis in the frequency domain (i.e. X_k (F) is Fourier transform of X_k (t)). The significant modes are identified at peaks on the resulting magnitude plots or at 90 degree phase crossings on the accompanying phase plot as illustrated.

MEASURED FREQUENCY RESPONSE FUNCTIONS - A SAMPLE



PHASE
IN DEGREES



MAGNITUDE IN G'S PER
UNIT FORCE

MEASURED FORCED RESPONSE FUNCTIONS - A SAMPLE

(FIRST VERTICAL BENDING MODE)

Amplitude/phase and real/imaginary acceleration response for each transducer was measured at discrete frequencies during dwell tests. No data storage capability was available so only hard copies exist for comparison purposes. These forced response functions can be used to identify phase relationships between accelerometer responses and to compare with NASTRAN forced response mode shapes. Force amplitudes are recorded and the force channel phase is used as the reference phase for determining which component (sine or cosine) is the real and imaginary part. The imaginary component is the one closest to 90° out-of-phase with the force channel.

MEASURED FORCED RESPONSE FUNCTIONS - A SAMPLE
(FIRST VERTICAL BENDING MODE)

02/23/87 1522

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 430 SAMPLE RATE: 512

1/REV FREQUENCY: 8.33 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.0 DEG.

SW	POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	67.65	39.22	-55.12	144.56	67.34
2	1	A002NOSE V	0.2729	-0.2308	-0.1457	-122.2651	0.2741
3	1	A003GUNNER	0.1425	-0.1183	-0.0794	-123.8910	0.1434
4	1	A004LT SKI	0.1318	-0.1070	-0.0770	-125.7481	0.1312
5	1	A005RT SKI	0.0874	-0.0663	-0.0569	-130.6672	0.1055
6	1	A006PILOT	0.0516	-0.0381	-0.0349	-132.4876	0.0518
7	1	A007C/G VT	0.0764	0.0706	0.0293	67.4175	0.0784
8	1	A008SUSP V	0.0825	0.0761	0.0320	67.2078	0.0843
9	1	A009SUSP L	0.0112	0.0106	-0.0034	107.8568	0.0125
10	1	A010SUSP F	0.0168	-0.0133	-0.0103	-127.8151	0.0191
11	1	A011LT SKI	0.2966	-0.2965	0.0089	-88.2722	0.4573
12	1	A012RT SKI	0.1831	0.1654	0.0786	64.5885	0.1979
13	1	A01342 BOX	0.3925	-0.3901	0.0431	-83.6958	0.3952
14	1	A014RT WIN	0.1135	0.1101	-0.0278	104.1966	0.1124
15	1	A015LT WIN	0.0745	0.0696	0.0266	69.0785	0.0743
16	1	A016ENG FW	0.1298	0.1182	0.0535	65.6355	0.1329
17	1	A017ENG AF	0.1648	0.1483	0.0718	64.1745	0.1659
18	1	A018ENG DE	0.1596	0.1439	0.0690	64.3829	0.1610
19	1	A019T/B JU	0.1710	0.1529	0.0764	63.4417	0.1715
20	1	A020ELEV C	0.0388	-0.0234	-0.0309	-142.8376	0.0442
21	1	A021TAIL S	0.5302	-0.4530	-0.2755	-121.3044	0.5330
22	1	A02290 BOX	0.9110	-0.7805	-0.4699	-121.0532	0.9116
23	1	A02390 BOX	0.0189	0.0163	0.0095	59.7173	0.0225
24	1	A024T/R HU	0.9980	-0.8572	-0.5111	-120.8028	1.0002
25	1	A025T/R HU	0.7479	-0.5686	-0.4858	-130.5114	0.7672

MODAL PARAMETER EXTRACTION (MODAL PLUS *)

Extraction of resonance frequency (ω_r), modal damping (ζ_r), mode shape coefficients (Ψ_r) and residue (A_r) from digitized test frequency response data (H_{ik}) was accomplished by using Modal Plus. Modal Plus is an SDRC modal analysis software package used to determine the dynamic characteristics of a structure from frequency response functions (Ref. 4). It provides interactive analysis, validation and graphic display of data to extract modal parameters from test. A sample frequency response function obtained from test along with a MODAL PLUS synthesized overlay is provided. The basic analytical representation of a given frequency response function is also shown.

Natural frequency estimates and modal properties from MODAL PLUS were obtained using a multi-degree-of-freedom time domain extraction technique known as polyreference. Polyreference manipulates multiple response functions for up to 3 load cases simultaneously to obtain global least squares estimates of the modal parameters.

Modal damping estimates (% critical) are determined using the 1/2 power bandwidth technique. Damping estimates are provided for each mode extracted.

Mode shape coefficients are determined from the modal properties extracted using the Polyreference technique by a circle fit routine.

* Product of Structural Dynamics Research Corporation

MODAL PARAMETER EXTRACTION (MODAL PLUS*)

Test vs Synthesized Function

- MODAL PARAMETERS - POLYREFERENCE
- MODAL DAMPING - 1/2 POWER BANDWIDTH
- MODE SHAPES - CIRCLE FIT

$$H_{mn} = \sum_{r=1}^{2N} \left(\frac{\Psi_m^{\ r} \Psi_n^{\ r}}{\Psi_i^{\ r} \Psi_k^{\ r}} \right) \frac{A_{ik}^{\ r}}{(jw_r + \zeta_r w_r \pm jw_r \sqrt{1 - \zeta_r^2})}$$

<u>Modal Parameters</u>

H_{mn}	=	Synthesized FRF for point m due to force at n
Ψ_m	=	Mode coefficient at response point m
Ψ_n	=	Mode coefficient at response point n
Ψ_i	=	Measured mode coefficient at point i
Ψ_k	=	Measured mode coefficient at point k
A_{ik}	=	Amplitude (residue) determined from test H_{ik}
W_r	=	Natural frequency of r^{th} mode
ζ_r	=	Modal damping of r^{th} mode

*Product of Structural Dynamics Research Corporation

TEST LOG SUMMARY

Frequency response sweeps and forced response dwells were performed under several loading conditions on each of the test article configurations as described in the test matrix on the next two pages of text. 40 separate sinusoidal sweeps from 0-35 Hz were performed and are listed in the table. The trends associated with the measured frequency response data will be highlighted for each configuration on the next 30-40 pages by showing direct overplot comparisons of two response points, the gunner and tail skid, for each successive configuration. These comparisons enable one to visualize the effect of each component, in a cursory manner, on the overall frequency response. More detailed investigations of frequency response changes for each of the 24 channels measured during each test require the complete database. The 40 measured frequency response sweeps are stored on magnetic tape and are available upon request.

In addition to the sinusoidal sweeps, many discrete frequency dwells were performed during the test to obtain forced response mode shapes used to identify the modes. The frequencies of interest were identified from the phase plots obtained during sine sweeps. The collection of dwells is detailed in Appendix B. No capability existed to digitize this data so a comprehensive sample is contained in the appendix for future use.

FREQUENCY RESPONSE TEST LOG SUMMARY

SWEEP NO.	TEST DATE	TEST TIME	EXCITATION CONDITION			INSTRUMENTATION SETUP NO.	MODAL TAPE NUMBER	CONFIGURATION NUMBER
			DIRECTION	LOCATION	FORCE (LB)			
1	02-03-87	0901	Vertical	M/R Hub	100	002	141	1
2	02-03-87	1036	Vertical	M/R Hub	200	003	142	1
3	02-04-87	1301	Vertical	Tail Gear	40	005	143	1
4	02-04-87	1418	Vertical	Tail Gear	20	005	144	1
5	02-06-87	0941	Longitudinal	M/R Hub	100	008	148	1
6	02-06-87	1042	Longitudinal	M/R Hub	200	008	149	1
7	02-09-87	1341	Lateral	M/R Hub	100	010	138	1
8	02-09-87	1425	Lateral	M/R Hub	150	010	160	1
9	02-10-87	1313	Lateral	T/R Hub	10	011	108	1
10	02-23-87	1350	Vertical	Lift Beam	100	013	116	2
11	02-23-87	1443	Vertical	Lift Beam	200	013	117	2
12	02-24-87	1129	Vertical	Tail Gear	20	015	118	2
13	02-24-87	1253	Vertical	Tail Gear	40	015	119	2
14	02-25-87	1253	Lateral	T/R Hub	8	016	123	2
15	02-25-87	1357	Lateral	T/R Hub	20	017	124	2
16	02-25-87	1440	Lateral	T/R Hub	40	017	125	2
17	02-27-87	1137	Lateral	T/R Hub	20	017	163	3
18	02-27-87	1255	Lateral	T/R Hub	40	018	164	3
19	03-03-87	0920	Vertical	Tail Gear	40	019	168	3
20	03-03-87	1434	Vertical	Lift Beam	100	020	170	3

FREQUENCY RESPONSE TEST LOG SUMMARY (Concluded)

SWEEP NO.	TEST DATE	TEST TIME	EXCITATION CONDITION			INSTRUMENTATION SETUP NO.	MODAL TAPE NUMBER	CONFIGURATION NUMBER
			DIRECTION	LOCATION	FORCE (LB)			
21	03-03-87	1525	Vertical	Lift Beam	150	021	171	3
22	03-04-87	1519	Vertical	Lift Beam	100	021	174	4
23	03-06-87	1338	Vertical	Tail Gear	20	022	179	4
24	03-09-87	1324	Lateral	T/R Hub	20	018	183	4
25	03-05-87	1058	Vertical	Lift Beam	100	021	175	5
26	03-05-87	1236	Vertical	Lift Beam	200	021	176	5
27	03-05-87	1527	Vertical	Tail Gear	20	019	177	5
28	03-06-87	0832	Vertical	Tail Gear	40	022	178	5
29	03-09-87	1528	Lateral	T/R Hub	20	018	184	5
30	03-10-87	0853	Lateral	T/R Hub	40	018	185	5
31	03-12-87	1038	Lateral	T/R Hub	40	023	191	6
32	03-13-87	1059	Vertical	Tail Gear	20	024	192	6
33	03-13-87	1138	Vertical	Tail Gear	40	024	193	6
34	03-13-87	1545	Vertical	Lift Beam	100	025	194	6
35	03-17-87	1710	Vertical	Tail Gear	18	026	197	7
36	03-18-87	1021	Vertical	Lift Beam	100	026	198	7
37	03-18-87	1517	Lateral	T/R Hub	20	027	199	7
38	03-19-87	0838	Lateral	T/R Hub	20	027	200	8
39	03-19-87	1338	Vertical	Tail Gear	20	026	201	8
40	03-19-87	1636	Vertical	Lift Beam	100	026	202	8

TEST LOG SUMMARY

FREQUENCY RESPONSE SWEEPS

- 0 - 35 HZ, 2 MAGNITUDES PER SHAKE
  - 5 EXCITATIONS, CONFIGURATION 1
  - 3 EXCITATIONS, CONFIGURATIONS 2 - 8
- DATA DIGITIZED AND SAVED ON MODAL TAPE (40 SWEEPS)
- INSTRUMENTATION SETUP NUMBERS ASSOCIATED WITH EACH TEST

FORCED RESPONSE DWELLS (APPENDIX B)

- DWELLS PERFORMED AT DISCRETE FREQUENCIES IDENTIFIED FROM FREQUENCY SWEEPS (200 DWELLS)
- FORCING MAGNITUDES LARGE ENOUGH TO EXCITE MODE BUT NOT DAMAGE STRUCTURE
- PHASE CROSSING OF INDIVIDUAL RESPONSE POINT USED TO TUNE SHAKER
- INITIAL MODE IDENTIFICATION CATALOGED IN APPENDIX

AIRCRAFT GROUND VIBRATION TEST CONFIGURATIONS SUMMARY

In order to isolate the effects of various components on overall airframe vibratory response, multiple ground vibration tests were conducted. Each test represented a progressive removal of the suspect "difficult components" until only the primary airframe structure remained. The test article was a Bell Helicopter AH-1G Cobra series 880. As detailed on page 14 and 15, the initial test configuration consisted of the basic empty weight aircraft (5759 lb) plus useful load items of 163 lb (5922 lb). In addition, shake test ballast of 1006 lb was added to the initial test configuration as detailed on Page 38, yielding a 6928 lb initial test article weight.

Ballast at the pilot and co-pilot locations was varied during test to maintain the cg around FS 197 to minimize the pitch of the ship when suspended from the left fixture. All configurations maintained a fairly level (< 5° pitch) attitude with respect to the ground.

The test configurations are listed in the table below in the order they were configured with gross weight, excitation location/direction and the component being isolated in each test.

AIRCRAFT GROUND VIBRATION TEST CONFIGURATIONS SUMMARY

CONFIGURATION	GROSS WEIGHT	VERTICAL @ TAIL	VERTICAL @ HUB	LATERAL @ TAIL	F/A @ HUB	LATERAL @ HUB
1. BASELINE (FULL-UP)	6928	X	X	X	X	X
2. M/R PYLON REMOVED	5116	X	X	X		
3. SECONDARY STRUCTURE REMOVED	4857	X	X	X		
4. T/R DRIVESHAFTS REMOVED	4772	X	X	X		
5. SKID LANDING GEAR REMOVED	4664	X	X	X		
6. ENGINE REPLACED BY DUMMY ENGINE	4663	X	X	X		
7. DUMMY ENGINE REMOVED	3755	X	X	X		
8. FUEL REMOVED	3190	X	X	X		

AH-1G TEST ARTICLE
(Configuration 1 - Full up)

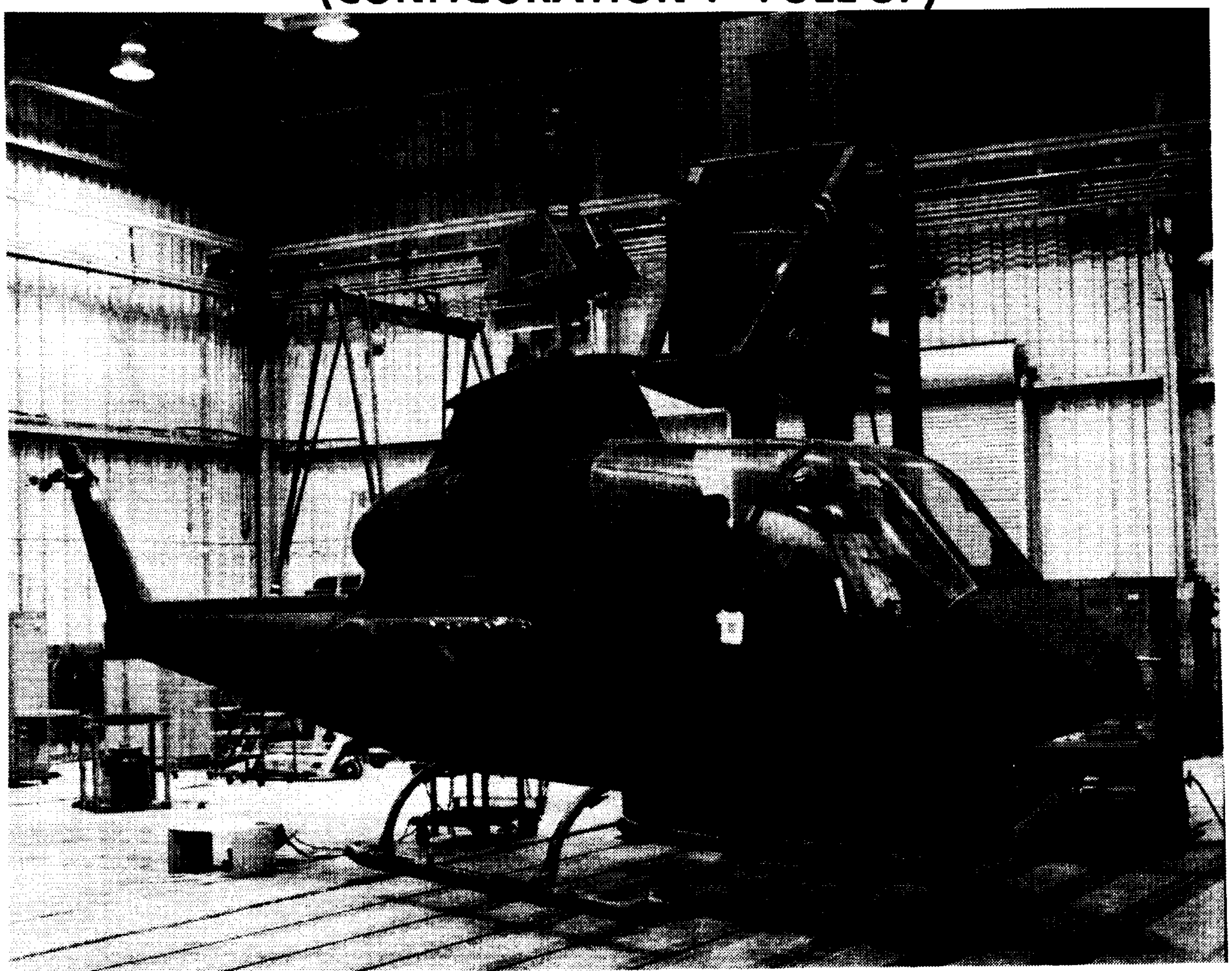
Prior to shake testing, the bailed aircraft was modified as indicated:

CONFIGURATION 1 MODIFICATIONS

Action	Weight (lb)
Preservation run fuel addition	+565.0
M/R hub and blades removed	-947.5
Hub and blade dummy weight test fixture added	+947.5
Pilot ballast added (175 lb/seat, 50 lb/floor)	+225.0
Gunner ballast added (175 lb/seat, 50 lb/floor)	+225.0
T/R blades replaced by dummy weight	+7.1
T/R mast nut and T-head assy removed	-6.7
Pitch links removed	-4.0
Stinger replaced by loading block	--
90° gearbox R.H. fairing removed	-1.4
Battery access panel removed	-1.9
Stinger fairing removed	-1.5

Delta weight from bailed A/C = 1006.6 lb
Configuration 1 Test Article weight = 5922 + 1006.6 = 6928.6 lb

AH-1G TEST ARTICLE
(CONFIGURATION 1 - FULL UP)



G. W. = 6928 LB

CONFIGURATION 2
(M/R Pylon Assembly Removed)

To obtain Configuration 2, Configuration 1 was modified as follows:

CONFIGURATION 2 MODIFICATIONS

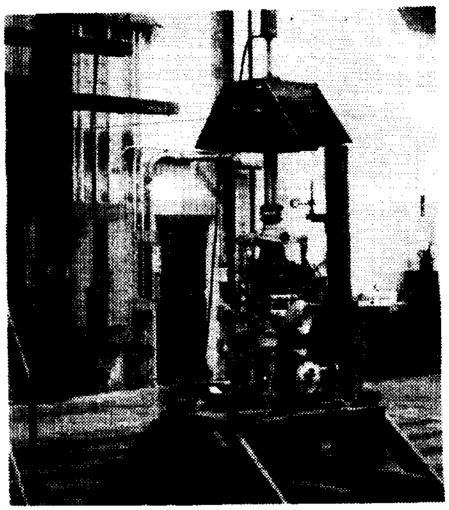
Action	Weight (lb)
Removed M/R hub and blades lumped mass fixture	-947.5
Removed pylon (XMSN, M/R mast, swashplate)	-653.0
Removed corner mounts	-20.5
Removed viscous dampers	-5.0
Removed hydraulic pump	-14.0
Removed boost cylinders (3) and elevator control tube	-56.0
Removed input driveshaft	-21.0
Removed side access panel to hell-hole	-8.2
Removed 42° gearbox fairing	-1.7
Removed belly access panel to hell-hole	-1.3
Removed lift link	-2.9
Removed 100 lb ballast (25 lb @ each floor and seat)	-100.0
Added quad-braced bridle to pylon mount plane	+19.3

Delta weight from Configuration 1 = 1811.8 lb
Configuration 2 Test Article Weight = 6928.6 - 1811.8 = 5116.8 lb

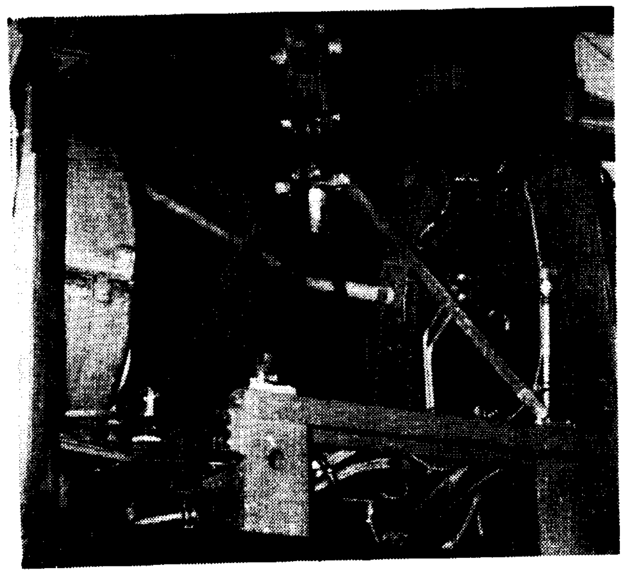
For the remainder of the ground vibration tests a bridle assembly was attached for hoisting purposes.

The figure shows the pylon, bridle and Configuration 2 in a vertical tail shake test arrangement.

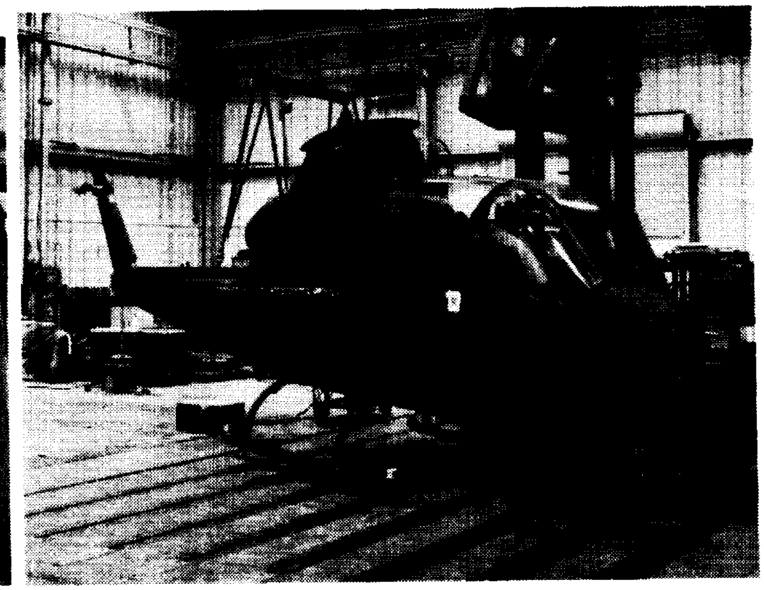
CONFIGURATION 2
(M/R PYLON ASSEMBLY REMOVED)



M/R PYLON



BRIDLE HOIST



G.W. = 5117 LB

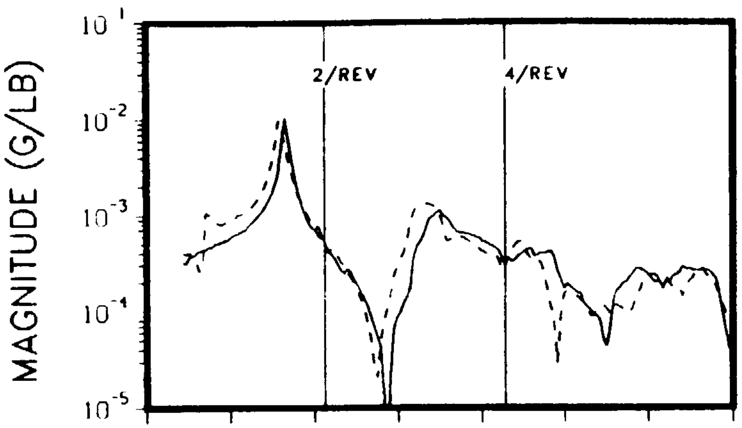
ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

CONF 1 VS CONF 2 - MAIN ROTOR PYLON EFFECTS (TEST DATA COMPARISONS)

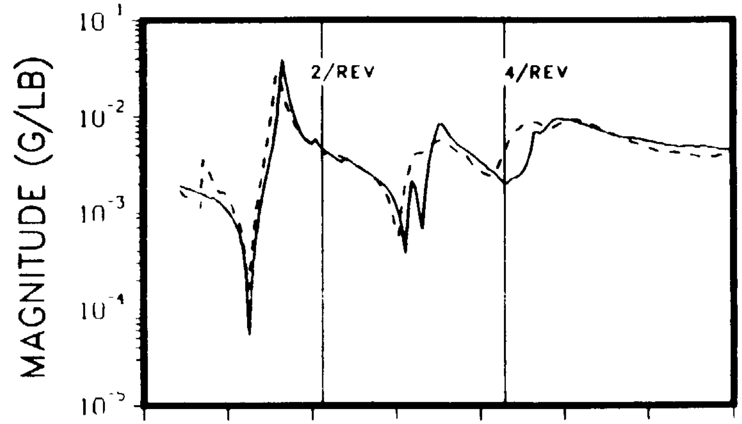
Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 1 and 2 to highlight the effect of the main rotor pylon on measured test response from 0 - 35 Hz.

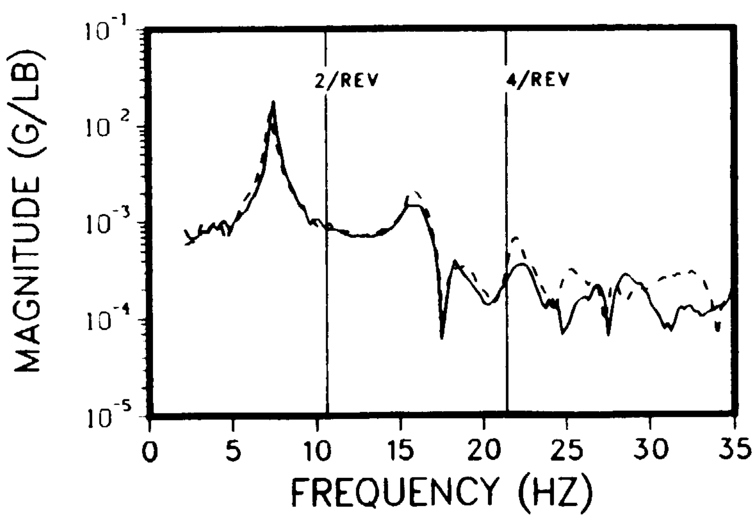
CONF 1 VS CONF 2 - MAIN ROTOR PYLON EFFECTS
(TEST DATA COMPARISONS)



GUNNER VERTICAL-VERT LOAD AT TAIL



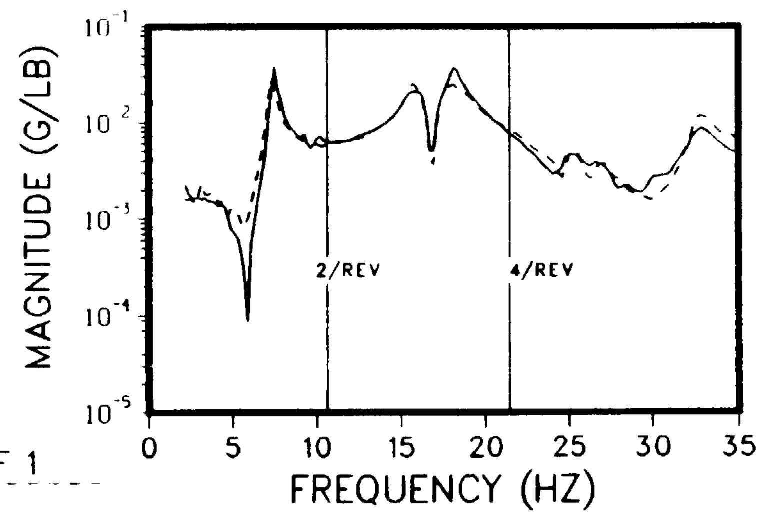
TAIL SKID VERT-VERT LOAD AT TAIL



GUNNER LATERAL-LAT LOAD AT T/R HUB

CONF 1 - - - - - -

CONF 2 ———



TAIL SKID LAT-LAT LOAD AT T/R HUB

CONFIGURATION 3
(Secondary Panels Removed)

After performing all tests on Configuration 2, all non-structural panels described in the AH-1G Maintenance Manual as well as hinged cockpit glass and some fairings were removed, weighed and cataloged.

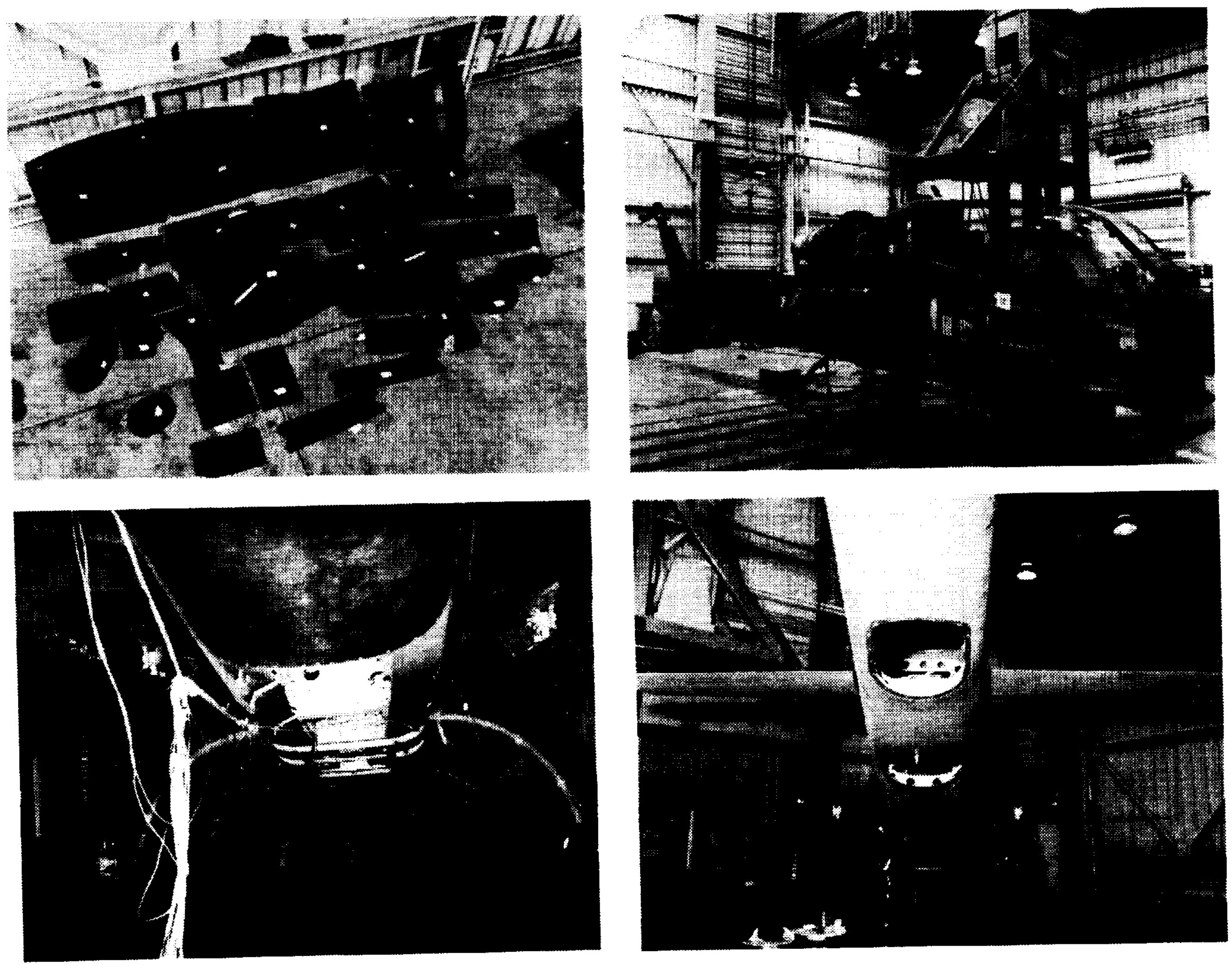
Configuration 3 Modifications

Action	Weight (lb)
Removed secondary panels	-359
Add ballast (25 lb @ pilot/gunner floor and seat)	+100

Delta weight from Configuration 2 = -259.0 lb.
Configuration 3 Test Article Weight = 5116.8 - 259.0 = 4857.8 lb.

The figure shows the panels which were removed, and Configuration 3 suspended in the shake test assembly in a vertical lift beam test arrangement.

CONFIGURATION 3
(SECONDARY PANELS REMOVED)



G. W. = 4858 LB

AH-1G SECONDARY PANELS

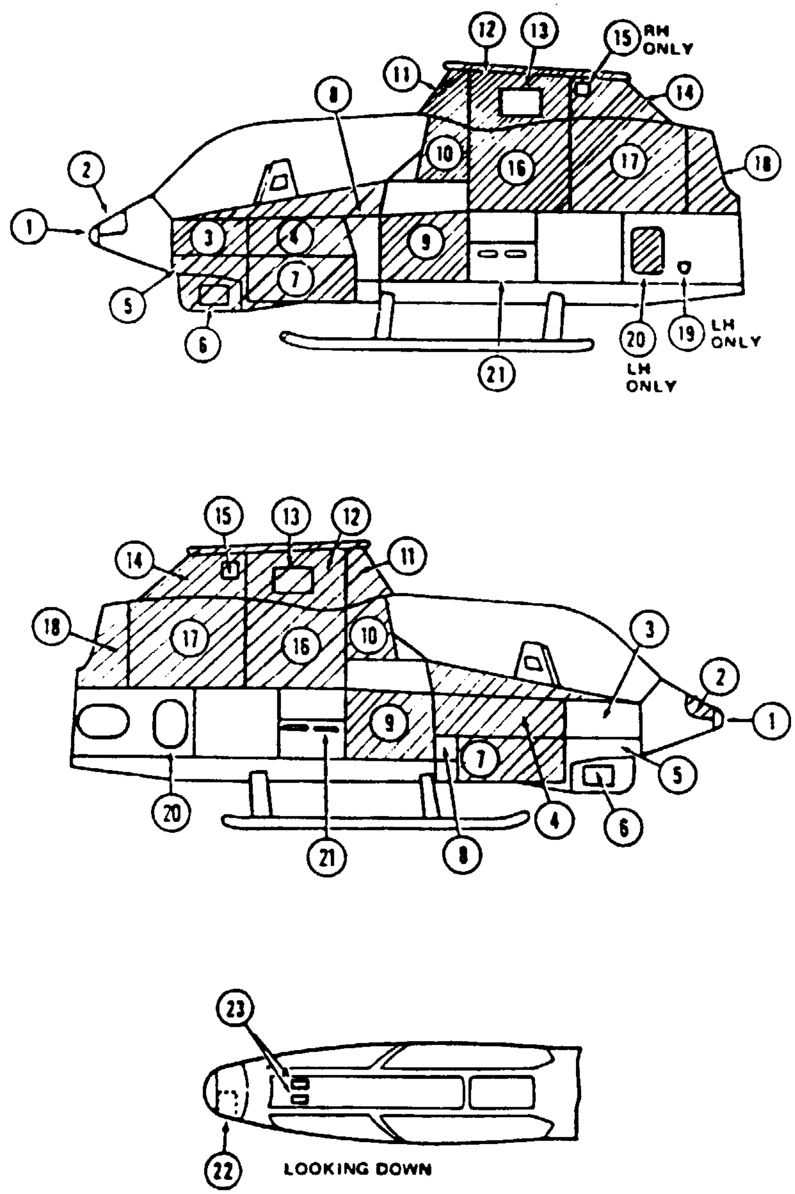
Schematics from the AH-1G Maintenance Manual describe the cataloging system used to identify the secondary panels removed (hatched area) to obtain Configuration 3. Weight records are shown in the Table.

SECONDARY PANELS REMOVED FOR CONFIGURATION 3

Panel #	Action	Weight (lb)
1	Nose cover	1.0
2	Nose door	2.2
3	Outer panels (RH & LH)	7.7
4	Outer panels (RH & LH)	9.4
5	Turret fairing	6.2
6	Turret fairing (others)	18.2
7	Ammunition compartment door (RH & LH)	27.0
8	Outer panel (RH & LH)	6.0
9	Outer panel (RH & LH)	12.7
10	Access door (RH & LH)	8.1
11	Forward pylon fairing	6.5
12 & 13	Canter fairing (RH & LH)	25.0
14 & 15	Aft pylon fairing (RH & LH)	56.5
16	Pylon cowl door (RH & LH)	37.5
17	Engine cowl door (RH & LH)	32.25
18	Tailpipe fairing	15.75
20	LH oil cooler duct panel	1.8

Sub Total = 273.8

AH-1G SECONDARY PANELS



AH-1G SECONDARY PANELS (Concluded)

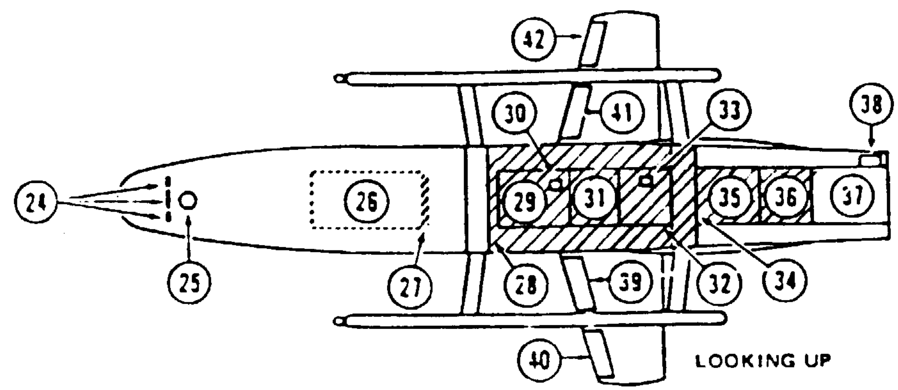
THE REMAINDER OF THE PANELS ARE LISTED HERE.

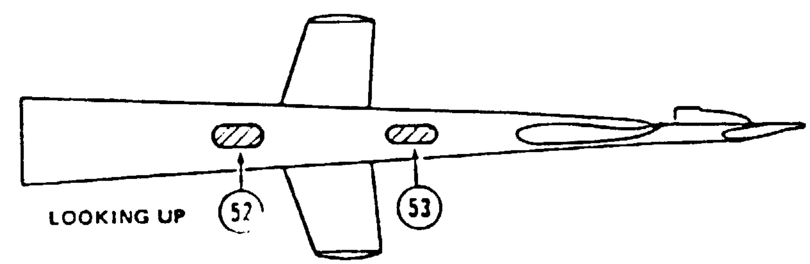
Panel #	Action	Weight (lb)
28	Forward crosstube fairing	1.0
29	Lower skin panel	1.8
31	Lower skin panel	1.8
34	Aft crosstube fairing	1.0
35	Lower skin panel	2.2
36	Lower skin panel	2.2
47	90° gearbox fairing & cover	.5
52	Tailboom access door	1.5
53	Tailboom access door	1.5
-	Pilot door	27.5
-	Red light box	2.1
-	Fairing	.5
-	Fairing	.5
-	Wing striping	2.0
-	Wing store pylon fairings	10.0
-	Gunner Door	29.0

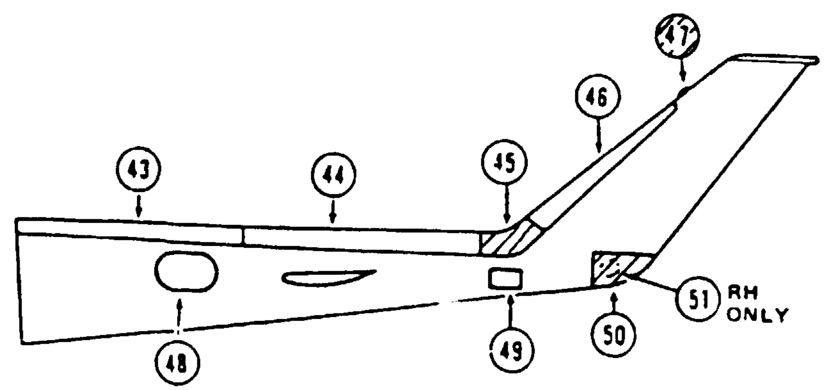
Sub Total = 85.1

Total = 359 lb

AH-1G SECONDARY PANELS (Concluded)





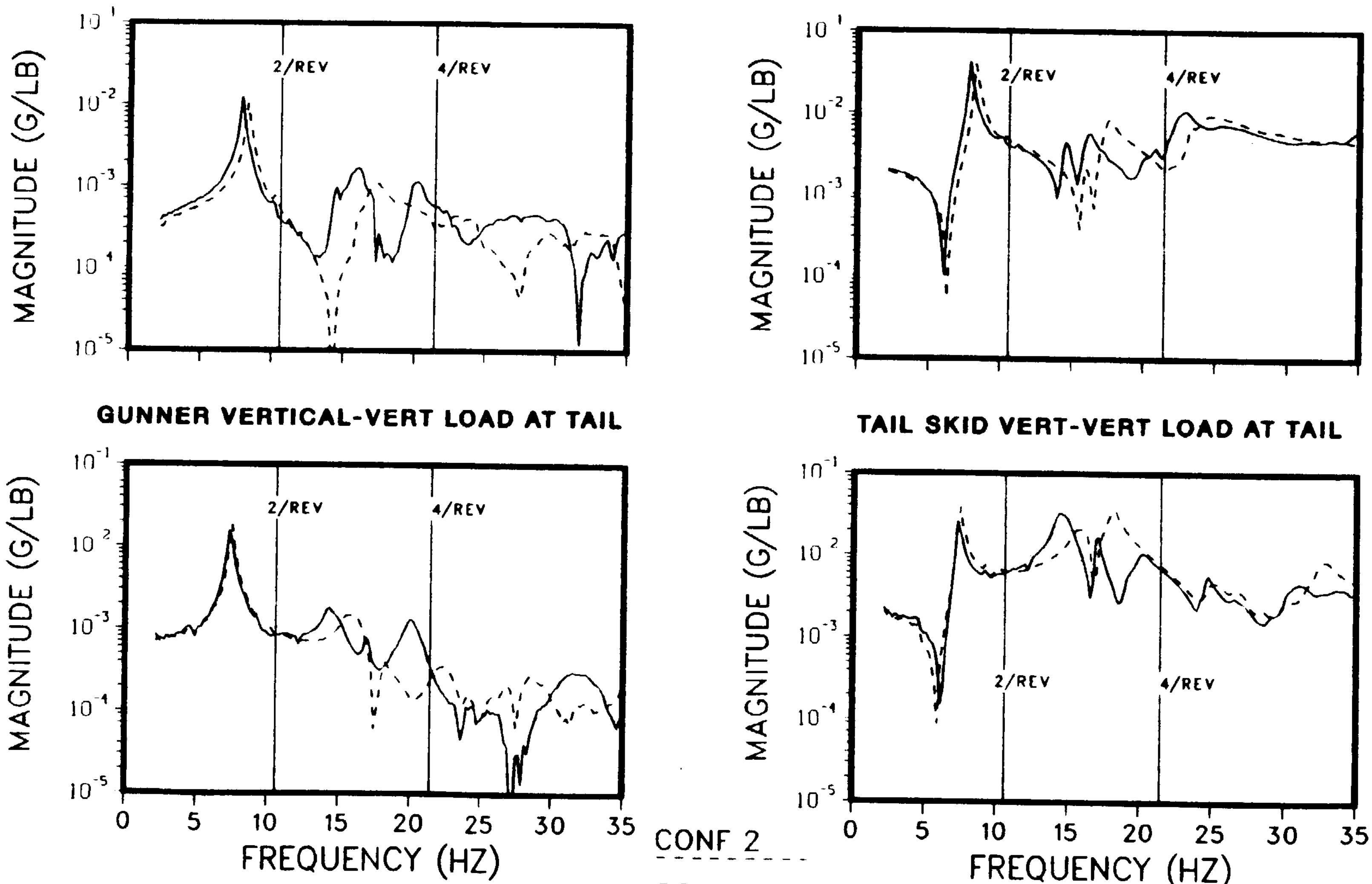


CONF 2 VS CONF 3 - SECONDARY PANEL EFFECTS
(TEST DATA COMPARISONS)

Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 2 and 3 to highlight the effect of secondary panels on measured test response from 0 - 35 Hz.

CONF 2 VS CONF 3 - SECONDARY PANEL EFFECTS
(TEST DATA COMPARISONS)



GUNNER VERTICAL-VERT LOAD AT TAIL

TAIL SKID VERT-VERT LOAD AT TAIL

GUNNER LATERAL-LAT LOAD AT T/R HUB

TAIL SKID LAT-LAT LOAD AT T/R HUB

CONF 2 - - - - -

CONF 3 ———

CONFIGURATION 4
(Tail Rotor Driveshaft Removed)

After performing all tests on Configuration 3, the tail rotor driveshaft and covers were removed and weighed.

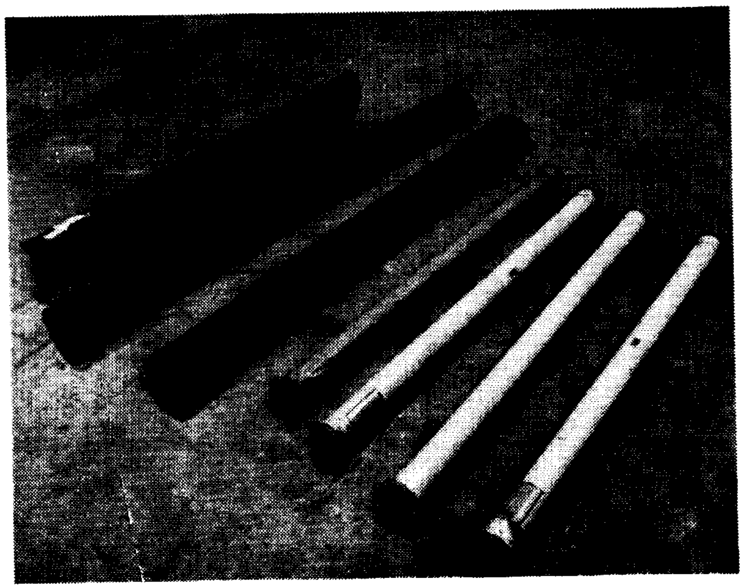
Configuration 4 Modifications

Action	Weight (lb)
Removed T/R driveshaft fairings and T/R driveshaft	-26.2
Removed ballast (25 lb @ each seat)	-50.0
Removed pylon fifth mount assembly	-9.5

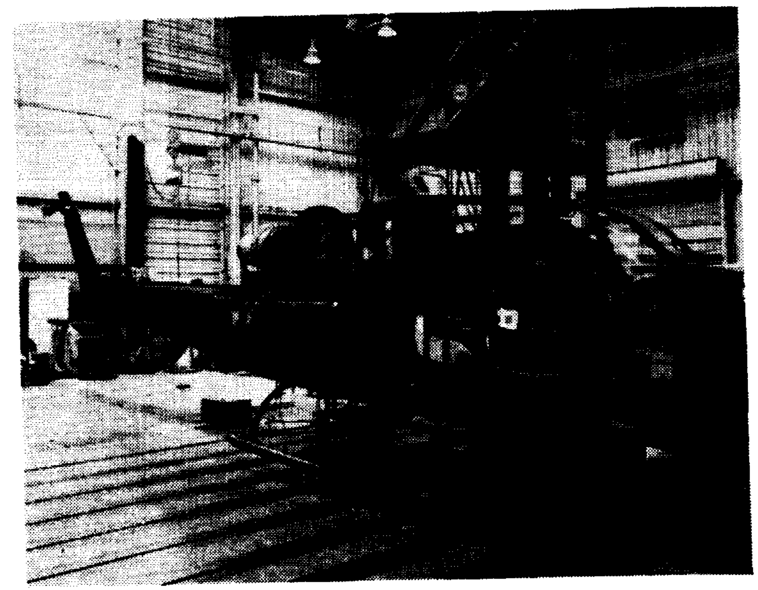
Delta weight from Configuration 3 = 85.7 lb
Configuration 4 Test Article Weight = 4857.8 - 85.7 = 4772.1 lb

The Figure contains photographs of the driveshafts and fairings and Configuration 4 suspended in the shake test assembly in a vertical lift beam test arrangement.

CONFIGURATION 4
(TAIL ROTOR DRIVESHAFT REMOVED)



TAIL ROTOR DRIVESHAFTS
AND COVERS



G.W. = 4772 LB

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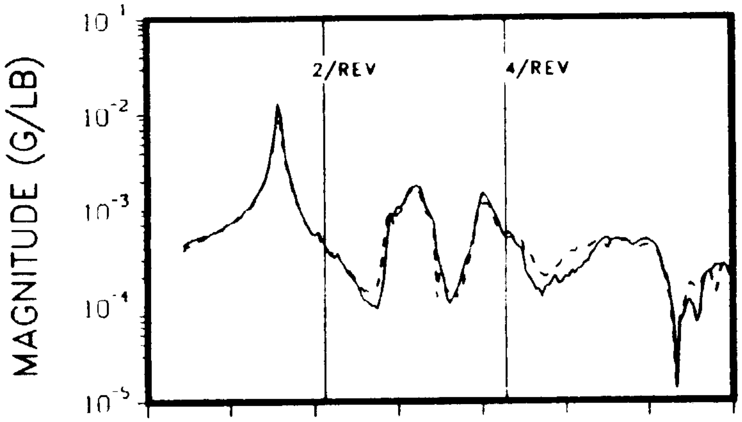
CONF 3 VS CONF 4 - TAIL ROTOR DRIVE SHAFT EFFECTS (TEST DATA COMPARISONS)

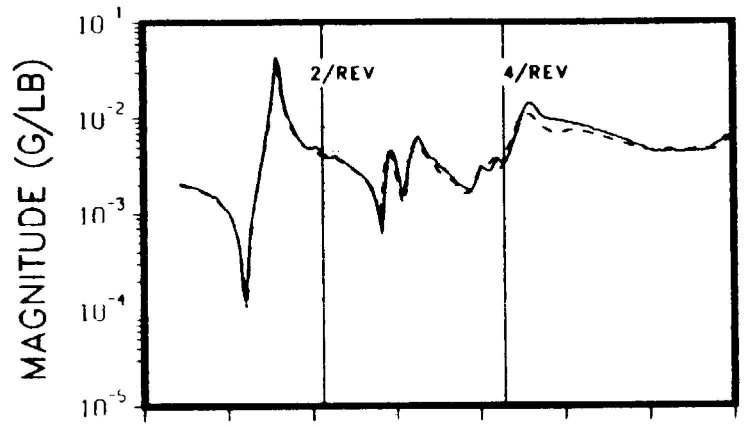
Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 3 and 4 to highlight the effect of the tail rotor driveshaft on measured test response from 0 - 35 Hz.

