(2)

AEFA Project No. 87-11

PRELIMINARY AIRWORTHINESS EVALUATION OF THE RC-12H AIRPLANE

Joseph C. Miess
CW4, USA
Project Officer/Pilot

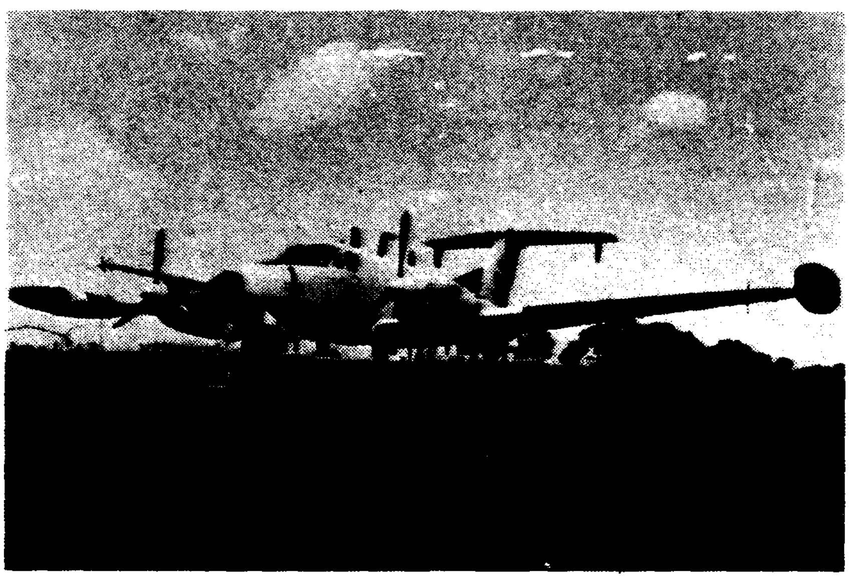
Reginald C. Murrell
CW4, USA
Project Pilot

Robert M. Buckanin
Project Engineer

AEFA

June 1988

Final Report



Approved for public release, distribution unlimited.

AVIATION ENGINEERING FLIGHT ACTIVITY
Edwards Air Force Base, California 93523-5000

DISCLAIMER NOTICE

The findings of this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

DISPOSITION INSTRUCTIONS

Destroy this report when it is no longer needed. Do not return it to the originator.

TRADE NAMES

The use of trade names in this report does not constitute an official endorsement or approval of the use of the commercial hardware and software.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	**1b. RESTRICTIVE MARKINGS**
2a. SECURITY CLASSIFICATION AUTHORITY U.S. ARMY AVIATION SYSTEMS COMMAND	**3. DISTRIBUTION/AVAILABILITY OF REPORT**
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AEFA PROJECT NO. 87-11	**5. MONITORING ORGANIZATION REPORT NUMBER(S)**
6a. NAME OF PERFORMING ORGANIZATION U.S. ARMY AVIATION ENGINEERING FLIGHT ACTIVITY; **6b. OFFICE SYMBOL** *(If applicable)*	**7a. NAME OF MONITORING ORGANIZATION**
6c. ADDRESS *(City, State, and ZIP Code)* EDWARDS AIR FORCE BASE, CALIFORNIA 93523-5000	**7b. ADDRESS** *(City, State, and ZIP Code)*
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. ARMY AVIATION SYSTEMS COMMAND; **8b. OFFICE SYMBOL** *(If applicable)*	**9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER**
8c. ADDRESS *(City, State, and ZIP Code)* 4300 GOODFELLOW BLVD. ST. LOUIS, MO 63120-1798	**10. SOURCE OF FUNDING NUMBERS** PROGRAM ELEMENT NO.: 1G-7-F3199-; PROJECT NO.: 4Q-45; TASK NO.: ; WORK UNIT ACCESSION NO.:

11. TITLE *(Include Security Classification)*
PRELIMINARY AIRWORTHINESS EVALUATION OF THE RC-12H AIRPLANE. UNCLASSIFIED

12. PERSONAL AUTHOR(S)
CW4 JOSEPH C. MIESS, CW4 REGINALD C. MURRELL, ROBERT M. BUCKANIN

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
FINAL	FROM 06/08/87 TO 06/16/87	OCTOBER 1987	