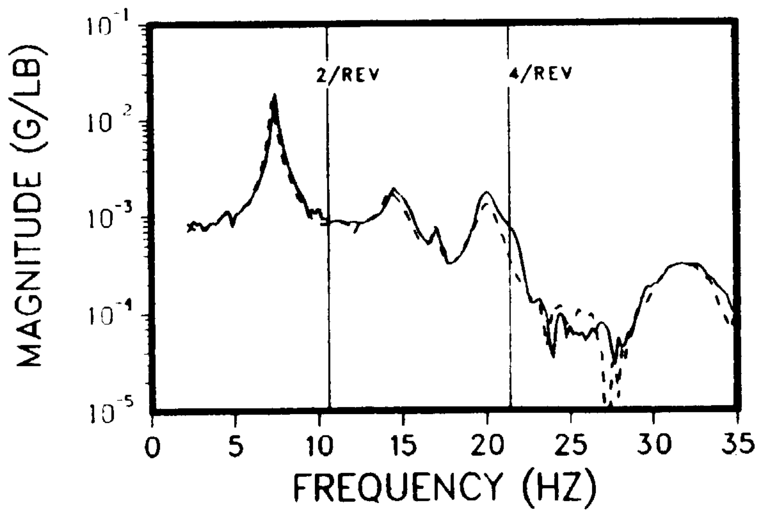
CONF 3 VS CONF 4 - T/R DRIVESHAFT EFFECTS
(TEST DATA COMPARISONS)



GUNNER VERTICAL-VERT LOAD AT TAIL



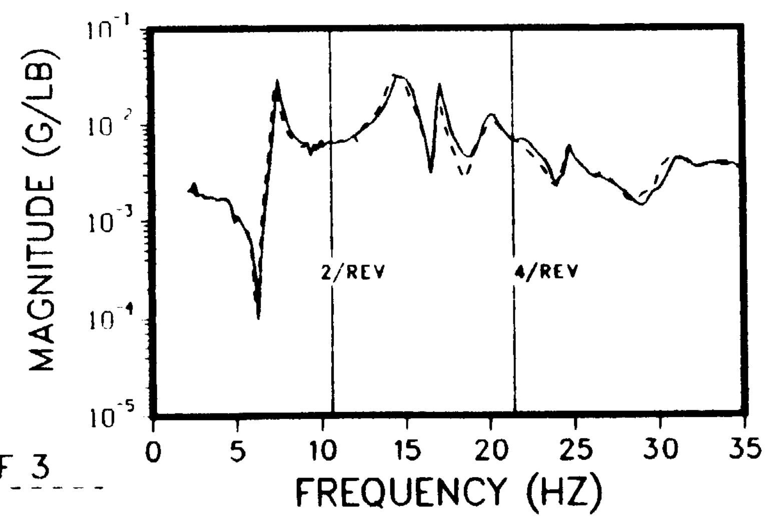
TAIL SKID VERT-VERT LOAD AT TAIL



GUNNER LATERAL-LAT LOAD AT T/R HUB

CONF 3 - - - - -

CONF 4 ———



TAIL SKID LAT-LAT LOAD AT T/R HUB

CONFIGURATION 5
(Skid Landing Rear Removed)

Configurations 4 and 5 were alternated for each series of tests to reduce instrumentation changes (see test log) since the landing gear was easy to remove and replace on the ship.

CONFIGURATION 5 MODIFICATIONS

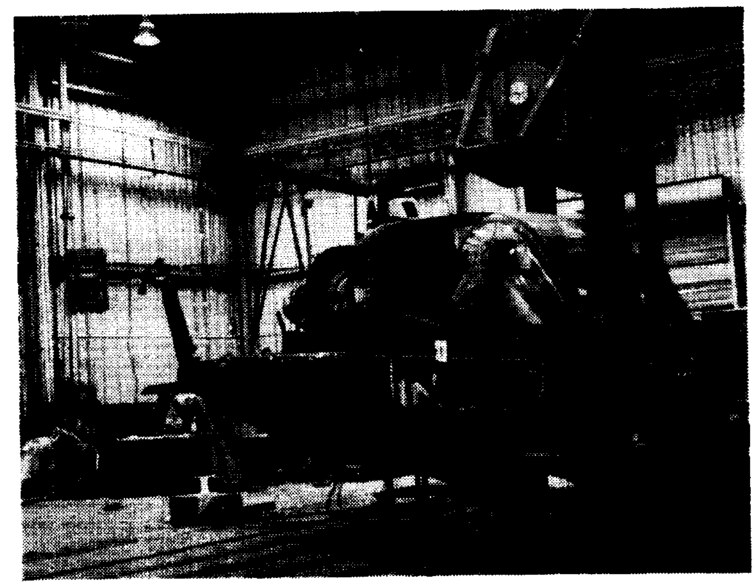
Action	Weight (lb)
Removed skid gear	-108.0

Delta Weight from Configuration 4 = -108 lb
Configuration 5 Test Article Weight = 4772.1 - 108.0 = 4664.1 lb

The Figure has photographs of the skid gear and the ship suspended in the shake test assembly in a lateral tail rotor gearbox excitation condition after removing the skid gear.

CONFIGURATION 5
(SKID LANDING GEAR REMOVED)

SKID LANDING GEAR



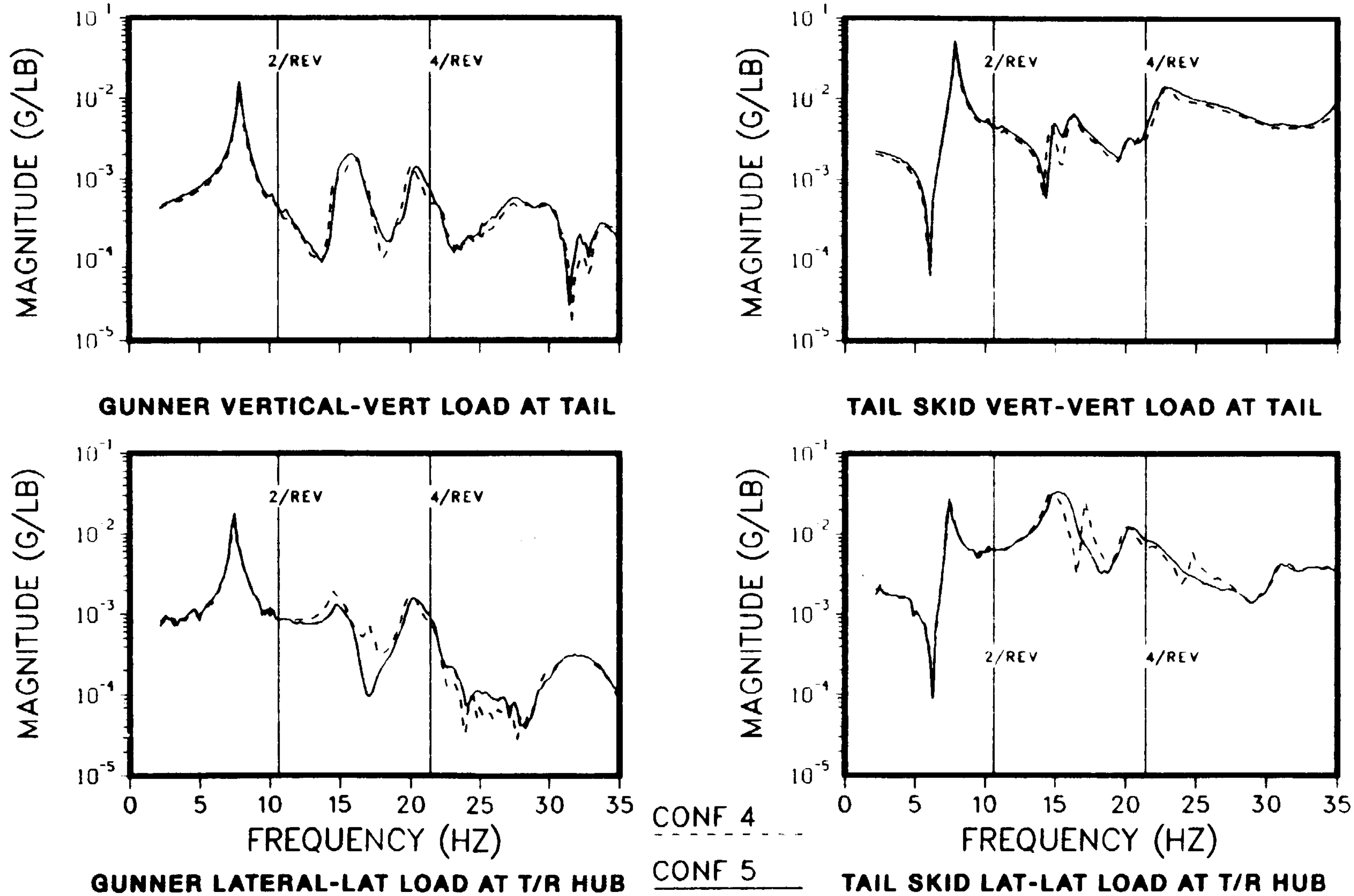
G. W. = 4664 LB

CONF 4 VS CONF 5 - LANDING GEAR EFFECTS
(TEST DATA COMPARISONS)

Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 4 and 5 to highlight the effect of the skid landing gear on measured test response from 0 - 35 Hz.

CONF 4 VS CONF 5 - LANDING GEAR EFFECTS
(TEST DATA COMPARISONS)



CONFIGURATION 6
(Engine Replaced by Dummy Engine)

After all Configuration 4 and 5 tests were performed, the engine was replaced by a dummy "rigid" engine in an attempt to identify any differences between a rigid engine and the real engine.

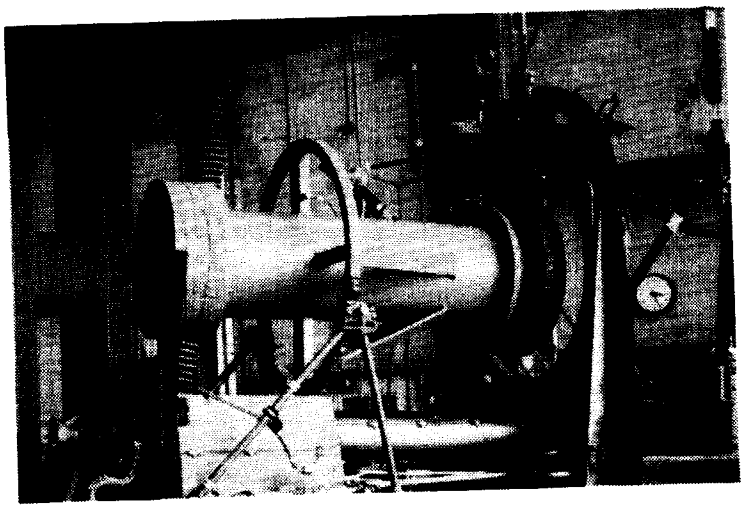
CONFIGURATION 6 MODIFICATIONS

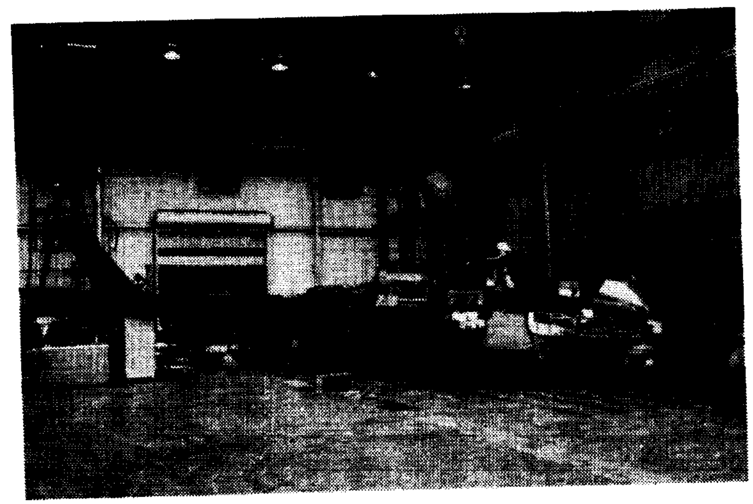
Action	Weight (lb)
Removed engine	-530.0
Removed starter	-48.0
Removed tachometer	-.8
Removed engine fuel filter assy	-5.0
Removed engine bell crank and push rod assy	-1.5
Add dummy engine	+608.0
Removed useful load for engine oil	-23.4

Delta weight from Configuration 5 = -0.7 lb
Configuration 6 Test Article Weight = 4664.1 - 0.7 = 4663.4

The photographs contain a close up of the dummy engine installed on the aircraft and a full side view of Configuration 6 in the shake test assembly.

CONFIGURATION 6
(ENGINE REPLACED BY DUMMY ENGINE)





DUMMY ENGINE ON THE AH-IG

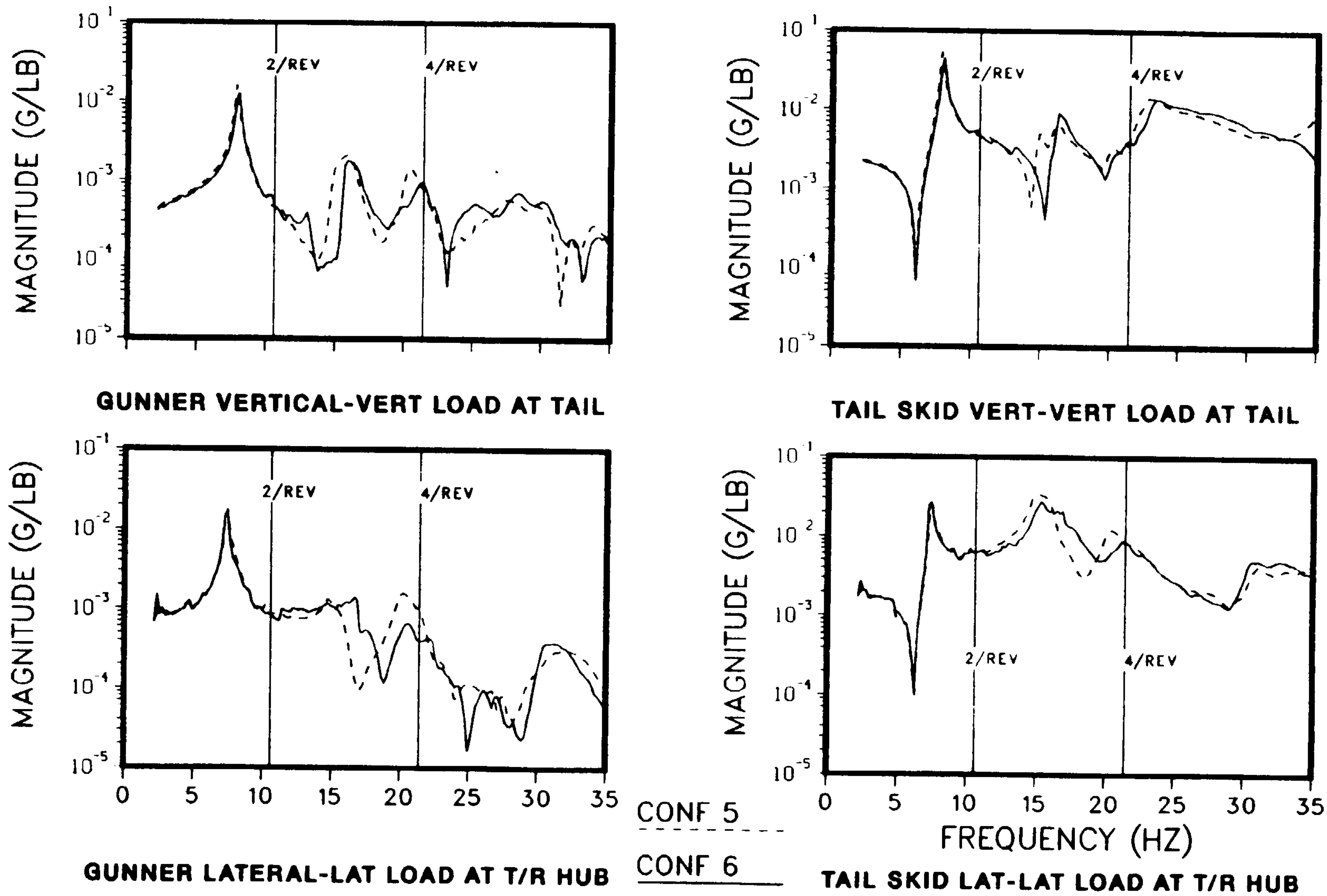
G. W. = 4663 LB

CONF 5 VS CONF 6 - DUMMY ENGINE EFFECTS
(TEST DATA COMPARISONS)

Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 5 and 6 to highlight the effect of the dummy engine on measured test response from 0 - 35 Hz.

CONF 5 VS CONF 6 - DUMMY ENGINE EFFECTS
(TEST DATA COMPARISONS)



CONFIGURATION 7
(Dummy Engine Removed)

After performing all tests on Configuration 6, the dummy engine was removed to obtain Configuration 7.

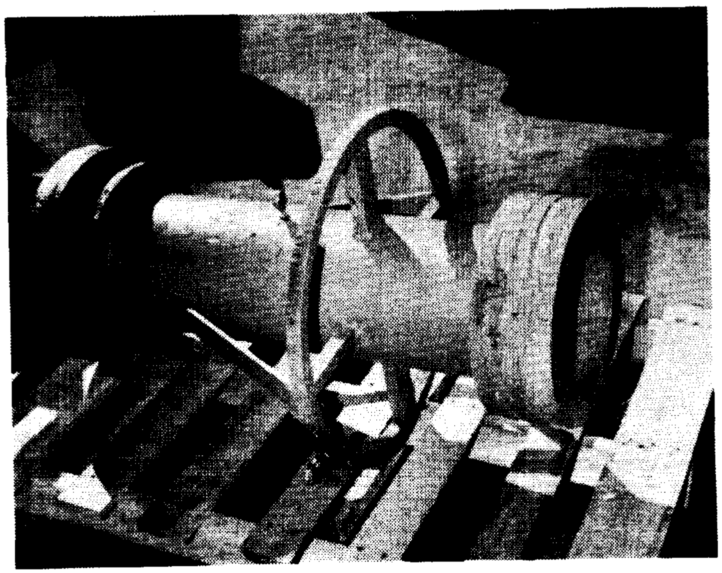
CONFIGURATION 7 MODIFICATIONS

Action	Weight (lb)
Removed dummy engine	-608
Removed ballast (125 lb from each seat) (25 lb from each floor)	-300

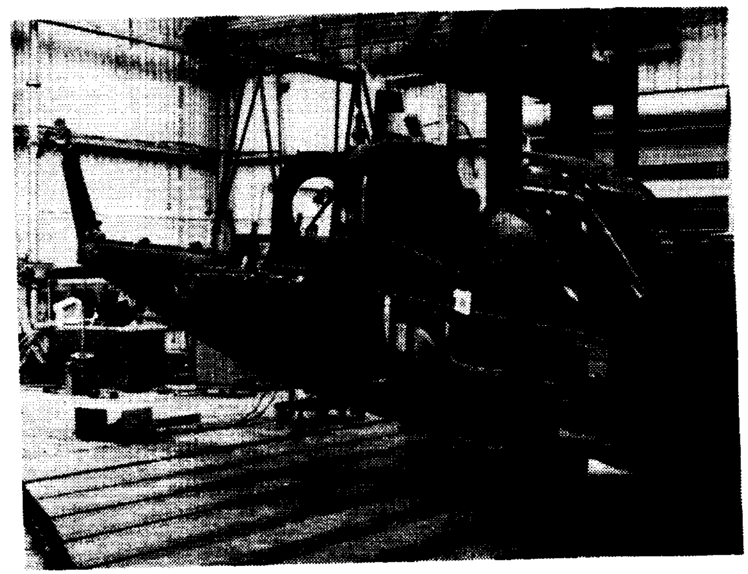
Delta Weight from Configuration 6 = -908 lb

Configuration 7 Test Article Weight = 4663.4 - 908 = 3755.4 lb

CONFIGURATION 7
(DUMMY ENGINE REMOVED)



DUMMY ENGINE



G. W. = 3755 LB

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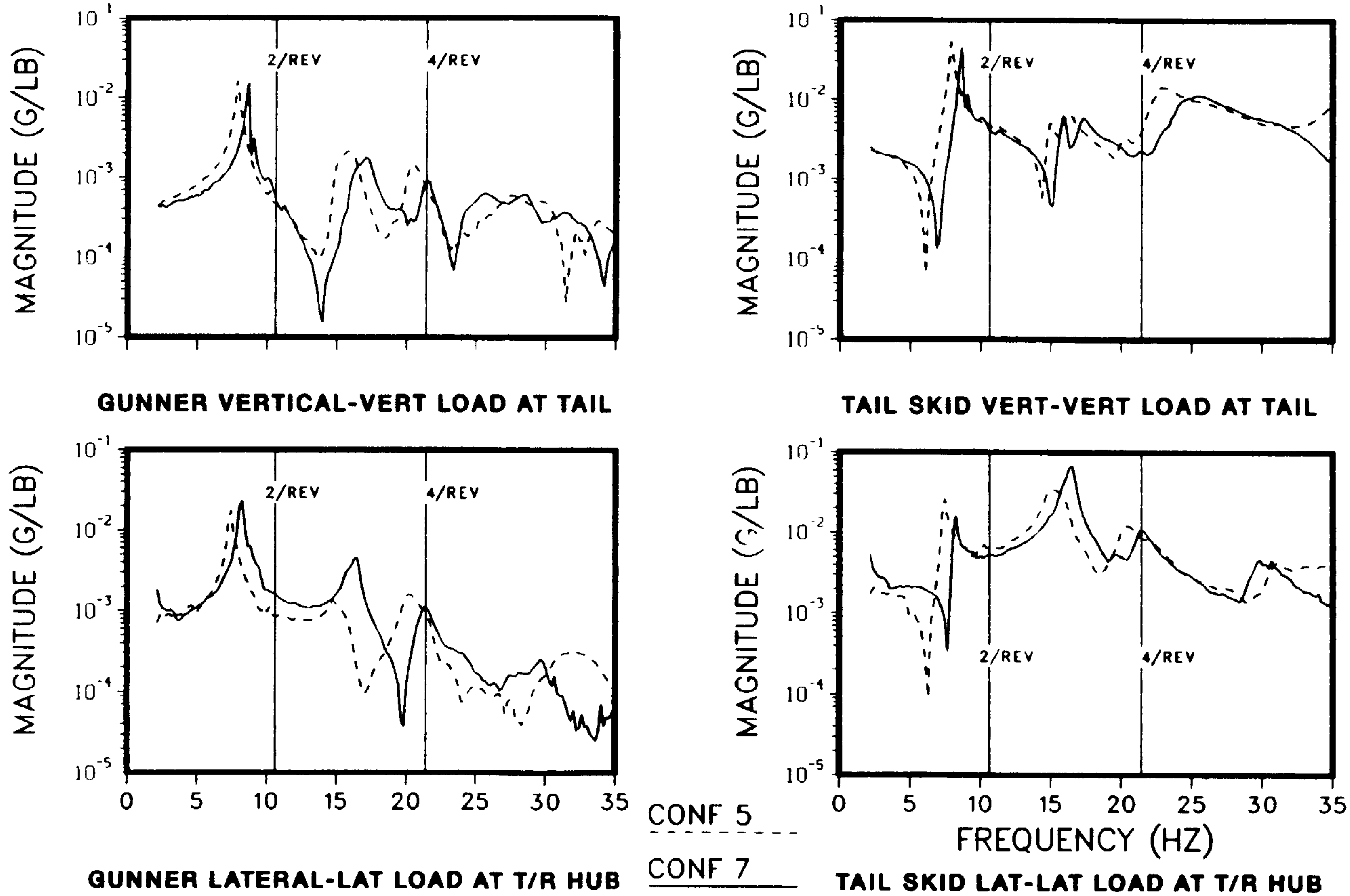
CONF 5 VS CONF 7 - ENGINE EFFECTS
(TEST DATA COMPARISONS)

Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 5 and 7 to highlight the effect of the engine on measured test response from 0 - 35 Hz.

CONF 5 VS CONF 7 - ENGINE EFFECTS
(TEST DATA COMPARISONS)



CONFIGURATION 8

To obtain Configuration 8, Configuration 7 was modified as detailed.

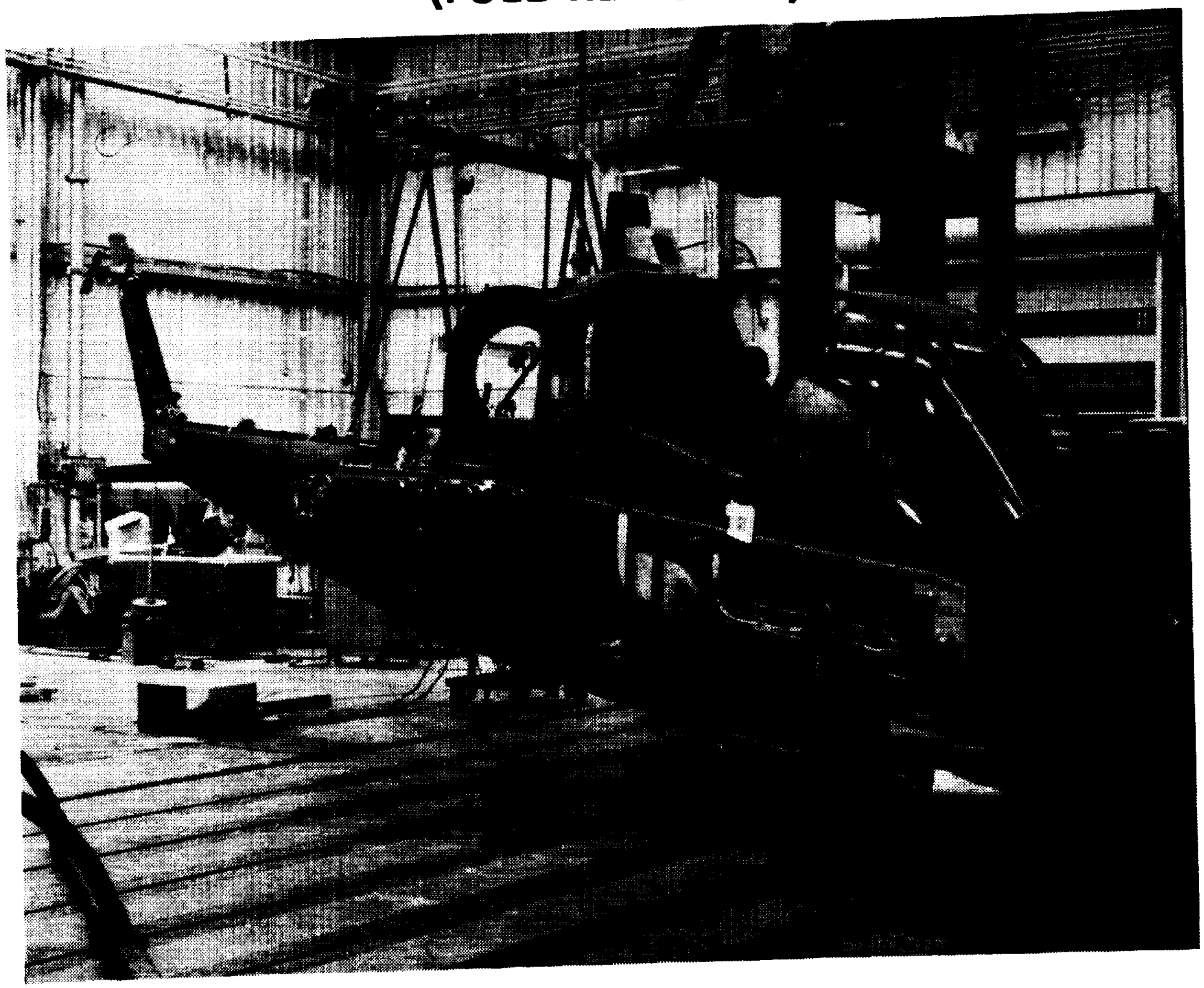
CONFIGURATION 8 MODIFICATIONS

Action	Weight (lb)
Removed remaining fuel	-565

Delta Weight from Configuration 6 = -565 lb

Configuration 8 Test Article Weight = 3755.4 - 565 = 3190.4 lb

CONFIGURATION 8
(FUEL REMOVED)



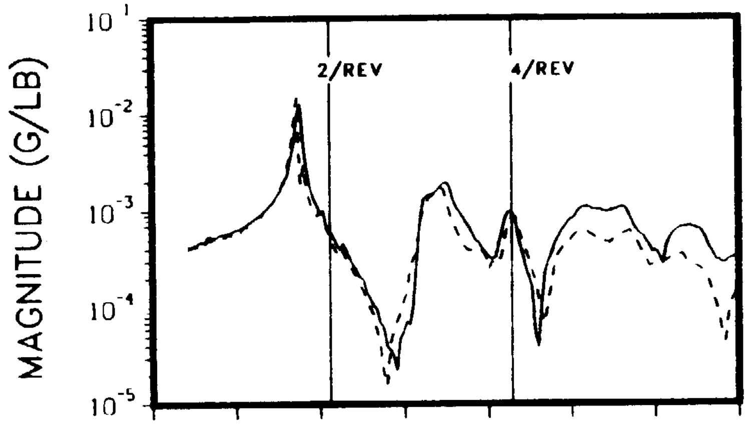
G. W. = 3190 LB

CONF 7 VS CONF 8 - FUEL EFFECTS
(TEST DATA COMPARISONS)

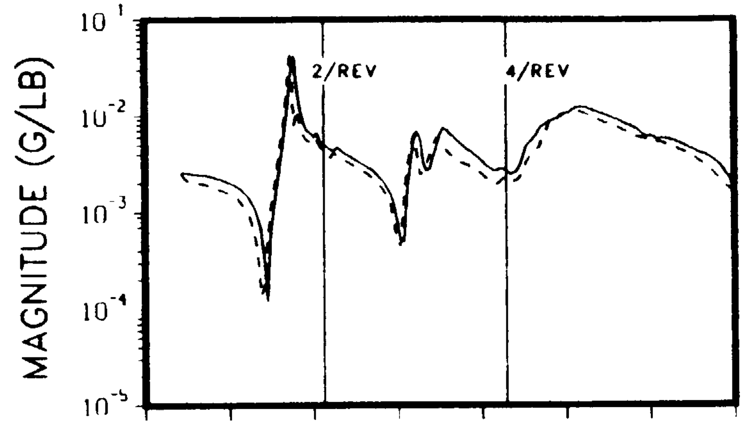
Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configurations 7 and 8 to highlight the effect of fuel on measured test response from 0 - 35 Hz.

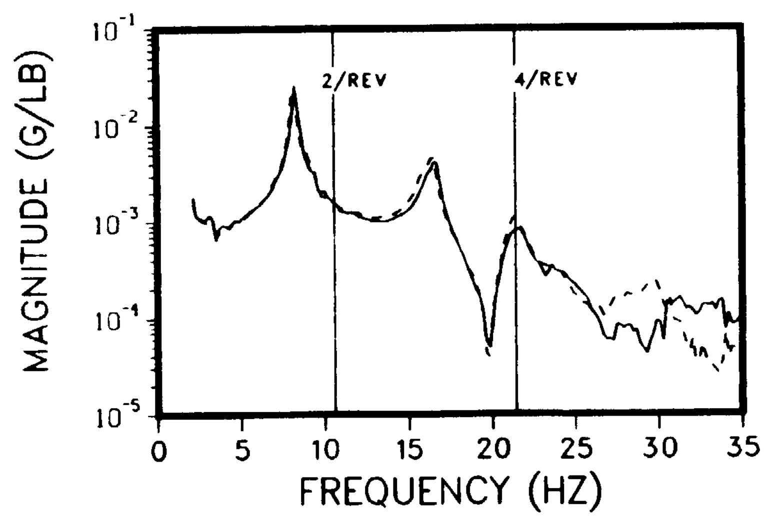
CONF 7 VS CONF 8 - FUEL EFFECTS
(TEST DATA COMPARISONS)



GUNNER VERTICAL-VERT LOAD AT TAIL



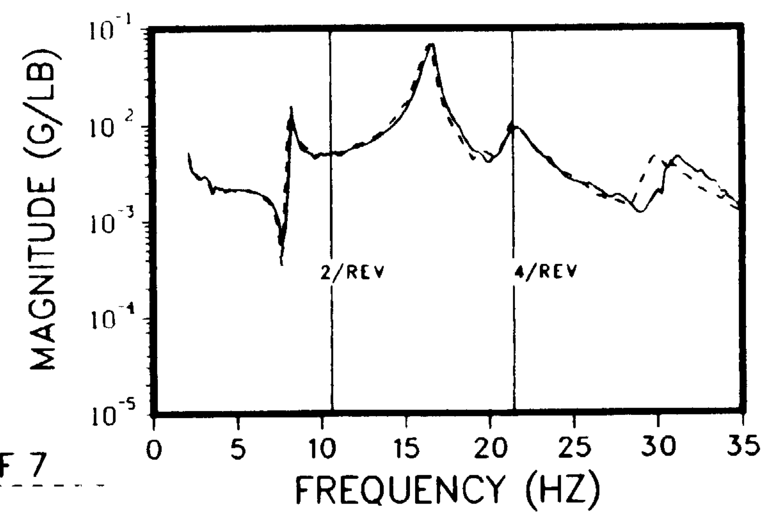
TAIL SKID VERT-VERT LOAD AT TAIL



GUNNER LATERAL-LAT LOAD AT T/R HUB

CONF 7 - - - - -

CONF 8 ———



TAIL SKID LAT-LAT LOAD AT T/R HUB

CONFIGURATION 8
(Windows, Black Boxes, Wings Removed)

Vertical tail shake tests were performed on Configuration 8 with the following components removed in successive tests to determine the effect of each component. The remaining (non-hinged) canopy glass, soft-mounted black boxes in the tailboom and the wings were removed.

Action	Weight (lb)
Removed center canopy glass	-17.5
Removed pilot left canopy glass	-18.5
Removed copilot right canopy glass	-12.5

Action	Weight (lb)
Removed tailboom black boxes	-80.0
Removed Ballast (25 lb @ ea. seat and floor)	-100.0

Action	Weight (lb)
Removed wings	-234.0

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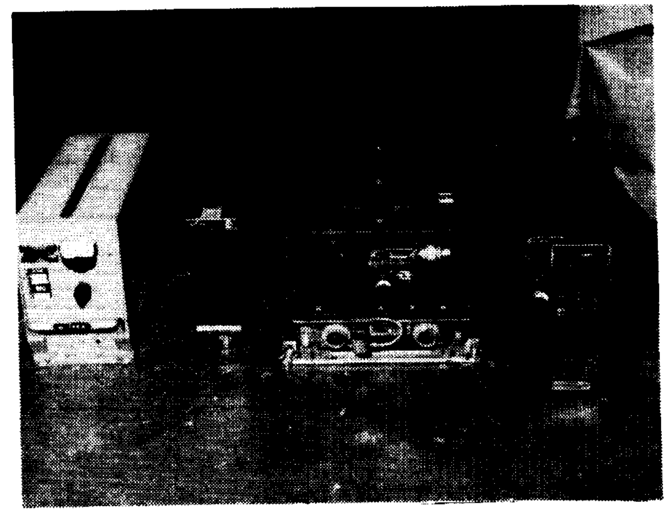
CONFIGURATION 8
(WINDOWS, BLACK BOXES, WINGS REMOVED)

CANOPY GLASS



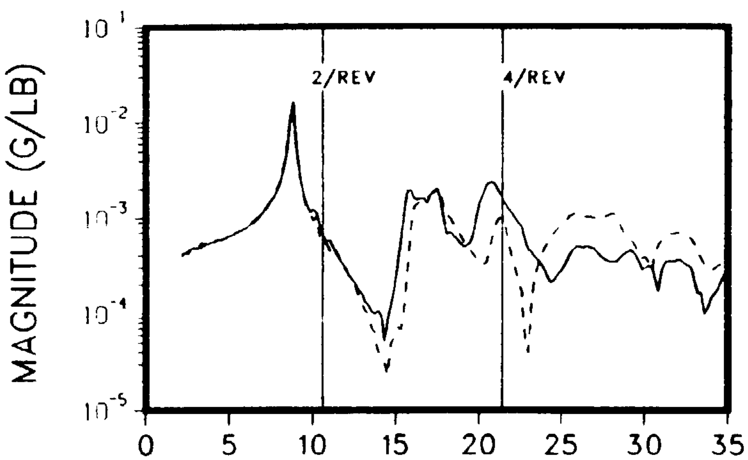
SOFT MOUNTED
BLACK BOXES

CONFIGURATION 8 - WINDOWS, BLACK BOXES, WING EFFECTS (TEST DATA COMPARISONS)

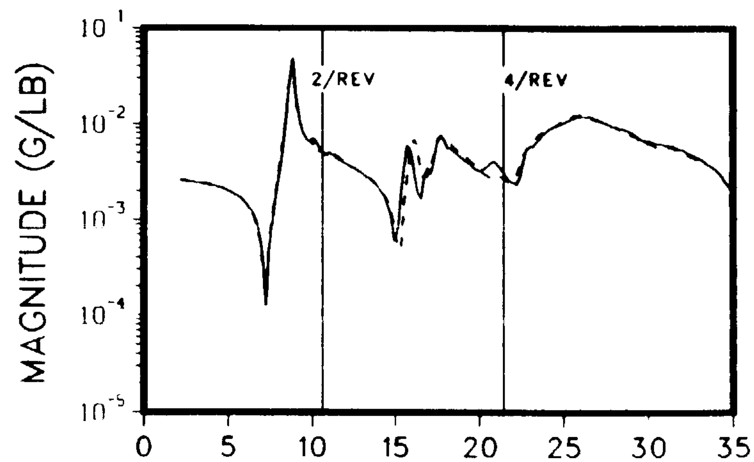
Frequency response functions for two response points (gunner and tail skid) representing the extreme locations at the front and rear of the ship are presented for comparison.

Vertical and lateral response at these two locations is plotted for configuration 8 with subcomponents removed on the next three pages to highlight the effect of the three subcomponents on measured test response from 0 - 35 Hz.

CONF 8 - CANOPY GLASS EFFECTS
(TEST DATA COMPARISONS)



GUNNER VERTICAL-VERT LOAD AT TAIL



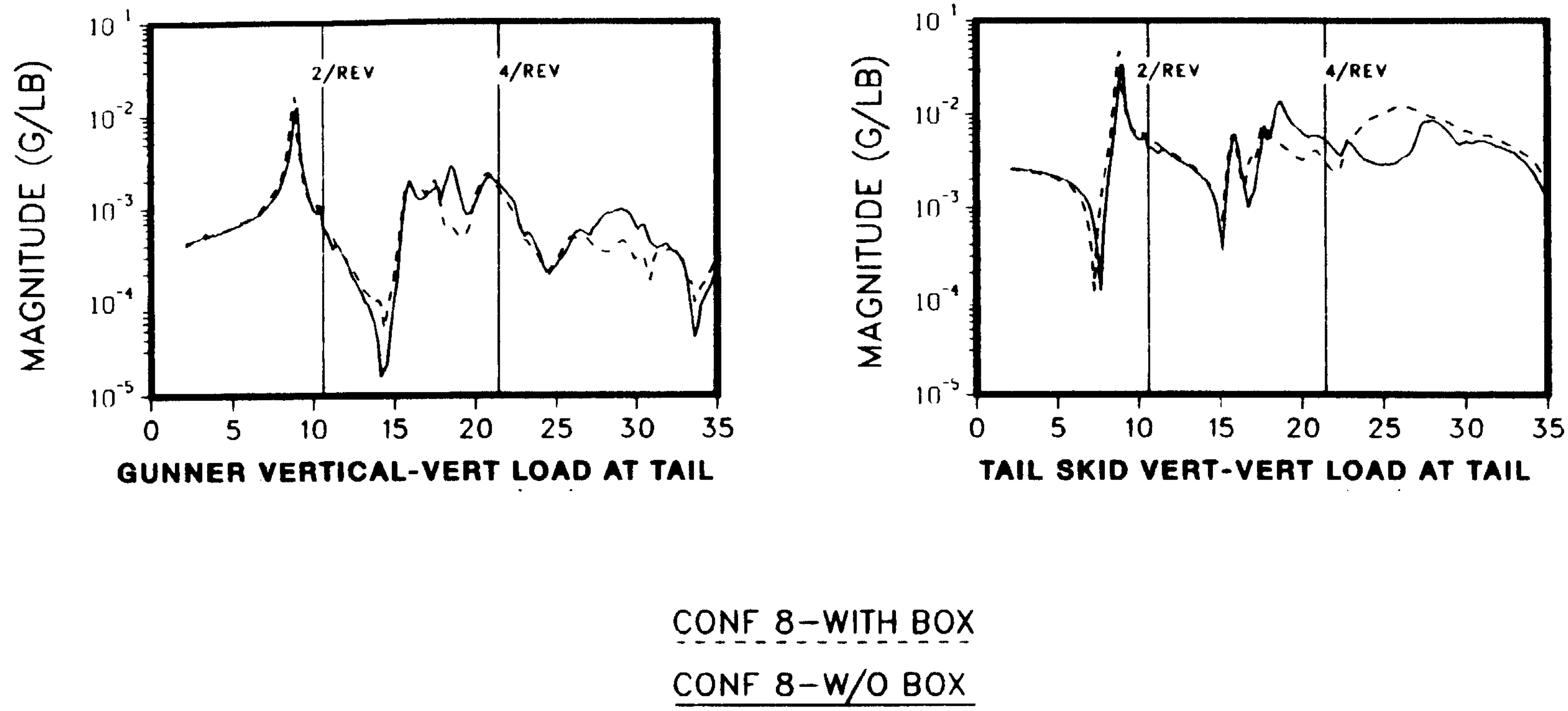
TAIL SKID VERT-VERT LOAD AT TAIL

CONF 8—WITH GLASS - - - - - - -

CONF 8—W/O GLASS ———

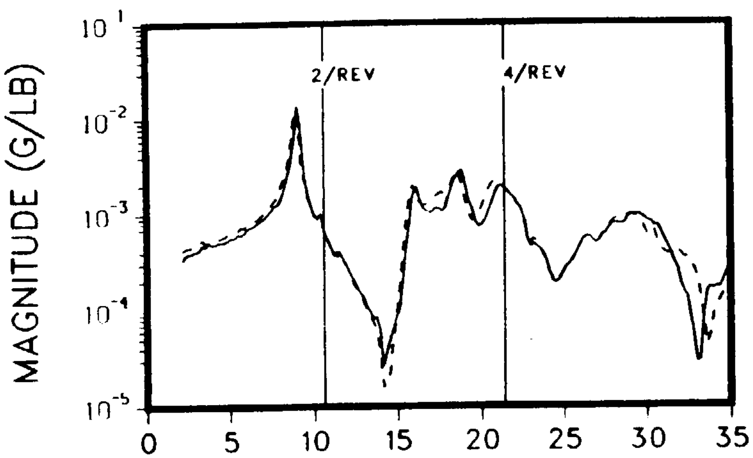
NO LATERAL TESTS PERFORMED

CONF 8 - BLACK BOX EFFECTS
(TEST DATA COMPARISONS)

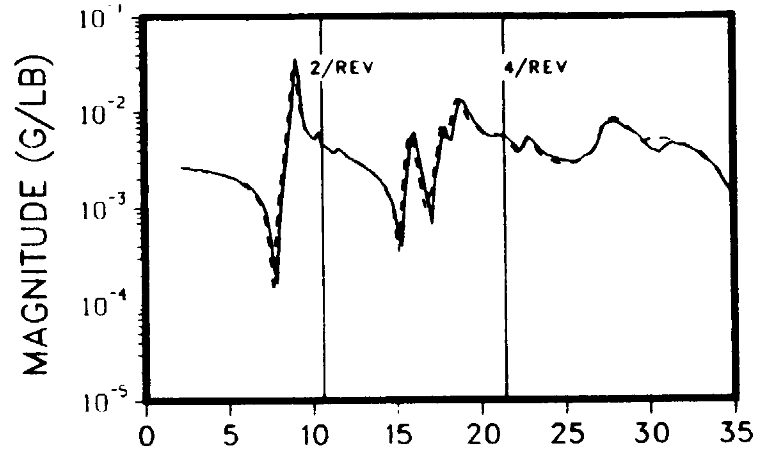


NO LATERAL TESTS PERFORMED

CONF 8 - WING EFFECTS



TEST DATA-GUNNER VERTICAL RESPONSE



TEST DATA-TAIL SKID VERTICAL RESPONSE

CONF 8—WITH WINGS

CONF 8—W/O WINGS

NO LATERAL TESTS PERFORMED

TEST NATURAL FREQUENCY AND DAMPING ESTIMATES

A concise summary of the natural frequency and damping parameters extracted from the digitized test data for the eight airframe configurations tested under this program is presented on the following four pages in tabular and graphical form. Details of the algorithms used to extract these parameters are contained in Reference 4.

The natural frequency summary enables one to quickly identify the effect of each component on the global airframe modes from 0-35 Hz. Of particular interest, one may identify the effect of each component as a predominately mass or stiffness effect by the upward or downward slope of the curve, respectively.

The damping summary shown in the second plot enables one to see the large difference between elastomeric pylon mount and airframe structural damping, as expected. Also of interest, the range of airframe modes damping (1-3%) seems to justify the use of 2% damping in NASTRAN as a global average.

TEST NATURAL FREQUENCY AND DAMPING ESTIMATES

MODE	#1		#2		#3		#4	
	ω_n	ζ	ω_n	ζ	ω_n	ζ	ω_n	ζ
PYLON PITCH	3.7	14.70	X	-	X	-	X	-
PYLON ROLL	5.0	5.81	X	-	X	-	X	-
FIRST LAT BENDING	7.3	1.99	7.5	1.42	7.3	1.47	7.5	1.46
FIRST VERT BENDING	8.0	1.25	8.3	1.12	7.9	1.19	7.9	1.20
SKID VERT	14.6	0.71	14.6	0.86	14.6	0.81	14.6	0.81
SECOND LAT BENDING	16.0	2.82	15.9	1.45	14.5	1.81	14.5	1.81
SECOND VERT BENDING	16.6	2.20	17.4	2.29	15.9	2.00	15.9	2.02
SKID LAT	21.1	1.28	21.0	1.71	17.1	1.21	17.1	1.21
FUSELAGE TORSION	23.5	1.68	23.2	0.80	20.1	2.67	20.1	2.66
ENGINE PITCH	24.6	1.47	24.6	2.25	22.1	3.38	22.1	3.35
THIRD VERTICAL	24.7	1.69	25.1	2.09	23.5	2.29	23.7	2.25
SKID	24.5	2.11	24.5	1.64	24.5	1.37	24.5	1.35
ROLL	27.5	0.68	27.7	1.74	27.4	1.24	27.5	1.33
M/R MAST F/A	28.4	0.99	X	-	X	-	X	-
M/R MAST LAT	27.7	1.08	X	-	X	-	X	-
3RD LATERAL	32.4	1.83	32.5	2.63	30.2	1.48	29.7	1.25
TORSION/ENGINE	34.8	1.32	33.3	2.26	33.5	1.41	34.2	0.75

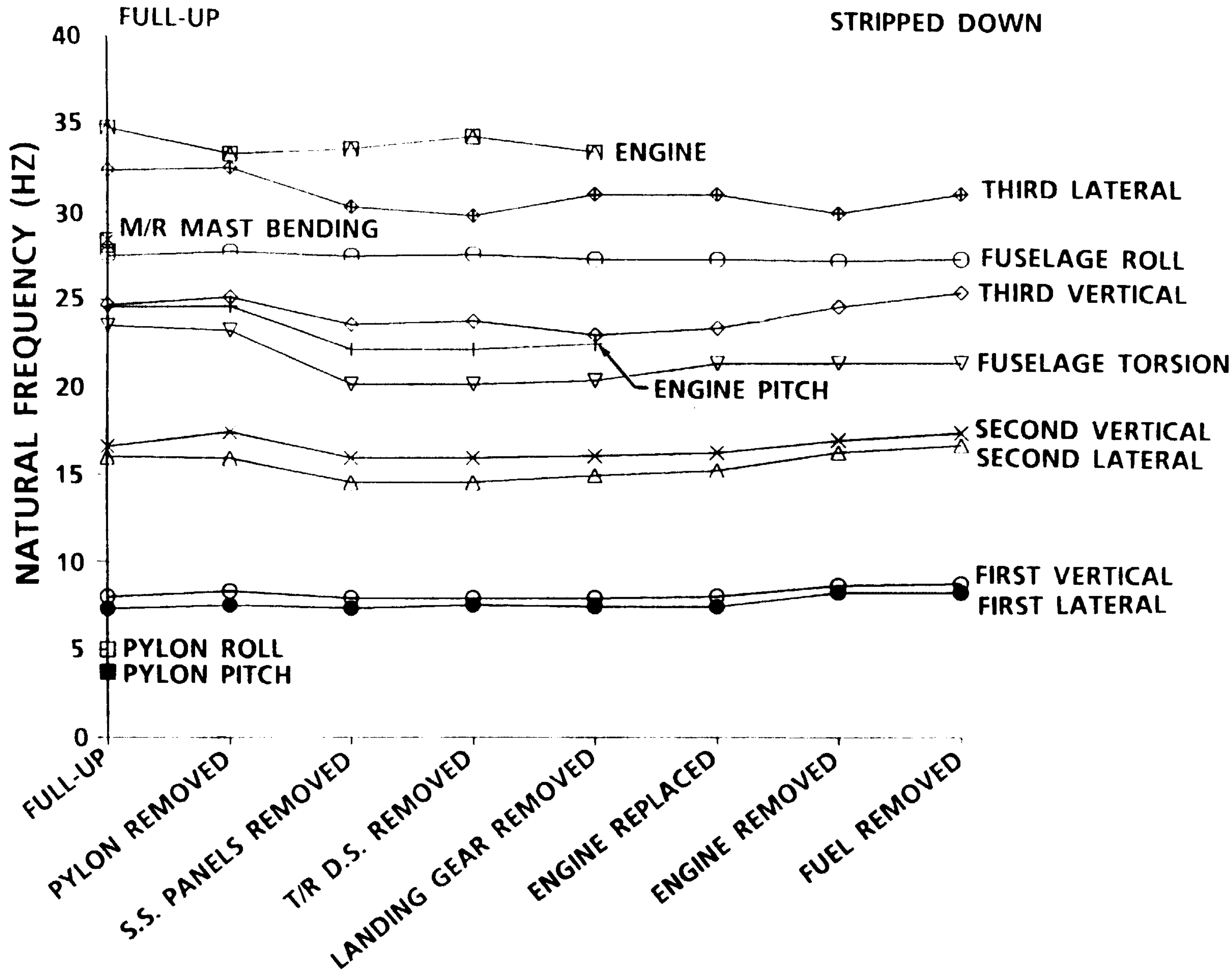
X - Mode does not exist (component removed).

TEST NATURAL FREQUENCY AND DAMPING ESTIMATES
(Concluded)

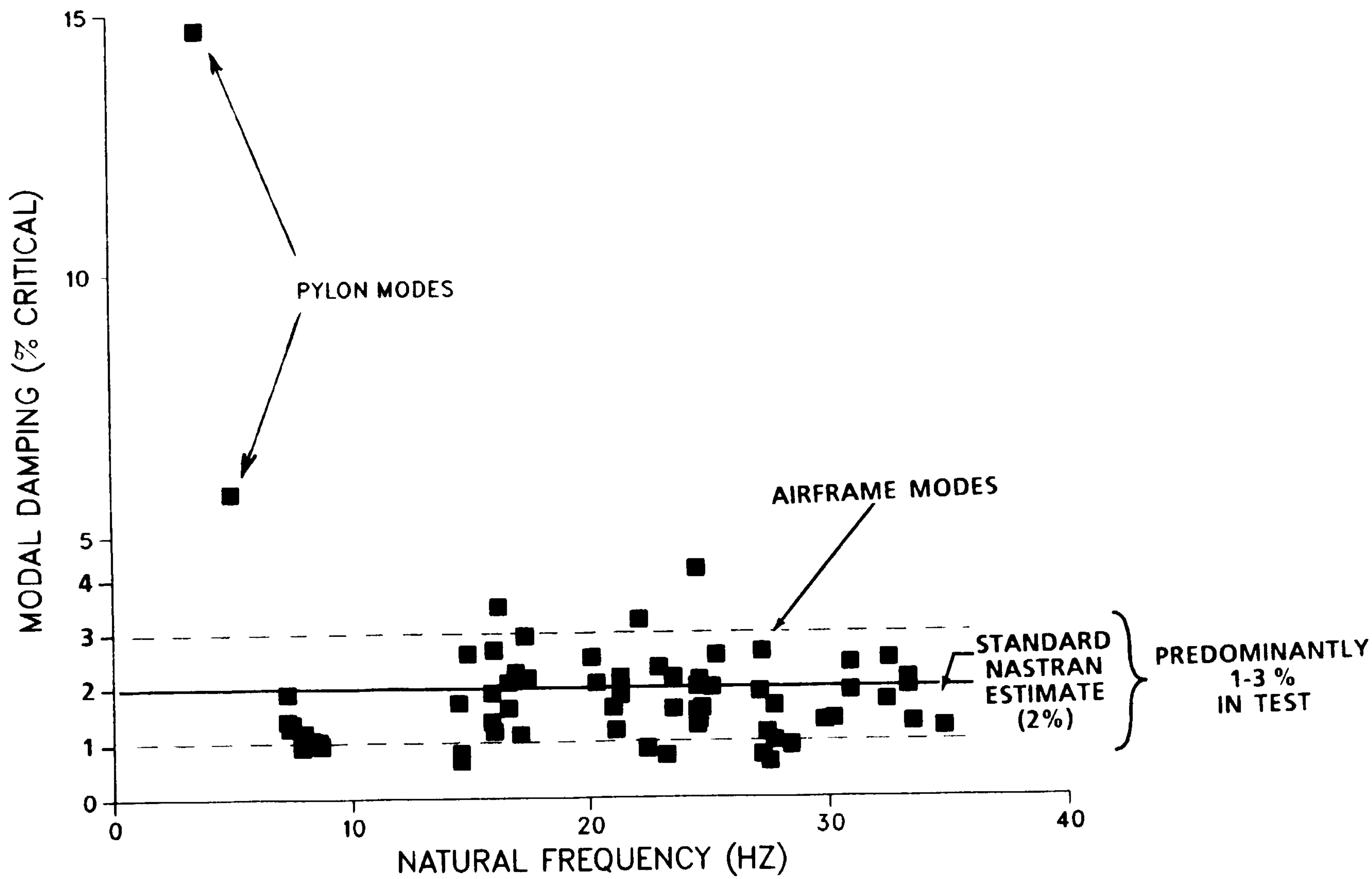
MODE	#5		#6		#7		#8	
	ωn	ζ	ωn	ζ	ωn	ζ	ωn	ζ
PYLON PITCH	X	-	X	-	X	-	X	-
PYLON ROLL	X	-	X	-	X	-	X	-
FIRST LAT BENDING	7.4	1.34	7.4	1.34	8.2	1.03	8.2	1.09
FIRST VERT BENDING	7.9	0.99	8.0	0.83	8.6	1.09	8.7	1.02
SKID VERT	X	-	X	-	X	-	X	-
SECOND LAT BENDING	14.9	2.75	15.2	2.89	16.2	3.64	16.6	1.71
SECOND VERT BENDING	16.0	1.27	16.2	1.71	16.9	2.39	17.3	3.08
SKID LAT	X	-	X	-	X	-	X	-
FUSELAGE TORSION	20.3	2.18	21.3	3.74	21.3	2.29	21.3	1.95
ENGINE PITCH	22.4	0.93	X	-	X	-	X	-
THIRD VERTICAL	22.9	2.47	23.3	3.45	24.5	4.34	25.3	2.70
SKID	X	-	X	-	X	-	X	-
ROLL	27.2	0.81	27.2	-	27.1	2.01	27.2	2.77
M/R MAST F/A	X	-	X	-	X	-	X	-
M/R MAST LAT	X	-	X	-	X	-	X	-
3RD LATERAL	30.9	2.55	30.9	1.16	29.8	1.45	30.9	2.02
TORSION/ENGINE	33.3	2.11	X	-	X	-	X	-

X - Mode does not exist (component removed).

NATURAL FREQUENCY VARIATIONS BY CONFIGURATION



MODAL DAMPING ESTIMATE POPULATION



3. COMPONENT TEST DESCRIPTION

COMPONENT GROUND TESTS

In addition to the eight aircraft tests, separate component tests were conducted to isolate the effects of various "difficult components" which have caused significant discrepancies between test and analysis in prior correlation efforts. The suspension system, pylon (transmission and main rotor shaft), engine, elastomeric mounts, and secondary structure are the prime candidates estimated to have the most significant effects.

Each progressive aircraft configuration removed and isolated a different component. The resulting aircraft structural response in comparison with the previous configuration as well as separate component test data will be used to determine the effect of each component. The bungee suspension system was statically and dynamically tested to obtain its characteristics. The cable-only suspension system was dynamically tested inplane at varying levels of tension to determine differential stiffening effects. The pylon was statically and dynamically tested on a separate test stand to obtain its characteristics. Nonlinearities and damping were investigated for the pylon. Separate tests of the pylon elastomeric mounts were also conducted.

COMPONENT GROUND TESTS

- SUSPENSION SYSTEM
  - A) BUNGEE SUSPENSION STATIC LOAD-DEFLECTION TEST (Z).
  - B) CABLE SUSPENSION STATIC TEST (Z) AND DYNAMIC TESTS (CABLE X, Y) WITH VARYING AMOUNTS OF TENSILE LOAD.
- MAIN ROTOR PYLON
  - A) SHAKE TEST (HUB X, Y) AND STATIC LOAD-DEFLECTION TEST (HUB AND MOUNTS X, Y, Z) OF MAIN ROTOR TRANSMISSION / MAST MOUNTED TO GROUND.
  - B) STATIC AND DYNAMIC STIFFNESS TESTING OF PYLON ELASTOMERIC MOUNTS.

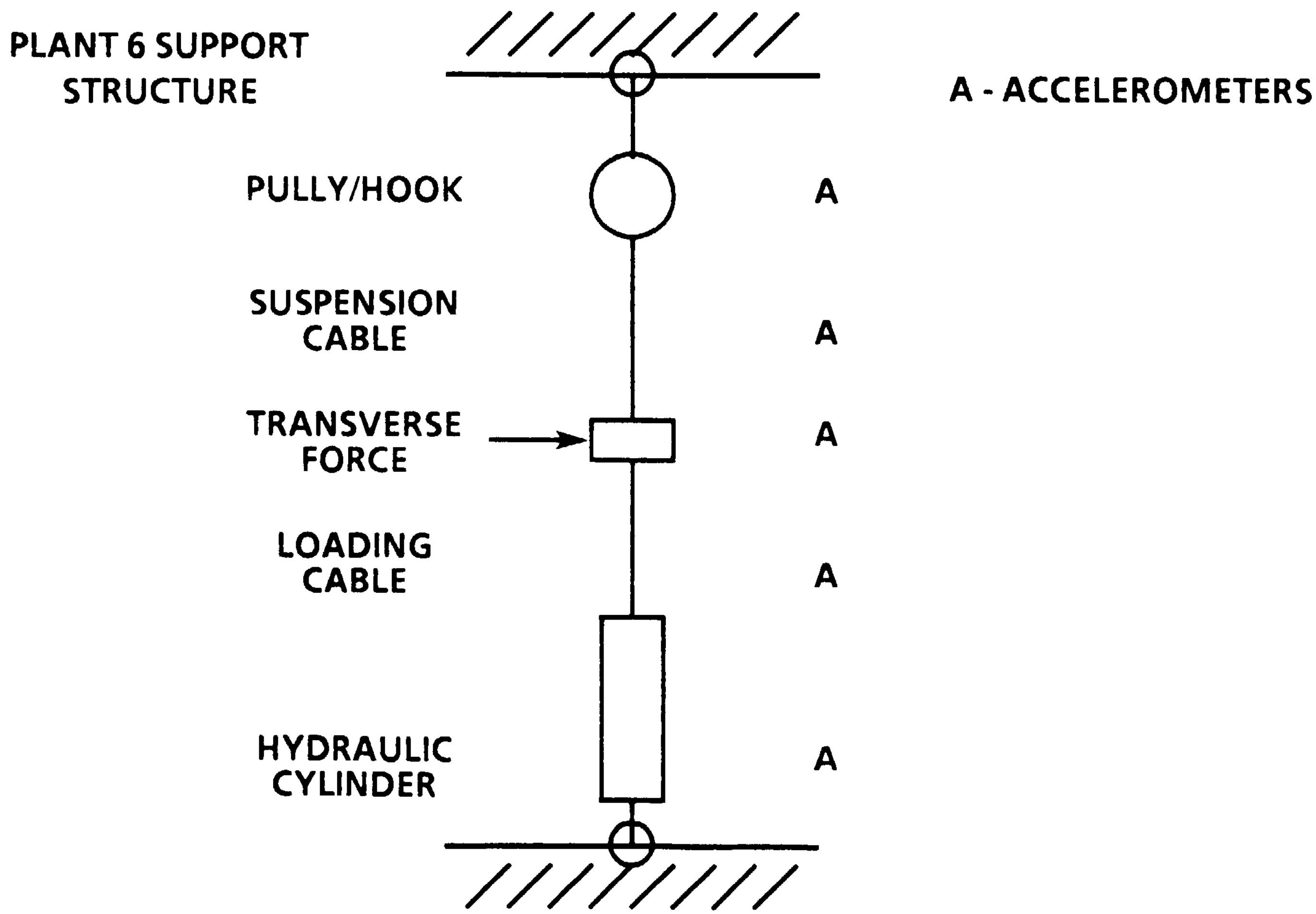
SUSPENSION SYSTEM COMPONENT TEST SETUP

The AH-1G was suspended by a cable from a hook attached to the BHTI Plant 6 vibration test support structure during vibration testing. To evaluate both static and dynamic response of the suspension system alone, a cable was attached to the lower end of the suspension cable (in place of the ship) and loaded by a hydraulic cylinder attached to ground.

The hydraulic cylinder force was varied to simulate various AH-1G gross weight test configurations. Three different cable tension loads were used. During static testing, a transverse force was applied, and the deflection of the loaded point recorded to determine the differential stiffening effect of the cable. A vertical pull test was also conducted to determine the stiffness of the cable.

Accelerometers were placed at the positions shown in the figure and a shake test performed with different cable tension settings.

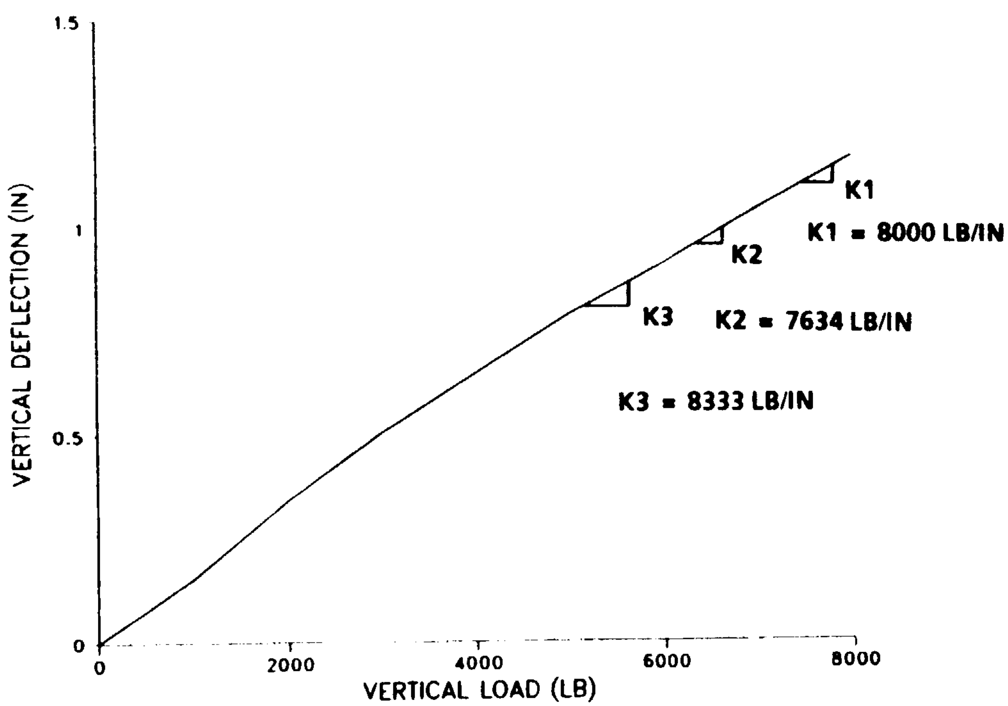
SUSPENSION SYSTEM COMPONENT TEST SETUP



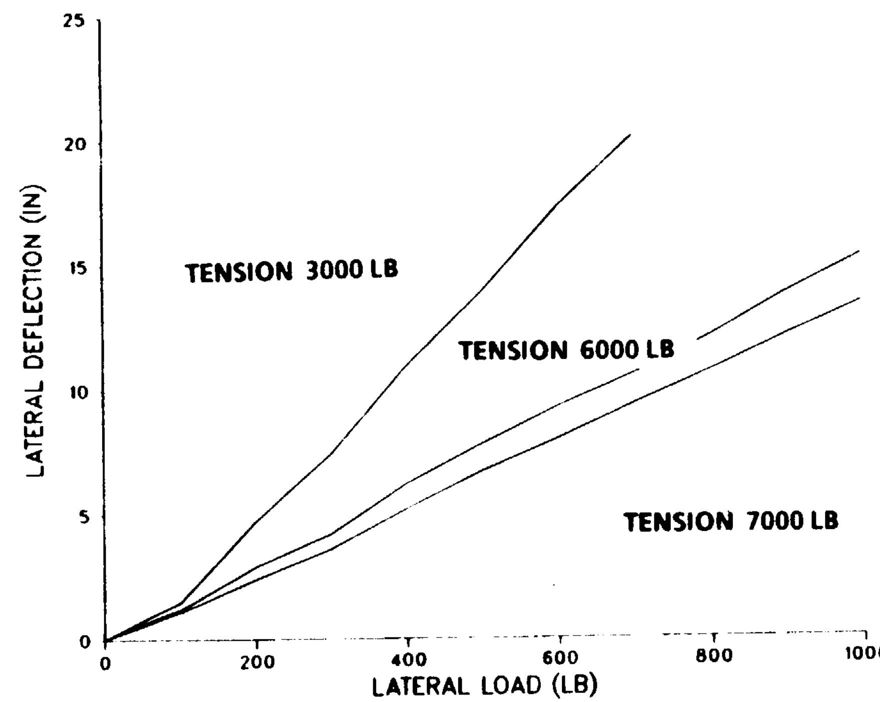
SUSPENSION SYSTEM STATIC TEST RESULTS
(12-ft Steel Cable)

The results of the static vertical and lateral tests discussed on the previous page are plotted below.

SUSPENSION SYSTEM STATIC TEST RESULTS
(12-FT STEEL CABLE)



VERTICAL PULL TEST

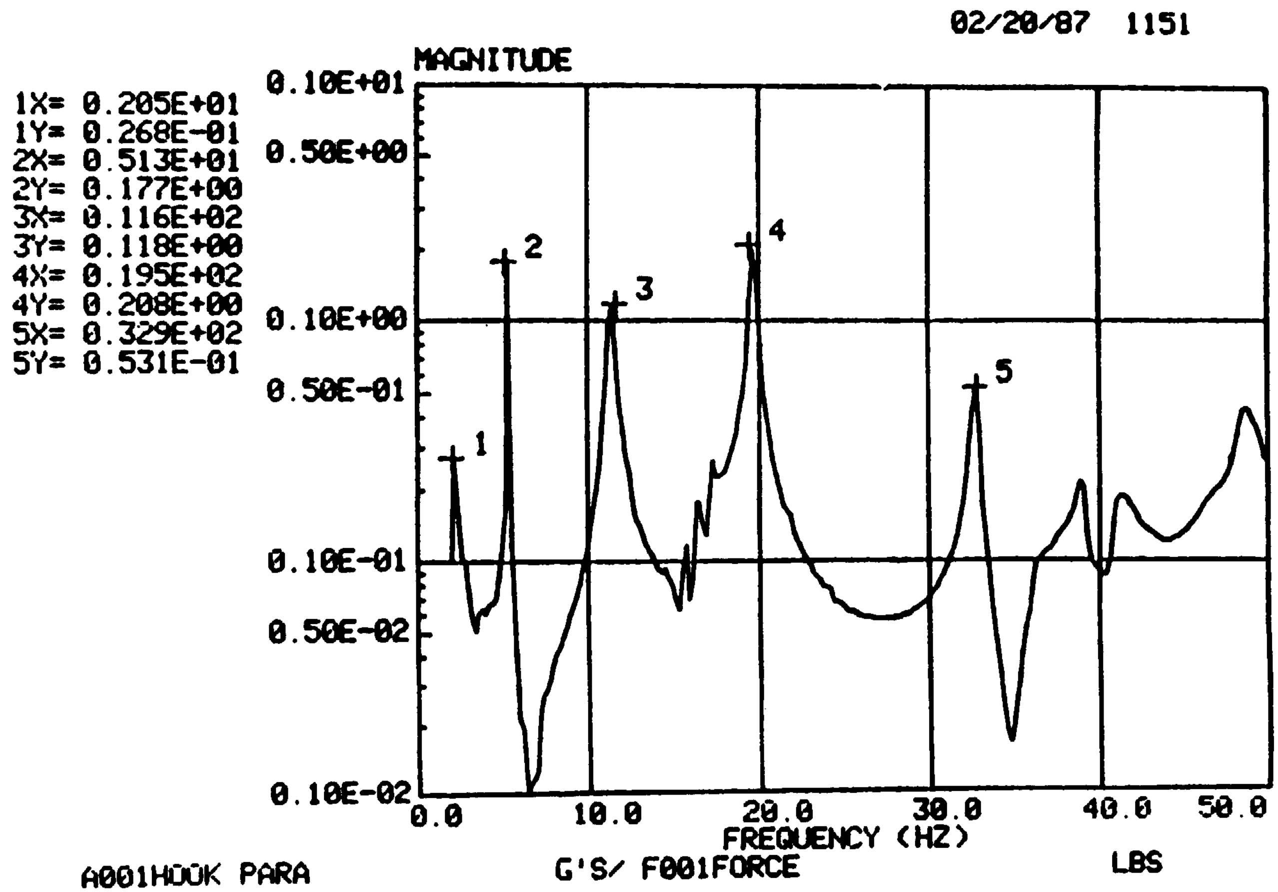


LATERAL PULL TESTS
(VARYING TENSION IN CABLE)

SUSPENSION SYSTEM DYNAMIC TEST RESULTS
(12-ft Steel Cable)

A typical frequency response curve for one accelerometer location (hook in-line with cable) obtained during the dynamic cable test described earlier is plotted below.

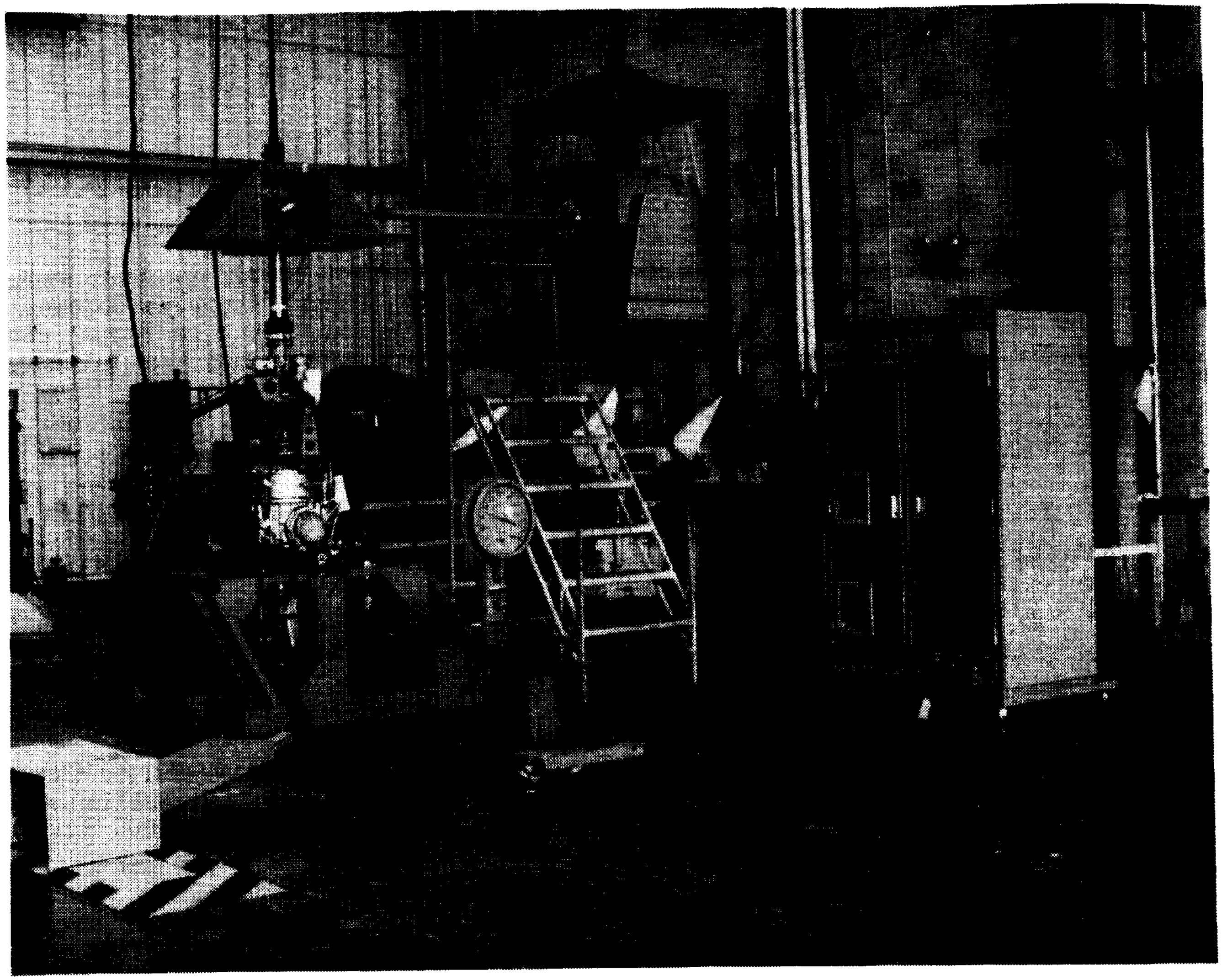
SUSPENSION SYSTEM DYNAMIC TEST RESULTS
(12-FT STEEL CABLE)



PYLON COMPONENT TEST SETUP

Static and dynamic in-plane tests were conducted on the AH-1G main rotor pylon while mounted on a stiff grounded test fixture as shown in the photograph. The pylon substructure, less the pitch link control levers, weighed 1596 lb which included a 948-lb lumped weight at the main rotor hub, WL 152.7. The photograph shows a shake test setup with force applied at the main rotor hub and a vertical lift at the main rotor hub applied through a guy wire. To study the effect of the rotor thrust on the pylon modes, a series of vertical lift loads was applied and maintained throughout the static and dynamic tests. The dampers under the aft pylon mounts, as can be seen in the photograph, were removed during some shake test configurations to examine their effect on the pylon forced response.

PYLON COMPONENT TEST SETUP



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PYLON COMPONENT TEST CONDITIONS

STATIC

The static tests consisted of in-plane longitudinal and lateral incrementally applied loads at the main rotor hub from 0-1,500 lb. Displacement transducers were used to measure the pylon deflection at each load increment in the following locations which are visible on the next schematic:

1. Main rotor hub, F/A and Lateral
2. Mid-mast (Mast Sta 22), F/A and Lateral
3. Mast upper bearing (Mast Sta 49), F/A and Lateral
4. Pylon corner mounts (4) and fifth mount, vertical.

The vertical lifts applied at the hub for both static and dynamic tests were as follows:

a. Full lift of 7000 lb, and
b. Nominal lift of 500 lb.

DYNAMIC

Twelve different shake tests were conducted as described in the table. In-plane excitations at two different magnitudes, with varying lift and with/without dampers, were used to quantify nonlinear rotor thrusts and damping effects, respectively. The frequency sweep range was 2 to 50 Hz and all cases were carried out with some hub thrust load applied to avoid brinelling in the bearings.

PYLON COMPONENT TEST CONDITIONS

CASE NO.	EXCITATION			SETUP NO.	APPLIED LIFT (LB)	WITH/WITHOUT DAMPERS	MODAL TAPE NO.
	LOCATION	DIRECTION	MAGNITUDE (LB)				
1	M/R Hub	F/A	200	001	1000	With	212
2	M/R Hub	F/A	200	001	7000	With	213
3	M/R Hub	F/A	400*	001	7000	With	104
4	M/R Hub	F/A	400*	001	1000	With	180
5	M/R Hub	F/A	200*	001	1000	Without	182
6	M/R Hub	F/A	400*	001	1000	Without	150
7	M/R Hub	Lateral	400*	002	1000	Without	214
8	M/R Hub	Lateral	200	002	1000	With	215
9	M/R Hub	Lateral	400*	002	1000	With	216
10	M/R Hub	Lateral	400*	002	7000	With	217
11	M/R Hub	Lateral	200	002	7000	With	218
12	M/R Hub	Lateral	200	002	1000	With	219

*Force = 100 lb from 2-6 Hz to prevent large displacement amplitudes

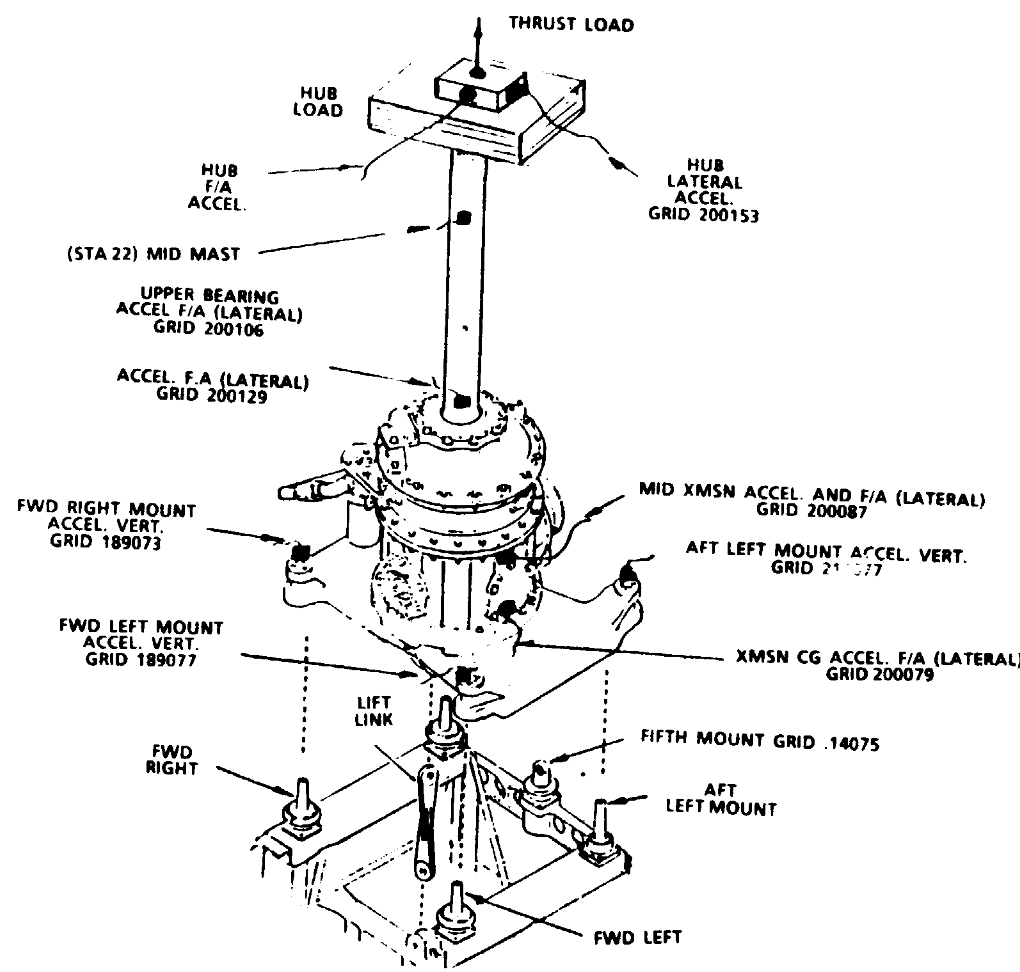
ACCELEROMETER LOCATIONS FOR PYLON SHAKE TEST

The accelerometer locations for the pylon shake test are listed below and illustrated on the drawing on the opposite page. Eleven accelerometers were used to measure the pylon forced response at 10 different locations. The locations and test codes (A002 for example) were maintained for both shake test directions. However, as indicated in the table, the orientations of the accelerometers were changed per setup 1 for longitudinal (F/A) excitation and setup 2 for lateral excitation. NASTRAN grid points associated with accelerometer locations are included here for reference.

CODE	LOCATION	SETUP 1	SETUP 2	COORDINATES			NASTRAN GRID
				X	Y	Z	
A002	Hub	F/A	Lat	200.00	0.0	152.76	200153
A003	Hub	Lat	F/A	200.00	0.0	152.76	200153
A004	Mid-Mast (Mast Sta 22)	F/A	Lat	200.00	0.0	130.76	200129
A005	Upper Bearing (Mast Sta 49)	F/A	Lat	200.00	0.0	105.70	200106
A006	Mid Xmsn	F/A	Lat	200.00	0.0	86.25	200087
A007	Engine Sump	F/A	Lat	200.00	0.0	70.00	200070
A008	C.G.	F/A	Lat	200.00	0.0	79.05	200079
A009	Lt Fwd Mount	Vert	Vert	189.94	-12.375	77.57	189077
A010	Rt Fwd Mount	Vert	Vert	189.94	12.375	77.57	189073
A011	Lt Aft Mount	Vert	Vert	211.72	-12.375	77.57	211077
A012	Rt Aft Mount	Vert	Vert	211.72	12.375	77.57	211073

C-2

ACCELEROMETER LOCATIONS FOR PYLON SHAKE TEST



PYLON COMPONENT TEST RESULTS

The results from the static and dynamic tests of the grounded pylon are summarized here. Variations in response associated with changes in magnitude and direction of the in-plane forces, magnitude of the lift applied, and the dampers are shown.

PYLON COMPONENT TEST RESULTS

STATIC – 1500 LB MAX LOAD

	1500 LB LATERAL LOAD AT HUB		1500 LB LONGITUDINAL LOAD AT HUB	
	1000 LB LIFT	7000 LB LIFT	1000 LB LIFT	7000 LB LIFT
ROTATION OF MOUNT PLANE	1.75°	2.10°	0.92°	0.99°
HUB DEFLECTION	2.90 IN.	3.48 IN.	1.88 IN.	2.21 IN.

DYNAMIC – (0 – 35 Hz SWEEP)

HUB LATERAL

MODE \ FORCE LEVEL	100/400	200	NO DAMPERS 100/400	200
PYLON ROLL	2.27	2.42	2.34	2.49
PYLON PITCH	3.16	3.70	2.81	3.51
M/R MAST LATERAL	25.00	24.90	22.98	25.26
M/R MAST F/A	31.20	29.00	27.40	29.00
	$\underbrace{\qquad\qquad}_{\text{NOMINAL LIFT}}$			7000 LB LIFT

HUB LONGITUDINAL

100/400	200	NO DAMPERS 100/400	200
2.60	2.63	2.38	2.35
2.81	2.71	2.71	3.22
24.04	23.20	23.48	24.21
30.90	29.50	27.73	30.50
$\underbrace{\qquad\qquad}_{\text{NOMINAL LIFT}}$			7000 LB LIFT

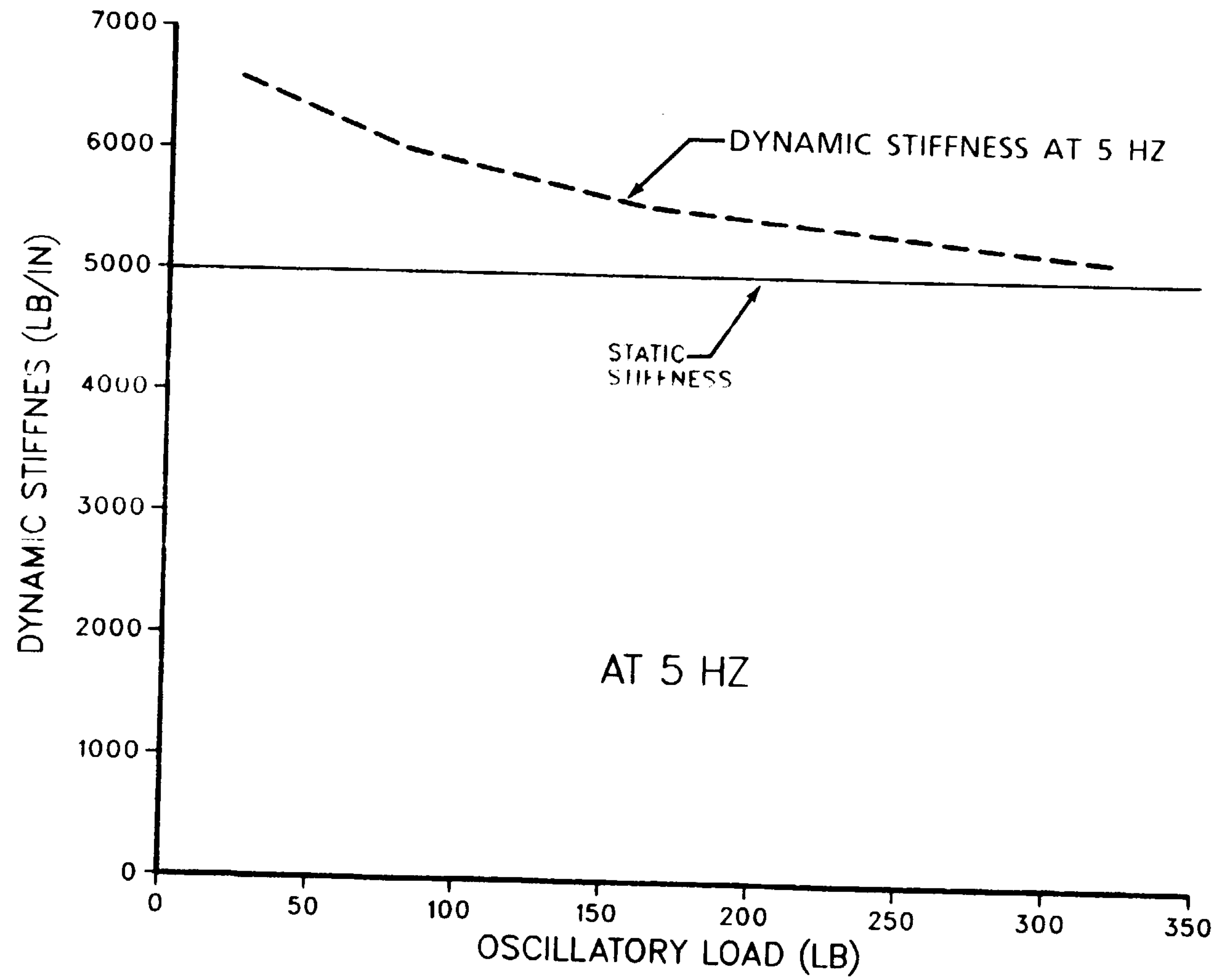
STIFFNESS OF THE PYLON ELASTOMERIC MOUNTS

The four pylon elastomeric corner mounts and the pylon fifth mount were tested to determine their static and dynamic stiffness characteristics. The dynamic stiffness tests were conducted at various oscillatory loads for two different frequencies (2, 5 Hz). Since the pylon mounts were actually used for long (undetermined) service life and were subjected to different loading environments, the stiffnesses of the corner mounts were found to vary by as much as 15%. Static stiffness of each pylon mount was tested under very slow load cycles (.03 cycle per second), then holding the displacement at .1 inch for a few seconds and measuring the applied load. The dynamic stiffness test starts by preflexing the mount by ±.25 inch (±.1 inch for the fifth mount) for five minutes. The amplitude of the dynamic stiffness is the ratio between the amplitudes of the applied load and displacement response. Measured dynamic stiffnesses for the right hand side corner mounts and the left mount are presented in the table. A typical dynamic stiffness plot versus frequency for various applied loads is presented in the figure for the R/H forward mount. The dynamic stiffness of the elastomeric mounts decreases rapidly with load and increases slightly with frequency.

CASE		CORNER MOUNT LOCATION				5TH MOUNT
		R.H. FWD	R.H. AFT	L.H. FWD*	L.H. AFT*	
Static Stiffness (lb/in)		5040	4660	4840	4640	21520
Dynamic Stiffness at 1000 lb Preload and at 2 Hz under Varying Oscillatory Load	±20	6392	5424			46797
	±40	6227	5294			39459
	±60	--	--			35863
	±80	5880	5050			32848
	±160	5446	4751			--
	±320	5056	4459			--
Dynamic Stiffness at 1000 lb Preload and at 5 Hz under Varying Oscillatory Load	±20	6652	5645			48925
	±40	6441	5422			40980
	±60	--	--			36912
	±80	6042	5152			33915
	160	5501	4884			--
	±320	5183	4561			--

* No dynamic testing performed for these mounts.

DYNAMIC STIFFNESS OF THE PYLON RIGHT HAND FORWARD MOUNT



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4. CONCLUSIONS

AH-1G GROUND VIBRATION AND COMPONENT TEST SUMMARY

The ground vibration test data obtained during this series of component investigations was very consistent. No data was lost or contaminated. This is very important because it removed the need to extract individual component effects from data that actually represented the removal of two components. All modes were excited through 50 Hz with multiple shaker locations to provide the capability to perform polyreference analysis in MODAL PLUS. The component tests, and progressive removal of components during each aircraft test, provide a significant data base for determining the effects of those difficult components (pylon, secondary structure, landing gear, tail rotor driveshafts, engine, fuel and suspension system) highlighted in this effort.

A summary of component predominant effects on the overall airframe vibratory response is presented below. The secondary structure and canopy glass are two components found to have significant stiffness contributions which generally are not accounted for in analysis. Individual component static and dynamic properties of the pylon and suspension, including thrust sensitivity, damping, and differential stiffness, also need to be included in analysis. The tests have provided some very important results for identifying difficult component effects and reducing discrepancies between test and analysis.

AH-1G GROUND VIBRATION AND COMPONENT TEST SUMMARY

COMPONENT INVESTIGATED	FINDINGS
• M/R PYLON ASSEMBLY	SENSITIVE TO: - LOAD DIRECTION AND AMPLITUDE - THRUST APPLIED - DAMPER INSTALLATION
• ELASTOMERIC MOUNTS	NONLINEAR DYNAMIC STIFFNESS EVIDENT (NEED FREQUENCY AND AMPLITUDE EFFECTS)
• SECONDARY STRUCTURE	LARGE STIFFNESS EFFECT EVIDENT (NEED TO INVESTIGATE FORCE AMPLITUDE EFFECTS)
• T/R DRIVESHAFT	MINIMAL EFFECT
• SKID LANDING GEAR	SKID MODES ELIMINATED, MINIMAL EFFECT ON FUSELAGE MODES AND RESPONSE
• DUMMY ENGINE	PROBLEM WITH FLEXIBLE MODES OR DUMMY ENGINE (NOT RIGID AS DESIRED)
• ENGINE	ENGINE MODE AT 22–25 HZ LOWERS FREQUENCIES BELOW 25 HZ (MASS EFFECT), RAISES FREQUENCIES ABOVE 25 HZ (STIFFENING EFFECT)
• FUEL	AFFECTS FREQUENCY RESPONSE ABOVE 4p

AH-1G GROUND VIBRATION AND COMPONENT TEST SUMMARY (Concluded)

COMPONENT INVESTIGATED	FINDINGS
• CANOPY GLASS	STIFFNESS EFFECT EVIDENT ON FUSELAGE TORSION MODE AND FREQUENCY RESPONSE ABOVE 4p
• BLACK BOXES	AFFECT FREQUENCY RESPONSE ABOVE 4p
• WINGS	REDUCED ROLL INERTIA HAS SLIGHT MASS EFFECT ON TORSION AND LATERAL MODES
• SUSPENSION	STATIC AND DYNAMIC PROPERTIES CHARACTERIZED
• MODAL DAMPING	PYLON DAMPING WAS 15% IN PITCH AND 6% IN ROLL; AIRFRAME DAMPING TREND WAS 1 TO 2 % CRITICAL $\leq$ 20 HZ, SLIGHTLY HIGHER DAMPING ABOVE 20 HZ

- SIGNIFICANT DATA BASE AVAILABLE FOR FUTURE STUDIES, SUCH AS COMPONENT MODAL SYNTHESIS, NON-PROPORTIONAL DAMPING, COMPONENT STUDIES, CORRELATION WITH ANALYSIS.

5. REFERENCES

REFERENCES

1. Cronkhike, J.D., Berry, V. L., Dompka, R. V., "Summary of the Modeling and Test Correlations of a NASTRAN Finite Element Vibrations Model for the AH-1G Helicopter," NASA CR 178201, January 1987.

2. Eubanks, A. L. and Dobson, P., "Interactive Test Data Analysis (INACT)," BHTI Report No. 299-099-898, September 1, 1981.

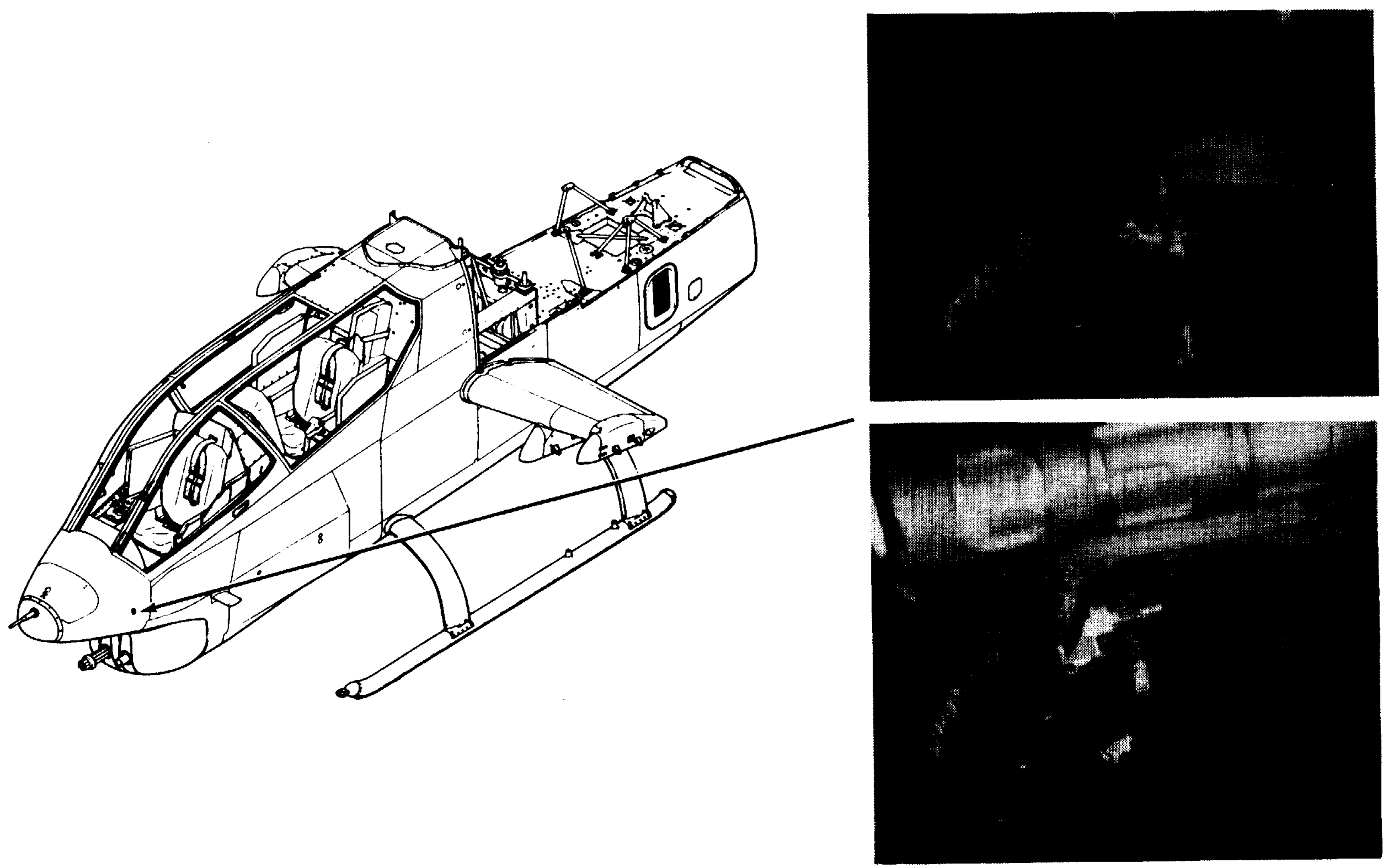
3. Klosterman, A.L. "On the Experimental Determination and Use of Modal Representations of Dynamic Characteristics," PhD Dissertation, University of Cincinnati, 1971.

4. "Modal Plus User's Manuals," Structural Dynamics Research Corporation, Milford, Ohio, 1983.