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
FIELD	GROUP	SUB-GROUP	Marginal Climb Performance, Service Ceiling, Stall Warning Margins, Wheel Lockup

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

The U.S. Army Aviation Engineering Flight Activity conducted a Preliminary Airworthiness Evaluation of the RC-12H aircraft with ballasted wing tip pods installed. ~~from 8 June through 16 June 1987 at Wichita, Kansas~~ During the test program, 7 flights were conducted for a total of 20.4 hours, of which 15.0 were productive. Tests were performed in a normal mission configuration ballasted to a maximum takeoff gross weight of 15,709 pounds and a center of gravity at fuselage station 189.5 (fwd) and 195.1 (aft). Test results were evaluated against military specification MIL-F-8785C. Takeoff performance data presented in the operator's manual were confirmed as was the Beech Aircraft Corporation provided drag polar. The RC-12H aircraft has marginal climb performance capabilities with a standard day 15,000 pound mission gross weight service ceiling at 22,250 feet. The handling qualities of the RC-12H were satisfactory. Artificial stall warning margins are inadequate for the cruise and single-engine power approach configurations and are a deficiency. A previously reported deficiency of main landing gear wheel lockup during landings with maximum braking still exists. Three shortcomings were identified.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	**21. ABSTRACT SECURITY CLASSIFICATION** UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL SHEILA R. LEWIS	**22b. TELEPHONE** *(Include Area Code)* (805) 277-2115	**22c. OFFICE SYMBOL** SAVTE-PR

TABLE OF CONTENTS

CONCLUSIONS

APPENDIXES

INTRODUCTION

BACKGROUND

1. The RC-12H is an RC-12D aircraft reconfigured for additional externally mounted GUARDRAIL sensor pods and antennas. The aircraft is intended for electronic warfare/electronic intelligence (EW/ELINT) operations. Special equipment includes a series of external antennae. Six of these aircraft are currently being modified by Electronic Systems Laboratory Inc. with Beech Aircraft Corporation (BAC) as subcontractor for airframe modifications. A quantitative evaluation of aircraft performance and handling qualities was required to determine the effects of the RC-12H antenna configuration on aircraft handling qualities and performance. The U.S. Army Aviation Engineering Flight Activity (AEFA) was tasked by the U.S. Army Aviation Systems Command (ref 1, app A) to conduct a Preliminary Airworthiness Evaluation (PAE) of the RC-12H airplane.

TEST OBJECTIVE

2. The objective of this PAE was to conduct a limited quantitative performance and handling qualities evaluation of the RC-12H to determine the effects of the sensor pod and antenna configuration on performance and handling qualities.

DESCRIPTION

3. The RC-12H (GUARDRAIL/COMMON SENSOR) is an RC-12D aircraft which has been modified to accomodate larger direction finder/electronic intelligence (DF/ELINT) pods on each wing tip and the communications high accuracy airborne location system. The RC-12H manufactured by BAC, is a pressurized, all-weather transport with all-metal construction. The aircraft is powered by two Pratt-Whitney PT6A-41 turboprop engines, rated at 850 shaft horsepower at sea level standard day conditions, manufactured by United Aircraft of Canada Ltd. The aircraft is equipped with dual flight controls and the pilot and copilot are seated side by side. The retractable tricycle landing gear is electrically driven. The flight control system is fully reversible. A pneumatic rudder boost is installed to help compensate for asymmetrical thrust and a yaw damper system is provided to improve dynamic lateral/directional stability. A more detailed description of the RC-12H aircraft is contained in the operator's manual (ref 2) and Beech Specification BS-23938 (ref 3). Appendix B contains a brief description, diagrams, and photographs of the test aircraft.