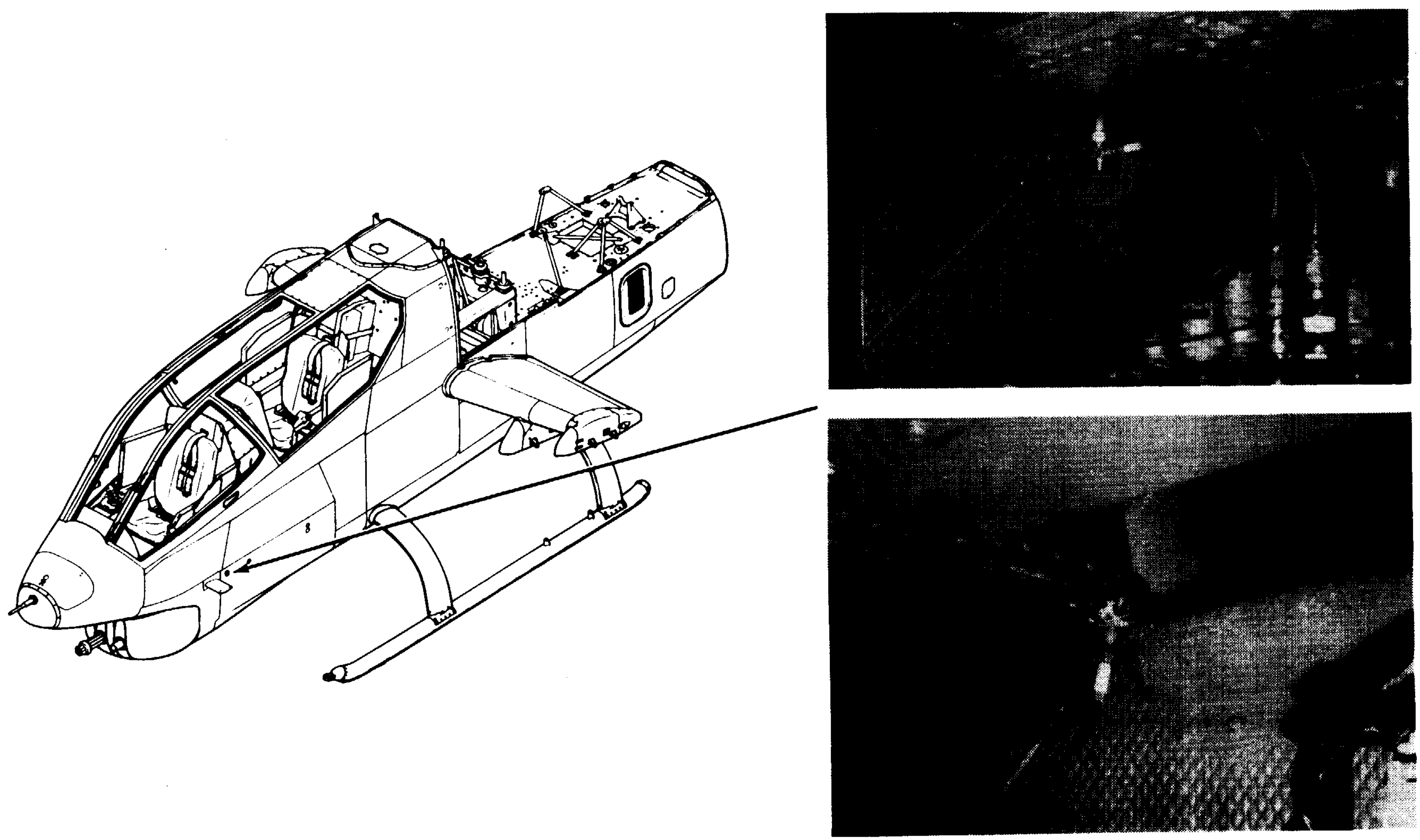
APPENDIX A

INSTRUMENTATION LOCATION PHOTOGRAPHS

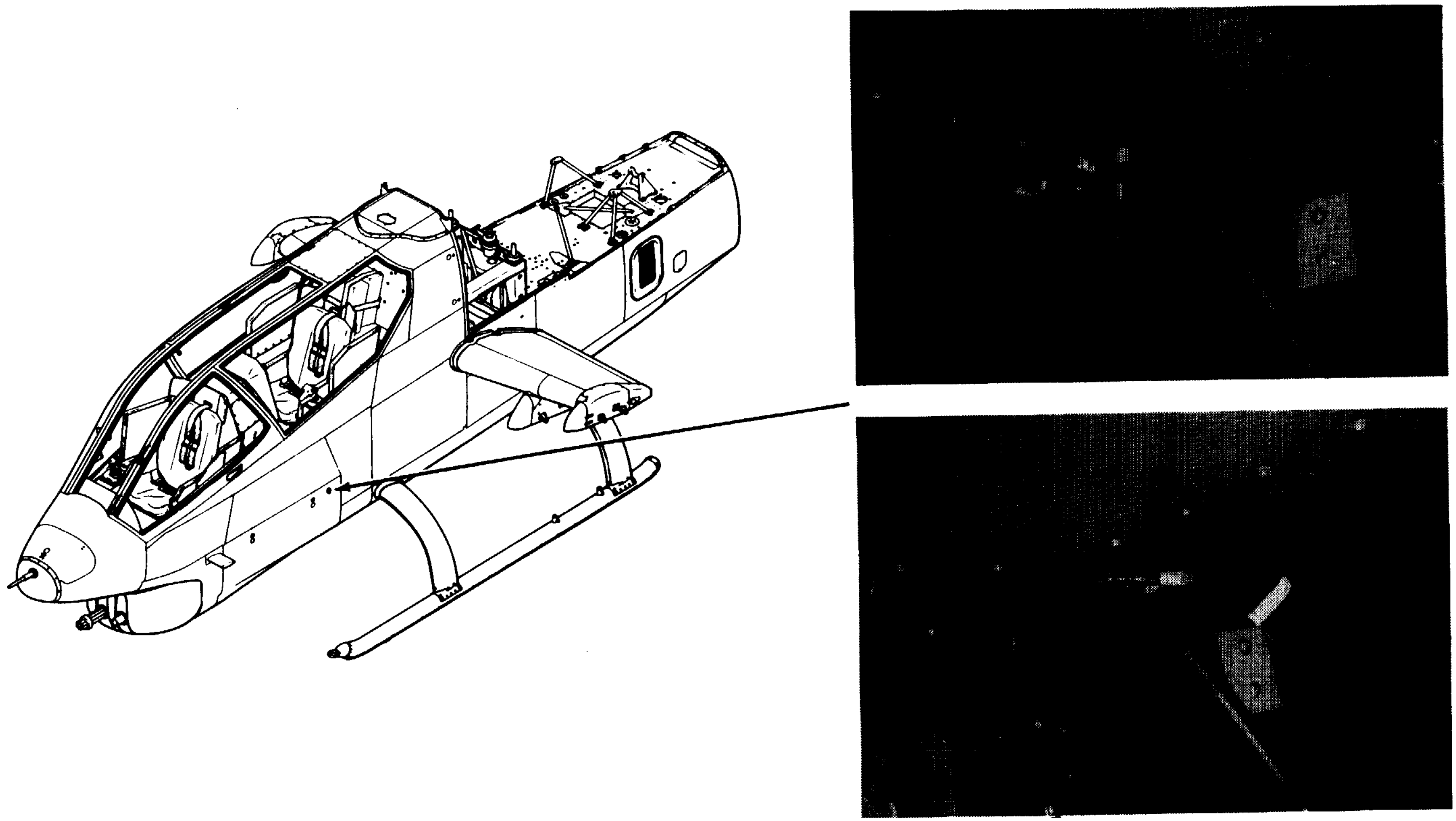
ACCELEROMETER LOCATION
(GUNNER HEEL REST - VERTICAL AND LATERAL RESPONSE)



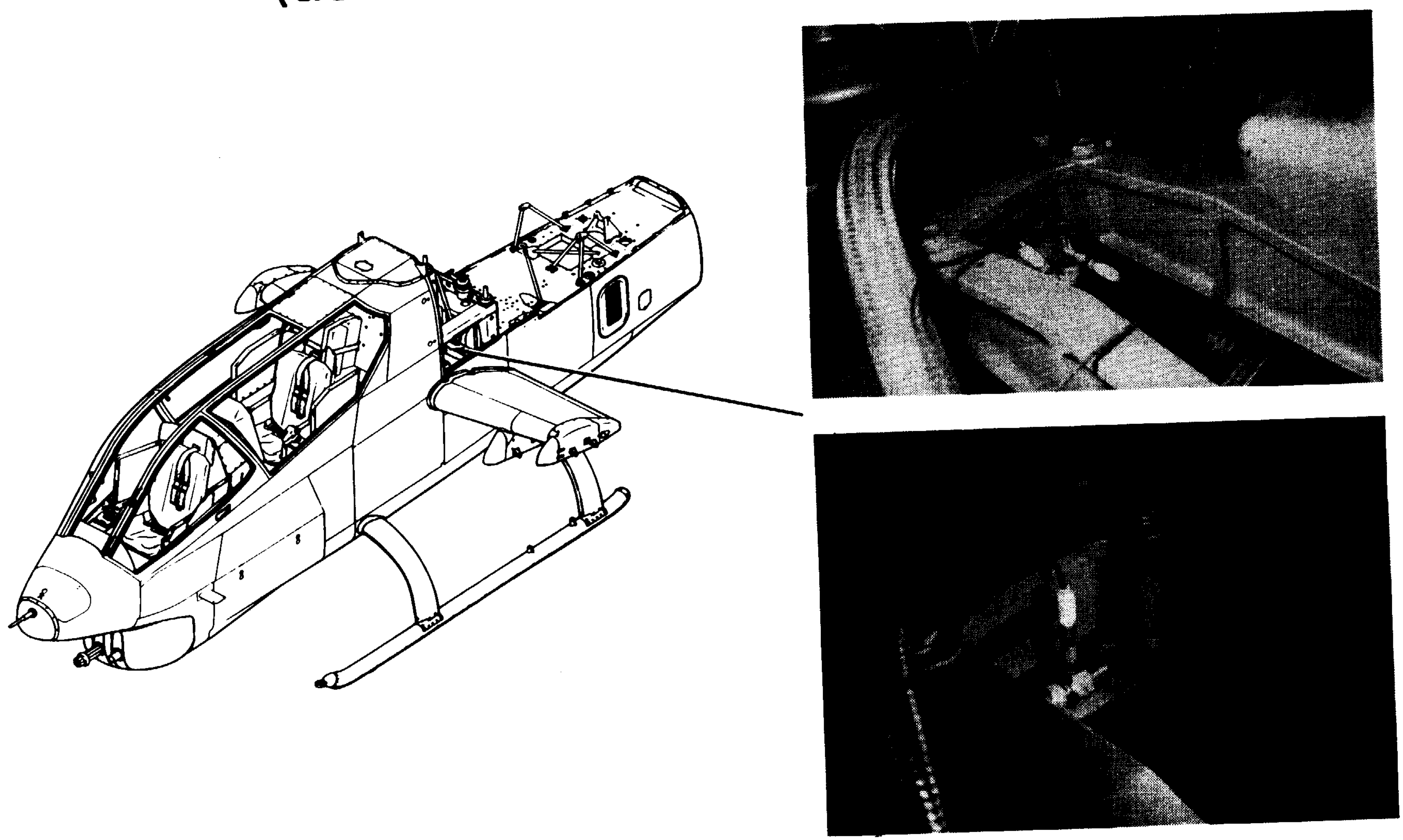
ACCELEROMETER LOCATION
(GUNNER FLOOR - VERTICAL AND LATERAL RESPONSE)



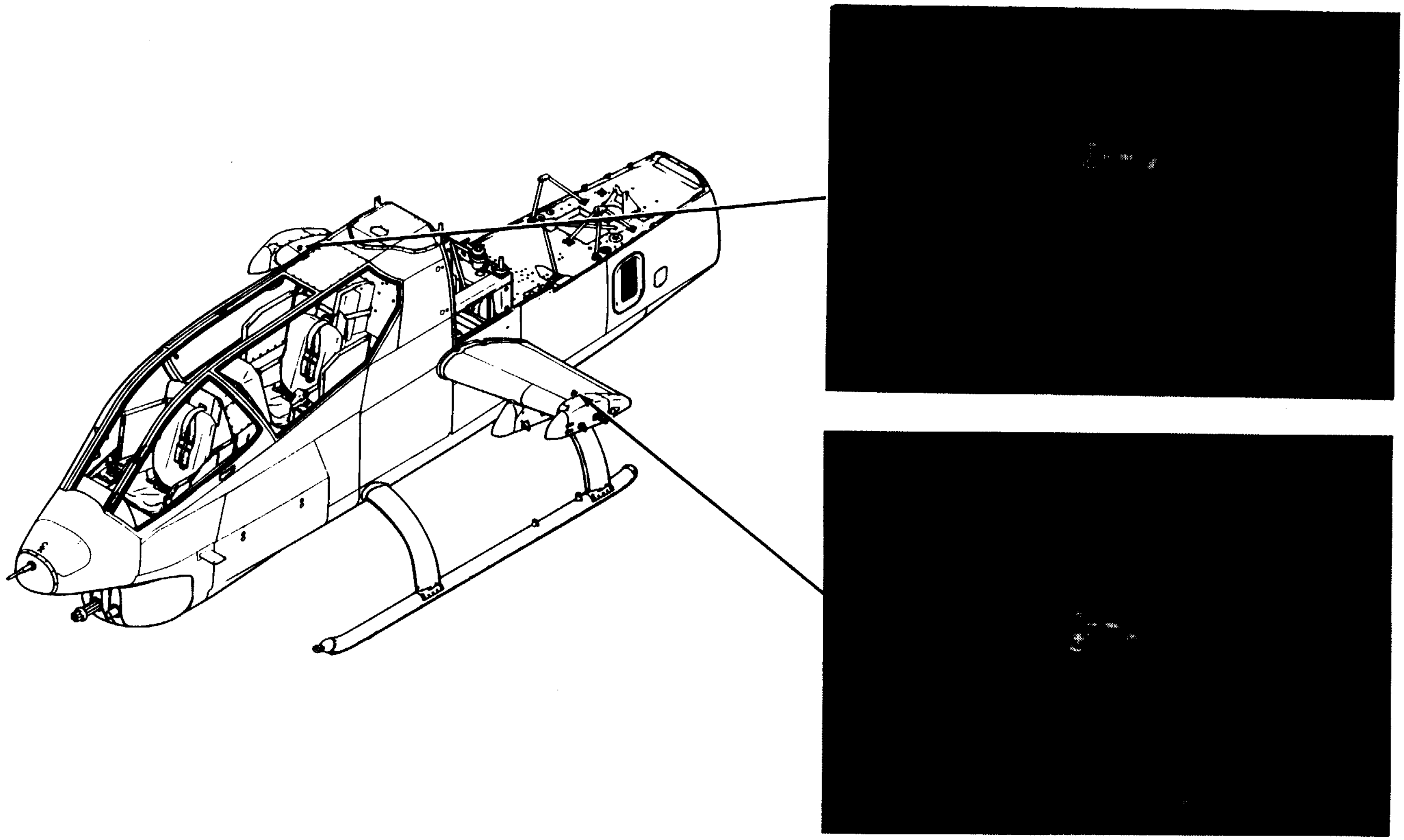
ACCELEROMETER LOCATION
(PILOT FLOOR - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(C.G. - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(WING TIP - VERTICAL RESPONSE ONLY)



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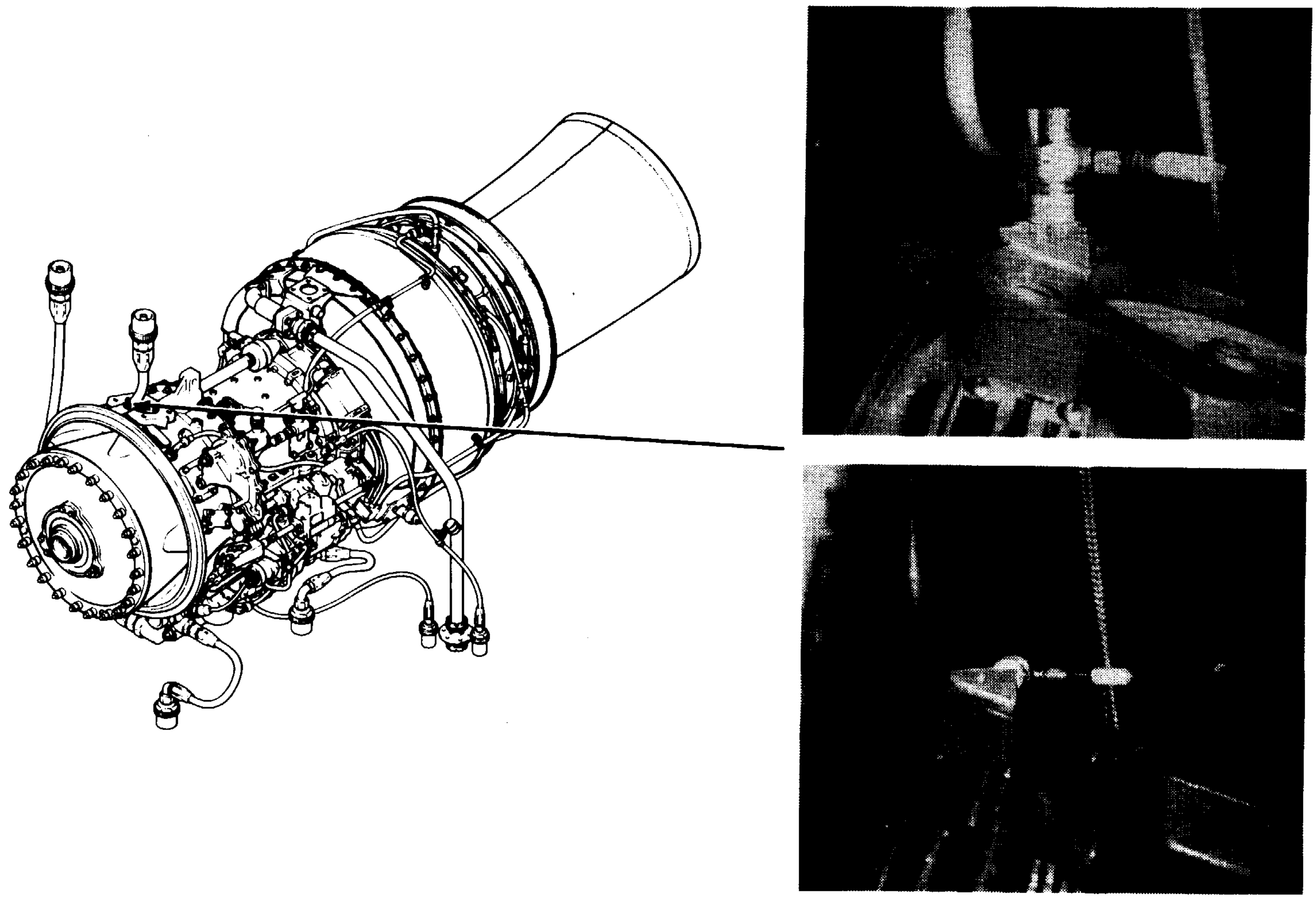
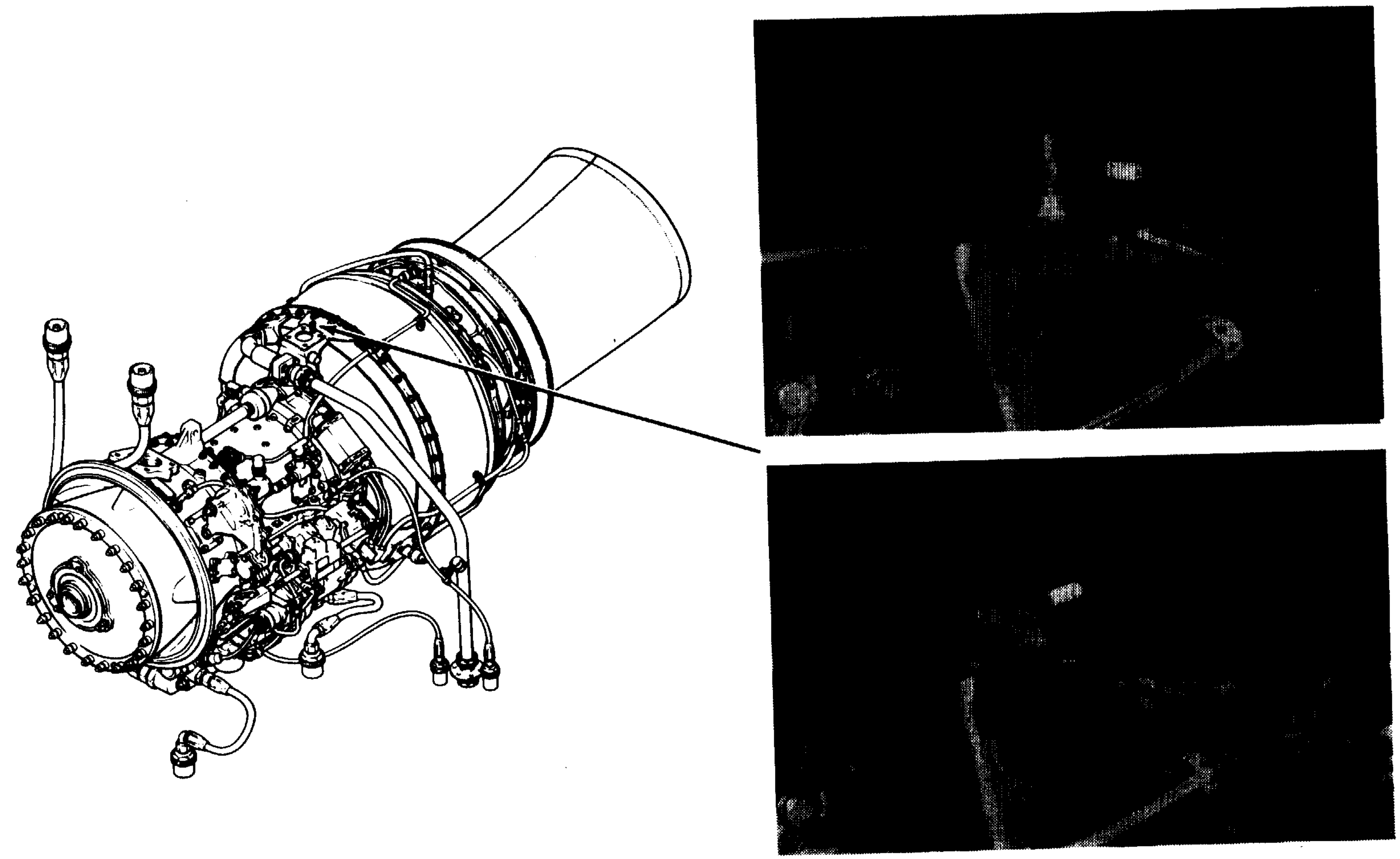
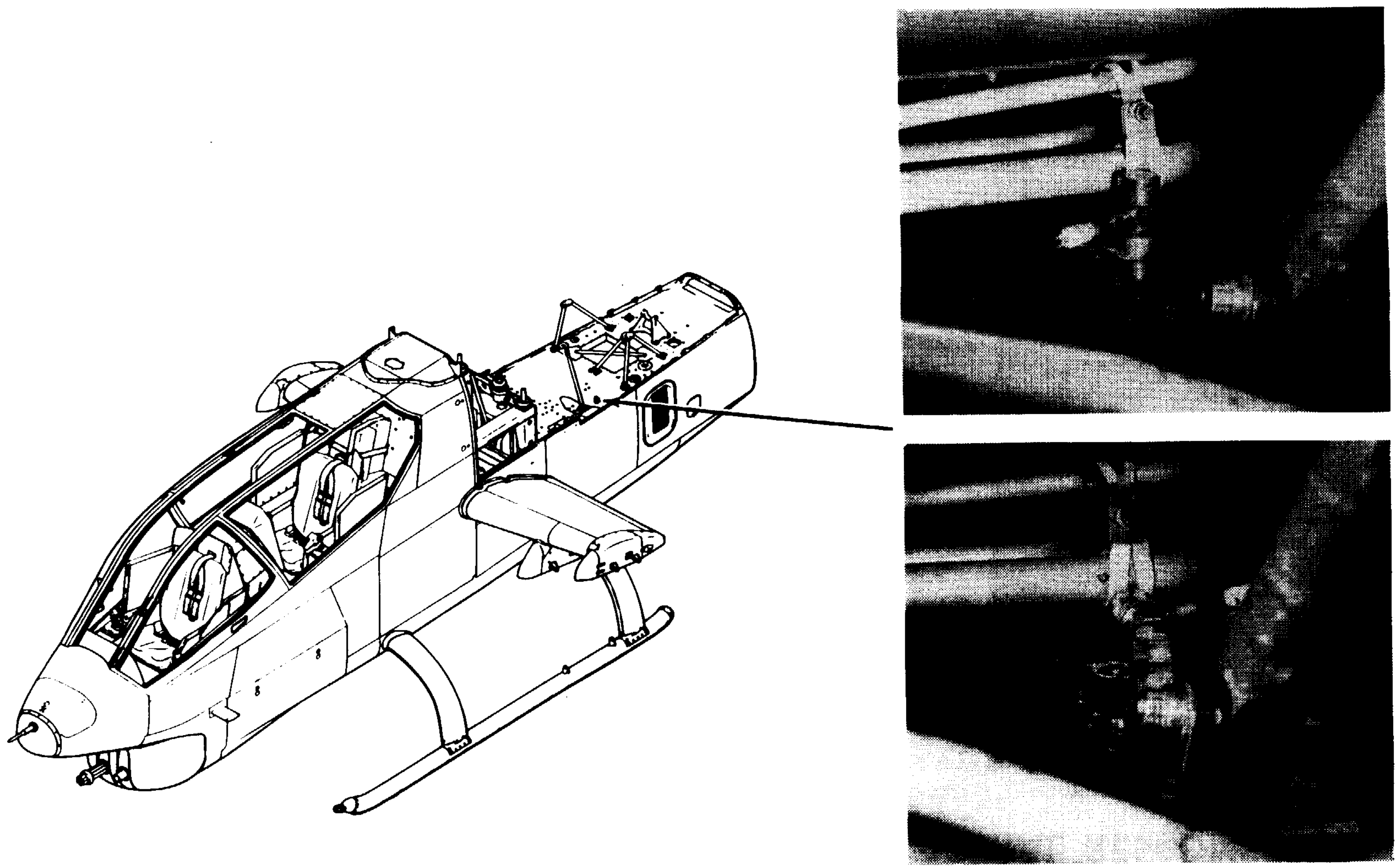
ACCELEROMETER LOCATION
(FORWARD ENGINE - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(AFT ENGINE - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(FORWARD ENGINE DECK - VERTICAL AND LATERAL RESPONSE)



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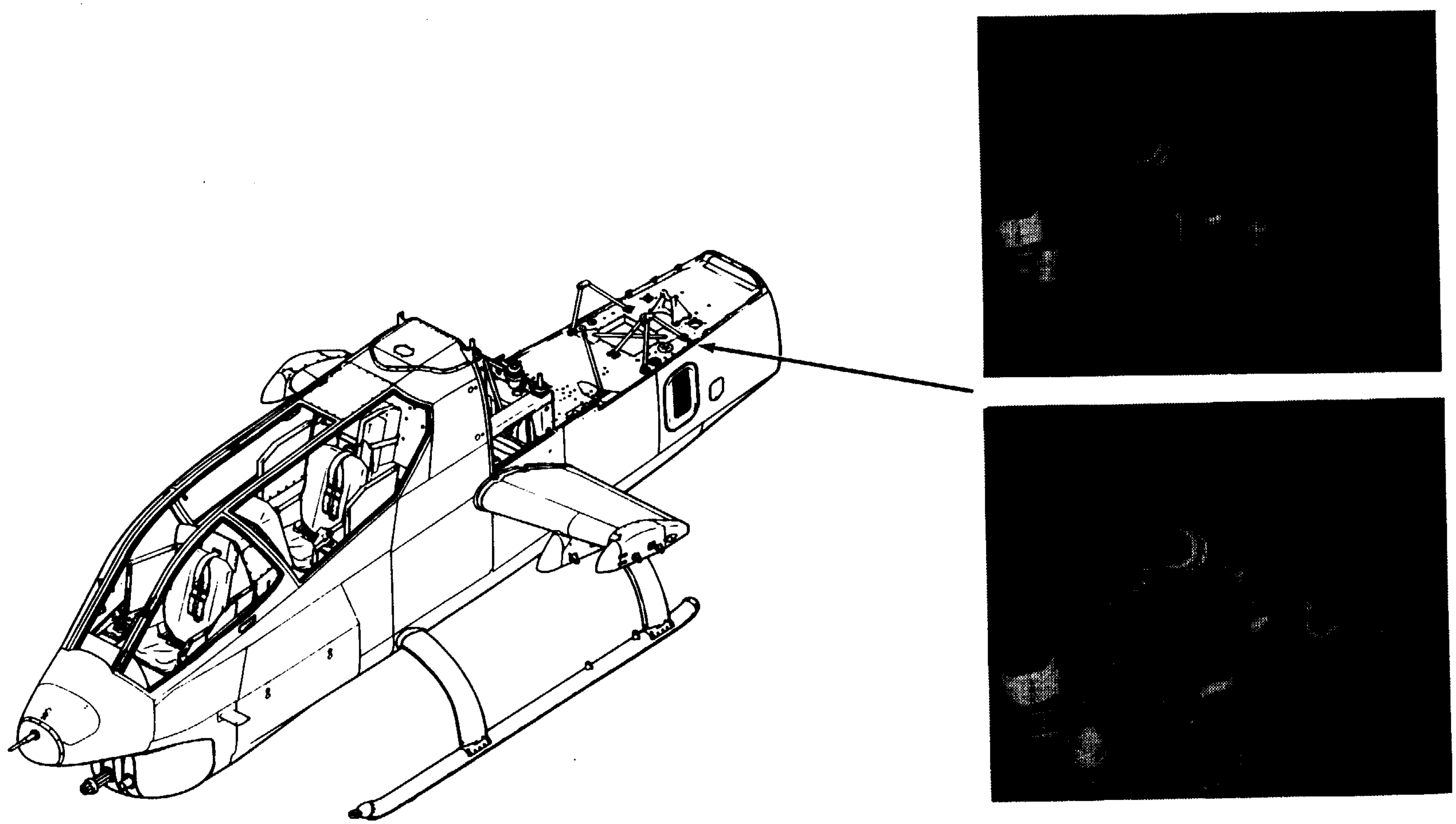
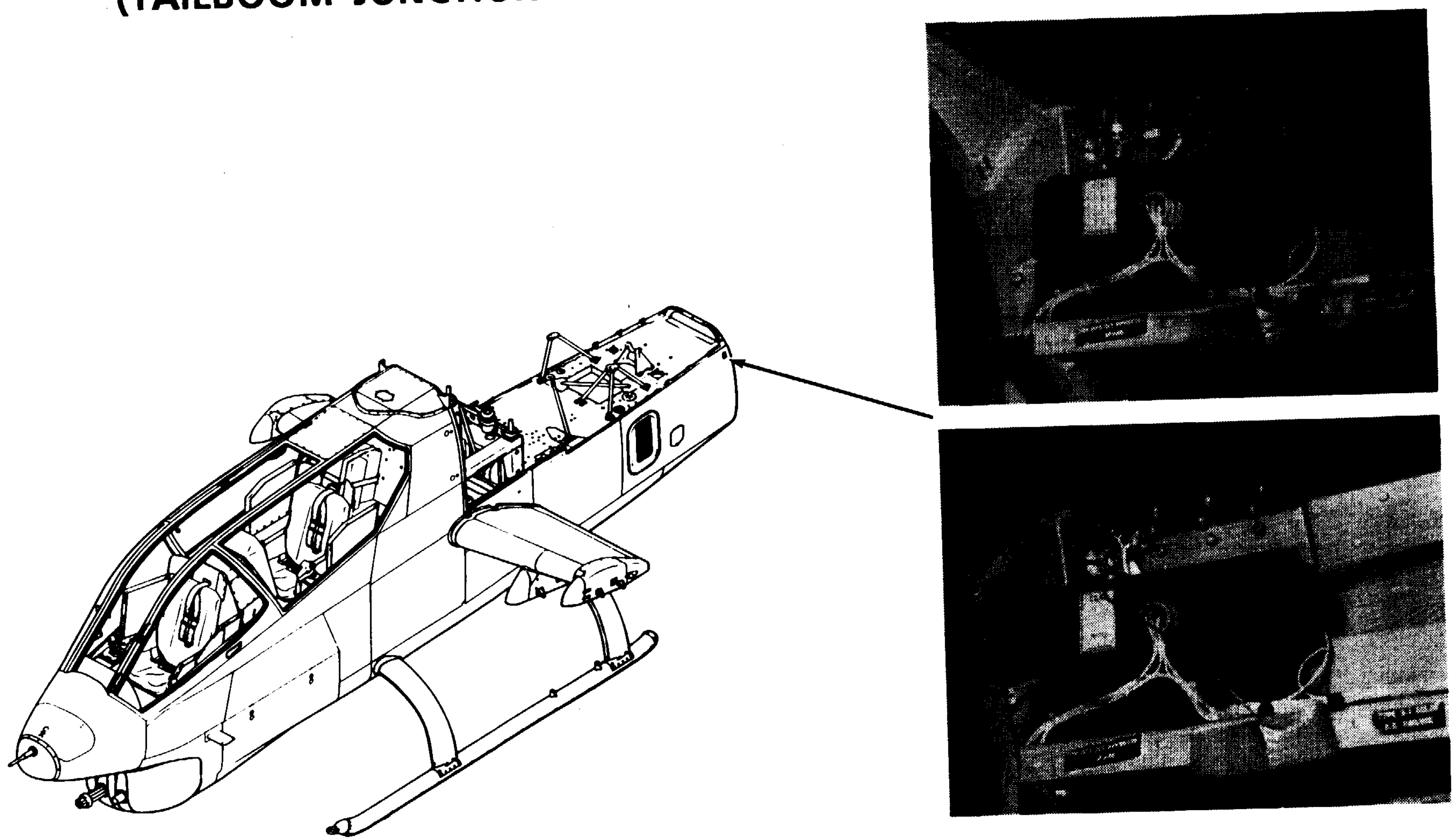
ACCELEROMETER LOCATION
(AFT ENGINE DECK - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION (TAILBOOM JUNCTION - VERTICAL AND LATERAL RESPONSE)



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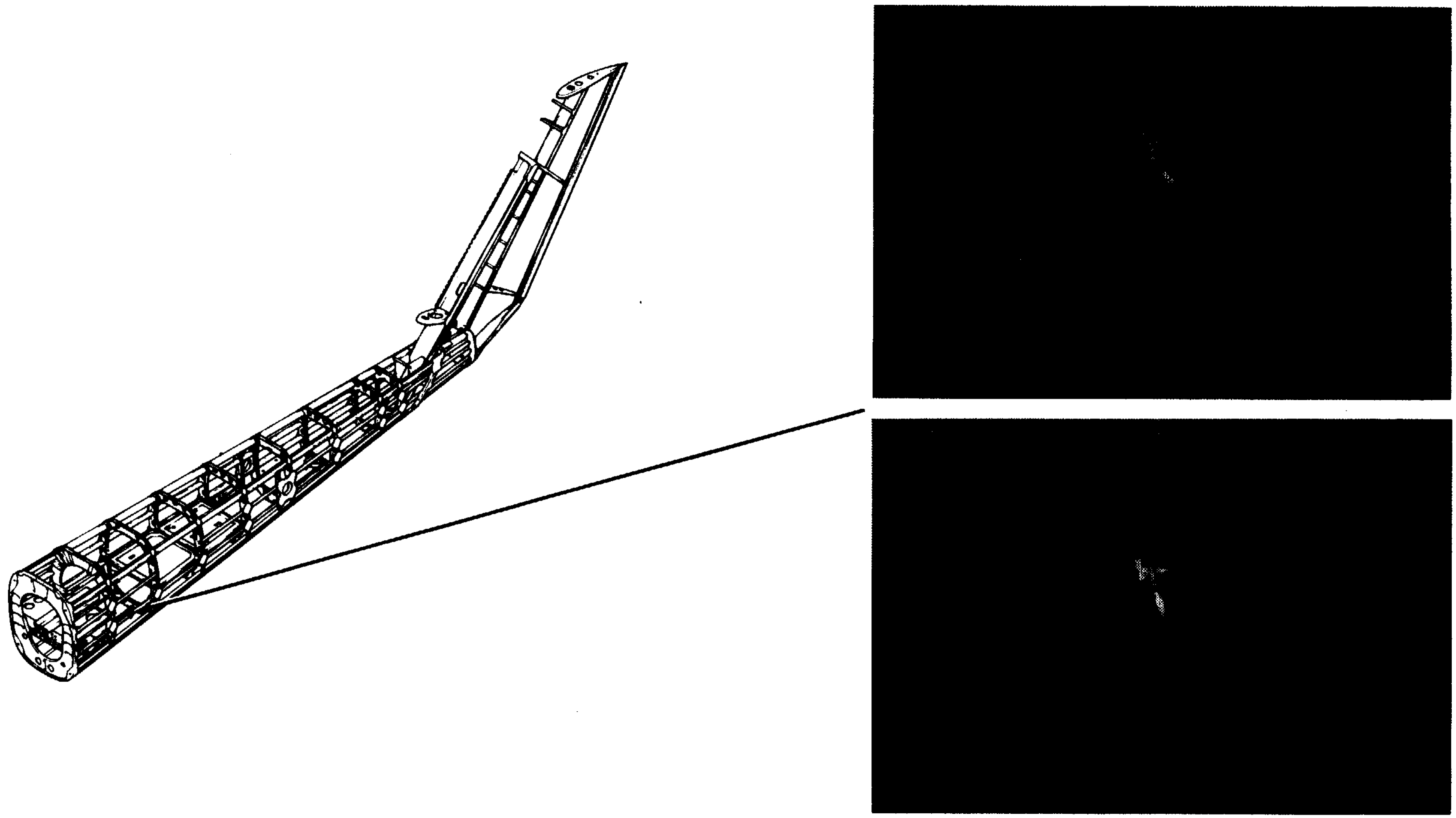
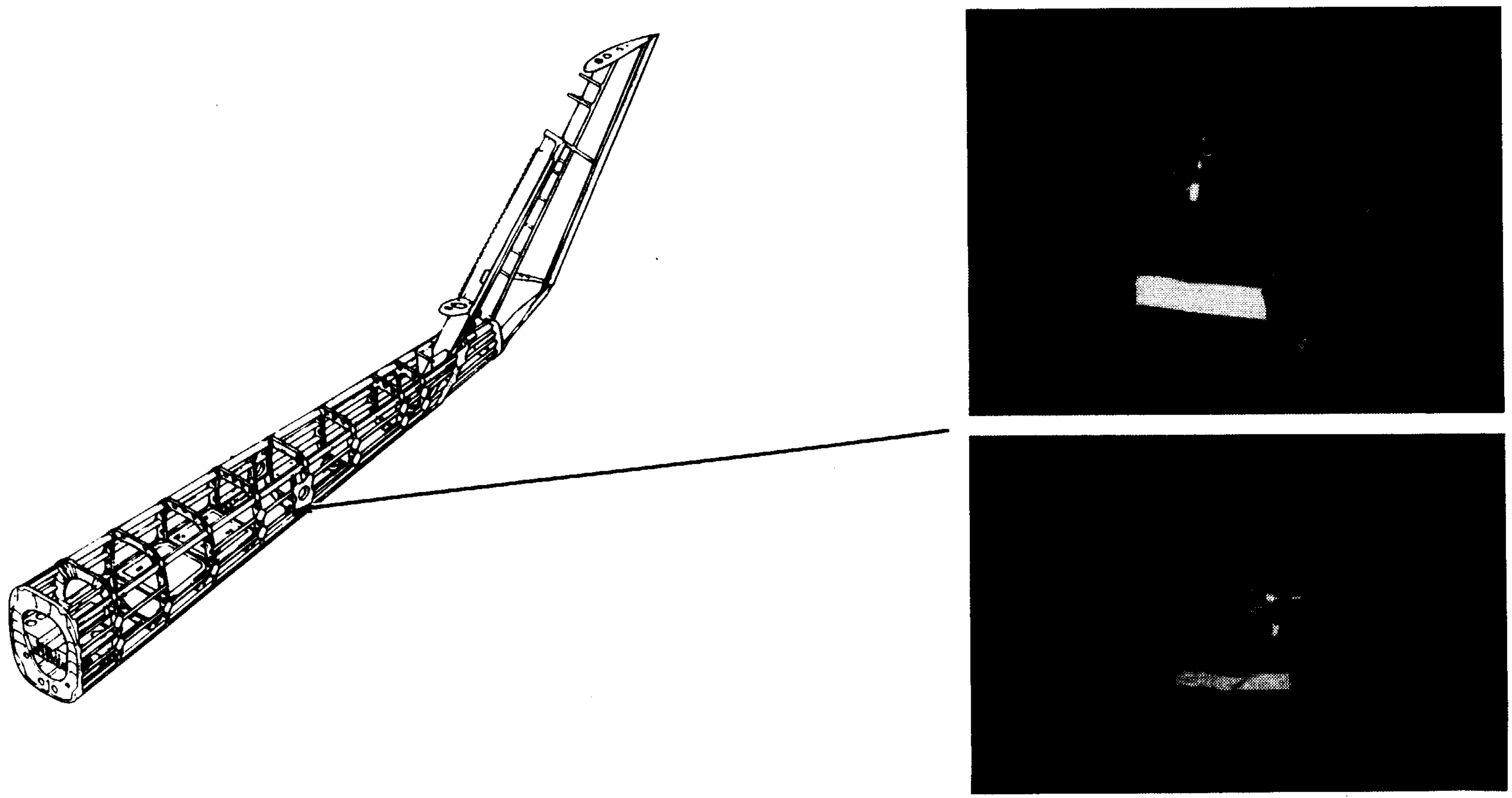
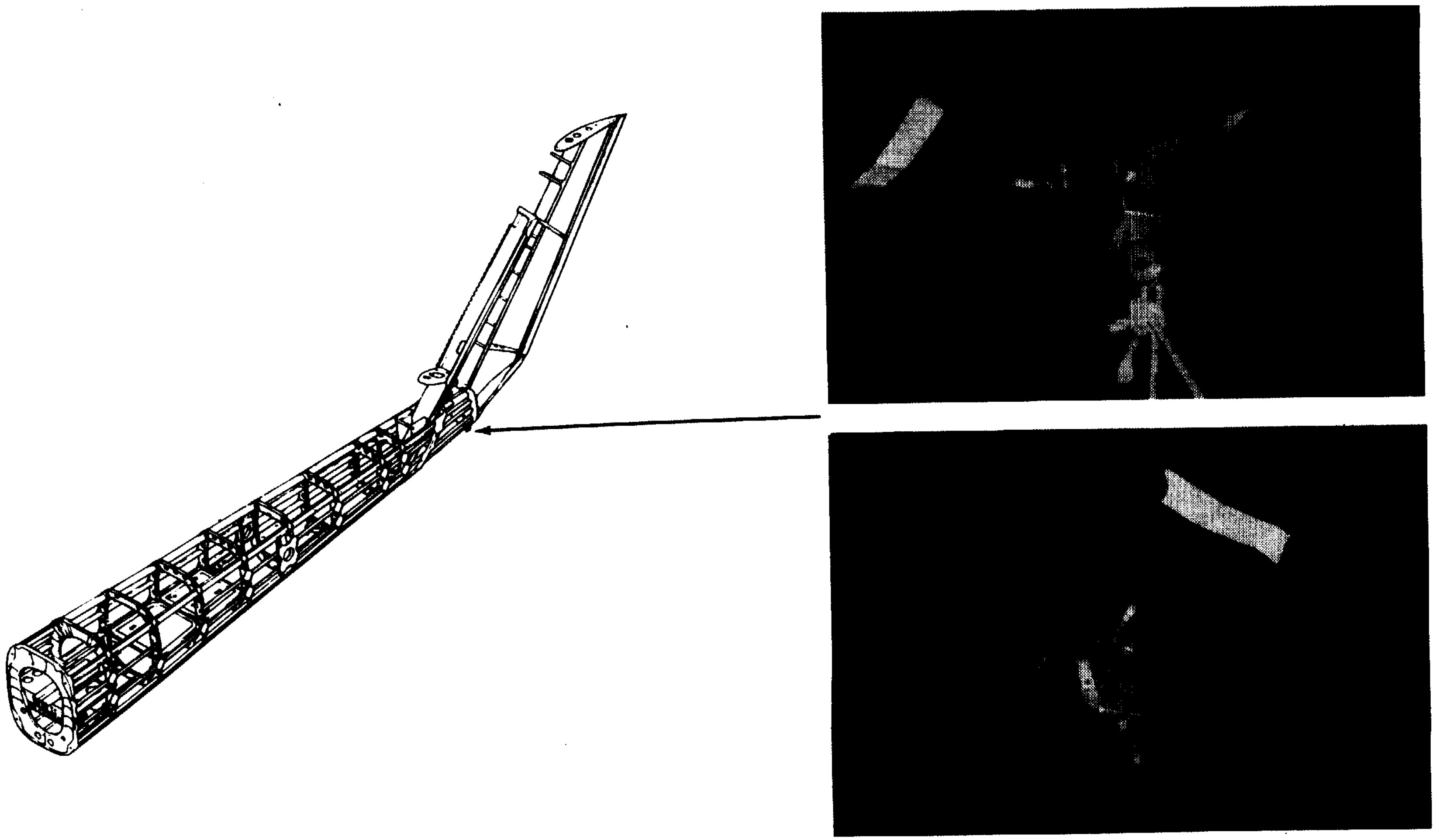
ACCELEROMETER LOCATION
(TAILBOOM ANTENNA - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(ELEVATOR CENTERLINE - VERTICAL AND LATERAL RESPONSE)



ACCELEROMETER LOCATION
(TAIL SKID TUBE - VERTICAL AND LATERAL RESPONSE)



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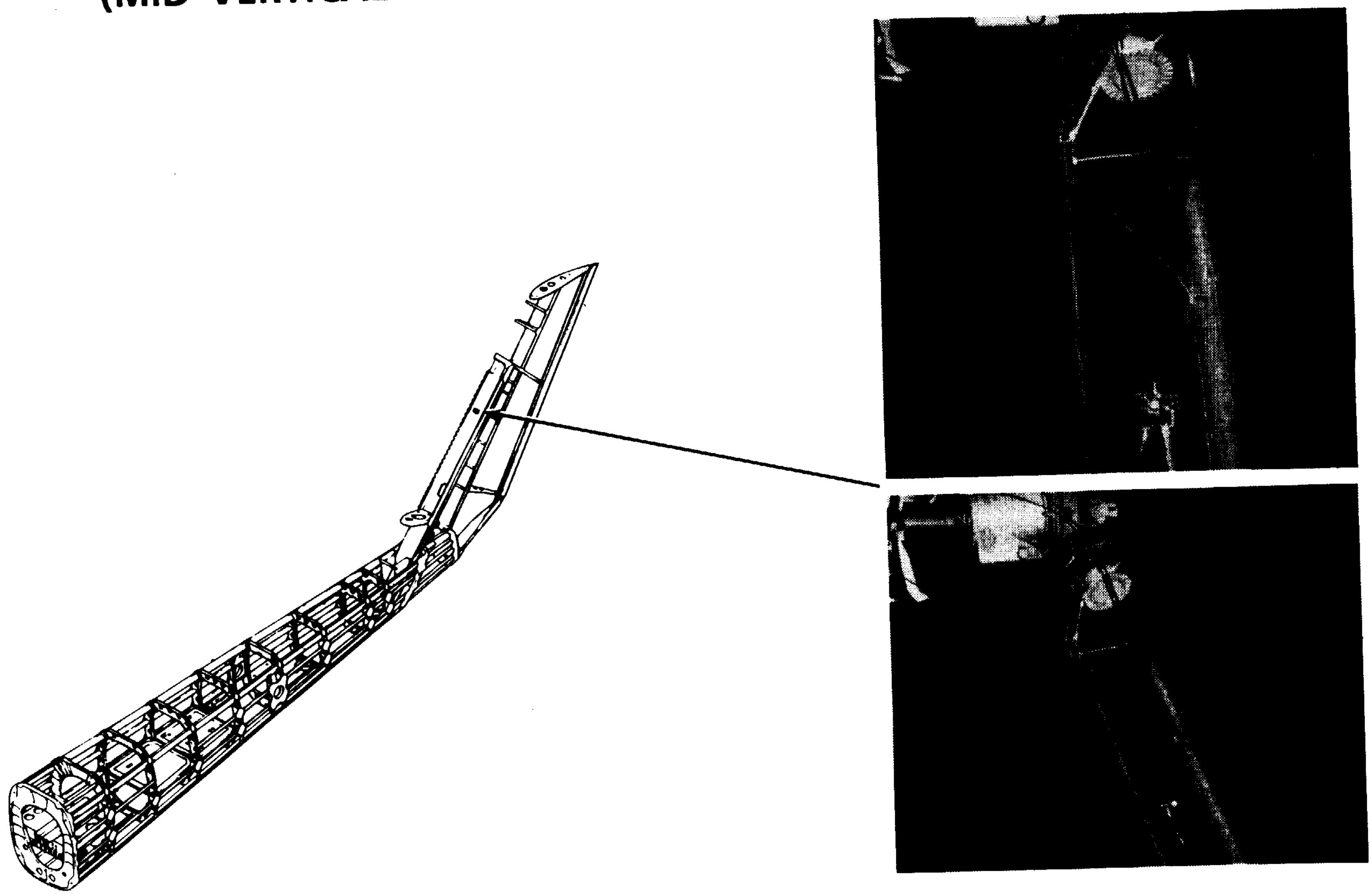
ACCELEROMETER LOCATION
(MID VERTICAL FIN - VERTICAL AND LATERAL RESPONSE)



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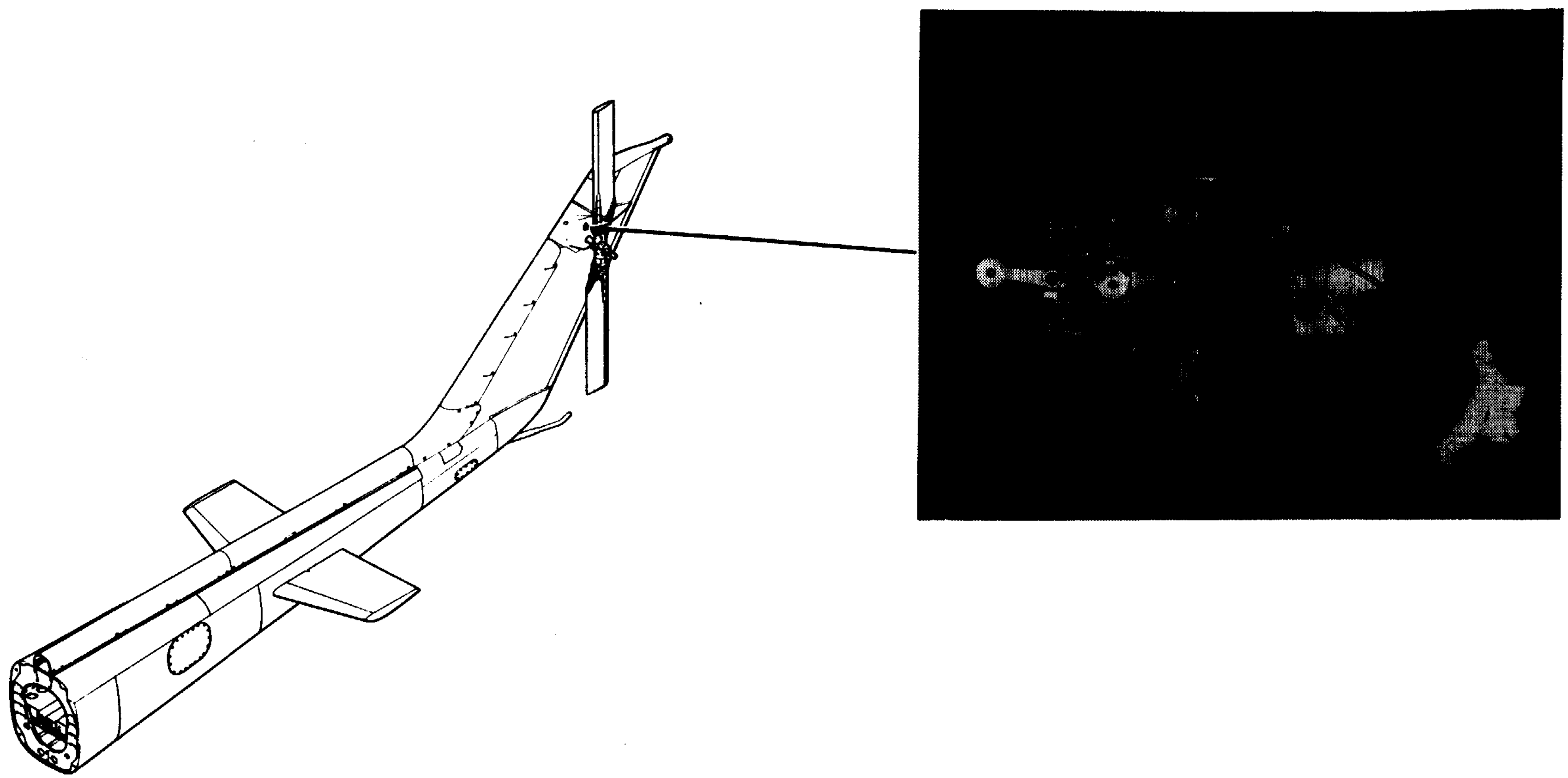
ACCELEROMETER LOCATION
(TAIL ROTOR HUB - VERTICAL RESPONSE)



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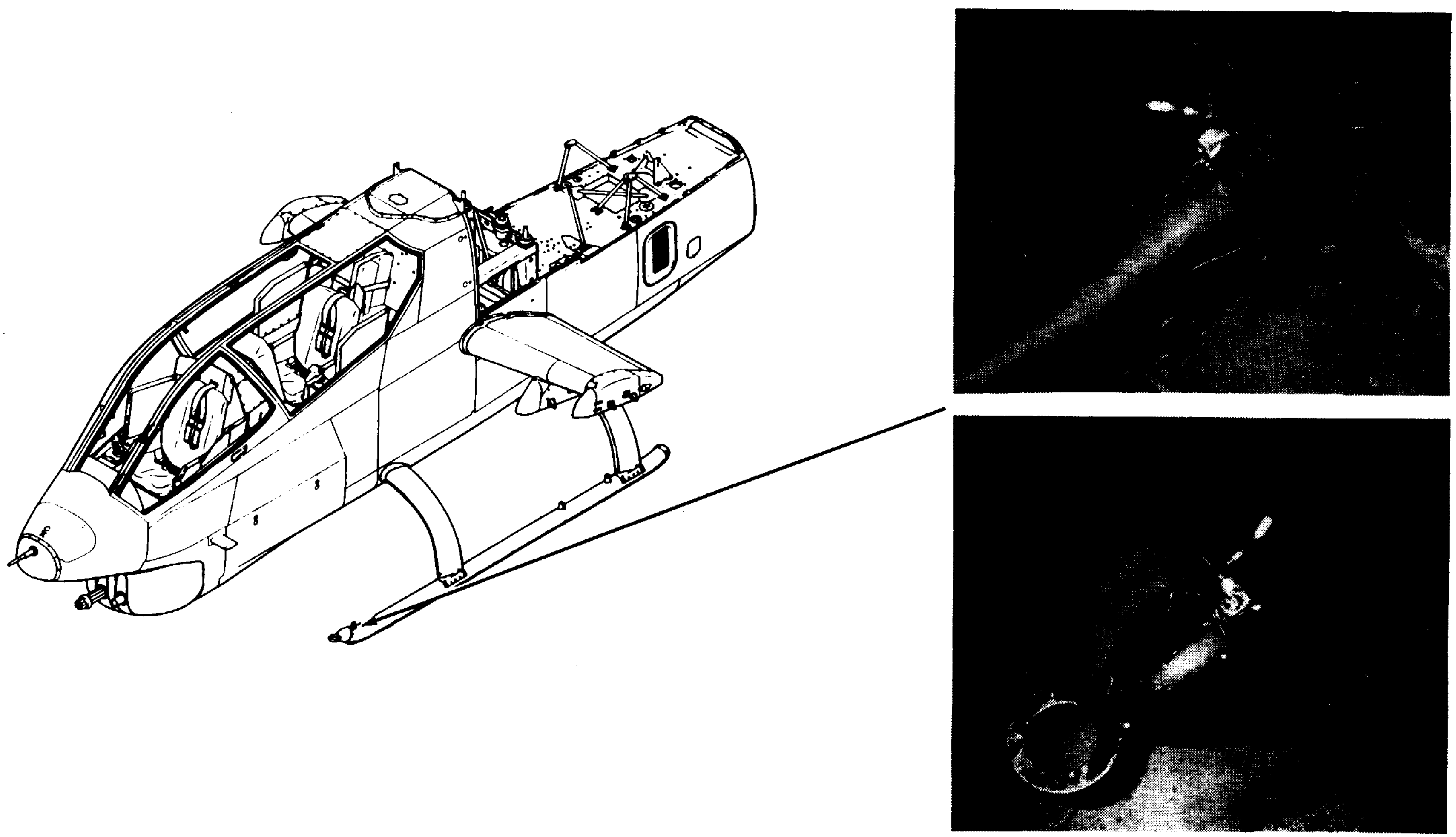
ACCELEROMETER LOCATION
(FORWARD SKID - VERTICAL AND LATERAL RESPONSE)



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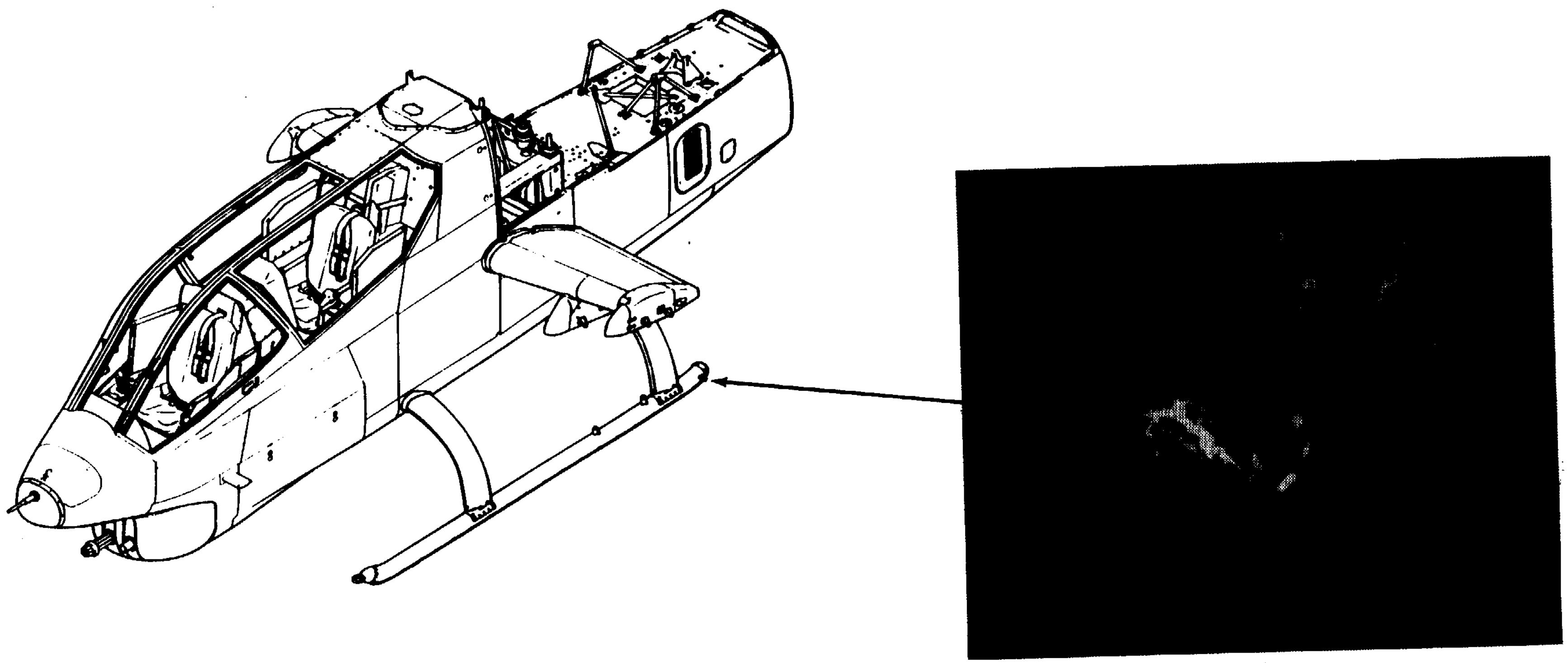
ACCELEROMETER LOCATION
(AFT SKID - LATERAL RESPONSE ONLY)



APPENDIX B

MEASURED FORCED RESPONSE MODE SHAPES

DISCRETE FREQUENCY DWELLS TEST LOG

Each test configuration was subjected to forced response dwells at discrete frequencies identified from the frequency response phase plots as possible mode locations. Discrete frequencies were identified by looking at the amplitude and phase response for all locations and picking the apparent location of modes (90° phase crossings). A list of the dwells performed and the <u>initial</u> mode name given from on-site investigations is contained on the next several pages. The natural frequencies listed in the dwells represent the frequency at which a <u>single</u> accelerometer registered a 90° phase crossing. Slight discrepancies between this value and the global natural frequency returned by the polyreference technique in Modal Plus, which represents the mean value of all accelerometers from several tests, are evident as expected. The VIBRATEC data acquisition system used at BHTI did not provide any capability to digitize this data for storage. Therefore, only hard copy records exist and a comprehensive sample is provided here to represent the majority of global airframe modes listed on Pages 80 and 81 for future use. The test log must be used to identify the dwells included in this appendix based on date, time and frequency listed in the header.

25-channel output is presented in amplitude/phase and sine/cosine (real/imaginary) format for the global airframe modes of all configurations except 4 and 6 because they do not represent major component effects.

NOTE: Dates on forced response dwell test sheets are correct for the month and day, but the tests were performed in 1987!

DISCRETE FREQUENCY DWELLS TEST LOG

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-3-87	1306	Vertical	M/R Hub	111	8.13	1st Fuselage Vertical	1	3
2-3-87	1323	Vertical	M/R Hub	270	10.15	Shake Tower Mode	1	3
2-3-87	1333	Vertical	M/R Hub	208	14.72	Front Skid Symm Vert	1	3
2-3-87	1348	Vertical	M/R Hub	210	15.80	Front Skid Asymm Vert	1	3
2-3-87	1354	Vertical	M/R Hub	208	16.81	2nd Fuselage Vertical	1	3
2-3-87	1417	Vertical	M/R Hub	208	19.20	Local Bungee Vertical	1	3
2-3-87	1426	Vertical	M/R Hub	208	21.24	Aft Skid Symmetric Vert	1	3
2-3-87	1431	Vertical	M/R Hub	207	23.71	-	1	3
2-3-87	1439	Vertical	M/R Hub	207	25.00	Asymm Skid Aft-Vert	1	3
2-3-87	1452	Vertical	M/R Hub	208	26.07	Fin Torsion	1	3
2-3-87	1540	Vertical	M/R Hub	203	27.98	Engine Vertical	1	3
2-4-87	1505	Vertical	Tail Gear	24	3.46	M/R Pylon F/A Rocking	1	5
2-4-87	1509	Vertical	Tail Gear	24	7.98	1st Fuselage Vertical	1	5
2-4-87	1522	Vertical	Tail Gear	39	10.24	Tail Fin Chain Rattling	1	5
2-4-87	1531	Vertical	Tail Gear	30	16.73	2nd Vertical	1	5
2-4-87	1548	Vertical	Tail Gear	30	14.81	Front Skid Symm Vert	1	5
2-4-87	1554	Vertical	Tail Gear	30	27.22	Engine Vertical	1	5
2-5-87	0830	Vertical	Tail Gear	29	4.64	Bungee/Cable F/A	1	5
2-5-87	0838	Vertical	Tail Gear	30	15.90	L/G Asymm	1	5

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-5-87	0841	Vertical	Tail Gear	30	21.19	L/G Symm	1	5
2-5-87	0846	Vertical	Tail Gear	30	25.20	Skid Mode	1	5
2-10-87	1529	Lateral	T/R Hub	27	5.08	M/R Pylon Roll	1	10
2-10-87	1532	Lateral	T/R Hub	8	7.28	1st Fuselage Lateral	1	10
2-10-87	1538	Lateral	T/R Hub	31	16.17	2nd Fuselage Lateral	1	10
2-10-87	1545	Lateral	T/R Hub	32	18.32	Cable Lateral	1	10
2-10-87	1601	Lateral	T/R Hub	32	21.99	Fus Roll/Eng Lateral	1	10
2-10-87	1610	Lateral	T/R Hub	32	24.90	Fus Torsion and Skid	1	10
2-10-87	1617	Lateral	T/R Hub	32	25.71	M/R Mast Lat Bending	1	10
2-6-87	1132	Longitudinal	M/R Hub	48	2.73	Suspension Cable	1	8
2-6-87	1135	Longitudinal	M/R Hub	25	3.62	Pylon F/A Rocking	1	8
2-6-87	1138	Longitudinal	M/R Hub	52	5.55	Hub Lat (Out-of-Plane)	1	8
2-6-87	1141	Longitudinal	M/R Hub	102	8.64	1st Fuselage Vertical	1	8
2-6-87	1144	Longitudinal	M/R Hub	103	11.42	Hoist Hook Pitch	1	8
2-6-87	1146	Longitudinal	M/R Hub	102	12.00	Hoist Hook Pitch Lat	1	8
2-6-87	1147	Longitudinal	M/R Hub	102	13.74	Shake Tube Mode	1	8
2-6-87	1155	Longitudinal	M/R Hub	102	16.48	2nd Vertical Fuselage	1	8
2-6-87	1157	Longitudinal	M/R Hub	102	18.29	1st Cable F/A Mode	1	8
2-6-87	1204	Longitudinal	M/R Hub	103	20.64	1st Cable Lat Mode	1	8

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-6-87	1255	Longitudinal	M/R Hub	101	17.39	90° Gearbox F/A	1	8
2-6-87	1257	Longitudinal	M/R Hub	102	25.11	Engine F/A Shuffle	1	8
2-6-87	1312	Longitudinal	M/R Hub	104	29.50	M/R Mast F/A Bending	1	8
2-6-87	1329	Longitudinal	M/R Hub	104	30.90	Fwd Engine Vertical	1	8
2-10-87	0909	Lateral	M/R Hub	32	2.40	Susp Hook/Pulley Lat	1	10
2-10-87	0916	Lateral	M/R Hub	32	4.95	M/R Pylon Lateral Rock	1	10
2-10-87	0929	Lateral	M/R Hub	41	7.19	1st Fuselage Lateral	1	10
2-10-87	0946	Lateral	M/R Hub	42	11.83	Cable (Lateral and F/A)	1	10
2-10-87	0955	Lateral	M/R Hub	52	14.84	Fwd Skid Symm	1	10
2-10-87	0958	Lateral	M/R Hub	53	16.13	1st Fuselage Torsion	1	10
2-10-87	1008	Lateral	M/R Hub	51	15.87	1st Fuselage Torsion	1	10
2-10-87	1012	Lateral	M/R Hub	52	17.91	2nd Fuselage Lateral	1	10
2-10-87	1014	Lateral	M/R Hub	52	18.40	Cable	1	10
2-10-87	1020	Lateral	M/R Hub	52	22.03	-	1	10
2-10-87	1024	Lateral	M/R Hub	51	24.08	Skid	1	10
2-10-87	1028	Lateral	M/R Hub	52	25.98	M/R Mast Lat Bending	1	10
2-10-87	1033	Lateral	M/R Hub	51	26.31	3rd Fuselage Lateral	1	10
2-10-87	1035	Lateral	M/R Hub	52	28.04	Skid	1	10

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-23-87	1522	Vertical	Lift Beam	68	8.33	1st Fuselage Vert Bend	2	13
2-23-87	1527	Vertical	Lift Beam	96	14.82	Fwd Skid Butterfly	2	13
2-23-87	1528	Vertical	Lift Beam	96	16.07	Fwd Skid Asymm	2	13
2-23-87	1532	Vertical	Lift Beam	96	16.93	2nd Fuselage Vert Bend	2	13
2-23-87	1535	Vertical	Lift Beam	96	17.43	Skid	2	13
2-23-87	1549	Vertical	Lift Beam	96	21.38	Skid	2	13
2-23-87	1552	Vertical	Lift Beam	96	23.64	Skid	2	13
2-23-87	1555	Vertical	Lift Beam	96	30.00	3rd Vert	2	13
2-23-87	1615	Vertical	Lift Beam	96	25.70	Engine Pitch	2	13
2-24-87	1423	Vertical	Tail Gear	82	3.94	Bungee, Cable F/A	2	15
2-24-87	1428	Vertical	Tail Gear	30	7.26	-	2	15
2-24-87	1436	Vertical	Tail Gear	10	8.37	1st Fuselage Vert Bend	2	15
2-24-87	1443	Vertical	Tail Gear	50	16.10	Asymm Skid	2	15
2-24-87	1445	Vertical	Tail Gear	30	17.50	2nd Fuselage Vert Bend	2	15
2-24-87	1456	Vertical	Tail Gear	40	21.29	Skid	2	15
2-24-87	1459	Vertical	Tail Gear	40	22.45	Engine/T/R Hub/Skid	2	15
2-24-87	1500	Vertical	Tail Gear	40	23.37	Skid	2	15

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-26-87	0830	Lateral	T/R Hub	8	3.18	Shaker Bounce Mode	2	17
2-26-87	0837	Lateral	T/R Hub	6	7.46	1st Fuselage Lat Bend	2	17
2-26-87	0855	Lateral	T/R Hub	9	10.04	Chain Rattle in Vert Fin	2	17
2-26-87	0909	Lateral	T/R Hub	30	11.40	Suspension Cable	2	17
2-26-87	0915	Lateral	T/R Hub	29	16.20	Vert Fwd Skid	2	17
2-26-87	0930	Lateral	T/R Hub	30	17.70	2nd Fuselage Lat Bend	2	17
2-26-87	0939	Lateral	T/R Hub	30	19.32	Fuselage Roll/Eng Lat	2	17
2-26-87	0946	Lateral	T/R Hub	30	22.54	Fus. Torsion/Wing Yaw	2	17
2-26-87	0952	Lateral	T/R Hub	30	25.18	-	2	17
2-26-87	1013	Lateral	T/R Hub	40	32.73	3rd Lat or Roll	2	17
2-27-87	1421	Lateral	T/R Hub	7	1.90	Hook/Pully Lateral	3	18
2-27-87	1424	Lateral	T/R Hub	6	7.28	1st Fuselage Lat Bend	3	18
2-27-87	1438	Lateral	T/R Hub	19	9.58	---	3	18
2-27-87	1443	Lateral	T/R Hub	49	10.99	Cable Lateral	3	18
2-27-87	1451	Lateral	T/R Hub	19	14.81	2nd Fuselage Lat	3	18
2-27-87	1458	Lateral	T/R Hub	20	17.21	Skid	3	18
2-27-87	1505	Lateral	T/R Hub	38	15.58	Cable Lateral	3	18

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
2-27-87	1507	Lateral	T/R Hub	29	19.98	Fus Roll/Eng/Wing Yaw	3	18
2-27-87	1517	Lateral	T/R Hub	30	24.92	Skid (Windshield Wiper)	3	18
2-27-87	1524	Lateral	T/R Hub	48	28.72	---	3	18
2-27-87	1528	Lateral	T/R Hub	30	30.06	T/R Hub Block Vertical	3	18
3-3-87	1017	Vertical	Tail Gear	20	4.10	Bungee/Hoist Lateral	3	19
3-3-87	1022	Vertical	Tail Gear	8	7.91	1st Fuselage Vert Bend	3	19
3-3-87	1026	Vertical	Tail Gear	28	14.44	Asymm Skid Mode	3	19
3-3-87	1031	Vertical	Tail Gear	28	16.17	2nd Fuselage Vert Bend	3	19
3-3-87	1037	Vertical	Tail Gear	38	17.25	Skid Asymm (Scissor)	3	19
3-3-87	1049	Vertical	Tail Gear	38	20.74	Skid Vert Pitch Mode	3	19
3-3-87	1058	Vertical	Tail Gear	28	22.54	Engine & T/R Hub F/A	3	19
3-3-87	1100	Vertical	Tail Gear	28	22.93	Engine & T/R Hub F/A	3	19
3-3-87	1108	Vertical	Tail Gear	38	25.60	Tail Whip	3	19
3-3-87	1122	Vertical	Tail Gear	38	31.54	Wing Roll	3	19

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-4-87	0923	Vertical	Lift Beam	197	4.11	Bungee/Hoist	3	21
3-4-87	0926	Vertical	Lift Beam	63	7.93	1st Vertical Bending	3	21
3-4-87	0934	Vertical	Lift Beam	98	14.66	Asymm Skid Mode	3	21
3-4-87	0939	Vertical	Lift Beam	100	16.07	2nd Vertical Bending	3	21
3-4-87	1003	Vertical	Lift Beam	100	21.07	Skid	3	21
3-4-87	1007	Vertical	Lift Beam	145	24.98	Skid	3	21
3-4-87	1015	Vertical	Lift Beam	145	29.56	3rd Vertical	3	21
3-5-87	1312	Vertical	Lift Beam	197	4.04	Bungee/Hook Lateral	5	21
3-5-87	1317	Vertical	Lift Beam	143	6.98	Coupling w/Lat. T/B	5	21
3-5-87	1323	Vertical	Lift Beam	48	8.02	1st Vertical Bending	5	21
3-5-87	1329	Vertical	Lift Beam	191	9.31	---	5	21
3-5-87	1341	Vertical	Lift Beam	166	14.96	Wing, T/B	5	21
3-5-87	1345	Vertical	Lift Beam	98	16.10	2nd Vertical Bending	5	21
3-5-87	1353	Vertical	Lift Beam	189	22.45	Engine Pitch	5	21
3-5-87	1354	Vertical	Lift Beam	189	22.59	Engine Pitch	5	21
3-5-87	1400	Vertical	Lift Beam	186	24.28	C/g is Singing (Shaker)	5	21
3-5-87	1408	Vertical	Lift Beam	186	27.11	C/g is Singing (Shaker)	5	21
3-5-87	1411	Vertical	Lift Beam	186	30.43	Wing Roll	5	21

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-6-87	0926	Vertical	Tail Gear	42	4.03	Bungee/Hook	5	22
3-6-87	0929	Vertical	Tail Gear	9	7.96	1st Vertical Bending	5	22
3-6-87	0933	Vertical	Tail Gear	20	15.12	Coupled Lat/Vert	5	22
3-6-87	0937	Vertical	Tail Gear	30	16.31	2nd Vertical	5	22
3-6-87	0941	Vertical	Tail Gear	30	19.98	F/A at 90 Box	5	22
3-6-87	0945	Vertical	Tail Gear	30	22.78	T/R Hub F/A	5	22
3-6-87	0946	Vertical	Tail Gear	30	23.08	Engine Pitch	5	22
3-6-87	0952	Vertical	Tail Gear	30	26.61	-	5	22
3-6-87	1003	Vertical	Tail Gear	30	31.00	Wing Vert/Fuselage Roll	5	22
3-10-87	1045	Lateral	T/R Hub	6	7.50	1st Lateral Bending	5	18
3-10-87	1049	Lateral	T/R Hub	29	9.33	Tail Whip	5	18
3-10-87	1106	Lateral	T/R Hub	40	10.89	Cable Mode	5	18
3-10-87	1109	Lateral	T/R Hub	19	15.77	2nd Lateral	5	18
3-10-87	1111	Lateral	T/R Hub	39	14.73	T/B @ 2p - Fuse @ 1p	5	18
3-10-87	1121	Lateral	T/R Hub	39	16.52	2nd Lateral Bending	5	18
3-10-87	1127	Lateral	T/R Hub	39	17.07	Cable	5	18
3-10-87	1130	Lateral	T/R Hub	39	19.65	Engine Lat/Fuse Roll	5	18

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-10-87	1142	Lateral	T/R Hub	39	21.72	Cable	5	18
3-10-87	1146	Lateral	T/R Hub	48	24.48	Eng/T/B Lat	5	18
3-10-87	1150	Lateral	T/R Hub	40	26.68	Possible Torsion	5	18
3-10-87	1154	Lateral	T/R Hub	39	29.20	Cable	5	18
3-10-87	1156	Lateral	T/R Hub	39	31.03	Roll/Eng Lat	5	18
3-12-87	1131	Lateral	T/R Hub	9	3.12	Shaker Bounce Mode	6	23
3-12-87	1138	Lateral	T/R Hub	2	7.38	1st Lateral Bending	6	23
3-12-87	1144	Lateral	T/R Hub	18	11.30	Eng and 90° Box Lat	6	23
3-12-87	1153	Lateral	T/R Hub	19	12.32	Dummy Eng Lat/Vert	6	23
3-12-87	1300	Lateral	T/R Hub	19	16.10	2nd Lateral	6	23
3-12-87	1303	Lateral	T/R Hub	19	17.85	Eng Lateral/Fus Roll	6	23
3-12-87	1319	Lateral	T/R Hub	19	21.77	Torsion Mode	6	23
3-12-87	1327	Lateral	T/R Hub	19	22.88	Dummy Engine Yaw	6	23
3-13-87	1253	Vertical	Tail Gear	20	3.96	Bungee/Cable Lateral	6	24
3-13-87	1258	Vertical	Tail Gear	8	8.07	1st Vertical Bending	6	24
3-13-87	1309	Vertical	Tail Gear	38	12.83	Eng Coupled Pitch/Yaw	6	24
3-13-87	1321	Vertical	Tail Gear	19	15.87	2nd Vertical Bend	6	24
3-13-87	1319	Vertical	Tail Gear	19	16.62	2nd Vertical Bend	6	24

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-13-87	1338	Vertical	Tail Gear	19	21.74	Global Mode Roll	6	24
3-13-87	1346	Vertical	Tail Gear	24	22.21	Cable F/A	6	24
3-13-87	1403	Vertical	Tail Gear	37	23.74	Engine Pitch	6	24
3-13-87	1410	Vertical	Tail Gear	32	25.86	3rd Vertical	6	24
3-13-87	1414	Vertical	Tail Gear	28	27.56	Engine - Vertical Float	6	24
3-13-87	1419	Vertical	Tail Gear	46	30.43	Wing Roll/T/B Torsion	6	24
3-17-87	1741	Vertical	Tail Gear	13	8.66	1st Vertical Bending	7	26
3-17-87	1744	Vertical	Tail Gear	17	16.03	Coupled 2nd Vert Lat	7	26
3-17-87	1753	Vertical	Tail Gear	17	17.32	2nd Vertical	7	26
3-17-87	1758	Vertical	Tail Gear	17	21.56	Possible Roll/Torsion	7	26
3-18-87	0849	Vertical	Tail Gear	17	21.83	Possible Roll/Torsion	7	26
3-18-87	0856	Vertical	Tail Gear	17	26.61	3rd Vert Bending	7	26
3-18-87	0901	Vertical	Tail Gear	17	24.72	T/B Lat Coupled w/Vert	7	26
3-18-87	0907	Vertical	Tail Gear	17	30.24	---	7	26
3-18-87	1055	Vertical	Lift Beam	93	7.81	Coupled Lat & Vert 1st	7	26
3-18-87	1057	Vertical	Lift Beam	46	8.66	1st Vertical	7	26
3-18-87	1102	Vertical	Lift Beam	93	16.14	Coupled Lat & Vert 2nd	7	26
3-18-87	1105	Vertical	Lift Beam	96	17.18	2nd Vertical	7	26

DISCRETE FREQUENCY DWELLS TEST LOG (Continued)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-18-87	1108	Vertical	Lift Beam	96	21.47	Wing Roll/Tail Vert	7	26
3-18-87	1112	Vertical	Lift Beam	96	25.28	Pulley Wire Shake	7	26
3-18-87	1548	Lateral	T/R Hub	8	8.20	1st Lateral Bending	7	27
3-18-87	1558	Lateral	T/R Hub	19	9.78	90° Box Whirl Mode	7	27
3-18-87	1603	Lateral	T/R Hub	14	15.12	Cable Lateral	7	27
3-18-87	1605	Lateral	T/R Hub	14	16.58	2nd Lateral	7	27
3-18-87	1609	Lateral	T/R Hub	19	21.56	Fuselage Roll	7	27
3-18-87	1611	Lateral	T/R Hub	19	25.65	Susp Mode	7	27
3-18-87	1616	Lateral	T/R Hub	28	29.99	Torsion/Roll Mode	7	27
3-19-87	0932	Lateral	T/R Hub	6	7.91	1st Lateral Bending	8	27
3-19-87	0936	Lateral	T/R Hub	14	14.19	Cable Lateral	8	27
3-19-87	0952	Lateral	T/R Hub	14	16.48	2nd Lateral Bending	8	27
3-19-87	1000	Lateral	T/R Hub	18	21.60	Fuselage Roll	8	27
3-19-87	1005	Lateral	T/R Hub	18	23.66	Cable Mode	8	27
3-19-87	1418	Vertical	Tail Gear	19	3.44	Bungee F/A Shuffle	8	26
3-19-87	1423	Vertical	Tail Gear	7	8.81	1st Vertical	8	26
3-19-87	1427	Vertical	Tail Gear	19	9.91	Local T/R Motion	8	26
3-19-87	1432	Vertical	Tail Gear	38	14.16	Cable	8	26

DISCRETE FREQUENCY DWELLS TEST LOG (Concluded)

TEST DATE	TEST TIME	EXCITATION CONDITION			FREQ (Hz)	MODE DESCRIPTION	CONFIGURATION NUMBER	INSTRUMENTATION TEST SETUP NO.
		DIRECTION	LOCATION	FORCE (LB)				
3-19-87	1440	Vertical	Tail Gear	28	17.66	2nd Vertical	8	26
3-19-87	1442	Vertical	Tail Gear	38	19.24	Suspension F/A	8	26
3-19-87	1444	Vertical	Tail Gear	38	21.16	Global with Roll	8	26
3-19-87	1448	Vertical	Tail Gear	38	23.89	Global w/o Roll	8	26
3-19-87	1452	Vertical	Tail Gear	26	26.61	3rd Vertical	8	26
3-19-87	1455	Vertical	Tail Gear	26	27.11	---	8	26
3-19-87	1457	Vertical	Tail Gear	26	30.87	Slight Roll	8	26
3-19-87	1724	Vertical	Lift Beam	145	8.11	1st Vertical	8	28
3-19-87	1727	Vertical	Lift Beam	135	9.91	Local	8	28
3-19-87	1732	Vertical	Lift Beam	115	16.27	2nd Vert	8	28

02/04/87 1505

CYCLES ANALYZED: 2 POINTS ANALYZED: 296 SAMPLE RATE: 512.
1/REV FREQUENCY: 3.46 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	24.39	-5.07	23.86	-11.99	23.96
2	1	A002NOSE V	0.0389	0.0356	-0.0157	113.8171	0.0408
3	1	A003GUNNER	0.0264	0.0249	-0.0087	109.2553	0.0271
4	1	A004LT SKI	0.0246	0.0237	-0.0067	105.6750	0.0498
5	1	A005RT SKI	0.0153	0.0137	-0.0070	116.9731	0.0388
6	1	A006PILOT	0.0151	0.0148	-0.0030	101.2964	0.0169
7	1	A007C G VT	0.0054	-0.0005	0.0054	-5.2379	0.0068
8	1	A008SUSPEN	0.0089	0.0056	0.0069	39.0767	0.0132
9	1	A009SUSPEN	0.0086	0.0072	0.0047	57.0383	0.0589
10	1	A010SUSPEN	0.0537	0.0523	0.0122	76.8130	0.0530
11	1	A011HUB VT	0.0069	-0.0054	0.0043	-51.9878	0.0105
12	1	A012HUB LA	0.0077	-0.0075	-0.0019	-104.2008	0.0127
13	1	A013HUB F/	0.1592	0.1550	0.0365	76.7467	0.1593
14	1	A014RT WIN	0.0097	-0.0078	0.0057	-53.4840	0.0159
15	1	A015LT WIN	0.0104	0.0070	0.0077	42.2362	0.0198
16	1	A016ENG FW	0.0114	-0.0061	0.0097	-32.0488	0.0144
17	1	A017ENG AF	0.0183	-0.0127	0.0131	-44.0133	0.0205
18	1	A018ENG DE	0.0163	-0.0100	0.0130	-37.5332	0.0173
19	1	A019T/B JU	0.0273	-0.0214	0.0170	-51.5200	0.0383
20	1	A020ELEV C	0.0627	-0.0591	0.0211	-70.3092	0.0640
21	1	A021TAIL S	0.0923	-0.0903	0.0189	-78.1577	0.0975
22	1	A02290 BOX	0.1108	-0.1093	0.0186	-80.3628	0.1158
23	1	A02390 BOX	0.0097	0.0096	0.0013	82.0104	0.0195
24	1	A024T/R HU	0.1071	-0.1054	0.0195	-79.5049	0.1209
25	1	A025XM F/A	0.0193	-0.0186	-0.0053	-105.8863	0.0288

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OF POOR QUALITY

02/10/87 0916

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 4 POINTS ANALYZED: 414 SAMPLE RATE: 512.
1/REV FREQUENCY: 4.95 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	32.17	-22.06	-23.41	-136.70	32.90
2	1	A002NOSE L	0.0143	0.0120	-0.0077	122.6752	0.0159
3	1	A003GUNNER	0.0009	0.0000	-0.0009	179.2377	0.0032
4	1	A004LT SKI	0.0852	-0.0750	0.0403	-61.7439	0.1676
5	1	A005RT SKI	0.0881	-0.0774	0.0421	-61.4777	0.1588
6	1	A006PILOT	0.0116	-0.0104	0.0051	-63.7654	0.0129
7	1	A007C/G LA	0.0149	0.0128	-0.0075	120.4387	0.0188
8	1	A008AFT SK	0.1080	-0.0957	0.0501	-62.3851	0.1334
9	1	A009AFT SK	0.1020	-0.0893	0.0494	-61.0380	0.1563
10	1	A010SUSP L	0.0654	-0.0452	0.0473	-43.7290	0.0989
11	1	A011HUB VT	0.0044	0.0044	0.0002	88.0261	0.0098
12	1	A012HUB LA	0.1075	-0.0682	0.0831	-39.3634	0.1121
13	1	A013HUB F/	0.0118	-0.0088	0.0078	-48.5711	0.0154
14	1	A014RT WIN	0.1268	-0.1096	0.0637	-59.8198	0.1273
15	1	A015LT WIN	0.1207	0.1070	-0.0558	117.5283	0.1207
16	1	A016ENG FW	0.0730	0.0637	-0.0357	119.2648	0.0765
17	1	A017ENG AF	0.0796	0.0697	-0.0385	118.9447	0.0940
18	1	A018ENG DE	0.0042	0.0036	-0.0023	123.0318	0.0064
19	1	A019T/B JU	0.0122	-0.0109	0.0054	-63.9174	0.0142
20	1	A020ELEV C	0.0649	-0.0572	0.0306	-61.8970	0.0699
21	1	A021TAIL S	0.0394	-0.0350	0.0180	-62.8276	0.0540
22	1	A02290 BOX	0.0193	-0.0148	0.0124	-50.0651	0.0222
23	1	A02390 BOX	0.1628	0.1424	-0.0788	118.9520	0.1693
24	1	A024T/R HU	0.0496	-0.0416	0.0270	-57.0848	0.0584
25	1	A025XM LAT	0.0413	0.0404	-0.0084	101.6812	0.0581

ORIGINAL PAGE IS
OF POOR QUALITY

02/10/87 0929

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 6 POINTS ANALYZED: 427 SAMPLE RATE: 512.
1/REV FREQUENCY: 7.19 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	41.22	-39.76	-10.86	-105.28	42.13
2	1	A002NOSE L	0.1082	-0.0215	0.1060	-11.4822	0.1185
3	1	A003GUNNER	0.0682	-0.0125	0.0670	-10.5522	0.0723
4	1	A004LT SKI	0.1024	-0.0100	0.1019	-5.6306	0.1087
5	1	A005RT SKI	0.1040	-0.0101	0.1035	-5.5752	0.1273
6	1	A006PILOT	0.0343	-0.0052	0.0339	-8.7431	0.0349
7	1	A007C/G LA	0.0329	0.0054	-0.0324	170.5322	0.0393
8	1	A008AFT SK	0.0110	0.0103	0.0036	70.5762	0.0486
9	1	A009AFT SK	0.0102	0.0099	0.0026	75.5168	0.0203
10	1	A010SUSP L	0.0595	0.0386	0.0453	40.3794	0.0923
11	1	A011HUB VT	0.0037	-0.0019	-0.0032	-149.2315	0.0073
12	1	A012HUB LA	0.0750	0.0543	0.0518	46.3400	0.0769
13	1	A013HUB F/	0.0001	0.0001	0.0000	57.3557	0.0059
14	1	A014RT WIN	0.0703	-0.0024	0.0702	-1.9595	0.0799
15	1	A015LT WIN	0.0663	0.0012	-0.0663	178.9444	0.0752
16	1	A016ENG FW	0.0967	0.0092	-0.0963	174.5511	0.1023
17	1	A017ENG AF	0.1185	0.0132	-0.1178	173.6154	0.1141
18	1	A018ENG DE	0.0678	0.0132	-0.0665	168.7589	0.0699
19	1	A019T/B JU	0.0744	0.0173	-0.0723	166.5483	0.0757
20	1	A020ELEV C	0.0195	0.0110	-0.0161	145.6181	0.0220
21	1	A021TAIL S	0.1189	-0.0182	0.1175	-8.7980	0.1231
22	1	A02290 BOX	0.0374	0.0101	-0.0360	164.4013	0.0391
23	1	A02390 BOX	0.5109	-0.1187	0.4969	-13.4320	0.5122
24	1	A024T/R HU	0.0921	0.0239	-0.0889	164.9277	0.1028
25	1	A025XM LAT	0.0572	0.0246	-0.0517	154.5880	0.0708

02/03/87 1306

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 441 SAMPLE RATE: 512.
1/REV FREQUENCY: 8.13 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	111.5	-48.9	100.2	-26.0	111.1
2	1	A002NOSE V	0.3809	0.3266	0.1960	59.0361	0.3867
3	1	A003GUNNER	0.2187	0.1844	0.1177	57.4493	0.2228
4	1	A004LT SKI	0.2037	0.1732	0.1074	58.1996	0.2902
5	1	A005RT SKI	0.1188	0.0874	0.0805	47.3587	0.1612
6	1	A006PILOT	0.0869	0.0678	0.0544	51.2748	0.0874
7	1	A007C/G VT	0.0743	-0.0706	-0.0229	-107.9461	0.0760
8	1	A008SUSPEN	0.0833	-0.0781	-0.0289	-110.3251	0.0872
9	1	A009SUSPEN	0.0144	-0.0133	-0.0057	-113.3267	0.0188
10	1	A010SUSPEN	0.0526	-0.0257	-0.0459	-150.7375	0.0572
11	1	A011HUB VT	0.0905	-0.0851	-0.0308	-109.8875	0.0931
12	1	A012HUB LA	0.0194	-0.0191	0.0035	-79.5741	0.0232
13	1	A013HUB F/	0.0684	0.0580	0.0363	57.9303	0.0672
14	1	A014RT WIN	0.1271	-0.1211	-0.0383	-107.5549	0.1297
15	1	A015LT WIN	0.0563	-0.0536	-0.0173	-107.9151	0.0628
16	1	A016ENG FW	0.1337	-0.1249	-0.0475	-110.8148	0.1495
17	1	A017ENG AF	0.1764	-0.1622	-0.0692	-113.1084	0.1817
18	1	A018ENG DE	0.1702	-0.1570	-0.0656	-112.6820	0.1734
19	1	A019T/B JU	0.1809	-0.1650	-0.0743	-114.2298	0.1891
20	1	A020ELEV C	0.0723	0.0518	0.0505	45.7389	0.1280
21	1	A021TAIL S	0.6674	0.5772	0.3350	59.8688	0.6808
22	1	A02290 BOX	1.1662	1.0153	0.5738	60.5255	1.1820
23	1	A02390 BOX	0.0326	0.0135	0.0297	24.3855	0.0474
24	1	A024T/R HU	1.1206	0.9756	0.5512	60.5320	1.1622
25	1	A025T/R HU	0.9061	0.6839	0.5944	49.0066	0.9936

02/03/87 1333

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 14 POINTS ANALYZED: 487 SAMPLE RATE: 512.
1/REV FREQUENCY: 14.72 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	208.4	203.4	45.6	77.4	209.6
2	1	A002NOSE V	0.0739	0.0676	0.0300	66.0861	0.0743
3	1	A003GUNNER	0.0428	0.0389	0.0177	65.4720	0.0442
4	1	A004LT SKI	0.9331	0.3451	-0.8670	158.2930	0.9526
5	1	A005RT SKI	1.0945	0.4363	-1.0037	156.5046	1.1036
6	1	A006PILOT	0.0208	0.0188	0.0090	64.4654	0.0213
7	1	A007C/G VT	0.0105	0.0086	0.0061	54.8741	0.0115
8	1	A008SUSPEN	0.0170	-0.0101	0.0137	-36.4822	0.0191
9	1	A009SUSPEN	0.0166	-0.0166	-0.0010	-93.4010	0.0173
10	1	A010SUSPEN	0.1366	-0.0637	0.1208	-27.8230	0.1363
11	1	A011HUB VT	0.0085	-0.0067	0.0052	-51.9066	0.0110
12	1	A012HUB LA	0.0117	-0.0116	-0.0014	-96.8650	0.0127
13	1	A013HUB F/	0.0114	-0.0073	0.0088	-39.4711	0.0110
14	1	A014RT WIN	0.0236	0.0209	0.0109	62.4428	0.0254
15	1	A015LT WIN	0.0187	0.0176	0.0061	70.7908	0.0203
16	1	A016ENG FW	0.0318	0.0298	0.0109	69.8524	0.0332
17	1	A017ENG AF	0.0540	0.0521	0.0143	74.6594	0.0542
18	1	A018ENG DE	0.0463	0.0444	0.0132	73.3774	0.0467
19	1	A019T/B JU	0.0878	0.0858	0.0188	77.6615	0.0889
20	1	A020ELEV C	0.1419	0.1399	0.0240	80.2826	0.1426
21	1	A021TAIL S	0.0486	0.0484	0.0038	85.4927	0.0491
22	1	A02290 BOX	0.1316	-0.1292	-0.0251	-100.9782	0.1319
23	1	A02390 BOX	0.0523	0.0523	-0.0012	91.3363	0.0532
24	1	A024T/R HU	0.1532	-0.1514	-0.0236	-98.8525	0.1532
25	1	A025T/R HU	0.4011	-0.3637	-0.1691	-114.9380	0.4294

02/10/87 1538

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 15 POINTS ANALYZED: 475 SAMPLE RATE: 512.
1/REV FREQUENCY: 16.17 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	30.81	24.00	19.31	51.18	30.92
2	1	A002NOSE L	0.0767	0.0735	-0.0221	106.7454	0.0813
3	1	A003GUNNER	0.0365	0.0346	-0.0118	108.7856	0.0381
4	1	A004LT SKI	0.9783	-0.6571	0.7248	-42.1968	1.0002
5	1	A005RT SKI	0.8115	-0.5556	0.5915	-43.2092	0.8488
6	1	A006PILOT	0.0041	0.0015	-0.0038	158.5771	0.0122
7	1	A007C/G LA	0.0219	-0.0216	-0.0038	-100.0017	0.0261
8	1	A008AFT SK	0.1314	-0.1178	0.0582	-63.6862	0.1395
9	1	A009AFT SK	0.1815	-0.1483	0.1046	-54.7851	0.1971
10	1	A010SUSP L	0.0063	0.0061	-0.0017	105.1099	0.0264
11	1	A011HUB VT	0.0068	0.0051	-0.0044	130.7542	0.0103
12	1	A012HUB LA	0.0028	0.0026	0.0011	66.0065	0.0042
13	1	A013HUB F/	0.0014	-0.0008	0.0011	-37.1156	0.0037
14	1	A014RT WIN	0.0105	-0.0047	0.0094	-26.5160	0.0278
15	1	A015LT WIN	0.0247	0.0189	-0.0159	130.1770	0.0340
16	1	A016ENG FW	0.1109	-0.0522	0.0979	-28.0625	0.1182
17	1	A017ENG AF	0.1074	-0.0559	0.0917	-31.3866	0.1241
18	1	A018ENG DE	0.0299	-0.0299	0.0010	-88.0313	0.0318
19	1	A019T/B JU	0.0279	0.0089	-0.0264	161.3259	0.0437
20	1	A020ELEV C	0.3145	0.2794	-0.1445	117.3454	0.3229
21	1	A021TAIL S	0.5230	0.5052	-0.1353	104.9892	0.5618
22	1	A02290 BOX	0.0677	0.0522	-0.0431	129.5710	0.0845
23	1	A02390 BOX	0.3657	-0.0857	0.3555	-13.5496	0.3972
24	1	A024T/R HU	0.2390	0.1965	-0.1361	124.7057	0.3305
25	1	A025XM LAT	0.0307	-0.0276	-0.0134	-116.0084	0.0447

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02/03/87 1354

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 15 POINTS ANALYZED: 457 SAMPLE RATE: 512.