Keywords: Utility aircraft, Transport aircraft. (SRU)

TEST SCOPE

4. A PAE was conducted on RC-12H (GUARDRAIL/COMMON SENSOR), USA S/N 83-24314 at the BAC facility in Wichita, Kansas. Tests were conducted from 8 June to 16 June 1987 for a total of 20.4 hours of which 15.0 were productive. The flight evaluation was conducted in a "fully configured" external mission configuration except that the following antennas were not installed: (1) low-band vertical dipole near each wing tip at butt line 310.0, (2) low-band whip on the top of the fuselage at fuselage station (FS) 332.0, (3) low-band towel bar on each side of the fuselage at FS 423.34, and (4) the AN/APR-39 blade at FS 173.0 (a smaller telemetry antenna was installed at this location). The test aircraft had an 86 inch boom installed on the nose at FS 14.0 to accommodate test instrumentation (sideslip, angle-of-attack, pitot/static pressure). The test aircraft was ballasted to a takeoff gross weight of 15,700 pounds and longitudinal center of gravity (cg), at FS 189.5 (fwd) and 195.1 (aft). Ballast was added to bring each pod weight up to 400 pounds to simulate mission loading. The test aircraft handling qualities were compared to the requirements of military specification MIL-F-8785C (ref 4, app A). Performance was compared with reference 9 and drag polars provided by BAC. Flight restrictions and operation limitations contained in the operator's manual and the airworthiness release (ref 5) were observed. The aircraft configurations are presented in table 1 and the test conditions are shown in tables 2 and 3.

TEST METHODOLOGY

5. Established flight test techniques and data reduction procedures were used during this test program (refs 6 and 7). The test methods are described briefly in the Results and Discussion section of this report. Flight test data were recorded on magnetic tape and logged from calibrated cockpit instruments. A test airspeed boom system was mounted on the nose at fuselage station 14.0. A list of the test instrumentation is contained in appendix C. Test techniques (other than the standard techniques described in the appropriate references), weight and balance, and data reduction techniques are described in appendix D. Control system rigging check, fuel cell calibration, and aircraft weight and balance were performed by BAC and monitored by AEFA personnel. A pitot-static system calibration was provided to AEFA personnel by BAC. Deficiencies and shortcomings are in accordance with the definitions presented in appendix D.

Table 1. Aircraft Configurations

Configuration	Landing Gear Position	Flap Setting (%)	Power Setting	Propeller Speed (rpm)
Takeoff (TO)	Down	0 40	Takeoff	2000
Cruise (CR)	Up	0	As Required	As Required
Landing (L)	Down	100	Idle	2000
Power Approach (PA)	Down	100	Power to maintain 5 deg descent angle	2000
Glide (GL)	Up	0	Power off, propellers feathered	0
Go-Around (GA)	Down	100	Takeoff	2000

Table 2. Performance Test Conditions[1]

Test	Average Longitudinal Center of Gravity	Average Density Altitude (ft)	Trim Calibrated Airspeed (kt)	Aircraft Configuration
Takeoff[2]	194.8 (aft)	1,820	105	TO
Climb	189.3 (fwd)	16,450	111 to 174	CR
Glide	189.1 (fwd)	16,140	111 to 221	CR
Level Flight	189.1 (fwd)	16,400	114 to 189	CR
Landing[3]	194.8 (aft)	1,860	95	L

NOTES:

[1]Tests conducted with ball-centered at a gross weight between 14,300 and 15,500 pounds.
[2]Takeoff tests conducted with 0% and 40% flaps.
[3]Landing tests conducted with 0% and 100% flaps.

Table 3. Handling Qualities Test Conditions[1]

Test	Average Longitudinal Center of Gravity Location (FS)	Average Density Altitude (ft)	Trim Calibrated Airspeed (kt)	Aircraft Configuration
Control Positions in Trimmed Forward Flight	189.1 (fwd)	16,400	114 to 189	CR
Static Longitudinal Stability	195.0 (aft)	7,100	95	PA
		24,000	130	CR
Static Lateral-Directional Stability	195.0 (aft)	6,460	93	CR
		26,000	129	
Roll Performance	195.0 (aft)	24,400	130	CR
Dynamic Longitudinal[2] Stability	194.9 (aft)	7,100	95	PA
	194.7 (aft)	25,500	129	CR
Dynamic Lateral-Directional Stability	194.7 (aft)	25,200	127	CR
Dual-Engine[3] Stall Characteristics	189.3 (fwd)	16,140	115	TO (0% Flaps)
			105	TO (40% Flaps)
			115	CR
	194.8 (aft)		97	L
			105	PA
Single-Engine[3,4] Stall Characteristics	189.2 (fwd)	14,240	123	TO, PA
	194.7 (aft)			TO, PA, CR
Single-Engine[5] Characteristics	194.6 (aft)	9,120	124	TO, GA
		13,180	94 to 105	TO