1/REV FREQUENCY: 16.81 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	208.4	208.3	4.2	88.8	210.1
2	1	A002NOSE V	0.2334	0.0399	-0.2299	170.1515	0.2362
3	1	A003GUNNER	0.0866	0.0252	-0.0828	163.1017	0.0894
4	1	A004LT SKI	0.6372	0.5089	-0.3835	126.9986	0.6639
5	1	A005RT SKI	0.5517	-0.5430	0.0974	-79.8317	0.5628
6	1	A006PILOT	0.0249	0.0149	0.0199	36.8800	0.0283
7	1	A007C/G VT	0.0703	0.0114	0.0693	9.3176	0.0747
8	1	A008SUSPEN	0.0775	-0.0214	0.0745	-16.0378	0.0828
9	1	A009SUSPEN	0.0047	-0.0047	-0.0007	-98.6283	0.1190
10	1	A010SUSPEN	0.0485	0.0416	-0.0250	121.0187	0.0542
11	1	A011HUB VT	0.0161	0.0139	0.0081	59.6466	0.0176
12	1	A012HUB LA	0.0148	0.0147	0.0023	81.1608	0.0175
13	1	A013HUB F/	0.0048	0.0046	-0.0016	108.9037	0.0090
14	1	A014PT WIN	0.0854	0.0502	0.0691	35.9719	0.1043
15	1	A015LT WIN	0.0686	0.0036	0.0685	3.0475	0.0948
16	1	A016ENG FW	0.0924	0.0910	0.0158	80.1392	0.1106
17	1	A017ENG AF	0.0619	0.0608	0.0114	79.3469	0.0874
18	1	A018ENG DE	0.0497	0.0480	0.0127	75.1542	0.0662
19	1	A019T/B JU	0.1338	0.0719	-0.1128	147.4584	0.1285
20	1	A020ELEV C	0.4326	0.1163	-0.4167	164.4064	0.4292
21	1	A021TAIL S	0.2563	0.0264	-0.2549	174.0789	0.2829
22	1	A02290 BOX	0.2802	-0.0775	0.2692	-16.0511	0.2836
23	1	A02390 BOX	0.1363	-0.0700	-0.1170	-149.1033	0.1334
24	1	A024T/R HU	0.3299	-0.0184	0.3294	-3.1910	0.3840
25	1	A025T/R HU	1.2894	-0.5909	1.1460	-27.2749	1.2956

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02/05/87 0841

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 19 POINTS ANALYZED: 459 SAMPLE RATE: 512.
1/REV FREQUENCY: 21.19 START TIME: 0 00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	29.53	-29.40	2.74	-84.67	29.68
2	1	A002NOSE V	0.0488	-0.0473	0.0122	-75.5386	0.0493
3	1	A003GUNNER	0.0105	-0.0096	0.0041	-67.0181	0.0120
4	1	A004LT SKI	0.1726	-0.0329	-0.1695	-169.0131	0.1817
5	1	A005RT SKI	0.2029	-0.0559	-0.1950	-163.9970	0.2066
6	1	A006PILOT	0.0142	0.0141	-0.0015	96.1280	0.0147
7	1	A007C/G VT	0.0173	0.0173	-0.0002	90.5777	0.0176
8	1	A008SUSPEN	0.0266	0.0266	-0.0007	91.5479	0.0291
9	1	A009SUSPEN	0.0081	-0.0072	0.0036	-63.5999	0.1111
10	1	A010SUSPEN	0.0024	-0.0024	0.0004	-81.3485	0.0032
11	1	A011HUB VT	0.0216	0.0214	-0.0025	96.5860	0.0232
12	1	A012HUB LA	0.0055	-0.0022	-0.0050	-155.9324	0.0066
13	1	A013HUB F/	0.0022	-0.0013	0.0018	-34.4890	0.0032
14	1	A014RT WIN	0.0106	0.0103	-0.0023	102.6894	0.0237
15	1	A015LT WIN	0.0205	0.0201	0.0043	77.8915	0.0247
16	1	A016ENG FW	0.0442	-0.0053	-0.0438	-173.1066	0.0464
17	1	A017ENG AF	0.0263	-0.0159	0.0209	-37.1861	0.0322
18	1	A018ENG DE	0.0131	-0.0057	0.0118	-25.5707	0.0147
19	1	A019T/B JU	0.0504	-0.0489	0.0122	-75.9662	0.0586
20	1	A020ELEV C	0.0967	-0.0868	-0.0426	-116.1321	0.0938
21	1	A021TAIL S	0.0929	-0.0453	-0.0812	-150.8584	0.0931
22	1	A02290 BOX	0.1050	-0.1049	0.0031	-88.2927	0.1048
23	1	A02390 BOX	0.0327	-0.0125	-0.0302	-157.5785	0.0335
24	1	A024T/R HU	0.1465	-0.1409	0.0400	-74.1329	0.1583
25	1	A025XM F/A	0.0193	0.0148	-0.0123	129.8237	0.0313

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02/10/87 1601

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 21 POINTS ANALYZED: 489 SAMPLE RATE: 512.
1/REV FREQUENCY: 21.99 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	31.85	31.65	3.62	83.47	32.27
2	1	A002NOSE L	0.0435	-0.0315	-0.0300	-133.5741	0.0437
3	1	A003GUNNER	0.0119	-0.0063	-0.0098	-145.0137	0.0127
4	1	A004LT SKI	0.1372	-0.1040	-0.0895	-130.7048	0.1404
5	1	A005RT SKI	0.0677	-0.0401	-0.0545	-143.6910	0.0706
6	1	A006PILOT	0.0152	0.0123	0.0089	54.1072	0.0156
7	1	A007C/G LA	0.0200	0.0130	0.0153	40.3014	0.0208
8	1	A008AFT SK	0.0311	0.0009	0.0311	1.7053	0.0340
9	1	A009AFT SK	0.1518	0.0903	0.1220	36.4953	0.1541
10	1	A010SUSP L	0.0608	0.0216	0.0568	20.8494	0.0625
11	1	A011HUB VT	0.0023	-0.0008	0.0022	-19.4260	0.0032
12	1	A012HUB LA	0.0028	-0.0018	-0.0022	-140.8873	0.0037
13	1	A013HUB F/	0.0009	0.0008	0.0003	71.3460	0.0027
14	1	A014RT WIN	0.0186	0.0153	0.0105	55.6754	0.0230
15	1	A015LT WIN	0.0189	-0.0171	-0.0080	-114.9899	0.0249
16	1	A016ENG FW	0.0258	0.0153	-0.0208	143.6675	0.0269
17	1	A017ENG AF	0.0413	0.0026	-0.0412	176.3620	0.0420
18	1	A018ENG DE	0.0067	0.0047	0.0048	44.2561	0.0090
19	1	A019T/B JU	0.0190	-0.0187	-0.0034	-100.3965	0.0225
20	1	A020ELEV C	0.1420	-0.1259	-0.0656	-117.5297	0.1448
21	1	A021TAIL S	0.1697	-0.1265	-0.1131	-131.8130	0.1790
22	1	A02290 BOX	0.0363	-0.0327	-0.0159	-115.9280	0.0442
23	1	A02390 BOX	0.4035	0.3746	0.1499	68.1876	0.4199
24	1	A024T/R HU	0.1388	-0.1186	-0.0721	-121.2935	0.2770
25	1	A025XM LAT	0.0289	0.0120	0.0263	24.6108	0.0420

02/10/87 1610

1 REV HARMONIC ANALYSIS

1 FILES ANALYZED 23 POINTS ANALYZED: 473 SAMPLE RATE: 512
1 REV FREQUENCY 24.90 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	31.81	29.11	-12.82	113.77	32.29
2	1	A002NOSE L	0.0167	-0.0165	0.0021	-82.7892	0.0171
3	1	A003GUNNER	0.0042	-0.0005	0.0042	-7.2739	0.0051
4	1	A004LT SKI	0.3953	-0.0158	0.3950	-2.2947	0.3991
5	1	A005RT SKI	0.2421	0.0271	0.2406	6.4227	0.2465
6	1	A006PILOT	0.0142	0.0118	0.0079	56.2687	0.0144
7	1	A007C G LA	0.0178	0.0159	0.0080	63.3455	0.0193
8	1	A008AFT SK	0.3230	0.0114	-0.3228	177.9840	0.3239
9	1	A009AFT SK	0.4387	0.0023	-0.4387	179.7033	0.4399
10	1	A010SUSP L	0.0480	0.0453	-0.0157	109.1199	0.0515
11	1	A011HUB VT	0.0058	-0.0056	0.0012	-77.6292	0.0068
12	1	A012HUB LA	0.0065	-0.0061	0.0023	-69.1765	0.0073
13	1	A013HUB F/	0.0023	-0.0022	0.0005	-76.6293	0.0034
14	1	A014RT WIN	0.0278	-0.0098	0.0260	-20.6648	0.0293
15	1	A015LT WIN	0.0236	-0.0053	-0.0230	-166.9480	0.0249
16	1	A016ENG FW	0.0408	-0.0187	-0.0363	-152.8255	0.0415
17	1	A017ENG AF	0.0331	0.0010	-0.0331	178.2591	0.0344
18	1	A018ENG DE	0.0158	0.0026	0.0156	9.6033	0.0166
19	1	A019T/B JU	0.0342	-0.0196	0.0281	-34.8632	0.0362
20	1	A020ELEV C	0.0957	-0.0943	0.0158	-80.5107	0.1001
21	1	A021TAIL S	0.0867	-0.0570	-0.0654	-138.9232	0.0906
22	1	A02290 BOX	0.0334	-0.0334	0.0002	-89.7285	0.0393
23	1	A02390 BOX	0.3486	0.3465	-0.0375	96.1751	0.3591
24	1	A024T/R HU	0.1104	-0.0979	-0.0509	-117.4822	0.1424
25	1	A025XM LAT	0.0463	0.0450	0.0110	76.2928	0.0569

ORIGINAL PAGE IS
OF POOR QUALITY

02/06/87 1257

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 23 POINTS ANALYZED: 469 SAMPLE RATE: 512.
1/REV FREQUENCY: 25.11 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	101.72	101.46	7.25	85.91	102.22
2	1	A002NOSE V	0.0191	0.0059	-0.0181	161.9909	0.0193
3	1	A003C/G F/	0.0056	-0.0043	-0.0035	-128.8480	0.0071
4	1	A004LT SKI	0.0251	-0.0237	0.0084	-70.3449	0.0261
5	1	A005RT SKI	0.0153	-0.0065	-0.0139	-155.0019	0.0166
6	1	A006PILOT	0.0061	-0.0033	0.0051	-33.1163	0.0064
7	1	A007C/G VT	0.0034	-0.0032	-0.0012	-110.8255	0.0042
8	1	A008ELEV R	0.0092	0.0056	0.0073	37.3584	0.0134
9	1	A009ELEV L	0.0046	0.0014	0.0044	17.9714	0.0088
10	1	A010SUSP F	0.2123	-0.2089	-0.0380	-100.3142	0.2140
11	1	A011HUB VT	0.0055	0.0003	-0.0055	176.3677	0.0059
12	1	A012HUB LA	0.0051	-0.0051	-0.0006	-97.3006	0.0059
13	1	A013HUB F/	0.1073	0.1068	0.0108	84.2172	0.1085
14	1	A014ENG FW	0.0289	-0.0059	0.0283	-11.7048	0.0293
15	1	A015T/R HU	0.0410	0.0186	0.0366	26.9391	0.0420
16	1	A016ENG FW	0.0180	-0.0002	-0.0180	-179.2669	0.0186
17	1	A017ENG AF	0.0031	-0.0029	-0.0012	-113.3755	0.0039
18	1	A018ENG DE	0.0036	0.0004	-0.0036	173.9531	0.0042
19	1	A019T/B JU	0.0030	0.0003	0.0030	5.1432	0.0037
20	1	A020ELEV C	0.0042	0.0011	0.0040	14.7084	0.0051
21	1	A021TAIL S	0.0108	-0.0050	-0.0096	-152.2049	0.0112
22	1	A02290 BOX	0.0066	-0.0012	-0.0065	-169.2711	0.0076
23	1	A02390 BOX	0.0057	-0.0050	-0.0027	-117.8827	0.0068
24	1	A024T/R HU	0.0098	0.0094	0.0031	71.81[illegible]	0.0105
25	1	A025XM F/A	0.0405	0.0400	-0.0067	[illegible]	0.0449

02/03/87 1439

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 23 POINTS ANALYZED: 471 SAMPLE RATE: 512.
1/REV FREQUENCY: 25.00 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	207.7	64.4	-197.4	161.9	208.6
2	1	A002NOSE V	0.0533	-0.0495	-0.0199	-111.9065	0.0537
3	1	A003GUNNER	0.0156	0.0043	-0.0150	163.8634	0.0171
4	1	A004LT SKI	0.3706	-0.3006	-0.2167	-125.7941	0.3832
5	1	A005RT SKI	0.3400	0.3242	0.1025	72.4570	0.3495
6	1	A006PILOT	0.0332	0.0324	-0.0076	103.2917	0.0335
7	1	A007C/G VT	0.0366	0.0364	-0.0031	94.9041	0.0381
8	1	A008SUSPEN	0.0951	0.0730	0.0610	50.1072	0.0967
9	1	A009SUSPEN	0.0527	0.0379	-0.0365	133.9188	0.0540
10	1	A010SUSPEN	0.0377	-0.0300	-0.0228	-127.2576	0.0418
11	1	A011HUB*VT	0.0850	0.0585	0.0616	43.5372	0.0857
12	1	A012HUB LA	0.0129	0.0128	0.0017	82.5370	0.0137
13	1	A013HUB F/	0.0162	-0.0069	-0.0146	-154.7699	0.0166
14	1	A014RT WIN	0.0758	0.0651	-0.0389	120.8943	0.0826
15	1	A015LT WIN	0.0506	0.0166	-0.0478	160.8719	0.0515
16	1	A016ENG FW	0.1462	0.0024	-0.1462	179.0640	0.1470
17	1	A017ENG AF	0.1497	-0.0183	-0.1486	-172.9614	0.1502
18	1	A018ENG DE	0.1159	0.0018	-0.1158	179.1098	0.1165
19	1	A019T/B JU	0.1565	-0.0546	-0.1466	-159.5879	0.1568
20	1	A020ELEV C	0.0310	-0.0252	0.0181	-54.3366	0.0318
21	1	A021TAIL S	0.2009	0.1077	0.1695	32.4294	0.2022
22	1	A02290 BOX	0.0602	0.0513	0.0315	58.4621	0.0608
23	1	A02390 BOX	0.1049	0.0775	0.0707	47.6346	0.1077
24	1	A024T/P HU	0.0826	-0.0644	-0.0517	-128.7917	[illegible]
25	1	A025T/R HU	0.6952	-0.2268	-0.6572	-160.9594	0.7518

02/10/87 1024

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 23 POINTS ANALYZED: 489 SAMPLE RATE: 512

1/REV FREQUENCY: 24.08 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	51.18	50.88	-5.51	96.18	52.03
2	1	A002NOSE L	0.0087	-0.0058	-0.0065	-138.1593	0.0093
3	1	A003GUNNER	0.0032	-0.0030	-0.0012	-112.5499	0.0042
4	1	A004LT SKI	0.0572	-0.0492	-0.0292	-120.7023	0.0596
5	1	A005RT SKI	0.0995	0.0124	0.0987	7.1620	0.1009
6	1	A006PILOT	0.0022	0.0000	0.0022	0.4232	0.0024
7	1	A007C/G LA	0.0061	-0.0003	0.0061	-2.3840	0.0076
8	1	A008AFT SK	0.0601	0.0088	-0.0594	171.5709	0.0613
9	1	A009AFT SK	0.0426	0.0424	-0.0037	94.9675	0.0440
10	1	A010SUSP L	0.1107	0.1088	0.0199	79.6264	0.1165
11	1	A011HUB VT	0.0029	-0.0016	0.0024	-34.7041	0.0034
12	1	A012HUB LA	0.0520	-0.0519	0.0022	-87.6278	0.0535
13	1	A013HUB F/	0.0007	-0.0004	0.0006	-35.2608	0.0015
14	1	A014RT WIN	0.0074	0.0017	-0.0073	167.1754	0.0081
15	1	A015LT WIN	0.0063	-0.0014	0.0061	-12.7911	0.0068
16	1	A016ENG FW	0.0077	0.0027	-0.0072	159.8536	0.0083
17	1	A017ENG AF	0.0243	0.0097	-0.0222	156.5096	0.0249
18	1	A018ENG DE	0.0015	0.0015	-0.0000	91.5082	0.0022
19	1	A019T/B JU	0.0032	0.0029	-0.0015	117.4567	0.0037
20	1	A020ELEV C	0.0017	-0.0003	0.0016	-9.1702	0.0022
21	1	A021TAIL S	0.0093	-0.0056	0.0074	-37.2364	0.0100
22	1	A02290 BOX	0.0014	-0.0014	0.0001	-85.7206	0.0022
23	1	A02390 BOX	0.0039	0.0017	-0.0036	154.5328	0.0051
24	1	A024T/R HU	0.0079	-0.0049	0.0062	-38.1908	0.0088
25	1	A025XM LAT	0.0364	-0.0326	0.0162	-63.5155	0.0440

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02/10/87 1030

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 26 POINTS ANALYZED: 474 SAMPLE RATE: 512.
1/REV FREQUENCY: 28.08 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	51.41	49.04	-15.43	107.47	52.61
2	1	A002NOSE L	0.0116	-0.0063	0.0098	-32.9242	0.0120
3	1	A003GUNNER	0.0045	-0.0035	0.0028	-51.7781	0.0054
4	1	A004LT SKI	0.2059	-0.0707	-0.1933	-159.9029	0.2079
5	1	A005RT SKI	0.1459	-0.0448	-0.1389	-162.1329	0.1470
6	1	A006PILOT	0.0033	-0.0011	-0.0031	-159.9958	0.0034
7	1	A007C/G LA	0.0080	0.0070	-0.0040	119.6285	0.0098
8	1	A008AFT SK	0.0447	0.0284	0.0345	39.4904	0.0449
9	1	A009AFT SK	0.0522	0.0301	0.0426	35.2363	0.0528
10	1	A010SUSP L	0.1006	0.0994	-0.0155	98.8739	0.1026
11	1	A011HUB VT	0.0020	0.0014	0.0015	43.9474	0.0027
12	1	A012HUB LA	0.0579	-0.0560	0.0145	-75.5066	0.0594
13	1	A013HUB F/	0.0059	0.0032	0.0050	32.7623	0.0064
14	1	A014RT WIN	0.0216	-0.0215	-0.0024	-96.3603	0.0222
15	1	A015LT WIN	0.0190	0.0187	0.0031	80.5636	0.0198
16	1	A016ENG FW	0.0048	0.0014	-0.0046	162.8190	0.0054
17	1	A017ENG AF	0.0161	-0.0156	0.0039	-75.9467	0.0166
18	1	A018ENG DE	0.0040	0.0014	-0.0037	159.5284	0.0044
19	1	A019T B JU	0.0053	-0.0017	-0.0051	-161.7003	0.0056
20	1	A020ELEV C	0.0028	-0.0019	-0.0021	-137.7934	0.0032
21	1	A021TAIL S	0.0109	0.0086	0.0066	52.8367	0.0115
22	1	A02290 BOX	0.0009	-0.0009	0.0002	-78.6917	0.0020
23	1	A02390 BOX	0.0062	-0.0055	-0.0028	-117.5559	0.0066
24	1	A024T/R HU	0.0142	0.0110	0.0090	50.7382	0.0154
25	1	A025XM LAT	0.0215	0.0124	0.0176	35.1430	0.0278

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CYCLES ANALYZED: 28 1/REV HARMONIC ANALYSIS POINTS ANALYZED: 486 02/06/87 1312 SAMPLE RATE: 512.

1/REV FREQUENCY: 29.50 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001FORCE	103.51	97.32	-35.26	109.92	104.20
2	1 A002NOSE V	0.0299	-0.0132	-0.0268	-153.7433	0.0305
3	1 A003C/G F/	0.0138	-0.0015	0.0137	-6.0775	0.0147
4	1 A004LT SKI	0.0076	0.0063	-0.0043	124.6234	0.0103
5	1 A005RT SKI	0.0189	0.0171	0.0081	64.6976	0.0208
6	1 A006PILOT	0.0137	0.0080	0.0111	35.6414	0.0142
7	1 A007C/G VT	0.0099	0.0011	0.0098	6.2000	0.0107
8	1 A008ELEV R	0.0342	-0.0251	-0.0232	-132.7932	0.0357
9	1 A009ELEV L	0.0263	-0.0232	-0.0123	-117.9444	0.0276
10	1 A010SUSP F	0.2298	-0.2256	-0.0440	-101.0385	0.2316
11	1 A011HUB VT	0.0230	-0.0120	-0.0196	-148.6176	0.0234
12	1 A012HUB LA	0.0128	-0.0123	-0.0036	-106.4033	0.0133
13	1 A013HUB F/	0.1147	0.1133	-0.0182	99.1040	0.1158
14	1 A014ENG FW	0.0396	0.0294	-0.0265	132.1009	0.0401
15	1 A015T/R HV	0.0143	0.0042	-0.0136	162.8381	0.0169
16	1 A016ENG FW	0.0407	-0.0175	0.0367	-25.4418	0.0418
17	1 A017ENG AF	0.0084	-0.0048	-0.0070	-145.6760	0.0090
18	1 A018ENG DE	0.0101	-0.0093	-0.0039	-112.5247	0.0105
19	1 A019T/B JV	0.0079	-0.0074	-0.0028	-110.9830	0.0083
20	1 A020ELEV C	0.0178	-0.0160	-0.0078	-115.9191	0.0186
21	1 A021TAIL S	0.0085	-0.0067	-0.0052	-128.0181	0.0095
22	1 A02290 BOX	0.0027	0.0027	-0.0005	100.8148	0.0039
23	1 A02390 BOX	0.0467	0.0335	0.0326	45.8395	0.0481
24	1 A024T/R HV	0.0570	-0.0446	-0.0356	-128.5960	0.0576
25	1 A025XM F/A	0.1214	0.0001	-0.1214	179.9721	0.1280

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02/10/87 1035

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 27 POINTS ANALYZED: 493 SAMPLE RATE: 512.
1/REV FREQUENCY: 28.04 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	51.77	51.29	-7.09	97.87	52.98
2	1	A002NOSE L	0.0118	-0.0079	0.0087	-42.3637	0.0120
3	1	A003GUNNER	0.0045	-0.0039	0.0022	-60.9533	0.0056
4	1	A004LT SKI	0.2077	-0.0352	-0.2047	-170.2554	0.2101
5	1	A005RT SKI	0.1478	-0.0191	-0.1466	-172.5685	0.1497
6	1	A006PILOT	0.0033	-0.0006	-0.0032	-169.8579	0.0034
7	1	A007C/G LA	0.0081	0.0076	-0.0028	110.0877	0.0093
8	1	A008AFT SK	0.0449	0.0219	0.0392	29.1681	0.0452
9	1	A009AFT SK	0.0524	0.0221	0.0476	24.8948	0.0530
10	1	A010SUSP L	0.1017	0.1017	0.0005	89.7099	0.1041
11	1	A011HUB VT	0.0020	0.0011	0.0017	34.2085	0.0027
12	1	A012HUB LA	0.0583	-0.0581	0.0050	-85.1117	0.0594
13	1	A013HUB F/	0.0058	0.0022	0.0054	22.5651	0.0061
14	1	A014RT WIN	0.0217	-0.0209	-0.0060	-105.9860	0.0225
15	1	A015LT WIN	0.0191	0.0181	0.0062	71.0443	0.0198
16	1	A016ENG FW	0.0048	0.0021	-0.0043	154.2165	0.0054
17	1	A017ENG AF	0.0162	-0.0162	0.0013	-85.5030	0.0169
18	1	A018ENG DE	0.0040	0.0021	-0.0035	148.9642	0.0044
19	1	A019T/B JU	0.0054	-0.0007	-0.0053	-172.4349	0.0059
20	1	A020ELEV C	0.0027	-0.0014	-0.0023	-149.5237	0.0034
21	1	A021TAIL S	0.0109	0.0074	0.0080	42.7791	0.0120
22	1	A02290 BOX	0.0009	-0.0009	0.0001	-85.7350	0.0027
23	1	A02390 BOX	0.0062	-0.0049	-0.0037	-127.3009	0.0073
24	1	A024T/R HU	0.0142	0.0092	0.0109	40.0822	0.0154
25	1	A025XM LAT	0.0211	0.0086	0.0193	24.0476	0.0300

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02/10/87 1037

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 30 POINTS ANALYZED: 481 SAMPLE RATE: 512
1/REV FREQUENCY: 31.93 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	51.12	44.52	-25.11	119.42	52.61
2	1	A002NOSE L	0.0061	-0.0051	0.0033	-57.7446	0.0066
3	1	A003GUNNER	0.0014	-0.0008	0.0012	-34.0067	0.0024
4	1	A004LT SKI	0.0032	-0.0019	0.0026	-36.4533	0.0068
5	1	A005RT SKI	0.0083	0.0040	-0.0073	151.1401	0.0105
6	1	A006PILOT	0.0018	0.0017	-0.0002	97.8466	0.0020
7	1	A007C/G LA	0.0050	0.0043	-0.0025	119.7658	0.0068
8	1	A008AFT SK	0.0058	0.0047	-0.0033	125.0789	0.0066
9	1	A009AFT SK	0.0046	0.0036	-0.0029	129.1845	0.0056
10	1	A010SUSP L	0.4851	0.3073	-0.3753	140.6882	0.4939
11	1	A011HUB VT	0.0017	0.0016	0.0004	75.8661	0.0022
12	1	A012HUB LA	0.0484	-0.0448	0.0183	-67.8300	0.0506
13	1	A013HUB F/	0.0031	-0.0019	0.0025	-37.4689	0.0037
14	1	A014RT WIN	0.0125	-0.0108	0.0062	-60.1737	0.0132
15	1	A015LT WIN	0.0094	0.0082	-0.0047	119.6131	0.0103
16	1	A016ENG FW	0.0141	-0.0110	-0.0087	-128.3513	0.0149
17	1	A017ENG AF	0.0064	0.0008	0.0063	7.5675	0.0068
18	1	A018ENG DE	0.0025	-0.0008	-0.0023	-160.8014	0.0032
19	1	A019T/B JU	0.0025	-0.0017	-0.0018	-136.6510	0.0029
20	1	A020ELEV C	0.0023	0.0009	0.0021	23.8940	0.0029
21	1	A021TAIL S	0.0062	0.0060	0.0016	75.1908	0.0076
22	1	A02290 BOX	0.0013	-0.0013	-0.0002	-98.4625	0.0027
23	1	A02390 BOX	0.0031	-0.0029	0.0009	-72.0473	0.0044
24	1	A024T/R HU	0.0068	-0.0025	-0.0063	-158.8217	0.0085
25	1	A025XM LAT	0.0136	0.0033	0.0132	13.9420	0.0205

02/10/87 1626

1 REV HARMONIC ANALYSIS

CYCLES ANALYZED 33 POINTS ANALYZED: 497 SAMPLE RATE: 512.
1/REV FREQUENCY 34.00 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	31.61	10.55	-29.80	160.50	31.80
2	1	A002NOSE L	0.0249	0.0248	-0.0017	93.8933	0.0252
3	1	A003GUNNER	0.0020	-0.0004	-0.0020	-168.4160	0.0037
4	1	A004LT SKI	0.0201	-0.0080	-0.0184	-156.5541	0.0225
5	1	A005RT SKI	0.0721	-0.0596	0.0406	-55.7233	0.0755
6	1	A006PILOT	0.0211	-0.0207	-0.0039	-100.6516	0.0213
7	1	A007C G LA	0.0137	-0.0136	-0.0017	-97.1380	0.0149
8	1	A008AFT SK	0.0053	0.0051	0.0013	76.0481	0.0068
9	1	A009AFT SK	0.0130	0.0101	0.0082	50.6649	0.0142
10	1	A010BUSP L	0.0098	0.0086	-0.0048	118.9950	0.0112
11	1	A011HUB VT	0.0109	0.0107	0.0020	79.4615	0.0115
12	1	A012HUB LA	0.0011	-0.0011	0.0003	-76.1578	0.0020
13	1	A013HUB F/	0.0014	0.0002	0.0014	6.7982	0.0020
14	1	A014RT WIN	0.0264	-0.0220	-0.0146	-123.6780	0.0271
15	1	A015LT WIN	0.0341	0.0281	0.0194	55.4410	0.0347
16	1	A016ENG FW	0.0189	-0.0162	-0.0098	-121.3652	0.0193
17	1	A017ENG AF	0.0197	-0.0098	-0.0171	-150.0887	0.0200
18	1	A018ENG DE	0.0150	0.0149	-0.0022	98.5379	0.0154
19	1	A019T/B JU	0.0506	0.0459	0.0213	65.1129	0.0511
20	1	A020ELEV C	0.0330	-0.0208	0.0257	-38.9924	0.0374
21	1	A021TAIL S	0.1911	-0.1663	-0.0941	-119.5162	0.1935
22	1	A02290 BOX	0.0359	-0.0334	0.0131	-68.6412	0.0440
23	1	A02390 BOX	0.2741	0.2721	0.0332	83.0465	0.2763
24	1	A024T/R HU	0.2482	-0.1777	-0.1732	-134.2660	0.2636
25	1	A025XM LAT	0.0039	-0.0008	-0.0038	-168.6721	0.0090

02/26/86 0837

1 [illegible] HARMONIC ANALYSIS

[illegible] POINTS ANALYZED 412 SAMPLE RATE 512

[illegible] START TIME 0.00

[illegible] AZIMUTH CORRECTION ANGLE 0.00 DEG.

		LABEL	AMP	SIN	COS	PHASE	[illegible]
1	1	A001F[illegible]RCE	6.38	-5.68	2.89	-63.05	8.62
2	1	A002NOSE L	0.2096	-0.0920	-0.1887	-157.9669	0.2396
3	1	A003[illegible]	0.1177	-0.0512	-0.1060	-154.2097	0.1234
4	1	A004LT SKI	0.1216	-0.0433	-0.1136	-159.1184	0.2382
5	1	A005RT SKI	0.1319	-0.0469	-0.1232	-159.1469	0.3473
6	1	A00[illegible]	0.0543	-0.0227	-0.0493	-155.3174	0.[illegible]
7	1	[illegible]	0.05[illegible]	0.0235	0.0536	23.6739	0.0752
8	1	A008LT ELE	0.06[illegible]	-0.0357	-0.0566	-147.7519	0.2570
9	1	A009RT ELE	0.05[illegible]	0.0299	0.0499	30.9435	0.301[illegible]
10	1	A010SUSP L	0.0741	0.0258	0.0694	20.3850	0.3177
11	1	A011LT SKI	0.0[illegible]	-0.0527	0.0203	-68.9052	0.15[illegible]
12	1	A012RT SKI	0.[illegible]	0.0488	0.0691	35.2274	0.1627
13	1	A01342 BOX	0.2763	-0.2525	-0.1122	-113.9564	0.2904
14	1	A014RT WIN	0.0353	-0.0239	-0.0260	-137.4892	0.0525
15	1	A015LT WIN	0.0490	0.0108	0.0478	12.6662	0.0933
16	1	A016ENG FW	0.1737	0.0988	0.1429	34.6482	0.2113
17	1	A017ENG AF	0.2124	0.1069	0.1836	30.2133	0.2787
18	1	A018ENG DE	0.1296	0.0547	0.1175	24.9493	0.1505
19	1	A019T/B JU	0.1489	0.0592	0.1366	23.4352	0.1698
20	1	A020ELEV C	0.0518	0.0105	0.0507	11.6627	0.0931
21	1	A021TAIL S	0.2617	-0.1378	-0.2225	-148.2207	0.3100
22	1	A02290 BOX	0.0815	0.0349	0.0737	25.3694	0.0948
23	1	A02390 BOX	1.1737	-0.5498	-1.0369	-152.0634	1.1915
24	1	A024T/R HU	0.1588	0.0701	0.1425	26.1813	0.2389
25	1	A025T/R HU	0.1188	-0.0333	-0.1141	-163.7431	0.2428

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02/23/87 1522

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 430 SAMPLE RATE: 512.
1/REV FREQUENCY: 8.33 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	67.65	39.22	-55.12	144.56	67.34
2	1	A002NOSE V	0.2729	-0.2308	-0.1457	-122.2651	0.2741
3	1	A003GUNNER	0.1425	-0.1183	-0.0794	-123.8910	0.1434
4	1	A004LT SKI	0.1318	-0.1070	-0.0770	-125.7481	0.1312
5	1	A005RT SKI	0.0874	-0.0663	-0.0569	-130.6672	0.1055
6	1	A006PILOT	0.0516	-0.0381	-0.0349	-132.4876	0.0518
7	1	A007C/G VT	0.0764	0.0706	0.0293	67.4175	0.0784
8	1	A008SUSP V	0.0825	0.0761	0.0320	67.2078	0.0843
9	1	A009SUSP L	0.0112	0.0106	-0.0034	107.8568	0.0125
10	1	A010SUSP F	0.0168	-0.0133	-0.0103	-127.8151	0.0191
11	1	A011LT SKI	0.2966	-0.2965	0.0089	-88.2722	0.4573
12	1	A012RT SKI	0.1831	0.1654	0.0786	64.5885	0.1979
13	1	A01342 BOX	0.3925	-0.3901	0.0431	-83.6958	0.3953
14	1	A014FT WIN	0.1135	0.1101	-0.0278	104.1966	0.1124
15	1	A015LT WIN	0.0745	0.0696	0.0266	69.0785	0.0743
16	1	A016ENG FW	0.1298	0.1182	0.0535	65.6355	0.1329
17	1	A017ENG AF	0.1648	0.1483	0.0718	64.1745	0.1659
18	1	A018ENG DE	0.1596	0.1439	0.0690	64.3829	0.1610
19	1	A019T/B JU	0.1710	0.1529	0.0764	63.4417	0.1715
20	1	A020ELEV C	0.0388	-0.0234	-0.0309	-142.8376	0.0442
21	1	A021TAIL S	0.5302	-0.4530	-0.2755	-121.3044	0.5330
22	1	A02290 BOX	0.9110	-0.7805	-0.4699	-121.0532	0.9116
23	1	A02390 BOX	0.0189	0.0163	0.0095	59.7173	0.0225
24	1	A024T/R HU	0.9980	-0.8572	-0.5111	-120.8028	1.0002
25	1	A025T/R HU	0.7479	-0.5686	-0.4858	-130.5114	0.7672

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02/23/87 1527

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 13 POINTS ANALYZED: 449 SAMPLE RATE: 512
1/REV FREQUENCY: 14.82 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001FORCE	96.43	-75.81	-59.60	-128.17	97.02
2	1 A002NOSE V	0.0395	-0.0265	-0.0292	-137.7376	0.0398
3	1 A003GUNNER	0.0212	-0.0141	-0.0159	-138.5390	0.0220
4	1 A004LT SKI	0.4634	-0.0096	0.4633	-1.1809	0.4646
5	1 A005RT SKI	0.4886	-0.0479	0.4862	-5.6276	0.4939
6	1 A006PILOT	0.0111	-0.0070	-0.0085	-140.4978	0.0115
7	1 A007C/G VT	0.0046	-0.0023	-0.0040	-150.6646	0.0066
8	1 A008SUSP V	0.0093	-0.0059	-0.0072	-140.7505	0.0103
9	1 A009SUSP L	0.0004	-0.0001	0.0004	-14.0466	0.0029
10	1 A010SUSP F	0.0002	-0.0000	-0.0002	-171.4390	0.0029
11	1 A011LT SKI	0.0495	-0.0109	0.0483	-12.6934	0.0579
12	1 A012RT SKI	0.0425	-0.0232	0.0356	-33.1503	0.0432
13	1 A01342 BOX	0.0373	-0.0310	0.0207	-56.2972	0.0374
14	1 A014RT WIN	0.0136	-0.0129	0.0044	-70.9462	0.0139
15	1 A015LT WIN	0.0082	-0.0057	-0.0059	-135.8525	0.0085
16	1 A016ENG FW	0.0162	-0.0112	-0.0116	-135.8645	0.0164
17	1 A017ENG AF	0.0242	-0.0177	-0.0166	-133.1555	0.0244
18	1 A018ENG DE	0.0214	-0.0154	-0.0149	-134.1021	0.0217
19	1 A019T/B JU	0.0367	-0.0278	-0.0240	-130.8449	0.0369
20	1 A020ELEV C	0.0560	-0.0437	-0.0349	-128.6313	0.0564
21	1 A021TAIL S	0.0155	-0.0130	-0.0085	-123.3242	0.0159
22	1 A02290 BOX	0.0508	0.0390	0.0325	50.1787	0.0513
23	1 A02390 BOX	0.0149	-0.0133	-0.0067	-116.8145	0.0154
24	1 A024T/R HU	0.0795	0.0625	0.0491	51.8432	0.0806
25	1 A025T/R HU	0.1919	0.1206	0.1492	38.9494	0.1927

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1 REV HARMONIC ANALYSIS
CYCLES ANALYZED — POINTS ANALYZED: 474 — SAMPLE RATE 512
1/REV FREQUENCY — START TIME 0.00
ROTOR — DEFLECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	29.14	23.65	17.03	54.24	29.21
2	1	A002NOSE	0.0773	0.0702	-0.0324	114.7597	0.0818
3	1	A003GUNNER	0.0349	0.0312	-0.0155	116.4146	0.0347
4	1	A004LT SKI	1.1555	-0.7137	0.9087	-38.1473	1.1695
5	1	A005RT SKI	1.0939	-0.7011	0.8397	-39.8579	1.1043
6	1	A006PILOT	0.0054	0.0027	-0.0047	150.4031	0.0172
7	1	A007C G LA	0.0182	-0.0180	-0.0030	-99.5493	0.0259
8	1	A008LT ELE	0.1155	-0.0773	0.0857	-42.0382	0.1441
9	1	A009RT ELE	[illegible]	0.0398	-0.0222	119.1182	0.1182
10	1	A010	0.0184	-0.0012	0.0183	-3.8454	0.0374
11	1	A011LT S/I	0.1663	-0.0843	0.1434	-30.4547	0.1778
12	1	A012RT S/I	0.1363	-0.1250	0.0543	-66.5444	0.1404
13	1	A01342 BOX	0.4320	-0.0261	-0.4312	-176.5303	0.4326
14	1	A014RT WIN	0.0151	0.0068	0.0135	26.6078	0.0161
15	1	A015LT WIN	0.0317	0.0251	-0.0194	127.6592	0.0432
16	1	A016ENG FW	0.1391	-0.0797	0.1140	-34.9839	0.1446
17	1	A017ENG AF	0.1287	-0.0823	0.0989	-39.7514	0.1412
18	1	A018ENG DE	0.0308	-0.0306	0.0041	-82.2844	0.0340
19	1	A019T/B JU	0.0281	0.0088	-0.0267	161.7225	0.0349
20	1	A020ELEV C	0.3408	0.2929	-0.1742	120.7457	0.3495
21	1	A021TAIL S	0.5619	0.5333	-0.1771	108.3703	0.5862
22	1	A02290 BOX	0.0696	0.0481	-0.0503	136.3032	0.0752
23	1	A02390 BOX	0.4078	-0.0870	0.3984	-12.3136	0.4104
24	1	A024T/R HU	0.2388	0.1918	-0.1422	126.5413	0.2675
25	1	A025T/R HU	0.0703	-0.0623	0.0326	-62.3450	0.1749

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02/23/87 1532

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 16 POINTS ANALYZED: 484 SAMPLE RATE 512
1/REV FREQUENCY: 16.93 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	[illegible]
1	1	F001FORCE	96.36	-91.55	-30.07	-108.18	37.03
2	1	A002NOSE V	0.0964	-0.0947	0.0180	-79.2534	0.0972
3	1	A003GUNNER	0.0364	-0.0362	0.0034	-84.6613	0.0387
4	1	A004LT SKI	0.4782	-0.4416	-0.1835	-112.5643	0.4876
5	1	A005RT SKI	0.3446	0.2792	0.2020	54.1235	0.3481
6	1	A006PILOT	0.0065	0.0019	-0.0062	162.9160	0.0061
7	1	A007C/G VT	0.0288	0.0268	-0.0106	111.5060	0.0305
8	1	A008SUSP V	0.0339	0.0282	-0.0188	123.6916	0.0366
9	1	A009SUSP L	0.0061	0.0045	-0.0041	132.6632	0.0081
10	1	A010SUSP F	0.0002	-0.0002	0.0001	-45.3405	0.0044
11	1	A011LT SKI	0.0394	-0.0387	-0.0075	-100.9111	0.0711
12	1	A012RT SKI	0.0392	0.0319	-0.0227	125.3975	0.0410
13	1	A01342 BOX	0.1544	0.0096	0.1541	3.5698	0.1551
14	1	A014RT WIN	0.0236	-0.0204	-0.0119	-120.3216	0.0239
15	1	A015LT WIN	0.0349	0.0339	-0.0083	103.8229	0.0364
16	1	A016ENG FW	0.0242	0.0140	-0.0198	144.7745	0.0264
17	1	A017ENG AF	0.0160	-0.0071	-0.0144	-153.6973	0.0193
18	1	A018ENG DE	0.0155	-0.0026	-0.0153	-170.2454	0.0169
19	1	A019T B VU	0.0513	-0.0512	-0.0034	-93.8530	0.0552
20	1	A020ELEV C	0.1691	-0.1677	0.0220	-82.5217	0.1734
21	1	A021TAIL S	0.0905	-0.0868	0.0258	-73.4439	0.0894
22	1	A02290 BOX	0.0954	0.0942	-0.0151	99.1055	0.0975
23	1	A02390 BOX	0.0352	0.0023	0.0352	3.6994	0.0391
24	1	A024T/R HU	0.1688	0.1593	-0.0558	109.2948	0.1751
25	1	A025T/R HU	0.6204	0.6190	0.0417	86.1476	0.6192

ORIGINAL PAGE IS
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02/24/86 1456

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 20 POINTS ANALYZED: 481 SAMPLE RATE: 512.
1/REV FREQUENCY: 21.29 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	40.25	-39.99	4.57	-83.48	40.69
2	1	A002NOSE V	0.0620	-0.0619	0.0032	-87.0391	0.0645
3	1	A003GUNNER	0.0142	-0.0141	-0.0014	-95.7916	0.0161
4	1	A004LT SKI	0.2465	-0.1297	-0.2097	-148.2725	0.2506
5	1	A005RT SKI	0.1702	-0.0305	-0.1674	-169.6847	0.1744
6	1	A006PILOT	0.0174	0.0167	-0.0046	105.2103	0.0195
7	1	A007C/G VT	0.0258	0.0258	0.0009	88.0325	0.0298
8	1	A008SUSP V	0.0233	0.0230	0.0042	79.7389	0.0244
9	1	A009SUSP L	0.0027	-0.0009	0.0025	-19.3990	0.0054
10	1	A010SUSP F	0.0024	-0.0023	-0.0007	-107.4748	0.0073
11	1	A011LT SKI	0.2582	0.1079	0.2346	24.7019	0.2609
12	1	A012RT SKI	0.2855	0.1005	0.2673	20.6062	0.2902
13	1	A01342 BOX	0.1132	-0.0676	0.0908	-36.6525	0.1204
14	1	A014RT WIN	0.0250	0.0006	-0.0250	178.5237	0.0264
15	1	A015LT WIN	0.0317	0.0316	-0.0027	94.8402	[illegible]
16	1	A016ENG FW	0.0665	0.0259	-0.0612	157.0654	0.0677
17	1	A017ENG AF	0.0248	-0.0027	0.0247	-6.1948	0.0253
18	1	A018ENG DE	0.0084	0.0035	0.0076	24.6843	[illegible]
19	1	A019T/B VU	0.0457	-0.0434	0.0143	-71.7747	[illegible]
20	1	A020ELEV C	0.1046	-0.0951	-0.0436	-114.6230	0.1204
21	1	A021TAIL S	0.1009	-0.0542	-0.0851	-147.4988	0.1114
22	1	A02290 BOX	0.1238	-0.1235	0.0084	-86.1115	0.1246
23	1	A02390 BOX	0.0454	-0.0190	-0.0413	-155.2336	0.0589
24	1	A024T/R HU	0.2121	-0.1901	0.0942	-63.6237	0.2491
25	1	A025T/R HU	0.5543	-0.3956	0.3882	-45.5386	0.6102

02/26/86 0946

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED [illegible] POINTS ANALYZED: 477 SAMPLE RATE 512

1/REV FREQUENCY [illegible] START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	30.02	30.00	1.27	87.57	30.19
2	1	A002NOSE L	0.0346	-0.0150	-0.0311	-154.2063	0.0349
3	1	A003GUNNER	0.0117	0.0009	-0.0117	175.8194	0.0127
4	1	A004LT SKI	0.1282	-0.1242	-0.0321	-104.5059	0.1290
5	1	A005RT SKI	0.0840	-0.0573	-0.0614	-136.9585	0.0850
6	1	A006PILOT	0.0134	0.0127	0.0040	72.5144	0.0137
7	1	A007C/G LA	0.0173	0.0092	0.0147	32.1214	0.0181
8	1	A008LT ELE	0.0565	0.0561	0.0068	83.0686	0.1351
9	1	A009RT ELE	0.0474	-0.0472	-0.0034	-94.0706	0.1082
10	1	A010SUSP L	0.0344	0.0072	-0.0336	167.9802	0.0359
11	1	A011LT SKI	0.1[illegible]	-0.0180	-0.1877	-174.5339	0.1927
12	1	A012RT SKI	0.0841	0.0154	0.0827	10.5817	0.0852
13	1	A01342 BOX	0.1070	-0.0101	0.1065	-5.4[illegible]	0.107[illegible]
14	1	A014FT WIN	0.0[illegible]	-0.0125	-0.0180	-144.[illegible]	0.0232
15	1	A015LT WIN	0.0[illegible]	-0.0258	[illegible]	[illegible]	0.0283
16	1	A016ENG FW	0.0[illegible]	0.0279	[illegible]	[illegible]	0.0366
17	1	A017ENG AF	0.0442	0.0238	-0.037[illegible]	14[illegible]	0.0442
18	1	A018ENG DE	0.0071	0.0053	0.00[illegible]	4[illegible]	0.00[illegible]
19	1	A019T B [illegible]	0.0190	-0.0188	0.00[illegible]	-8[illegible]	0.0193
20	1	A020ELEV C	0.1361	-0.1316	-0.0[illegible]	-10[illegible].8722	0.137[illegible]
21	1	A021TAIL [illegible]	0.1527	-0.1291	-0.0815	1[illegible] 2892	0.1539
22	1	A02290 BOX	0.0428	-0.0415	-0.0105	-10[illegible] 2023	0.0437
23	1	A02390 BOX	0.4083	0.4021	0.0742	79.5391	0.4096
24	1	A024T/R HU	0.0961	[illegible]	-0.0476	-119.70[illegible]	0.09[illegible]
25	1	A025T/R HU	0.2730	[illegible]	0.4030	67.8533	0.3090

02/24/86 0914

1 REV HARMONIC ANALYSIS

CYCLES ANALYZED [illegible] POINTS ANALYZED: 474 SAMPLE RATE: 512
1/REV FREQUENCY: [illegible] START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	98.11	-84.60	49.70	-59.57	98.34
2	1	A002NOSE	0.0155	0.0113	0.0106	46.9107	0.0156
3	1	A003GUNNER	[illegible]	-0.0014	-0.0015	-136.8601	0.0032
4	1	A004LT SKI	[illegible]	-0.0380	0.0246	-57.0530	0.0462
5	1	A005RT SKI	0.0316	-0.0163	-0.0271	-149.0087	0.0322
6	1	A006PILOT	0.0118	-0.0096	-0.0069	-125.4557	0.0122
7	1	A007C/G VT	0.0124	-0.0051	-0.0113	-155.6354	0.0142
8	1	A008SUSP V	0.0185	-0.0173	-0.0064	-110.2519	0.0198
9	1	A009SUSP L	0.0015	-0.0015	0.0001	-87.9046	0.0066
10	1	A010SUSP F	[illegible]	-0.0060	0.0050	-49.8330	0.0081
11	1	A011LT SKI	[illegible]	0.0041	-0.0200	168.4977	0.0249
12	1	A012RT SKI	[illegible]	0.0208	0.0323	32.8079	0.0396
13	1	A01342 BOX	0.0376	-0.0375	-0.0034	-95.1747	0.0379
14	1	A014RT WIN	0.0239	0.0140	0.0194	35.7828	0.0239
15	1	A015LT WIN	0.0225	-0.0225	-0.0005	-91.2920	0.0252
16	1	A016ENG FW	0.0668	-0.0537	0.0397	-53.5191	0.0672
17	1	A017ENG AF	0.0350	-0.0331	0.0114	-71.0514	0.0354
18	1	A018ENG DE	0.0328	-0.0312	0.0102	-71.9040	0.0332
19	1	A019T/B JU	0.0276	-0.0196	0.0195	-45.1506	0.0278
20	1	A020ELEV C	0.0242	0.0205	0.0128	57.9837	0.0247
21	1	A021TAIL S	0.0360	0.0237	-0.0272	138.9222	0.0401
22	1	A02290 BOX	0.0161	-0.0064	-0.0147	-156.5170	0.0169
23	1	A02390 BOX	0.0209	-0.0026	-0.0208	-172.9960	0.0213
24	1	A024T/R HU	0.0310	-0.0082	[illegible]	-15.3846	[illegible]
25	1	A025T/R HU	0.2138	-0.1022	[illegible]	[illegible]	[illegible]

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02/23/87 1615

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 35 POINTS ANALYZED: 498 SAMPLE RATE: 512

1 REV FREQUENCY: 25.70 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	95.80	-79.32	53.73	-55.89	96.43
2	1	A002NOSE V	0.0161	0.0095	0.0131	36.0176	0.0164
3	1	A003GUNNER	0.0027	-0.0024	-0.0013	-117.4965	0.0029
4	1	A004LT SKI	0.0578	-0.0340	0.0468	-36.0082	0.0566
5	1	A005RT SKI	0.0448	-0.0198	-0.0402	-153.7953	0.0454
6	1	A006PILOT	0.0123	-0.0094	-0.0079	-129.7271	0.0125
7	1	A007C G VT	0.0125	-0.0051	-0.0115	-156.2425	0.0166
8	1	A008SUSP V	0.0176	-0.0164	-0.0064	-111.3333	0.0176
9	1	A009SUSP L	0.0013	-0.0013	0.0001	-84.0693	0.0051
10	1	A010SUSP F	0.0123	-0.0097	0.0076	-51.6673	0.0154
11	1	A011LT SKI	0.0557	-0.0070	-0.0552	-172.7268	0.0681
12	1	A012RT SKI	0.0603	0.0245	0.0551	33.9382	0.0606
13	1	A01342 BOX	0.0405	-0.0403	-0.0039	-95.5058	0.0406
14	1	A014RT WIN	0.0238	0.0113	0.0210	28.3105	0.0243
15	1	A015LT WIN	0.0206	-0.0205	0.0019	-84.6180	0.0212
16	1	A016ENG FW	0.0668	-0.0482	0.0462	-46.2189	0.0677
17	1	A017ENG AF	0.0339	-0.0311	0.0136	-66.4572	0.0342
18	1	A018ENG DE	0.0315	-0.0292	0.0120	-67.5578	0.0320
19	1	A019T/B JU	0.0293	-0.0187	0.0225	-39.7398	0.0296
20	1	A020ELEV C	0.0243	0.0213	0.0118	60.8728	0.0249
21	1	A021TAIL S	0.0387	0.0254	-0.0293	139.0336	0.0396
22	1	A02290 BOX	0.0151	-0.0054	-0.0141	-159.1991	0.0154
23	1	A02390 BOX	0.0228	-0.0032	-0.0226	-171.9827	0.0227
24	1	A024T/R HU	0.0337	-0.0068	0.0330	-11.6890	0.0374
25	1	A025T/R HU	0.2347	-0.1199	0.2018	-30.7301	0.2399

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02/23/87 1551

1 REV HARMONIC ANALYSIS

CYCLES ANALYZED 22 POINTS ANALYZED 476 SAMPLE RATE 512.

1/REV FREQUENCY 23 66 START TIME 0.00

ROTOR AZIMUTH CORRECTION ANGLE 0.00 DEG

SN-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	96.18	-88.73	37.12	-67.30	96.80
2	1	A002NOSE U	0.0261	0.0084	0.0247	18.7510	0.0261
3	1	A003GUNNER	0.0071	-0.0036	0.0061	-30.6873	0.0053
4	1	A004LT SKI	0.0832	-0.0611	0.0564	-47.2938	0.0847
5	1	A005RT SKI	0.0793	0.0226	0.0761	16.5317	0.1439
6	1	A006PILOT	0.0119	-0.0107	-0.0052	-116.0599	0.0122
7	1	[illegible]	0.0101	-0.0086	-0.0053	-121.7453	0.0129
8	1	[illegible]	0.0186	-0.0185	-0.0019	-95.7242	0.0200
9	1	[illegible] L	0.0015	0.0003	-0.0015	170.5213	0.0029
10	1	[illegible] F	0.0144	0.0107	-0.0097	132.2135	0.0151
11	1	[illegible] SKI	0.0178	-0.0037	-0.0174	-168.1285	0.0050
12	1	[illegible] SKI	0.1393	-0.0555	0.1066	-156.3147	[illegible]
13	1	A01342 BOX	0.0814	-0.0768	-0.0269	-109.3017	0.0816
14	1	A014RT WIN	0.0242	0.0135	0.0201	33.7780	0.0247
15	1	A015LT WIN	0.0254	-0.0253	0.0022	-85.1124	0.0264
16	1	A016ENG FW	0.0457	-0.0430	0.0153	-70.4246	0.0467
17	1	A017ENG AF	0.0432	-0.0384	0.0198	-62.7164	0.0437
18	1	A018ENG DE	0.0387	-0.0350	0.0165	-64.8094	0.0386
19	1	A019T/B JU	0.0334	-0.0240	0.0232	-46.0245	0.0335
20	1	A020ELEV C	0.0384	0.0379	-0.0065	99.7584	0.0388
21	1	A021TAIL S	0.0715	0.0537	-0.0473	131.3463	0.0723
22	1	A02290 BOX	0.0148	-0.0036	-0.0143	-165.7280	0.0154
23	1	A02390 BOX	0.0210	0.0020	-0.0209	174.4345	0.0195
24	1	A024T/R HU	0.0440	-0.0277	0.0342	-38.9677	0.0436
25	1	A025T/R HU	0.3710	-0.3068	0.2086	-55.7811	0.3967

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02/26/86 1002

1/REV HARMONIC ANALYSIS

[illegible]LES ANALYZED [illegible] POINTS ANALYZED 483 SAMPLE RATE 512

[illegible] FREQUENCY [illegible] START TIME 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-PCS	LABEL	AMP	SIN	COS	PHASE	[illegible]
1	1 F001FORCE	[illegible] 34	35.22	-17.54	116.48	[illegible] 45
2	1 A002NOSE L	0.0264	-0.0207	0.0164	-51.5918	[illegible]
3	1 A003GUNNER	0.0066	-0.0063	-0.0020	-107.3290	0.0076
4	1 A004LT SKI	0.2396	-0.1947	-0.1398	-125.6851	0.2411
5	1 A005RT SKI	0.1854	-0.1478	-0.1119	-127.1297	0.1861
6	1 A006PILOT	0.0175	0.0086	-0.0152	150.3691	0.017[illegible]
7	1 A007C/G LA	0.0257	0.0211	-0.0147	124.8869	0.02[illegible]
8	1 A008LT ELE	0.0981	0.0888	-0.0416	115.1045	0.10[illegible]
9	1 A009RT ELE	0.0223	-0.0223	-0.0019	-94.8951	0.0[illegible]
10	1 A010SUSP L	0.0[illegible]	0.0105	0.0379	15.5[illegible]	[illegible]
11	1 A011LT SKI	[illegible]	0.0196	0.0103	62.5[illegible]	0.0[illegible]
12	1 A012RT SKI	0.04[illegible]	0.0012	0.0466	1.48[illegible]	[illegible]
13	1 A01342 BOX	0.0533	-0.0514	-0.0139	-105.1429	0.0542
14	1 A014RT WIN	0.0213	0.0213	-0.0019	95.1641	0.0220
15	1 A015LT WIN	0.0182	-0.0150	0.0103	-55.4856	0.0191
16	1 A016ENG FW	0.0159	-0.0019	-0.0158	-173.0254	0.0166
17	1 A017ENG AF	0.0334	-0.0324	0.0080	-76.1140	0.0340
18	1 A018ENG DE	0.0162	0.0161	-0.0005	91.8977	0.0164
19	1 A019T/B JU	0.0176	0.0005	0.0176	1.4914	0.0181
20	1 A020ELEV C	0.1149	-0.1062	0.0439	-67.5559	0.1150
21	1 A021TAIL S	0.1106	-0.1086	-0.0208	-100.8294	0.1128
22	1 A02290 BOX	0.0191	-0.0177	0.0072	-67.9648	0.0217
23	1 A02390 BOX	0.4713	0.4458	-0.1529	108.9313	0.4719
24	1 A024T/R HU	0.1477	-0.1476	-0.0069	-92.6665	0.1510
25	1 A025T/R HU	0.1225	-0.0758	-0.0961	-141.7340	0.1317

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02/26/86 1013

1 REV HARMONIC ANALYSIS

[illegible] ANALYZED 71 POINTS ANALYZED 485 SAMPLE RATE 512

[illegible] FREQUENCY 32.73 START TIME 0.00

[illegible] AZIMUTH CORRECTION ANGLE 0.00 DEG

SW-POS	LABEL	AMP	SIN	COS	PHASE	[illegible]
1	1 F001FORCE	39.32	26.30	-29.23	138.03	39.45
2	1 A002NOSE L	0.0589	0.0502	0.0309	58.3764	0.0594
3	1 A003GUNNER	0.0018	-0.0013	0.0012	-48.9865	0.0031
4	1 A004LT SKI	0.0493	-0.0155	-0.0468	-161.6709	0.0506
5	1 A005RT SKI	0.0494	-0.0295	-0.0396	-143.2721	0.0513
6	1 A006PILOT	0.0490	-0.0411	-0.0248	-121.1268	0.0486
7	1 A007C/G LA	0.0366	-0.0321	-0.0214	-123.7270	0.0393
8	1 A008LT ELE	0.1571	0.1500	-0.0468	107.3127	0.1607
9	1 A009RT ELE	0.1876	-0.1616	-0.0952	-120.5062	0.1527
10	1 A010SUSP L	0.0405	-0.0399	0.0069	-80.2214	[illegible]
11	1 A011LT SKI	[illegible]	-0.0328	0.0007	-88.7252	[illegible]
12	1 A012RT SKI	[illegible]	[illegible]	[illegible]	7.8837	[illegible]
13	1 A01342 BOX	0.1510	-0.1457	-0.0397	-105.2534	0.1517
14	1 A014RT WIN	0.0522	-0.0169	-0.0493	-161.0426	0.0530
15	1 A015LT WIN	0.0537	0.0166	0.0510	18.0002	0.0542
16	1 A016ENG FW	0.0171	-0.0161	0.0058	-70.3056	0.0176
17	1 A017ENG AF	0.0348	-0.0266	-0.0225	-130.2489	0.0352
18	1 A018ENG DE	0.0249	0.0248	-0.0021	94.7474	0.0252
19	1 A019T/B JU	0.0974	0.0846	0.0483	60.2913	0.0979
20	1 A020ELEV C	0.1009	-0.0165	0.0995	-9.3885	0.1014
21	1 A021TAIL S	0.3289	-0.3056	-0.1216	-111.6904	0.3305
22	1 A02290 BOX	0.0593	-0.0571	-0.0160	-105.6704	0.0608
23	1 A02390 BOX	0.4578	0.4195	-0.1833	113.6056	0.4580
24	1 A024T/R HU	0.4275	-0.3871	-0.1814	-115.1025	0.4294
25	1 A025T/R HU	0.1567	0.1470	0.0543	69.7157	0.1732

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02/27/86 1424

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 6 POINTS ANALYZED: 422 SAMPLE RATE: 512. START TIME: 0.00
1/REV FREQUENCY: 7.28
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	6.22	-5.65	2.60	-65.29	9.04
2	1	A002NOSE L	0.1959	-0.0841	-0.1769	-154.5787	0.2262
3	1	A003GUNNER	0.1085	-0.0467	-0.0979	-154.5057	0.1131
4	1	A004LT SKI	0.1249	-0.0429	-0.1173	-159.9316	0.2543
5	1	A005RT SKI	0.1184	-0.0410	-0.1111	-159.7544	0.2960
6	1	A006PILOT	0.0486	-0.0209	-0.0438	-154.5049	0.0679
7	1	A007C/G LA	0.0678	0.0235	0.0636	20.2608	0.1087
8	1	A008LT ELE	0.0814	-0.0407	-0.0705	-150.0037	0.1773
9	1	A009RT ELE	0.0795	0.0379	0.0698	28.5096	0.1788
10	1	A010SUSP L	0.0828	0.0259	0.0786	18.2344	0.3356
11	1	A011LT SKI	0.0565	0.0299	0.0480	31.8981	0.1356
12	1	A012RT SKI	0.0597	0.0322	0.0502	32.7129	0.2218
13	1	A01342 BOX	0.2213	-0.1186	-0.1868	-147.5880	0.2816
14	1	A014RT WIN	0.0486	-0.0099	-0.0476	-168.2141	0.1353
15	1	A015LT WIN	0.0649	0.0146	0.0632	13.0235	0.1495
16	1	A016ENG FW	0.1860	0.1036	0.1545	33.8522	0.2106
17	1	A017ENG AF	0.2162	0.1071	0.1878	29.6972	0.2584
18	1	A018ENG DE	0.1215	0.0466	0.1122	22.5339	0.1426
19	1	A019T/B JU	0.1346	0.0487	0.1255	21.2028	0.1607
20	1	A020ELEV C	0.0866	0.0227	0.0836	15.1880	0.1619
21	1	A021TAIL S	0.1694	-0.0943	-0.1407	-146.1524	0.2931
22	1	A02290 BOX	0.0851	0.0363	0.0770	25.2722	0.0997
23	1	A02390 BOX	1.1238	-0.5038	-1.0045	-153.3645	1.1219
24	1	A024T/R HU	0.1672	0.0719	0.1509	25.4743	0.2462
25	1	A025T/R HU	0.1869	-0.0421	-0.1821	-166.9965	0.3319

03/03/86 1022

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 453 SAMPLE RATE: 512.
1/REV FREQUENCY: 7.91 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	8.07	7.12	-3.79	118.04	8.48
2	1	A002NOSE V	0.3853	0.1721	0.3447	26.5311	0.3889
3	1	A003 GUNNE	0.1950	0.0871	0.1745	26.5300	0.1959
4	1	A004 LT SK	0.1485	0.0662	0.1329	26.4836	0.3986
5	1	A005 RT SK	0.0961	0.0411	0.0868	25.3351	0.2118
6	1	A006 PILOT	0.0566	0.0250	0.0508	26.1654	0.0594
7	1	A007 C/G V	0.1144	-0.0499	-0.1030	-154.1471	0.1185
8	1	A008 SUSP	0.1180	-0.0516	-0.1062	-154.0696	0.1202
9	1	A009 SUSP	0.0034	0.0023	0.0025	41.9245	0.0061
10	1	A010 SUSP	0.0215	0.0058	0.0207	15.5967	0.0227
11	1	A011LT SKI	0.1938	-0.0829	-0.1752	-154.6862	0.2118
12	1	A012 RT SK	0.2488	-0.1175	-0.2193	-151.8181	0.3085
13	1	A013 42 BO	0.4872	0.2330	0.4279	28.5648	0.5117
14	1	A014 RT WI	0.1612	-0.0718	-0.1444	-153.5416	0.1693
15	1	A015 LT WI	0.1145	-0.0496	-0.1032	-154.3571	0.1243
16	1	A016 ENG F	0.1815	-0.0807	-0.1626	-153.5985	0.1878
17	1	A017 ENG A	0.2161	-0.0925	-0.1952	-154.6515	0.2189
18	1	A018ENG DE	0.2128	-0.0915	-0.1922	-154.5474	0.2164
19	1	A019 T/B J	0.2164	-0.0881	-0.1976	-155.9772	0.2218
20	1	A020 ELEV	0.0348	0.0252	0.0239	46.4471	0.0564
21	1	A021 TAIL	0.6504	0.3034	0.5753	27.8044	0.6712
22	1	A02290 BOX	1.1131	0.5083	0.9903	27.1710	1.1160
23	1	A023 90 BO	0.0435	0.0179	0.0397	24.2291	0.0769
24	1	A024 T/R H	1.1867	0.5463	1.0535	27.4113	1.2604
25	1	A025 T/R H	0.8906	0.2810	0.8451	18.3913	1.0002

03/03/86 1026

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 13 POINTS ANALYZED: 461 SAMPLE RATE: 512

1/REV FREQUENCY: 14.44 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	28.25	-19.66	-20.28	-135.88	28.38
2	1	A002NOSE V	0.0198	0.0107	0.0167	32.5847	0.0274
3	1	A003 GUNNE	0.0174	-0.0119	0.0127	-43.1026	0.0205
4	1	A004 LT SK	0.3154	-0.3057	0.0774	-75.7874	0.3070
5	1	A005 RT SK	0.3187	0.2348	-0.2156	132.5657	0.3202
6	1	A006 PILOT	0.0205	-0.0193	0.0070	-69.9295	0.0264
7	1	A007 C/G V	0.0205	-0.0205	0.0014	-86.2038	0.0283
8	1	A008 SUSP	0.0166	-0.0166	0.0001	-89.7688	0.0239
9	1	A009 SUSP	0.0003	-0.0000	-0.0003	-177.9677	0.0115
10	1	A010 SUSP	0.0009	0.0009	-0.0001	97.9752	0.0032
11	1	A011LT SKI	0.0752	-0.0746	0.0092	-82.9800	0.0865
12	1	A012 RT SK	0.0386	0.0242	-0.0301	141.2265	0.0638
13	1	A013 42 BO	0.0508	0.0350	-0.0368	136.4564	0.0550
14	1	A014 RT WI	0.0212	0.0137	-0.0162	139.9308	0.0393
15	1	A015 LT WI	0.0500	-0.0479	0.0146	-73.0396	0.0606
16	1	A016 ENG F	0.0434	-0.0342	0.0266	-52.0952	0.0547
17	1	A017 ENG A	0.0104	-0.0079	-0.0068	-130.6792	0.0193
18	1	A018ENG DE	0.0149	-0.0148	0.0008	-86.8939	0.0164
19	1	A019 T/B J	0.0092	0.0078	-0.0049	122.1391	0.0181
20	1	A020 ELEV	0.0466	0.0454	-0.0104	102.8596	0.0501
21	1	A021 TAIL	0.0768	0.0417	-0.0645	147.1500	0.0806
22	1	A02290 BOX	0.2031	-0.1634	-0.1207	-126.4583	0.2030
23	1	A023 90 BO	0.2777	0.2665	-0.0780	106.3116	0.2789
24	1	A024 T/R H	0.3661	-0.3480	-0.1135	-108.0596	0.3701
25	1	A025 T/R H	0.3542	-0.1709	-0.3102	-151.1580	0.3596

02/27/86 1451

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 14 POINTS ANALYZED: 484 SAMPLE RATE: 512
1/REV FREQUENCY: 14.81 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	18.92	9.99	16.06	31.89	19.00
2	1	A002NOSE L	0.0918	0.0891	-0.0219	103.7879	0.0989
3	1	A003GUNNER	0.0289	0.0288	-0.0029	95.7112	0.0310
4	1	A004LT SKI	0.7567	-0.6542	0.3803	-59.8291	0.7819
5	1	A005RT SKI	0.2394	0.0434	0.2354	10.4376	0.2770
6	1	A006PILOT	0.0150	-0.0128	0.0078	-58.6450	0.0375
7	1	A007C/G LA	0.0345	-0.0345	-0.0003	-90.5488	0.0520
8	1	A008LT ELE	0.1391	-0.1066	0.0893	-50.0388	0.2000
9	1	A009RT ELE	0.0500	0.0383	-0.0321	129.9747	0.1326
10	1	A010SUSP L	0.0251	-0.0227	-0.0109	-115.6648	0.2345
11	1	A011LT SKI	0.1838	-0.1729	0.0624	-70.1434	0.2023
12	1	A012RT SKI	0.0633	-0.0491	0.0400	-50.8606	0.0965
13	1	A01342 BOX	0.3842	0.3671	-0.1134	107.1613	0.3996
14	1	A014RT WIN	0.0270	-0.0162	0.0216	-36.8735	0.0779
15	1	A015LT WIN	0.0482	0.0335	-0.0347	136.0475	0.0914
16	1	A016ENG FW	0.1358	-0.0819	0.1083	-37.1006	0.1373
17	1	A017ENG AF	0.1189	-0.0801	0.0879	-42.3518	0.1390
18	1	A018ENG DE	0.0449	-0.0448	0.0030	-86.1437	0.0606
19	1	A019T/B JU	0.0225	-0.0069	-0.0214	-162.0914	0.0574
20	1	A020ELEV C	0.3634	0.3189	-0.1742	118.6463	0.3732
21	1	A021TAIL S	0.5641	0.5292	-0.1952	110.2514	0.5796
22	1	A02290 BOX	0.0853	0.0699	-0.0489	124.9789	0.0916
23	1	A02390 BOX	0.4462	-0.2325	0.3808	-31.3984	0.4499
24	1	A024T/R HU	0.2559	0.2157	-0.1377	122.5581	0.2660
25	1	A025T/R HU	0.0681	-0.0484	0.0479	-45.3372	0.1575

03/03/86 1031

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 15 POINTS ANALYZED: 475 SAMPLE RATE: 512.
1/REV FREQUENCY: 16.17 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001 FORCE	28.47	-24.30	-14.83	-121.40	28.70
2	1 A002NOSE V	0.1590	0.0939	-0.1283	143.8057	0.1627
3	1 A003 GUNNE	0.0462	0.0314	-0.0340	137.2632	0.0476
4	1 A004 LT SK	0.4412	0.4154	-0.1487	109.6923	0.4807
5	1 A005 RT SK	0.1981	-0.1114	-0.1638	-145.7909	0.2235
6	1 A006 PILOT	0.0301	-0.0132	0.0270	-25.9841	0.0322
7	1 A007 C/G V	0.0601	-0.0344	0.0492	-34.9522	0.0647
8	1 A008 SUSP	0.0547	-0.0299	0.0457	-33.1906	0.0552
9	1 A009 SUSP	0.0016	-0.0013	0.0010	-51.9769	0.0037
10	1 A010 SUSP	0.0053	0.0033	-0.0041	141.0061	0.0071
11	1 A011LT SKI	0.0461	-0.0159	0.0433	-20.1506	0.0616
12	1 A012 RT SK	0.0605	-0.0416	0.0440	-43.3773	0.0835
13	1 A013 42 BO	0.2050	0.0925	-0.1830	153.1855	0.2135
14	1 A014 RT WI	0.0621	-0.0326	0.0528	-31.7159	0.0684
15	1 A015 LT WI	0.0698	-0.0437	0.0545	-38.7295	0.0686
16	1 A016 ENG F	0.0835	-0.0285	0.0785	-19.9575	0.0874
17	1 A017 ENG A	0.0246	-0.0188	0.0158	-49.9434	0.0318
18	1 A018ENG DE	0.0246	-0.0161	0.0186	-40.9651	0.0283
19	1 A019 T/B J	0.0623	0.0256	-0.0568	155.7307	0.0728
20	1 A020 ELEV	0.2267	0.1226	-0.1907	147.2652	0.2504
21	1 A021 TAIL	0.1288	0.0176	-0.1276	172.1549	0.1473
22	1 A02290 BOX	0.1959	-0.1953	0.0160	-85.3234	0.2059
23	1 A023 90 BO	0.0653	-0.0640	-0.0125	-101.0667	0.0681
24	1 A024 T/R H	0.2443	-0.2369	0.0596	-75.8830	0.2631
25	1 A025 T/R H	0.7786	-0.7336	0.2610	-70.4149	0.7807

02/27/86 1458

1 REV HARMONIC ANALYSIS

CYCLES ANALYZED 16 POINTS ANALYZED: 476 SAMPLE RATE: 512

1 REV FREQUENCY 17.21 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

NUM	POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	19.80	14.58	13.40	47.41	20.10
2	1	A002NOSE L	0.0299	0.0051	-0.0294	170.1300	0.0318
3	1	A003GUNNER	0.0180	-0.0116	0.0137	-40.2407	0.0180
4	1	A004LT SKI	2.0657	1.3556	-1.5586	138.9845	2.0760
5	1	A005RT SKI	1.5711	1.0850	-1.1362	136.3198	1.5938
6	1	A006PILOT	0.0502	-0.0264	0.0427	-31.7389	0.0508
7	1	A007C/G LA	0.0448	-0.0236	0.0382	-31.7051	0.2360
8	1	A008LT ELE	0.0790	0.0662	0.0431	56.8879	0.1150
9	1	A009RT ELE	0.0203	-0.0203	0.0002	-89.3457	0.0630
10	1	A010SWEP L	0.3734	-0.3727	-0.0224	-93.4436	0.3576
11	1	A011LT SKI	0.0768	0.0478	-0.0601	141.4939	0.0845
12	1	A012RT SKI	0.2140	-0.1028	0.1877	-28.7042	0.2191
13	1	A01342 BOX	0.2583	0.1538	-0.2074	143.4446	0.2584
14	1	A014RT WIN	0.1282	-0.0916	0.0898	-45.5582	0.1282
15	1	A015LT WIN	0.1314	0.0812	-0.1033	141.8234	0.1358
16	1	A016ENG FW	0.0520	0.0518	-0.0047	95.1635	0.0552
17	1	A017ENG AF	0.0603	0.0579	-0.0170	106.3383	0.0620
18	1	A018ENG DE	0.0429	-0.0229	0.0363	-32.2701	0.0432
19	1	A019T/B JU	0.0283	-0.0237	0.0155	-56.8262	0.0298
20	1	A020ELEV C	0.1985	0.0505	-0.1920	165.2551	0.1983
21	1	A021TAIL S	0.3595	0.1807	-0.3108	149.8322	0.3613
22	1	A02290 BOX	0.0485	-0.0059	-0.0481	-172.9566	0.0503
23	1	A02390 BOX	0.3838	0.0685	0.3777	10.2869	0.3840
24	1	A024T/R HU	0.1676	0.0204	-0.1664	173.0063	0.1766
25	1	A025T/R HU	0.1204	-0.0922	0.0774	-49.9960	0.1451

02/27/86 1507

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 19 POINTS ANALYZED: 487 SAMPLE RATE: 512
START TIME: 0.00
1/REV FREQUENCY: 19.98
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001FORCE	29.64	27.23	11.70	66.75	29.82
2	1 A002NOSE L	0.0657	-0.0065	-0.0654	-174.3649	0.0674
3	1 A003GUNNER	0.0351	0.0137	-0.0324	157.1007	0.0362
4	1 A004LT SKI	0.1340	-0.0211	-0.1324	-170.9597	0.2733
5	1 A005RT SKI	0.1674	0.0193	-0.1663	173.3731	0.1898
6	1 A006PILOT	0.0224	0.0222	0.0031	81.9379	0.0234
7	1 A007C G LH	0.0294	0.0103	0.0275	20.5544	0.0325
8	1 A008LT ELE	0.0885	0.0793	0.0393	63.6292	0.0872
9	1 A009RT ELE	0.0599	-0.0515	-0.0305	-120.6101	0.0703
10	1 A010SUSP L	0.0538	-0.0537	0.0018	-88.0516	0.0586
11	1 A011LT SKI	0.2025	-0.0654	0.1917	-18.8304	0.2113
12	1 A012RT SKI	0.2736	-0.1073	0.2516	-23.0920	0.2777
13	1 A01342 BOX	0.1884	0.0260	-0.1866	172.0801	0.1908
14	1 A014RT WIN	0.0465	-0.0205	0.0418	-26.1651	0.0506
15	1 A015LT WIN	0.0398	0.0103	-0.0385	165.0427	0.0437
16	1 A016ENG FW	0.0775	0.0354	-0.0689	152.8342	0.0755
17	1 A017ENG AF	0.0872	0.0275	-0.0827	161.6409	0.0867
18	1 A018ENG DE	0.0225	-0.0045	0.0221	-11.5630	0.0242
19	1 A019T/B JU	0.0315	-0.0242	0.0203	-49.9859	0.0330
20	1 A020ELEV C	0.1698	-0.0794	-0.1501	-152.1098	0.1724
21	1 A021TAIL S	0.2884	-0.0075	-0.2883	-178.5065	0.2938
22	1 A02290 BOX	0.0425	-0.0201	-0.0375	-151.8653	0.0445
23	1 A02390 BOX	0.4320	0.3217	0.2883	48.1315	0.4338
24	1 A024T/R HU	0.1533	-0.0521	-0.1442	-160.1438	0.1612
25	1 A025T/R HU	0.1454	0.0438	0.1387	17.5189	0.1861

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03/03/86 1058

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 21 POINTS ANALYZED: 477 SAMPLE RATE: 512.

1/REV FREQUENCY: 22.54 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	28.44	-27.49	7.29	-75.15	28.70
2	1	A002NOSE V	0.0902	-0.0163	0.0887	-10.4342	0.0957
3	1	A003 GUNNE	0.0119	0.0045	0.0110	22.2034	0.0142
4	1	A004 LT SK	0.3437	-0.0269	0.3426	-4.4901	0.3679
5	1	A005 RT SK	0.2798	-0.0597	0.2734	-12.3181	0.3056
6	1	A006 PILOT	0.0325	0.0146	-0.0290	153.2828	0.0352
7	1	A007 C/G V	0.0223	0.0212	-0.0069	108.0222	0.0256
8	1	A008 SUSP	0.0246	0.0246	-0.0009	92.1690	0.0286
9	1	A009 SUSP	0.0033	0.0031	0.0011	69.7957	0.0059
10	1	A010 SUSP	0.0504	-0.0493	-0.0105	-102.0264	0.0518
11	1	A011LT SKI	0.3855	0.0441	-0.3830	173.4306	0.3928
12	1	A012 RT SK	0.4462	0.1035	-0.4341	166.5844	0.4499
13	1	A013 42 BO	0.2671	-0.0818	-0.2543	-162.1769	0.3024
14	1	A014 RT WI	0.0473	0.0427	0.0203	64.6277	0.0528
15	1	A015 LT WI	0.0215	0.0111	-0.0184	148.8822	0.0303
16	1	A016 ENG F	0.0523	-0.0444	-0.0276	-121.8264	0.0579
17	1	A017 ENG A	0.0504	0.0114	0.0490	13.0581	0.0552
18	1	A018ENG DE	0.0420	0.0089	0.0410	12.2561	0.0440
19	1	A019 T/B J	0.0616	-0.0252	0.0562	-24.1387	0.0681
20	1	A020 ELEV	0.1170	-0.0847	-0.0808	-133.6791	0.1365
21	1	A021 TAIL	0.2468	-0.0721	-0.2361	-163.0155	0.2653
22	1	A02290 BOX	0.1279	-0.1201	-0.0441	-110.1691	0.1414
23	1	A023 90 BO	0.0408	-0.0124	-0.0389	-162.3557	0.0576
24	1	A024 T/R H	0.1702	-0.1476	0.0849	-60.0949	0.1942
25	1	A025 T/R H	0.8229	-0.2178	0.7936	-15.3447	0.9587

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03/03/86 1100

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 21 POINTS ANALYZED: 469 SAMPLE RATE: 512.
1/REV FREQUENCY: 22.93 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	28.48	-27.78	6.29	-77.25	28.82
2	1	A002NOSE V	0.0783	0.0005	0.0783	0.3851	0.0845
3	1	A003 GUNNE	0.0086	0.0070	0.0050	54.4197	0.0107
4	1	A004 LT SK	0.2788	0.0214	0.2780	4.3922	0.3239
5	1	A005 RT SK	0.2725	-0.0105	0.2723	-2.2038	0.2990
6	1	A006 PILOT	0.0317	0.0095	-0.0303	162.4865	0.0347
7	1	A007 C/G V	0.0236	0.0218	-0.0090	112.4094	0.0318
8	1	A008 SUSP	0.0304	0.0299	-0.0055	100.3979	0.0357
9	1	A009 SUSP	0.0063	0.0062	0.0006	84.6116	0.0088
10	1	A010 SUSP	0.0235	-0.0105	0.0211	-26.5134	0.0247
11	1	A011LT SKI	0.3221	-0.0124	-0.3219	-177.7960	0.3319
12	1	A012 RT SK	0.4337	0.0395	-0.4319	174.7727	0.4411
13	1	A013 42 BO	0.3009	-0.1345	-0.2691	-153.4393	0.3398
14	1	A014 RT WI	0.0530	0.0529	0.0031	86.6648	0.0618
15	1	A015 LT WI	0.0140	0.0062	-0.0125	153.6325	0.0254
16	1	A016 ENG F	0.0461	-0.0432	-0.0159	-110.1877	0.0540
17	1	A017 ENG A	0.0476	0.0219	0.0423	27.3507	0.0525
18	1	A018ENG DE	0.0389	0.0160	0.0354	24.3636	0.0415
19	1	A019 T/B J	0.0563	-0.0168	0.0538	-17.3736	0.0633
20	1	A020 ELEV	0.1322	-0.1030	-0.0830	-128.8747	0.1575
21	1	A021 TAIL	0.2802	-0.1201	-0.2532	-154.6232	0.3012
22	1	A02290 BOX	0.1499	-0.1391	-0.0560	-111.9227	0.1656
23	1	A023 90 BO	0.0495	-0.0183	-0.0459	-158.2501	0.0669
24	1	A024 T/R H	0.1680	-0.1483	0.0788	-62.0294	0.2000
25	1	A025 T/R H	0.8475	-0.0633	0.8451	-4.2859	0.9392

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OF POOR QUALITY

03/04/86 1007

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 24 POINTS ANALYZED: 492 SAMPLE RATE: 512.
1/REV FREQUENCY: 24.98 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	145.10	-129.19	66.07	-62.92	145.60
2	1	A002NOSE V	0.0176	0.0163	0.0068	67.3399	0.0208
3	1	A003 GUNNE	0.0136	-0.0116	-0.0071	-121.3904	0.0164
4	1	A004 LT SK	0.1634	0.0427	0.1577	15.1525	0.1817
5	1	A005 RT SK	0.1856	-0.0930	-0.1607	-149.9456	0.2059
6	1	A006 PILOT	0.0208	-0.0177	-0.0109	-121.6950	0.0220
7	1	A007 C/G V	0.0184	-0.0050	-0.0177	-164.2875	0.0276
8	1	A008 SUSP	0.0344	-0.0271	-0.0213	-128.2222	0.0366
9	1	A009 SUSP	0.0113	-0.0041	-0.0105	-158.8622	0.0127
10	1	A010 SUSP	0.0132	-0.0127	0.0039	-72.9502	0.0142
11	1	A011LT SKI	0.1701	-0.0708	-0.1547	-155.4154	0.1773
12	1	A012 RT SK	0.2411	0.1077	0.2157	26.5207	0.2499
13	1	A013 42 BO	0.1023	0.0686	-0.0758	137.8549	0.1150
14	1	A014 RT WI	0.0773	-0.0550	-0.0543	-134.6003	0.0828
15	1	A015 LT WI	0.0279	-0.0106	0.0258	-22.2445	0.0344
16	1	A016 ENG F	0.0904	-0.0623	0.0655	-43.5879	0.0943
17	1	A017 ENG A	0.0672	-0.0619	0.0261	-67.1010	0.0699
18	1	A018ENG DE	0.0565	-0.0526	0.0206	-68.5958	0.0591
19	1	A019 T/B J	0.0651	-0.0434	0.0485	-41.8376	0.0708
20	1	A020 ELEV	0.0315	0.0289	0.0123	66.9248	0.0481
21	1	A021 TAIL	0.1067	0.0542	-0.0920	149.4834	0.1165
22	1	A02290 BOX	0.0391	0.0028	-0.0390	175.8521	0.0469
23	1	A023 90 BO	0.0458	-0.0018	-0.0458	-177.7735	0.0545
24	1	A024 T/R H	0.0481	0.0053	0.0478	6.3258	0.0733
25	1	A025 T/R H	0.5113	-0.3381	0.3835	-41.3960	0.5664

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OF POOR QUALITY

03/03/86 1122

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 30 POINTS ANALYZED: 487 SAMPLE RATE: 512.
1/REV FREQUENCY: 31.54 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	37.58	-14.86	34.52	-23.29	37.96
2	1	A002NOSE V	0.0228	0.0227	0.0017	85.6329	0.0335
3	1	A003 GUNNE	0.0023	0.0018	0.0015	50.5018	0.0049
4	1	A004 LT SK	0.0262	0.0232	-0.0122	117.7263	0.0967
5	1	A005 RT SK	0.0807	-0.0767	0.0249	-72.0493	0.1356
6	1	A006 PILOT	0.0150	-0.0149	-0.0013	-94.8610	0.0178
7	1	A007 C/G V	0.0084	-0.0072	-0.0043	-121.1865	0.0161
8	1	A008 SUSP	0.0066	-0.0027	-0.0060	-155.9720	0.0100
9	1	A009 SUSP	0.0086	-0.0008	-0.0085	-174.6515	0.0095
10	1	A010 SUSP	0.0028	0.0021	-0.0019	131.0884	0.0046
11	1	A011LT SKI	0.0342	0.0275	0.0202	53.7150	0.0784
12	1	A012 RT SK	0.0296	-0.0232	-0.0185	-128.6126	0.1033
13	1	A013 42 BO	0.1527	-0.1400	0.0610	-66.4737	0.1788
14	1	A014 RT WI	0.0412	0.0379	0.0160	67.0579	0.0469
15	1	A015 LT WI	0.0476	-0.0427	-0.0209	-116.0881	0.0520
16	1	A016 ENG F	0.0290	-0.0194	0.0216	-41.9533	0.0342
17	1	A017 ENG A	0.0250	0.0235	-0.0085	109.7753	0.0310
18	1	A018ENG DE	0.0102	0.0095	-0.0039	112.6186	0.0151
19	1	A019 T/B J	0.0088	-0.0040	0.0078	-27.4310	0.0234
20	1	A020 ELEV	0.0819	-0.0803	0.0161	-78.6592	0.0937
21	1	A021 TAIL	0.1567	-0.1339	0.0814	-58.7093	0.1737
22	1	A02290 BOX	0.2507	-0.0770	0.2385	-17.8899	0.2587
23	1	A023 90 BO	0.0622	-0.0522	0.0337	-57.1546	0.0691
24	1	A024 T/R H	0.4240	0.0178	0.4236	2.4087	0.4389
25	1	A025 T/R H	0.7493	0.4831	-0.5727	139.8488	0.8043

03/03/86 1127

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 33 POINTS ANALYZED: 487 SAMPLE RATE: 512.
1/REV FREQUENCY: 34.69 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	37.48	-10.59	35.95	-16.42	37.69
2	1	A002NOSE V	0.0128	0.0085	0.0096	41.5653	0.0195
3	1	A003 GUNNE	0.0069	-0.0043	0.0055	-38.1242	0.0095
4	1	A004 LT SK	0.0214	-0.0084	-0.0197	-156.9049	0.0381
5	1	A005 RT SK	0.1312	-0.0481	0.1220	-21.5018	0.1466
6	1	A006 PILOT	0.0168	-0.0167	-0.0017	-95.8357	0.0188
7	1	A007 C/G V	0.0096	-0.0036	-0.0089	-157.8383	0.0188
8	1	A008 SUSP	0.0131	0.0024	-0.0129	169.4066	0.0159
9	1	A009 SUSP	0.0028	-0.0027	-0.0006	-103.2682	0.0039
10	1	A010 SUSP	0.0051	0.0024	-0.0045	152.1178	0.0056
11	1	A011LT SKI	0.0294	0.0287	-0.0067	103.1898	0.0418
12	1	A012 RT SK	0.0212	-0.0129	-0.0169	-142.7737	0.0381
13	1	A013 42 BO	0.2692	-0.2556	0.0846	-71.6788	0.2758
14	1	A014 RT WI	0.0591	0.0513	-0.0295	119.9017	0.0625
15	1	A015 LT WI	0.0392	-0.0392	0.0014	-87.9099	0.0430
16	1	A016 ENG F	0.0811	0.0758	0.0289	69.1506	0.0848
17	1	A017 ENG A	0.0296	0.0115	-0.0273	157.2224	0.0315
18	1	A018ENG DE	0.0132	0.0085	-0.0101	140.0336	0.0147
19	1	A019 T/B J	0.0381	-0.0061	0.0376	-9.2498	0.0423
20	1	A020 ELEV	0.2192	-0.2028	0.0831	-67.7160	0.2303
21	1	A021 TAIL	0.1870	-0.1811	0.0466	-75.5621	0.1920
22	1	A02290 BOX	0.2426	-0.0044	0.2426	-1.0397	0.2506
23	1	A023 90 BO	0.0355	-0.0166	-0.0314	-152.1752	0.0405
24	1	A024 T/R H	0.7506	0.2189	0.7180	16.9569	0.7643
25	1	A025 T/R H	0.5507	-0.0227	-0.5503	-177.6361	0.6124

03/10/87 1045

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 478 SAMPLE RATE 512
1/REV FREQUENCY: 7.50 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	6.39	-5.61	3.05	-61.44	10.89
2	1	A002NOSE L	0.1845	-0.0951	-0.1580	-148.9553	0.2147
3	1	A003GUNNER	0.1033	-0.0532	-0.0885	-148.9734	0.1060
~~4~~	~~1~~	~~A004LT SKI~~	~~0.0000~~	~~0.0000~~	-0.0000	168.7998	0.0007
~~5~~	~~1~~	~~A005RT SKI~~	~~0.0000~~	~~0.0000~~	-0.0000	136.1094	0.0007
6	1	A006PILOT	0.0458	-0.0234	-0.0393	-149.2141	0.0674
7	1	A007C/G LA	0.0507	0.0192	0.0469	22.3120	0.0747
8	1	A008LT ELE	0.0826	-0.0508	-0.0652	-142.0510	0.2887
9	1	A009RT ELE	0.0784	0.0474	0.0625	37.2202	0.3078
10	1	A010SUSP L	0.0709	0.0211	0.0677	17.2938	0.1993
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0000~~	~~0.0000~~	-0.0000	92.7452	0.0007
~~12~~	~~1~~	~~A012RT SKI~~	~~0.0000~~	~~0.0000~~	-0.0000	92.2863	0.0005
13	1	A01342 BOX	0.2324	-0.1501	-0.1774	-139.7540	0.3051
14	1	A014RT WIN	0.0441	-0.0034	-0.0439	-175.6226	0.1292
15	1	A015LT WIN	0.0548	0.0082	0.0542	8.6564	0.1302
16	1	A016ENG FW	0.1875	0.1285	0.1366	43.2645	0.2255
17	1	A017ENG AF	0.2103	0.1293	0.1658	37.9549	0.2640
18	1	A018ENG DE	0.1073	0.0486	0.0957	26.9429	0.1356
19	1	A019T/B JU	0.1166	0.0503	0.1052	25.5472	0.1461
20	1	A020ELEV C	0.0680	0.0172	0.0658	14.6836	0.1759
21	1	A021TAIL S	0.1838	-0.1219	-0.1376	-138.4577	0.2960
22	1	A02290 BOX	0.0859	0.0434	0.0741	30.3808	0.1063
23	1	A02390 BOX	1.0905	-0.5972	-0.9125	-146.7980	1.0772
24	1	A024T/R HU	0.1854	0.0969	0.1581	31.5019	0.3026
25	1	A025T/R HU	0.0158	-0.0122	-0.0100	-129.5000	0.0594

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03/05/86 1323

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 447 SAMPLE RATE: 512.
1/REV FREQUENCY: 8.02 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001 FORCE	47.69	33.46	-33.98	135.44	47.78
2	1 A002NOSE V	0.4719	-0.3418	-0.3254	-133.5953	0.4722
3	1 A003 GUNNE	0.2385	-0.1703	-0.1670	-134.4306	0.2396
~~4~~	~~1 A004 LT SK~~	0.0000	0.0000	-0.0000	116.6907	0.0007
~~5~~	~~1 A005 RT SK~~	0.0002	0.0000	-0.0002	165.5802	0.0015
6	1 A006 PILOT	0.0719	-0.0467	-0.0547	-139.5214	0.0738
7	1 A007 C/G V	0.1363	0.1052	0.0867	50.5015	0.1385
8	1 A008 SUSP	0.1416	0.1095	0.0898	50.6678	0.1436
9	1 A009 SUSP	0.0039	-0.0032	-0.0022	-124.6762	0.0098
10	1 A010 SUSP	0.0229	-0.0138	-0.0182	-142.8873	0.0259
~~11~~	~~1 A011LT SKI~~	0.0002	0.0001	-0.0002	148.3806	0.0015
~~12~~	~~1 A012 RT SK~~	0.0002	-0.0002	-0.0001	-123.9699	0.0015
13	1 A013 42 BO	0.6147	-0.4433	-0.4259	-133.8536	0.6277
14	1 A014 RT WI	0.2022	0.1562	0.1284	50.5776	0.2018
15	1 A015 LT WI	0.1278	0.0995	0.0803	51.0826	0.1448
16	1 A016 ENG F	0.2178	0.1680	0.1387	50.4463	0.2237
17	1 A017 ENG A	0.2590	0.1969	0.1683	49.4752	0.2606
18	1 A018ENG DE	0.2553	0.1941	0.1658	49.4940	0.2596
19	1 A019 T/B J	0.2560	0.1927	0.1686	48.8256	0.2611
20	1 A020 ELEV	0.0531	-0.0302	-0.0437	-145.3538	0.0664
21	1 A021 TAIL	0.8172	-0.5896	-0.5659	-133.8228	0.8361
22	1 A02290 BON	1.3924	-1.0084	-0.9603	-133.6000	1.3864
23	1 A023 90 BO	0.0624	-0.0376	-0.0499	-142.9731	0.1014
24	1 A024 T/R H	1.5011	-1.0912	-1.0308	-133.3701	1.5051
25	1 A025 T/R H	1.3900	-0.8268	-1.1173	-142.4995	1.4515

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03/10/87 1111

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 13 POINTS ANALYZED: 452 SAMPLE RATE: 512
1/REV FREQUENCY: 14.73 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	38.64	21.47	32.13	33.76	38.57
2	1	A002NOSE L	0.1110	0.0862	0.0699	50.9572	0.1175
3	1	A003GUNNER	0.0389	0.0224	0.0318	35.1213	0.0391
~~4~~	~~1~~	~~A004LT SKI~~	~~0.0000~~	-0.0000	-0.0000	-138.2503	0.0007
~~5~~	~~1~~	~~A005RT SKI~~	~~0.0000~~	-0.0000	-0.0000	-123.9944	0.0007
6	1	A006PILOT	0.0226	-0.0225	-0.0002	-90.4075	0.0364
7	1	A007C/G LA	0.0572	-0.0325	-0.0471	-145.3379	0.0723
8	1	A008LT ELE	0.0757	-0.0649	0.0390	-59.0307	0.4001
9	1	A009RT ELE	0.0208	0.0203	-0.0044	102.1805	0.2169
10	1	A010SUSP L	0.0264	-0.0005	-0.0264	-178.9067	[illegible]
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0001~~	-0.0001	-0.0000	-106.7541	0.0005
~~12~~	~~1~~	~~A012RT SKI~~	~~[illegible]~~	-0.0000	-0.0000	-115.1504	[illegible]
13	1	A01342 BOX	0.4507	0.4225	0.1572	69.5929	0.4453
14	1	A014RT WIN	0.0751	-0.0610	0.0439	-54.2477	0.1414
15	1	A015LT WIN	0.0907	0.0762	-0.0492	122.8488	0.1466
16	1	A016ENG FW	0.1369	-0.0801	0.1110	-35.7990	0.1397
17	1	A017ENG AF	0.1317	-0.0957	0.0904	-46.6366	0.1661
18	1	A018ENG DE	0.0694	-0.0467	-0.0514	-137.7534	0.0794
19	1	A019T/B JU	0.0542	-0.0097	-0.0533	-169.7010	0.0723
20	1	A020ELEV C	0.3274	0.3266	0.0215	86.2407	0.3563
21	1	A021TAIL S	0.5977	0.5699	0.1802	72.4569	0.6016
22	1	A02290 BOX	0.0574	0.0501	-0.0280	119.2302	0.0635
23	1	A02390 BOX	0.4006	-0.1186	0.3827	-17.2115	0.4111
24	1	A024T/R HU	0.2011	[illegible]	-0.0312	98.9197	0.2631
25	1	A025T/R HU	0.0582	[illegible]	0.0524	-25.6692	0.2198

03/05/86 1345

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 15 POINTS ANALYZED: 477 SAMPLE RATE 512
1/REV FREQUENCY: 16.10 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	97.81	-85.74	-47.08	-118.77	98.93
2	1	A002NOSE V	0.2606	-0.1309	0.2253	-30.1512	0.2645
3	1	A003 GUNNE	0.0832	-0.0484	0.0677	-35.5496	0.0828
~~4~~	~~1~~	~~A004 LT SK~~	~~0.0000~~	0.0000	-0.0000	93.5102	0.0000
~~5~~	~~1~~	~~A005 RT SK~~	~~0.0003~~	-0.0003	-0.0001	-112.1139	0.0015
6	1	A006 PILOT	0.0390	0.0058	-0.0385	171.4892	0.0420
7	1	A007 C/G V	0.0837	0.0281	-0.0788	160.3420	0.0835
8	1	A008 SUSP	0.0883	-0.0021	-0.0883	-178.6580	0.0931
9	1	A009 SUSP	0.0111	-0.0108	-0.0027	-104.1911	0.0191
10	1	A010 SUSP	0.0084	-0.0033	0.0078	-22.9014	0.0110
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0002~~	-0.0002	-0.0000	-97.3628	0.0015
~~12~~	~~1~~	~~A012 RT SK~~	~~0.0000~~	-0.0000	-0.0000	-117.9921	0.0015
13	1	A013 42 BO	0.2836	-0.1400	0.2467	-29.5670	0.2904
14	1	A014 RT WI	0.1182	0.0481	-0.1080	155.9876	0.1329
15	1	A015 LT WI	0.0763	0.0064	-0.0760	175.1908	0.0848
16	1	A016 ENG F	0.1723	-0.0204	-0.1711	-173.2020	0.1861
17	1	A017 ENG A	0.0408	-0.0110	-0.0393	-164.3914	0.0498
18	1	A018ENG DE	0.0421	-0.0128	-0.0400	-162.2141	0.0479
19	1	A019 T/B J	0.1053	-0.0750	0.0739	-45.3991	0.1282
20	1	A020 ELEV	0.3337	-0.1825	0.2794	-33.1503	0.3547
21	1	A021 TAIL	0.1461	-0.0662	0.1302	-26.9620	0.1517
22	1	A02290 BOX	0.1585	0.0906	-0.1301	145.1554	0.1656
23	1	A023 90 BO	0.1095	0.0694	-0.0847	140.6833	0.1238
24	1	A024 T/R H	0.1908	0.0907	-0.1679	151.6242	0.2382
25	1	A025 T/R H	1.1535	0.7946	-0.8362	136.4618	1.2157

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03/06/86 [illegible]

1 [illegible] HARMONIC ANALYSIS
[illegible] ANALYZED 14 POINTS ANALYZED 487 SAMPLE RATE 51[illegible]
[illegible] FREQUENCY 19.88 START TIME [illegible] 00
[illegible] AZIMUTH CORRECTION ANGLE 0.00 DEG.

[illegible]	LABEL	AMP	SIN	COS	PHASE	[illegible]
1	1 F001 FORCE	29.85	-29.84	-0.77	-91.49	30.12
2	1 A002NOSE V	0.0675	-0.0479	-0.0475	-134.7617	0.0694
3	1 A003 GUNNE	0.0228	0.0014	-0.0228	176.4911	0.0237
~~4~~	~~1 A004 LT SK~~	~~0.0001~~	-0.0000	0.0000	-54.7118	0.0015
~~5~~	~~1 A005 RT SK~~	~~0.0002~~	-0.0002	0.0001	-56.8837	0.0015
6	1 A006 PILOT	0.0266	0.0263	-0.0038	98.1414	0.0264
7	1 A007 C/G V	0.0218	0.0201	0.0085	67.1359	0.0222
8	1 A008 SUSP	0.0231	0.0212	0.0091	66.7430	0.0217
9	1 A009 SUSP	0.0026	0.0000	0.0020	0.9978	0.0027
10	1 A010 SUSP	0.0021	-0.0005	-0.0021	-165.6456	0.0029
[illegible]	~~1 A011LT SKT~~	~~0.0002~~	[illegible]	0.0001	-41.1130	0.0007
[illegible]	~~1 A012 RT SK~~	~~0.0000~~	[illegible]	-0.0000	-136.2457	0.0007
13	1 A013 42 BO	0.0831	-0.0295	-0.0776	-159.1815	0.0809
14	1 A014 RT WI	0.0309	0.0309	0.0001	89.8233	0.0322
15	1 A015 LT WI	0.0211	0.0124	0.0171	36.0490	0.0222
16	1 A016 ENG F	0.0592	0.0263	-0.0530	153.6362	0.0596
17	1 A017 ENG A	0.0213	-0.0155	0.0146	-46.7479	0.0225
18	1 A018ENG DE	0.0105	-0.0099	0.0033	-71.5003	0.0105
19	1 A019 T/B J	0.0576	-0.0567	0.0103	-79.7387	0.0584
20	1 A020 ELEV	0.0827	-0.0687	-0.0459	-123.7404	0.0872
21	1 A021 TAIL	0.0823	-0.0302	-0.0766	-158.5060	0.0835
22	1 A02290 BOX	0.1256	-0.1252	-0.0092	-94.1963	0.1304
23	1 A023 90 BO	0.0508	0.0038	-0.0506	175.7175	0.0515
24	1 A024 T/R H	0.1981	-0.1892	0.0586	-72.7983	0.1854
25	1 A025 T/R H	0.4434	-0.3877	0.2152	-60.9699	0.4323

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03/05/86 1353

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 21 POINTS ANALYZED: 479 SAMPLE RATE: 512.

1/REV FREQUENCY: 22.45 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001 FORCE	188.87	-182.73	47.77	-75.35	189.86
2	1 A002NOSE V	0.0658	0.0144	0.0642	12.5948	0.0703
3	1 A003 GUNNE	0.0154	-0.0152	0.0027	-79.9077	0.0193
~~4~~	~~1 A004 LT SK~~	~~0.0001~~	~~-0.0001~~	~~0.0000~~	-61.6609	0.0007
~~5~~	~~1 A005 RT SK~~	~~0.0002~~	~~-0.0001~~	0.0001	-34.9608	0.0015
6	1 A006 PILOT	0.0366	-0.0258	-0.0260	-135.2623	0.0396
7	1 A007 C/G V	0.0201	-0.0177	-0.0095	-118.2483	0.0244
8	1 A008 SUSP	0.0397	-0.0388	-0.0084	-102.2061	0.0447
9	1 A009 SUSP	0.0034	-0.0030	0.0016	-62.1515	0.0064
10	1 A010 SUSP	0.0414	0.0093	-0.0403	166.9943	0.0425
~~11~~	~~1 A011LT SKI~~	~~0.0001~~	~~-0.0001~~	~~0.0000~~	-67.9661	0.0015
~~12~~	~~1 A012 RT SK~~	~~0.0002~~	~~-0.0002~~	~~-0.0001~~	-69.6693	0.0015
13	1 A013 42 BO	0.1928	0.1828	-0.0612	108.5153	0 2215
14	1 A014 RT WI	0.0625	-0.0623	-0.0044	-94.0575	0.0696
15	1 A015 LT WI	0.0402	-0.0401	0.0023	-86.6822	0.0484
16	1 A016 ENG F	0.1109	-0.0625	0.0916	-34.3201	0.1160
17	1 A017 ENG A	0.0982	-0.0910	0.0369	-67.9447	0.1014
18	1 A018ENG DE	0.0856	-0 0801	0.0303	-69.2577	0.0879
19	1 A019 T/B J	0.0757	-0.0660	0.0370	-60.6904	0.0736
20	1 A020 ELEV	0 0843	0.0848	-0 0013	90.8480	0 1065
21	1 A021 TAIL	0.1723	0.1602	-0.0633	111.5776	0 1905
22	1 A02290 BOX	0.0436	0.0280	-0.0335	140.1291	0.0535
23	1 A023 90 BO	0.0326	0.0272	-0 0181	123.6421	0.0462
24	1 A024 T/R H	0.0365	-0.0337	0 0138	-67.7052	0 0608
25	1 A025 T/R H	0.7759	-0.7620	0 1454	-79 1261	0.8500

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03/05/86 1354

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 21 POINTS ANALYZED: 476 SAMPLE RATE: 512.
1/REV FREQUENCY: 22.59 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001 FORCE	188.87	-176.43	67.42	-69.09	189.57
2	1	A002NOSE V	0.0738	0.0416	0.0609	34.3216	0.0757
3	1	A003 GUNNE	0.0135	-0.0128	0.0042	-71.7029	0.0173
~~4~~	~~1~~	~~A004 LT GK~~	~~0.0000~~	~~-0.0000~~	~~0.0000~~	-42.8649	0.0007
~~5~~	~~1~~	~~A005 RT GK~~	~~0.0002~~	~~0.0001~~	~~0.0002~~	-17.8009	0.0015
6	1	A006 PILOT	0.0415	-0.0348	-0.0225	-122.8435	0.0442
7	1	A007 C/G V	0.0202	-0.0187	-0.0078	-112.6133	0.0254
8	1	A008 SUSP	0.0396	-0.0392	-0.0056	-98.0702	0.0462
9	1	A009 SUSP	0.0037	0.0015	0.0034	23.5389	0.0059
10	1	A010 SUSP	0.0565	-0.0177	-0.0536	-161.7254	0.0572
~~11~~	~~1~~	~~A011LT GKI~~	~~0.0001~~	~~-0.0001~~	~~0.0000~~	-88.0165	0.0015
~~12~~	~~1~~	~~A012 RT GK~~	~~0.0001~~	~~0.0000~~	~~0.0000~~	-55.1724	0.0015
13	1	A013 42 BO	0.1802	0.1575	-0.0876	119.0716	0.1996
14	1	A014 RT WI	0.0573	-0.0573	-0.0013	-91.2503	0.0645
15	1	A015 LT WI	0.0433	-0.0423	0.0094	-77.4699	0.0520
16	1	A016 ENG F	0.1053	-0.0497	0.0928	-28.1862	0.1106
17	1	A017 ENG A	0.0913	-0.0784	0.0467	-59.2138	0.0938
18	1	A018ENG DE	0.0797	-0.0691	0.0397	-60.1099	0.0816
19	1	A019 T/B J	0.0716	-0.0557	0.0451	-51.0209	0.0760
20	1	A020 ELEV	0.0772	0.0760	-0.0133	99.8996	0.0957
21	1	A021 TAIL	0.1622	0.1366	-0.0875	122.6225	0.1766
22	1	A02290 BOX	0.0431	0.0205	-0.0379	151.6084	0.0520
23	1	A023 90 BO	0.0336	0.0236	-0.0239	135.3042	0.0454
24	1	A024 T/R H	0.0344	-0.0277	0.0203	-53.7292	0.0586
25	1	A025 T/R H	0.7124	-0.6623	0.2623	-68.3934	0.7885

ORIGINAL PAGE IS
OF POOR QUALITY

03/10/87 1150

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 25 POINTS ANALYZED: 480 SAMPLE RATE: 512
1/REV FREQUENCY: 26.67 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	39.57	35.51	-17.47	116.19	39.86
2	1	A002NOSE L	0.0161	-0.0102	0.0124	-39.3911	0.0171
3	1	A003GUNNER	0.0036	-0.0034	0.0012	-71.3144	0.0044
~~4~~	~~1~~	~~A004LT SKI~~	~~0.0000~~	-0.0000	0.0000	-50.1439	0.0015
~~5~~	~~1~~	~~A005RT SKI~~	~~0.0001~~	-0.0000	0.0000	-35.7164	0.0007
6	1	A006PILOT	0.0105	0.0065	-0.0083	142.0062	0.0112
7	1	A007C/G LA	0.0108	0.0025	-0.0105	166.6051	0.0120
8	1	A008LT ELE	0.1528	0.1527	-0.0077	92.8857	0.1927
9	1	A009RT ELE	0.0332	0.0040	0.0329	6.9120	0.1150
10	1	A010SUSP L	0.1004	0.0927	0.0385	67.4472	0.1033
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0001~~	-0.0000	0.0001	-7.8595	0.0007
12	1	~~A012RT SKI~~	~~0.0000~~	-0.0000	0.0000	-50.6402	0.0010
13	1	A01342 BOX	0.0100	-0.0097	0.0021	-77.8266	0.0188
14	1	A014RT WIN	0.0326	0.0325	0.0034	84.0731	0.0352
15	1	A015LT WIN	0.0436	-0.0413	0.0138	-71.5803	0.0471
16	1	A016ENG FW	0.0107	-0.0068	-0.0083	-140.8766	0.0125
17	1	A017ENG AF	0.0087	-0.0005	0.0087	-3.2165	0.0105
18	1	A018ENG DE	0.0066	0.0064	-0.0018	105.6703	0.0088
19	1	A019T/B JU	0.0117	-0.0021	0.0115	-10.4247	0.0139
20	1	A020ELEV C	0.1193	-0.1096	0.0473	-66.6380	0.1246
21	1	A021TAIL S	0.0797	-0.0794	-0.0063	-94.5568	0.0938
22	1	A02290 BOX	0.0371	-0.0237	0.0286	-39.6977	0.0425
23	1	A02390 BOX	0.4659	0.4404	-0.1522	109.0691	0.4726
24	1	A024T/R HU	0.1243	-0.1241	0.0063	-87.0999	0.1612
25	1	A025T/R HU	0.4254	-0.0450	-0.4230	-173.9230	0.4946

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07/10/87 1156

1 REV HARMONIC ANALYSIS

REVS ANALYZED 30 POINTS ANALYZED 495 SAMPLE RATE 512.