NOTES:

[1]Tests conducted ball-centered at gross weights between 14,200 to 15,750 pounds. All flights conducted at aft cg and with 400 pounds installed in each wing-tip mounted DF/ELINT pod.
[2]Automatic flight control system ON and OFF.
[3]Unaccelerated and accelerated stalls were conducted.
[4]Single-engine stalls were conducted with takeoff power and power for single-engine approach with inoperative engine propeller feathered.
[5]Tests were conducted with yaw damper OFF.

RESULTS AND DISCUSSION

GENERAL

6. Limited performance and handling qualities tests of the RC-12H aircraft were conducted at the BAC facility in Wichita, Kansas. The aircraft was tested in the "full configured", (except as noted in paragraph 4), external mission configuration ballasted to the mission gross weight at the test conditions listed in tables 2 and 3. Lack of adequate stall warning was identified as a deficiency in addition to the previously identified deficiency of wheel lock up during maximum braking. Three shortcomings were identified.

PERFORMANCE

General

7. The performance characteristics of the RC-12H aircraft were evaluated in the normal mission configuration near the mission gross weight (15,000 lb) and longitudinal cg (FS 189.5 (fwd)). Takeoff and landing performance was measured at the BAC facility on a dry, hard surface runway. The RC-12H met or exceeded the handbook takeoff performance. Landing distances exceeded those presented in the operator's manual, however, maximum braking was not used. A previously reported deficiency of main landing gear wheel lockup during landings with brakes has not been corrected and remains a deficiency (ref 8, app A). Propeller feathered glide tests confirmed the baseline drag polar developed by BAC for the RC-12H.

Takeoff Performance

8. Dual-engine takeoff performance was quantitatively and qualitatively evaluated at the conditions presented in table 2 to verify handbook performance charts. Single-engine takeoff performance was not conducted during this evaluation. All takeoffs were conducted by aligning the aircraft on the centerline of the runway with the nose wheel straight. Full takeoff power was applied prior to brake release. The rotation and liftoff airspeeds were those presented in the operator's manual (ref 2). Trim was set for takeoff (three degrees up elevator, aileron and rudder set to zero). Takeoffs were conducted at 0 and 40 percent flap settings. Ground roll distances were determined by the use of runway ground observers. During all takeoff tests conducted, the observed ground roll distances were less than those specified in the operator's manual.

Table 4. Climb and Level Flight Drag Polar Coefficient[1]

Number of Engines Operating	Flight Condition	C_{Do}	$\frac{\Delta C_D^2}{\Delta C_L^2}$	A	B	C
2	Climb	0.0387	0.0416	Zero	0.1127	-0.0035
0	Level Flight			Zero	Zero	Zero
2				Zero	0.1480	-0.0045

The following coefficients were provided by BAC

0	Level Flight	0.0435	0.0404	Zero	Zero	Zero
2				Zero	0.1430	-0.0095

NOTES:

[1]General drag equation: $C_D = C_{Do} + \frac{\Delta C_D^2}{\Delta C_L} C_L^2 + AT'_c{}^2 + BT'_c + C$

Where:

C_D = Coefficient of drag.
C_{Do} = Minimum coefficients of drag of the propeller feathered drag polar
$\frac{\Delta C_D^2}{\Delta C_L^2}$ = Slope of drag polar
C_L = Coefficient of lift.
T_C = Coefficient of thrust.
A, B, C = Constants