1 REV FREQUENCY 31.03 START TIME 0.00

ROTOR AZIMUTH CORRECTION ANGLE 0.00 DEG

NO.	REV	LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	39.60	26.25	-29.30	137.15	38.69
2	1	A002NOSE L	0.0251	0.0072	0.0240	16.5732	0.0254
3	1	A003GUNNER	0.0107	-0.0080	-0.0072	-131.9606	0.0115
~~4~~	~~1~~	~~A004LT SKI~~	~~0.0000~~	~~-0.0000~~	0.0000	-41.9557	0.0007
~~5~~	~~1~~	~~A005RT SKI~~	~~0.0001~~	~~-0.0000~~	0.0000	-29.5494	0.0007
6	1	A006PILOT	0.0349	-0.0190	-0.0292	-146.8811	0.0352
7	1	A007C/G LA	0.0112	-0.0033	-0.0108	-163.1927	0.0127
8	1	A008LT ELE	0.1664	0.1205	-0.1147	133.6097	0.1722
9	1	A009RT ELE	0.0860	-0.0709	-0.0486	-124.4227	0.0989
10	1	A010BUSP L	0.0388	-0.0021	0.0387	-3.0456	0.0410
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0000~~	~~-0.0000~~	0.0000	-31.8224	0.0007
~~12~~	~~1~~	~~A012RT~~ SKI	~~0.0000~~	~~-0.0000~~	0.0000	-36.0005	0.0010
13	1	A01342 BOX	0.0581	-0.0421	-0.0401	-133.6426	0.0589
14	1	A014RT WIN	0.0492	-0.0132	-0.0474	-164.5058	0.0496
15	1	A015LT WIN	0.0688	0.0232	0.0647	19.7105	0.0699
16	1	A016ENG FW	0.0329	-0.0301	0.0131	-66.5250	0.0332
17	1	A017ENG AF	0.0369	-0.0067	-0.0363	-169.5739	0.0369
18	1	A018ENG DE	0.0216	0.0196	0.0091	65.0889	0.0220
19	1	A019T/B JU	0.0598	0.0384	0.0458	39.9814	0.0606
20	1	A020ELEV C	0.1219	-0.0683	0.1009	-34.1124	0.1234
21	1	A021TAIL S	0.1565	-0.1330	-0.0823	-121.7464	0.1597
22	1	A02290 BOX	0.0227	-0.0227	0.0003	-89.1888	0.0288
23	1	A02390 BOX	0.3923	0.3266	-0.2174	123.6447	0.3928
24	1	A024T/R HU	0.1617	-0.1347	-0.0895	-123.6115	0.1722
25	1	A025T/R HU	0.0480	0.0267	-0.0398	146.1420	0.0997

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OF POOR QUALITY

03/10/87 1200

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 32 POINTS ANALYZED: 490 SAMPLE RATE: 512.
1/REV FREQUENCY: 33.44 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	39.03	19.59	-33.75	149.87	39.42
2	1	A002NOSE L	0.0214	0.0211	0.0038	79.6588	0.0217
3	1	A003GUNNER	0.0130	-0.0000	0.0130	-0.1141	0.0137
~~4~~	~~1~~	~~A004LT SKI~~	~~0.0000~~	~~-0.0000~~	0.0000	-7.6074	0.0007
~~5~~	~~1~~	~~A005RT SKI~~	~~0.0000~~	~~-0.0000~~	0.0000	4.1891	0.0007
6	1	A006PILOT	0.0245	-0.0180	0.0167	-47.2243	0.0256
7	1	A007C/G LA	0.0096	-0.0077	0.0058	-53.1379	0.0117
8	1	A008LT ELE	0.2466	0.1203	-0.2153	150.8075	0.2763
9	1	A009RT ELE	0.1214	-0.1126	-0.0453	-111.9069	0.1634
10	1	A010SUSP L	0.0285	0.0117	0.0259	24.3273	0.0308
~~11~~	~~1~~	~~A011LT SKI~~	~~0.0001~~	~~0.0000~~	0.0001	7.5504	0.0005
~~12~~	~~1~~	~~A012RT SKI~~	~~0.0000~~	~~0.0000~~	0.0000	6.8168	0.0005
13	1	A01342 BOX	0.0547	-0.0411	0.0362	-48.6416	0.0603
14	1	A014RT WIN	0.0389	-0.0340	-0.0189	-119.0824	0.0403
15	1	A015LT WIN	0.0451	0.0404	0.0202	63.3808	0.0481
16	1	A016ENG FW	0.0099	-0.0099	0.0008	-85.1292	0.0112
17	1	A017ENG AF	0.0210	-0.0210	0.0011	-86.9056	0.0220
18	1	A018ENG DE	0.0233	0.0124	-0.0197	147.7325	0.0244
19	1	A019T/B JU	0.0463	0.0433	-0.0164	110.7733	0.0489
20	1	A020ELEV C	0.1165	-0.0337	0.1115	-16.8428	0.1268
21	1	A021TAIL S	0.1575	-0.1484	0.0528	-70.4219	0.1707
22	1	A02290 BOX	0.0326	-0.0238	0.0223	-46.8481	0.0369
23	1	A02390 BOX	0.3848	0.2665	-0.2776	136.1616	0.3898
24	1	A024T/R HU	0.1779	-0.1686	-0.0569	-108.6540	0.1913
25	1	A025T/R HU	0.2439	0.1121	-0.2166	152.6347	0.2785

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03/18/87 1548 1st L(

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 437 SAMPLE RATE: 512.
1/REV FREQUENCY: 8.20 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	7.79	7.79	0.26	88.11	10.92
2	1	A002NOSE L	0.4121	-0.0106	0.4120	-1.4767	0.4216
3	1	A003GUNNER	0.2443	-0.0074	0.2442	-1.7462	0.2462
4	1	A004PILOT	0.1553	0.0025	-0.1553	179.0609	0.1583
5	1	A005T/B AN	0.2913	0.0096	-0.2912	178.1068	0.2965
6	1	A006PILOT	0.1052	-0.0058	0.1050	-3.1331	0.1070
7	1	A007C/G LA	0.3179	0.0079	-0.3178	178.5827	0.3192
8	1	A008LT ELE	0.1127	0.0071	0.1125	3.5930	0.1707
9	1	A009RT ELE	0.0679	0.0014	-0.0679	178.8593	0.1451
10	1	A010SUSP L	1.1144	-0.1274	-1.1071	-173.4352	1.1299
11	1	A011ENG DE	0.3309	0.0118	-0.3307	177.9641	0.3302
12	1	A012MID FI	1.2094	0.0175	1.2093	0.8300	1.2179
13	1	A01342 BOX	0.2007	0.0210	0.1996	5.9932	0.2384
14	1	A014RT WIN	0.3039	-0.0106	0.3037	-1.9949	0.3097
15	1	A015LT WIN	0.3140	0.0146	-0.3137	177.3392	0.3261
16	1	A016TURRET	0.3610	-0.0111	0.3609	-1.7593	0.3593
17	1	A017INOP C	0.0000	-0.0000	0.0000	-84.2321	0.0010
18	1	A018ENG DE	0.3217	0.0101	-0.3216	178.1933	0.3212
19	1	A019T/B JU	0.3594	0.0183	-0.3589	177.0812	0.3598
20	1	A020ELEV C	0.3014	0.0206	-0.3007	176.0778	0.3156
21	1	A021TAIL S	0.1267	0.0210	0.1250	9.5390	0.2250
22	1	A02290 BOX	0.1889	0.0064	-0.1888	178.0619	0.1954
23	1	A02390 BOX	1.9964	-0.0231	1.9963	-0.6621	2.0107
24	1	A024T/R HU	0.4080	0.0078	-0.4080	178.9079	0.4287
25	1	A025T/R HU	0.3408	-0.0885	0.3291	-15.0564	0.4367

03/17/87 1741

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 414 SAMPLE RATE: 512.

1/REV FREQUENCY: 8.66 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	13.19	9.43	-9.22	134.36	13.39
2	1	A002NOSE V	0.6136	0.4318	0.4359	44.7347	0.6226
3	1	A003GUNNER	0.2967	0.2086	0.2110	44.6714	0.3017
4	1	A004PILOT	0.0668	-0.0466	-0.0478	-135.7526	0.0721
5	1	A005T/B AN	0.3399	-0.2279	-0.2522	-137.9005	0.3422
6	1	A006PILOT	0.0680	0.0471	0.0490	43.8448	0.0684
7	1	A007C/G VT	0.3554	-0.2460	-0.2565	-136.1892	0.3617
8	1	A008SUSP V	0.2005	-0.1355	-0.1478	-137.4915	0.2044
9	1	A009SUSP L	0.0088	0.0067	0.0056	49.9797	0.0161
10	1	A010SUSP F	0.0186	-0.0119	0.0143	-39.8386	0.0193
11	1	A011ENG DE	0.3823	-0.2610	-0.2794	-136.9466	0.3825
12	1	A012MID FI	1.2794	0.9349	0.8735	46.9437	1.2794
13	1	A01342 GEA	0.6031	0.4473	0.4046	47.8703	0.6063
14	1	A014RT WIN	0.2474	-0.1765	-0.1734	-134.4871	0.2472
15	1	A015LT WIN	0.2435	-0.1666	-0.1776	-136.8209	0.2567
16	1	A016TURRET	0.4324	0.3036	0.3079	44.5910	0.4372
17	1	A017INOP C	0.0001	0.0001	-0.0000	102.3686	0.0005
18	1	A018ENG DE	0.3700	-0.2546	-0.2686	-136.5336	0.3703
19	1	A019T/B JU	0.4000	-0.2677	-0.2972	-137.9847	0.3986
20	1	A020ELEV C	0.0739	-0.0308	-0.0672	-155.3524	0.0918
21	1	A021TAIL S	0.8665	0.6303	0.5946	46.6687	0.8683
22	1	A02290 BOX	1.5862	1.1403	1.1026	45.9625	1.5835
23	1	A02390 BOX	0.1257	0.0726	0.1025	35.3226	0.1321
24	1	A024T/R HU	1.8812	1.3553	1.3047	46.0887	1.9309
25	1	A025T/R HU	1.2395	0.6739	1.0402	32.9383	1.2728

C-3

ORIGINAL PAGE IS
OF POOR QUALITY

1/REV HARMONIC ANALYSIS 03/18/87 1605
CYCLES ANALYZED: 16 POINTS ANALYZED: 494 SAMPLE RATE 512
1/REV FREQUENCY: 16.58 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	14.03	-2.87	-13.73	-168.17	14.34
2	1	A002NOSE L	0.1909	-0.1855	0.0449	-76.3820	0.1915
3	1	A003GUNNER	0.0611	-0.0599	0.0120	-78.6732	0.0608
4	1	A004PILOT	0.0654	0.0626	-0.0190	106.8957	0.0689
5	1	A005T/B AN	0.0806	-0.0777	0.0215	-74.5513	0.0901
6	1	A006PILOT	0.0313	0.0295	-0.0105	109.5265	0.0332
7	1	A007C/G LA	0.1708	0.1652	-0.0431	104.6304	0.1659
8	1	A008LT ELE	0.1683	0.1601	-0.0520	107.9807	0.2081
9	1	A009RT ELE	0.1269	-0.1266	0.0079	-86.4339	0.2631
10	1	A010SUSP L	0.3514	-0.3425	0.0788	-77.0436	0.3715
11	1	A011ENG DE	0.0999	0.0974	-0.0225	102.9878	0.1023
12	1	A012MID FI	0.1530	-0.0964	-0.1188	-140.9407	0.1476
13	1	A01342 BOX	0.5813	-0.5799	0.0405	-86.0049	0.6114
14	1	A014RT WIN	0.0099	-0.0073	0.0067	-47.6105	0.0132
15	1	A015LT WIN	0.0251	-0.0247	0.0045	-79.7780	0.0305
16	1	A016TURRET	0.0800	-0.0788	0.0136	-80.1810	0.0809
17	1	A017INOP C	0.0001	0.0000	0.0000	42.4400	0.0007
18	1	A018ENG DE	0.1171	0.1142	-0.0257	102.6877	0.1160
19	1	A019T/B JU	0.0642	0.0626	-0.0139	102.5131	0.0747
20	1	A020ELEV C	0.5029	-0.4977	0.0719	-81.7778	0.4868
21	1	A021TAIL S	0.8857	-0.8818	0.0826	-84.6508	0.9387
22	1	A02290 BOX	0.0829	-0.0788	0.0257	-71.9595	0.0887
23	1	A02390 BOX	0.5318	0.4655	-0.2573	118.9295	0.5437
24	1	A024T/R HU	0.3622	-0.3484	0.0990	-74.1420	0.4162
25	1	A025T/R HU	0.1364	0.1327	0.0317	76.5726	0.2257

03/17/87 1753

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 16 POINTS ANALYZED: 473 SAMPLE RATE: 512.
1/REV FREQUENCY: 17.32 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	17.46	-15.25	-8.52	-119.19	17.64
2	1	A002NOSE V	0.1303	0.0648	-0.1131	150.1727	0.1299
3	1	A003GUNNER	0.0350	0.0208	-0.0281	143.4654	0.0349
4	1	A004PILOT	0.0385	-0.0144	0.0357	-21.9003	0.0391
5	1	A005T/B AN	0.0920	0.0379	-0.0838	155.6693	0.0931
6	1	A006PILOT	0.0254	-0.0084	0.0239	-19.4268	0.0259
7	1	A007C/G VT	0.0769	-0.0335	0.0692	-25.7984	0.0772
8	1	A008SUSP V	0.0451	-0.0176	0.0415	-23.0097	0.0454
9	1	A009SUSP L	0.0047	0.0044	-0.0017	110.4911	0.0068
10	1	A010SUSP F	0.0045	-0.0028	0.0035	-38.9798	0.0049
11	1	A011ENG DE	0.0037	-0.0036	0.0009	-75.4695	0.0046
12	1	A012MID FI	0.0631	-0.0487	-0.0402	-129.5800	0.0652
13	1	A01342 GEA	0.1480	0.0540	-0.1378	158.5860	0.1510
14	1	A014RT WIN	0.0501	-0.0226	0.0447	-26.8477	0.0513
15	1	A015LT WIN	0.0522	-0.0236	0.0465	-26.9179	0.0520
16	1	A016TURRET	0.0796	0.0434	-0.0668	146.9914	0.0799
17	1	A017INOP C	0.0000	-0.0000	-0.0000	-106.4139	0.0005
18	1	A018ENG DE	0.0213	-0.0111	0.0182	-31.3937	0.0220
19	1	A019T/B JU	0.0356	0.0138	-0.0328	157.2717	0.0362
20	1	A020ELEV C	0.1645	0.0760	-0.1458	152.4736	0.1656
21	1	A021TAIL S	0.0949	0.0137	-0.0939	171.7220	0.0953
22	1	A02290 BOX	0.0942	-0.0902	0.0270	-73.3516	0.0953
23	1	A02390 BOX	0.0675	-0.0674	-0.0037	-93.1490	0.0696
24	1	A024T/R HU	0.1765	-0.1360	0.1126	-50.3797	0.1817
25	1	A025T/R HU	0.6253	-0.5570	0.2841	-62.9772	0.6434

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OF POOR QUALITY

03/18/87 1609

1/REV HARMONIC ANALYSIS
CYCLES ANALYZED: 20 POINTS ANALYZED 475 SAMPLE RATE 512
1/REV FREQUENCY: 21.56 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	18.85	-10.89	-15.39	-144.70	19.03
2	1	A002NOSE L	0.0115	0.0091	0.0070	52.6919	0.0120
3	1	A003GUNNER	0.0183	-0.0155	0.0096	-58.2719	0.0193
4	1	A004PILOT	0.0367	-0.0341	0.0137	-68.0898	0.0371
5	1	A005T/B AN	0.0515	0.0513	-0.0048	95.3700	0.0540
6	1	A006PILOT	0.0155	-0.0154	0.0007	-87.4075	0.0161
7	1	A007C/G LA	0.0324	-0.0322	0.0035	-83.8726	0.0332
8	1	A008LT ELE	0.0700	-0.0584	-0.0385	-123.4074	0.1114
9	1	A009RT ELE	0.0531	0.0367	0.0383	43.7755	0.0887
10	1	A010SUSP L	0.1925	0.1709	-0.0885	117.3855	0.1964
11	1	A011ENG DE	0.0060	0.0032	-0.0051	148.3259	0.0068
12	1	A012MID FI	0.1287	-0.0990	-0.0823	-129.7350	0.1319
13	1	A01342 BOX	0.1183	-0.0750	0.0916	-39.2995	0.1204
14	1	A014RT WIN	0.0962	0.0817	-0.0509	121.9176	0.0965
15	1	A015LT WIN	0.0837	-0.0686	0.0480	-55.0209	0.0843
16	1	A016TURRET	0.0641	-0.0554	0.0324	-59.6907	0.0647
17	1	A017INOP C	0.0000	0.0000	0.0000	68.8741	0.0002
18	1	A018ENG DE	0.0054	-0.0024	-0.0048	-153.6879	0.0061
19	1	A019T/B JU	0.0124	0.0118	-0.0038	108.0606	0.0132
20	1	A020ELEV C	0.1004	0.0030	0.1004	1.7273	0.1031
21	1	A021TAIL S	0.1795	-0.0803	0.1606	-26.5676	0.1869
22	1	A02290 BOX	0.0234	-0.0021	0.0233	-5.2415	0.0256
23	1	A02390 BOX	0.2748	-0.0818	-0.2624	-162.6856	0.2770
24	1	A024T/R HU	0.1098	-0.0181	0.1083	-9.4827	0.1216
25	1	A025T/R HU	0.1096	0.0426	-0.1010	157.1344	0.1466

ORIGINAL PAGE IS
OF POOR QUALITY

03/18/87 0901

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 24 POINTS ANALYZED: 497 SAMPLE RATE: 512.
1/REV FREQUENCY: 24.72 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	17.31	-15.41	7.88	-62.91	17.90
2	1	A002NOSE V	0.0789	-0.0386	0.0688	-29.3197	0.0816
3	1	A003GUNNER	0.0082	-0.0031	-0.0076	-157.9482	0.0137
4	1	A004PILOT	0.0320	0.0160	-0.0277	150.0225	0.0342
5	1	A005T/B AN	0.0690	-0.0572	0.0385	-56.0137	0.0730
6	1	A006PILOT	0.0389	0.0158	-0.0356	156.1099	0.0405
7	1	A007C/G VT	0.0243	0.0179	-0.0165	132.7220	0.0278
8	1	A008SUSP V	0.0186	0.0101	-0.0156	146.9898	0.0213
9	1	A009SUSP L	0.0127	-0.0038	-0.0121	-162.8257	0.0151
10	1	A010SUSP F	0.0052	-0.0032	0.0041	-38.5125	0.0059
11	1	A011ENG DE	0.0443	-0.0106	0.0430	-13.8449	0.0464
12	1	A012MID FI	0.1756	-0.1210	-0.1272	-136.4346	0.1891
13	1	A01342 GEA	0.2084	-0.1282	-0.1642	-142.0171	0.2171
14	1	A014RT WIN	0.0100	0.0070	-0.0071	135.7052	0.0149
15	1	A015LT WIN	0.0163	0.0151	-0.0061	112.0811	0.0232
16	1	A016TURRET	0.0320	-0.0168	0.0273	-31.5645	0.0342
17	1	A017INOP C	0.0001	-0.0001	-0.0001	-140.9538	0.0024
18	1	A018ENG DE	0.0329	-0.0122	0.0306	-21.7707	0.0354
19	1	A019T/B JU	0.0671	-0.0428	0.0517	-39.6706	0.0686
20	1	A020ELEV C	0.1003	-0.0948	-0.0327	-109.0283	0.1136
21	1	A021TAIL S	0.1941	-0.1125	-0.1581	-144.5835	0.1993
22	1	A02290 BOX	0.0931	-0.0916	-0.0163	-100.0803	0.1092
23	1	A02390 BOX	0.0375	-0.0158	-0.0340	-155.1339	0.0476
24	1	A024T/R HU	0.1689	-0.0339	0.1655	-11.5684	0.2272
25	1	A025T/R HU	0.8765	0.0256	0.8761	1.6708	0.9409

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03/18/87 0906

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 25 POINTS ANALYZED 489 SAMPLE RATE: 512
1/REV FREQUENCY: 26.18 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	17.31	-15.69	7.30	-65.05	17.56
2	1	A002NOSE V	0.0672	0.0074	0.0668	6.2775	0.0689
3	1	A003GUNNER	0.0149	-0.0125	-0.0081	-123.0110	0.0171
4	1	A004PILOT	0.0275	-0.0026	-0.0274	-174.5989	0.0291
5	1	A005T/B AN	0.0615	-0.0261	0.0557	-25.1136	0.0696
6	1	A006PILOT	0.0379	-0.0109	-0.0362	-163.2230	0.0393
7	1	A007C/G VT	0.0184	0.0099	-0.0156	147.5938	0.0213
8	1	A008SUSP V	0.0095	0.0089	-0.0034	111.0354	0.0132
9	1	A009SUSP L	0.0179	0.0063	0.0167	20.7086	0.0203
10	1	A010SUSP F	0.0046	0.0013	0.0044	16.7929	0.0059
11	1	A011ENG DE	0.0513	0.0208	0.0469	23.9488	0.0570
12	1	A012MID FI	0.2249	-0.2100	-0.0805	-110.9764	0.2352
13	1	A01342 GEA	0.2424	-0.2216	-0.0982	-113.9015	0.2506
14	1	A014RT WIN	0.0159	-0.0009	-0.0159	-176.7210	0.0215
15	1	A015LT WIN	0.0174	0.0173	0.0013	85.5856	0.0217
16	1	A016TURRET	0.0210	-0.0027	0.0208	-7.5000	0.0234
17	1	A017INOP C	0.0002	-0.0001	-0.0001	-137.3866	0.0024
18	1	A018ENG DE	0.0381	0.0125	0.0360	19.1558	0.0398
19	1	A019T/B JU	0.0700	-0.0002	0.0700	-0.1708	0.0730
20	1	A020ELEV C	0.1062	-0.1059	0.0079	-85.7327	0.1150
21	1	A021TAIL S	0.2306	-0.2062	-0.1033	-116.6169	0.2345
22	1	A02290 BOX	0.1268	-0.1267	-0.0056	-92.5223	0.1378
23	1	A02390 BOX	0.0478	-0.0383	-0.0286	-126.7845	0.0623
24	1	A024T/R HU	0.1114	0.0118	0.1107	6.0737	0.1663
25	1	A025T/R HU	0.9375	0.5267	0.7756	34.1827	1.0215

03/18/87 1616

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 28 POINTS ANALYZED: 478 SAMPLE RATE 512

1/REV FREQUENCY: 29.99 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	27.91	-27.32	-5.70	-101.79	28.04
2	1	A002NOSE L	0.0524	0.0025	-0.0523	177.2323	0.0530
3	1	A003GUNNER	0.0075	0.0021	-0.0072	163.8141	0.0085
4	1	A004PILOT	0.0340	0.0032	0.0338	5.4271	0.0342
5	1	A005T/B AN	0.0551	0.0128	-0.0536	166.5864	0.0559
6	1	A006PILOT	0.0320	-0.0014	0.0320	-2.5074	0.0327
7	1	A007C/G LA	0.0276	-0.0046	0.0272	-9.6292	0.0281
8	1	A008LT ELE	0.1133	-0.0914	-0.0669	-126.2291	0.1187
9	1	A009RT ELE	0.0782	0.0503	0.0599	40.0213	0.0909
10	1	A010SUSP L	0.0070	0.0062	0.0032	62.3212	0.0110
11	1	A011ENG DE	0.0445	-0.0044	-0.0443	-174.2993	0.0447
12	1	A012MID FI	0.1693	-0.1692	-0.0029	-90.9908	0.172[illegible]
13	1	A01342 BOX	0.0562	-0.0021	0.0561	-2.1300	0.0579
14	1	A014RT WIN	0.0386	-0.0196	0.0332	-30.5587	0.0396
15	1	A015LT WIN	0.0334	0.0167	-0.0289	149.9690	0.0347
16	1	A016TURRET	0.0394	0.0101	-0.0381	165.1539	0.0398
17	1	A017INOP C	0.0000	0.0000	0.0000	66.5322	0.0005
18	1	A018ENG DE	0.0348	-0.0047	-0.0345	-172.1547	0.0349
19	1	A019T/B JU	0.0614	-0.0003	-0.0614	-179.7651	0.0620
20	1	A020ELEV C	0.0743	0.0728	0.0153	78.1489	0.0777
21	1	A021TAIL S	0.1497	0.0377	0.1449	14.6006	0.1546
22	1	A02290 BOX	0.0178	0.0032	0.0175	10.3214	0.0188
23	1	A02390 BOX	0.3180	-0.2961	-0.1160	-111.3964	0.3180
24	1	A024T/R HU	0.1208	0.0838	0.0871	43.8977	0.1297
25	1	A025T/R HU	0.0749	-0.0573	-0.0482	-130.0740	0.1048

AH-1G DAMVIBS CONFIG #8 03/19/87 0932

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 7 POINTS ANALYZED: 453 SAMPLE RATE 512

1/REV FREQUENCY: 7.91 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	6.07	5.99	0.99	80.61	13.75
2	1	A002NOSE LAT	0.2276	-0.0468	0.2227	-11.8678	0.2384
3	1	A003GUNNER LAT	0.1372	-0.0292	0.1340	-12.2842	0.1422
4	1	A004PILOT AFT LAT	0.0946	0.0294	-0.0900	161.9263	0.1011
5	1	A005T/B AN LAT	0.1716	0.0347	-0.1681	168.3433	0.1786
6	1	A006PILOT LAT	0.0606	-0.0140	0.0590	-13.3401	0.0638
7	1	A007C/G LA LAT	0.1850	0.0494	-0.1783	164.5234	0.1944
8	1	A008LT ELE VT	[illegible]	-0.0011	0.0622	-1.0295	0.0828
9	1	A009RT ELE VT	0.0217	-0.0086	-0.0199	-156.6482	0.0454
10	1	A010SUSP L	1.1831	-1.1178	-0.3875	-109.1196	1.4370
11	1	A011ENG DECK AFT LAT	0.1921	0.0481	-0.1860	165.5126	0.2013
12	1	A012MID FI	0.5894	-0.0838	0.5834	-8.1772	0.6265
13	1	A01342 BOX LAT	0.0543	0.0127	0.0528	13.4759	0.1172
14	1	A014RT WIN VT	0.1952	-0.0608	0.1855	-18.1350	0.2091
15	1	A015LT WIN VT	0.1932	0.0637	-0.1824	160.7575	0.2081
16	1	A016TURRET	0.2032	-0.0465	0.1978	-13.2392	0.2120
17	1	A017INOP C	0.0000	0.0000	0.0000	48.0491	0.0007
18	1	A018ENG DE	0.1865	0.0465	-0.1806	165.5527	0.1957
19	1	A019T/B JU	0.2104	0.0549	-0.2032	164.8739	0.2138
20	1	A020ELEV C LA	0.1969	0.0489	-0.1908	165.6232	0.2125
21	1	A021TAIL S LA	0.0188	0.0154	0.0108	54.9170	0.1143
22	1	A02290 BOX VT	0.0859	0.0054	-0.0857	176.4217	0.0906
23	1	A02390 BOX LAT	1.0234	-0.1809	1.0073	-10.1816	1.0699
24	1	A024T/R HU VT	0.2308	0.0315	-0.2287	172.1671	0.2338
25	1	A025T/R HU F/A	0.2089	-0.0916	0.1878	-26.0006	0.2565

1-REV HARMONIC ANALYSIS

CYCLES ANALYZED: 8 POINTS ANALYZED: 465 SAMPLE RATE 512
1/REV FREQUENCY 8.81 START TIME 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS	LABEL	AMP	SIN	COS	PHASE	OSC
1	3 F001FORCE	7.13	-7.12	0.30	-87.60	7.94
2	3 A002NOSE V	0.4698	-0.0010	-0.4698	-179.8792	0.4736
3	3 A003GUNNER	0.2214	-0.0001	-0.2214	-179.9741	0.2213
4	3 A004PILOT	0.0811	0.0006	0.0811	0.4559	0.0830
5	3 A005T/B AN	0.3262	-0.0086	0.3261	-1.5150	0.3273
6	3 A006PILOT	0.0325	0.0011	-0.0325	177.9785	0.0342
7	3 A007C/G VT	0.3307	-0.0031	0.3307	-0.5284	0.3327
8	3 A008SUSP V	0.1883	-0.0012	0.1883	-0.3702	0.1891
9	3 A009SUSP L	0.0005	-0.0002	0.0004	-27.0797	0.0044
10	3 A010SUSP F	0.0462	0.0006	-0.0462	179.2367	0.0469
11	3 A011ENG DE	0.3428	-0.0066	0.3427	-1.0968	0.3429
12	3 A012MID FI	0.9821	-0.0308	-0.9816	-178.2020	0.9856
13	3 A01342 GEH	0.4191	-0.0193	-0.4186	-177.2934	0.4206
14	3 A014RT WIN	0.2319	-0.0001	0.2319	-0.0243	0.2328
15	3 A015LT WIN	0.2193	-0.0016	0.2193	-0.4067	0.2207
16	3 A016TURRET	0.3314	0.0002	-0.3314	179.9674	0.3317
17	3 A017INOP C	0.0000	-0.0000	-0.0000	-162.2421	0.0007
18	3 A018ENG DE	0.3315	-0.0048	0.3314	-0.8379	0.3324
19	3 A019T/B JU	0.3664	-0.0130	0.3662	-2.0405	0.3664
20	3 A020ELEV C	0.1166	-0.0158	0.1156	-7.7795	0.1348
21	3 A021TAIL 8	0.6495	-0.0167	-0.6493	-178.5232	0.6580
22	3 A02290 BOX	1.2291	-0.0171	-1.2290	-179.2044	1.2311
23	3 A02390 BOX	0.0768	0.0046	-0.0767	176.5522	0.0804
24	3 A024T/R HU	1.4193	-0.0216	-1.4192	-179.1266	1.4437
25	3 A025T/R HU	1.1152	0.2310	-1.0910	168.0456	1.1373

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AH-1G DAMVIBS CONFIG #8 03/13/87 0952

1 REV HARMONIC ANALYSIS

CYCLES ANALYZED: 16 POINTS ANALYZED 497 SAMPLE RATE 512

1/REV FREQUENCY: 16.48 START TIME 0.00

ROTOR AZIMUTH CORRECTION ANGLE 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	1	F001FORCE	13.93	-0.95	-13.89	-176.08	14.22
2	1	A002NOSE L	0.1778	-0.1770	0.0165	-84.6654	0.1764
3	1	A003GUNNER	0.0556	-0.0556	0.0027	-87.1682	0.0567
4	1	A004PILOT	0.0658	0.0651	-0.0093	98.1588	0.0623
5	1	A005T/B AN	0.0450	-0.0447	0.0052	-83.3632	0.0716
6	1	A006PILOT	0.0333	0.0327	-0.0060	100.3368	0.0318
7	1	A007C/G LA	0.1747	0.1737	-0.0187	96.1358	0.1803
8	1	A008LT ELE	0.1243	0.1241	-0.0074	93.4313	0.1913
9	1	A009RT ELE	0.0897	-0.0897	-0.0003	-90.1884	0.2030
10	1	A010SUSP L	0.2512	-0.2496	0.0288	-83.4109	0.3605
11	1	A011ENG DE	0.1111	0.1107	-0.0093	94.8116	0.1180
12	1	A012MID FI	0.1749	-0.1283	-0.1189	-132.8197	0.1986
13	1	A01342 BOX	0.5365	-0.5346	-0.0449	-94.7954	0.5271
14	1	A014RT WIN	0.0030	-0.0028	0.0010	-69.7031	0.0122
15	1	A015LT WIN	0.0277	-0.0277	-0.0009	-91.8444	0.0296
16	1	A016TURRET	0.0749	-0.0748	0.0020	-88.5066	0.0762
17	1	A017INOP C	0.0001	0.0000	0.0000	41.6544	0.0005
18	1	A018ENG DE	0.1259	0.1255	-0.0098	94.4693	0.1375
19	1	A019T/B JU	0.0814	0.0811	-0.0060	94.2184	0.0809
20	1	A020ELEV C	0.4258	-0.4257	-0.0076	-91.0230	0.4624
21	1	A021TAIL S	0.7998	-0.7981	-0.0510	-93.6557	0.7819
22	1	A02290 BOX	0.0592	-0.0592	0.0023	-87.7730	0.0647
23	1	A02390 BOX	0.4013	0.3648	-0.1674	114.6446	0.4133
24	1	A024T/R HU	0.3383	-0.3367	0.0332	-84.3689	0.4155
25	1	A025T/R HU	0.1439	0.1436	0.0088	86.5116	0.2447

03/19/87 1440

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 17 POINTS ANALYZED: 493 SAMPLE RATE: 512
1/REV FREQUENCY: 17.66 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	3	F001FORCE	27.59	12.67	24 51	27.33	27.70
2	3	A002NOSE V	0.2263	-0.2034	0.0991	-64.0269	0.2298
3	3	A003GUNNER	0.0542	-0.0531	0.0109	-78.4172	0.0574
4	3	A004PILOT	0.0895	0.0747	-0.0494	123.5021	0 0914
5	3	A005T/B AN	0.1461	-0.1188	0.0850	-54.4054	0.1534
6	3	A006PILOT	0.0637	0.0505	-0.0388	127.5492	0.0655
7	3	A007C/G VT	0.1734	0 1519	-0.0836	118.8137	0.1751
8	3	A008SUSP V	0.1068	0.0916	-0.0548	120.8557	0.1089
9	3	A009SUSP L	0.0079	-0.0076	-0.0019	-104.2672	0.0110
10	3	A010SUSP F	0.0083	-0.0074	0 0037	-63.5771	0 0090
11	3	A011ENG DE	0.0309	0.0308	-0.0025	94.5738	0.0386
12	3	A012MID FI	0.1187	0.0173	0.1175	8.3674	0.1282
13	3	A01342 GEA	0.2731	-0.2236	0.1569	-54.9428	0.2916
14	3	A014RT WIN	0.1125	0.0971	-0.0569	120.3587	0.1202
15	3	A015LT WIN	0.1193	0.1073	-0.0521	115.9008	0.1216
16	3	A016TURRET	0.1356	-0.1264	0.0491	-68.7747	0.1387
17	3	A017INOP C	0.0000	-0.0000	0.0000	-4.2901	0.0007
18	3	A018ENG DE	0.0637	0.0596	-0.0224	110.6282	0.0681
19	3	A019T/B JU	0.0411	-0.0260	0.0318	-39.2945	0.0440
20	3	A020ELEV C	0.2947	-0.2461	0.1432	-59.8184	0.3012
21	3	A021TAIL S	0.1819	-0.1276	0.1297	-44.5454	0.1905
22	3	A02290 BOX	0.1827	0.1692	0.0689	67.8390	0.2022
23	3	A02390 BOX	0.0688	0.0399	0.0560	35.4723	0.0779
24	3	A024T/R HU	0.3094	0.3094	-0.0024	90.4468	0.3503
25	3	A025T/R HU	1.0087	0.9995	0.1358	82.2626	1.0728

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OF POOR QUALITY

03/19/87 1444

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 20 POINTS ANALYZED: 484 SAMPLE RATE: 512

1 REV FREQUENCY: 21.16 START TIME: 0.00

ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	3	F001FORCE	37.51	31.69	20.06	57.67	37.69
2	3	A002NOSE V	0.0917	0.0259	0.0880	16.4138	0.0953
3	3	A003GUNNER	0.0239	-0.0139	0.0194	-35.6766	0.0256
4	3	A004PILOT	0.0439	-0.0278	-0.0340	-140.7133	0.0467
5	3	A005T/B AN	0.0847	0.0571	0.0626	42.3620	0.0906
6	3	A006PILOT	0.0370	-0.0280	-0.0242	-130.8540	0.0393
7	3	A007C/G VT	0.0684	-0.0411	-0.0547	-143.0861	0.0694
8	3	A008SUSP V	0.0469	-0.0385	-0.0268	-124.7857	0.0476
9	3	A009SUSP L	0.0178	-0.0163	0.0070	-66.7034	0.0205
10	3	A010SUSP F	0.0060	0.0042	0.0043	44.1443	0.0068
11	3	A011ENG DE	0.0198	0.0198	-0.0000	90.0076	0.0256
12	3	A012MID FI	0.1018	0.0258	0.0985	14.6676	0.1092
13	3	A01342 GEA	0.1062	-0.0102	0.1057	-5.5009	0.1124
14	3	A014RT WIN	0.0710	-0.0709	-0.0032	-92.5826	0.0796
15	3	A015LT WIN	0.0617	0.0087	-0.0611	171.8548	0.0701
16	3	A016TURRET	0.0530	-0.0030	0.0529	-3.2000	0.0547
17	3	A017INOP C	0.0001	0.0000	0.0000	43.2977	0.0012
18	3	A018ENG DE	0.0081	-0.0041	-0.0070	-149.7900	0.0107
19	3	A019T/B JU	0.0489	0.0413	0.0262	57.5500	0.0601
20	3	A020ELEV C	0.1152	0.0551	0.1011	28.6027	0.1192
21	3	A021TAIL S	0.0935	-0.0152	0.0923	-9.3256	0.0975
22	3	A02290 BOX	0.1414	0.1139	0.0839	53.6307	0.1423
23	3	A02390 BOX	0.0370	-0.0208	0.0306	-34.2305	0.0442
24	3	A024T/R HU	0.2645	0.2596	0.0507	78.9521	0.2594
25	3	A025T/R HU	0.5226	0.5138	0.0952	79.5065	0.5730

03/19/87 1454

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 25 POINTS ANALYZED: 481 SAMPLE RATE: 512.
1/REV FREQUENCY: 26.61 START TIME: 0 00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG.

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	3	F001FORCE	26.56	26.37	3.23	83.01	26.94
2	3	A002NOSE V	0.0838	0.0228	-0.0807	164.1989	0.0884
3	3	A003GUNNER	0.0257	0.0090	0.0241	20.5763	0 0281
4	3	A004PILOT	0.0405	-0.0137	0.0381	-19.7709	0.0445
5	3	A005T/B AN	0.0794	0.0668	-0.0430	122 7715	0.0850
6	3	A006PILOT	0.0524	-0.0072	0.0519	-7.8699	0.0567
7	3	A007C/G VT	0.0328	-0.0218	0.0245	-41.6661	0.0369
8	3	A008SUSP V	0.0209	-0.0143	0.0152	-43 3638	0.0234
9	3	A009SUSP L	0.0070	-0.0032	-0.0062	-152.5410	0.0098
10	3	A010SUSP F	0.0078	0.0031	-0.0072	156.3116	0.0098
11	3	A011ENG DE	0.0608	0.0077	-0.0603	172.7021	0.0664
12	3	A012MID FI	0.3538	0.2697	0.2290	49.6623	0.3693
13	3	A01342 GEA	0.3648	0 2738	0.2411	48.6373	0.3723
14	3	A014RT WIN	0.0364	0.0028	0.0363	4.3714	0.0464
15	3	A015LT WIN	0.0319	-0 0308	-0 0085	-105.3405	0.0420
16	3	A016TURRET	0.0194	0.0153	-0.0120	128.0399	0.0234
17	3	A017INOP C	0.0001	0.0001	0.0000	75.2372	0 0007
18	3	A018ENG DE	0.0379	0.0005	-0.0378	179.1796	0.0427
19	3	A019T/B JU	0.0838	0 0270	-0.0793	161.2169	0.0874
20	3	A020ELEV C	0.1586	0.1518	0.0462	73.0847	0.1710
21	3	A021TAIL S	0.3483	0.2461	0 2465	44.9539	0 3547
22	3	A02290 BOX	0.2183	0.1927	0.1026	61.9589	0.2330
23	3	A02390 BOX	0.0699	0.0398	0.0574	34.6848	0.0937
24	3	A024T/R HU	0.1189	0.1041	-0.0575	118.8907	0.1393
25	3	A025T/R HU	1.3340	-0.4172	-1.2671	-161.7739	1.3974

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03/19/87 1455

1/REV HARMONIC ANALYSIS

CYCLES ANALYZED: 26 POINTS ANALYZED: 491 SAMPLE RATE: 512.
1/REV FREQUENCY: 27.11 START TIME: 0.00
ROTOR AZIMUTH CORRECTION ANGLE: 0.00 DEG

SW-POS		LABEL	AMP	SIN	COS	PHASE	OSC
1	3	F001FORCE	26.56	26.56	-0.18	90.38	26.89
2	3	A002NOSE V	0.0668	0.0002	-0.0668	179.8460	0.0694
3	3	A003GUNNER	0.0246	0.0150	0.0195	37.4924	0.0266
4	3	A004PILOT	0.0318	-0.0034	0.0316	-6.1695	0.0342
5	3	A005T/B AN	0.0662	0.0491	-0.0444	132.1323	0.0721
6	3	A006PILOT	0.0429	0.0063	0.0424	8.4676	0.0462
7	3	A007C/G VT	0.0232	-0.0135	0.0189	-35.5628	0.0256
8	3	A008SUSP V	0.0147	-0.0086	0.0119	-35.8641	0.0164
9	3	A009SUSP L	0.0056	-0.0042	-0.0037	-131.4364	0.0093
10	3	A010SUSP F	0.0067	0.0011	-0.0066	170.4849	0.0081
11	3	A011ENG DE	0.0528	-0.0078	-0.0522	-171.4887	0.0576
12	3	A012MID FI	0.3313	0.3022	0.1359	65.7871	0.3459
13	3	A01342 GEA	0.3327	0.2989	0.1462	63.9415	0.3405
14	3	A014RT WIN	0.0300	0.0161	0.0253	32.4996	0.0391
15	3	A015LT WIN	0.0336	-0.0332	-0.0052	-98.8970	0.0423
16	3	A016TURRET	0.0155	0.0129	-0.0086	123.7084	0.0210
17	3	A017INOP C	0.0001	0.0001	-0.0000	115.7225	0.0012
18	3	A018ENG DE	0.0344	-0.0078	-0.0335	-166.8177	0.0396
19	3	A019T/B JU	0.0690	0.0046	-0.0689	176.2121	0.0725
20	3	A020ELEV C	0.1445	0.1438	0.0148	84.1046	0.1512
21	3	A021TAIL S	0.3174	0.2772	0.1546	60.8490	0.3202
22	3	A02290 BOX	0.2177	0.2104	0.0560	75.0975	0.2257
23	3	A02390 BOX	0.0625	0.0501	0.0373	53.3231	0.0777
24	3	A024T/R HU	0.1098	0.1047	-0.0333	107.6743	0.1810
25	3	A025T/R HU	1.2209	-0.7069	-0.9955	-144.6206	1.2860

[illegible] CONFIG #8 03/13/87 1014

1 REV HARMONIC ANALYSIS

[illegible] ANALYZED 30 POINTS ANALYZED 432 SAMPLE RATE 512

[illegible] FREQUENCY 31.22 START TIME 0.00

ROTOR AZIMUTH CORRECTION ANGLE 0.00 DEG.

[illegible]	LABEL	AMP	SIN	COS	PHASE	OSC
1	1 F001FORCE	29.23	-29.23	-0.54	-91.07	29.53
2	1 A002NOSE L	0.0443	-0.0073	-0.0437	-170.5683	0.0447
3	1 A003GUNNER	0.0038	0.0006	-0.0038	171.1213	0.0049
4	1 A004PILOT	0.0329	0.0081	0.0319	14.2247	0.0337
5	1 A005T/[illegible] AN	0.0479	0.0001	-0.0479	179.8464	0.0496
6	1 A006PILOT	0.0312	0.0047	0.0309	8.6187	0.0315
7	1 A007C/G LA	0.0745	0.0006	0.0345	1.0779	0.0749
8	1 A008LT ELE	0.1320	-0.1258	-0.0401	-107.6950	0.1378
9	1 A009RT ELE	0.0771	0.0387	0.0667	30.1436	0.0901
10	1 A010SUSP L	0.0442	-0.0747	0.0274	-51.6412	0.0462
11	1 A011ENG DE	[illegible]	-0.0126	-0.0300	-157.3404	[illegible]
12	1 A012MID FI	[illegible]	-0.1006	0.0189	-83.[illegible]	0.1649
13	1 A01342 BOX	0.0406	0.0018	0.0406	2.5540	0.0425
14	1 A014RT WIN	0.0335	-0.0046	0.0332	-7.9050	0.0342
15	1 A015LT WIN	0.0352	0.0095	-0.0339	164.3474	0.0364
16	1 A016TURRET	0.0328	-0.0000	-0.0328	-179.9531	0.0335
17	1 A017INOP C	0.0000	0.0000	-0.0000	129.2439	0.0015
18	1 A018ENG DE	0.0237	-0.0110	-0.0210	-152.4076	0.0242
19	1 A019T/B JU	0.0494	-0.0129	-0.0477	-164.9060	0.0501
20	1 A020ELEV C	0.0652	0.0650	-0.0049	94.3150	0.0664
21	1 A021TAIL S	0.1290	0.0525	0.1179	24.0055	0.1341
22	1 A02290 BOX	0.0157	0.0104	0.0118	41.5842	0.0176
23	1 A02390 BOX	0.3127	-0.3069	-0.0599	-101.0408	0.3136
24	1 A024T/R HU	0.1560	0.1292	0.0874	55.9325	0.1678
25	1 A025T/R HU	0.1185	-0.1183	-0.0054	-92.6055	0.1568

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Report Documentation Page

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15. Supplementary Notes

Langley Technical Monitor: Raymond G. Kvaternik
Final Report (for Task #5 of the contract)

16. Abstract

Under the NASA-sponsored DAMVIBS (Design Analysis Methods for VIBrationS) program, a series of ground vibration tests and NASTRAN finite element model (FEM) correlations were conducted on the Bell AH-1G helicopter gunship to investigate the effects of difficult components on the vibration response of the airframe. Previous correlations of the AH-1G showed good agreement between NASTRAN and tests through 15-20 Hz, but poor agreement in the higher frequency range of 20-30 Hz. Thus, this effort emphasized the higher frequency airframe vibration response correlations and identified areas that need further R&T work. To conduct the investigations, selected difficult components (main rotor pylon, secondary structure, nonstructural doors/panels, landing gear, engine, fuel, etc.) were systematically removed to quantify their effects on overall vibratory response of the airframe. The entire effort was planned and documented, and the results reviewed by NASA and industry experts in order to ensure scientific control of the testing, analysis, and correlation exercise. In particular, secondary structure and damping had significant effects on the frequency response of the airframe above 15 Hz. Also, the nonlinear effects of thrust stiffening and elastomer mounts were significant on the low frequency pylon modes below main rotor 1p (5.4 Hz). This volume presents the results of the ground vibration testing.

17. Key Words (Suggested by Author(s)) Difficult Components Airframe Vibrations AH-1G Helicopter Structural Analysis Finite Element Helicopter NASTRAN Rotorcraft Dynamic		18. Distribution Statement Unclassified - Unlimited Subject Category 39	
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