Stall Performance

12. Stall performance was evaluated at the conditions listed in table 3. Unaccelerated stalls were conducted wings level with approximately 1 kt/sec deceleration, and accelerated stalls were conducted using windup turns at constant load factor with a deceleration of approximately 2 kt/sec. The stall speed as defined in MIL-F-8785C paragraph 6.2.2 was the speed at which uncommanded pitching, rolling, or yawing occurred. This definition differs from the Federal Aviation Regulation Part 23.201(c) which defines the stall as an uncontrollable downward pitching motion or when the control reaches the stop. The first uncommanded pitching in the RC-12H airplane can be reasonably controlled and the airspeed further reduced until full aft elevator control is reached. Stall speeds in accordance with both definitions for the various aircraft configurations, along with stall warning and buffet speeds are shown in table 5. For the purpose of this report the MIL-Spec stall definition will be used. In all configurations tested, aerodynamic buffet was followed very closely by stall (0 to 3 knots) and, therefore, provided inadequate stall warning. Artificial stall warning was provided by a stall warning horn. The activation of the stall warning horn during unaccelerated stalls as defined by MIL-F-8785C occurred within 12 to 14 knots above stall in all configurations except cruise (CR) and single-engine (S/E) power approach (PA) and is satisfactory. Activation of the stall warning horn in the CR configuration occurred one knot after the stall occurred. In the S/E PA configuration the stall warning horn activated one knot prior to the stall. The stall warning during unaccelerated stalls in the CR configuration and in the S/E PA configuration is a deficiency. During accelerated stalls (1.5 to 2.1g) the artificial stall warning system activated at 11 to 28 knots above stall depending on power setting and aircraft configuration and is satisfactory. The stall warning system does not meet the requirements of MIL-F-8785C paragraph 3.4.2.1.1.1 during unaccelerated (1g) stalls, in that the minimum stall warning onset is less than 5 knots in the TO (40% flap), CR, and PA (S/E) configurations. The following warning should be placed in paragraph 8-62 of the flight manual.

WARNING

> The RC-12H stall warning system does not provide adequate warning of impending stall. When operating under conditions where altitude loss is critical and stall recovery and aircraft control is difficult such as night, IMC and autopilot operations, the pilot must closely monitor airspeed.

Table 5. Stall Performance Airspeeds

Airplane Configuration	Engine Torque L/R (%)	Average Gross Weight (lbs)	Artificial Stall Warning (KIAS)	Aerodynamic Buffet (KIAS)	Stall MIL-F-8785C (KIAS)	Stall FAR Part 23 (KIAS)	Remarks
TO, 0% Flaps	88/87	14910	100	86	88	67	
TO, 40% Flaps	86/87	14840	83	79	79	60	
CR	49/48	14780	104	105	105	95	Unaccelerated (1g) stalls
PA	28/28	14850	81	74	71	71	
L, 100% Flaps	2/2	14840	89	80	81	77	
TO, 0% Flaps	90/91	14420	162	151	151	110	2.1g
TO, 40% Flaps	87/87	14340	131	103	103	83	1.5g
L, 100% Flaps	2/2	14200	115	108	108	104	1.5g
TO, 0% Flap	0/82	13910	100	93	94	80	Left engine shutdown and prop feathered
TO, 40% Flap	0/84	13790	87	80	80	65	
PA	0/79	13770	79	77	78	72	

NOTE:

[1]All test performed at FS 189.2 to FS 189.3 (fwd) longitudinal center of gravity and an average density altitude of 16,140 ft.

Landing Performance

13. Landing performance was quantitatively and qualitatively evaluated at the conditions presented in table 2. Landings were performed with flaps up, and with flaps set at 100 percent in accordance with the procedures described in the Aircrew Training Manual (ref 10, app A) by maintaining the operator's manual recommended reference airspeed (V_{ref}) at 50 feet above the landing threshold. Normal pilot technique was then utilized to obtain the predetermined touchdown point. After touchdown on the main wheels, the nose wheel was lowered to the ground immediately with braking applied to smoothly and rapidly stop the aircraft without the use of reverse propeller thrust. Landing distances were determined by a runway ground observer. Landing distances obtained for all configurations were greater than those presented in the operator's manual. However, maximum braking was not used due to a previously reported but uncorrected deficiency of wheel lockup during maximum braking (ref 8). A brake anti-skid system should be installed to optimize landing performance and prevent wheel lockup. Even though maximum braking was not used, the aircraft was brought to a stop in less than 3000 feet.

Roll Performance

14. Roll performance of the RC-12H was evaluated at the conditions presented in table 2 with the yaw damper on. These tests were initiated from a trimmed unaccelerated flight condition by applying 1/4 to full lateral control step inputs (in 0.2 seconds) without changing either longitudinal or directional control positions. Test results are presented in figure 5, appendix E. The aircraft was responsive in roll and the lateral control forces were satisfactory. Time required to roll 45 degrees either left or right with full control deflection was approximately 1.6 seconds at 130 knots indicated airspeed (KIAS) and maximum adverse yaw was 6.0 degrees. Representative time histories are presented in figures 6 and 7, appendix E. The roll performance of the RC-12H is satisfactory.

HANDLING QUALITIES

General

15. A limited handling qualities and pilot workload evaluation of the RC-12H aircraft was conducted to determine stability and control characteristics at the test conditions listed in table 3. Emphasis was placed on operation at the maximum mission gross weight of 15,000 pounds and aft mission cg, (FS 195.1). All maneuvers were flown using ball-centered flight as a trim reference.

Control Positions in Trimmed Flight

16. The capability to trim the aircraft to a given airspeed and zero control force was evaluated concurrently with other testing. Manual trim of all controls was satisfactory and easily accomplished for all configurations tested. The slow rate of travel (57 seconds from full nose-down to full nose-up) of the electrical pitch trim system, previously reported (ref 11), has been improved to approximately 47 seconds for full trim travel. However, the pilots preferred using the manual pitch trim wheel because the airplane could be trimmed more quickly and more precisely with the pitch trim wheel. The RC-12H control position characteristics in trimmed flight are satisfactory.

Control System Characteristics

17. Control system characteristics were measured on the ground under static conditions. Control surface travels and measured cable tensions are presented in table 1, appendix E.

Static Longitudinal Stability

18. Static longitudinal stability tests were performed at the conditions listed in table 3. The aircraft was trimmed in steady-heading, ball-centered level flight at 95 and 130 knots calibrated airspeed (KCAS), then stabilized at incremental airspeeds greater than and less than these trim airspeeds. Test data are presented in figure 10. The stick-free static longitudinal stability, as indicated by the variation in elevator control force with airspeed, was positive for both airspeeds above and below the trim airspeed. At 95 KCAS in the PA configuration a lightening of the elevator control forces was noted but was not objectionable. At 130 KCAS in the CR configuration the control force variation with airspeed was essentially linear at 0.5 lb/kt. The stick-fixed stability, as indicated by the variation in elevator control position with airspeed, was weak but positive. The control position variation with airspeed was 0.013 in/kt in the PA configuration at 95 KCAS and decreased to 0.005 in/kt in the CR configuration at 130 KCAS. The shallow elevator control position gradients were not objectionable. The static longitudinal stability characteristics of the RC-12H airplane are satisfactory and meet the requirements of MIL-F-8785C.

Static Lateral-Directional Stability

19. Static lateral-directional stability tests were performed at the conditions listed in table 3. Tests were conducted by

trimming the aircraft (ball-centered) at 93 KCAS in the PA configuration and 129 KCAS in the CR configuration, and then stabilizing at various sideslip angles both left and right in approximate 5 degree increments while maintaining a constant airspeed, power lever position, and zero turn rate. Test data are presented in figures 11 and 12, appendix E. Apparent dihedral (variation of lateral control position with sideslip) and apparent directional stability (variation of directional control position with sideslip) were both positive. The rudder control force variation with sideslip angle decreased to essentially a neutral gradient at sideslip angles greater than 5 degrees in the 93 KCAS, PA configuration. This neutral control force gradient was not objectionable. The RC-12H airplane had a nose-down sideslip to pitch coupling, as indicated by the requirement for increasing aft elevator control displacement and pull force with increasing sideslip angles in both directions. The side-force cues (variation of bank angle with sideslip) provided an excellent indication of out-of-trim conditions. The static lateral-directional stability characteristics of the RC-12H airplane are satisfactory. The static lateral-directional stability meets the requirements of MIL-F-8785C except for paragraph 3.3.6.1, in that, variation of sideslip angle with yaw control force was not essentially linear for sideslip angles between +10 degrees and -10 degrees.

Dynamic Longitudinal Stability

20. The dynamic longitudinal stability characteristics were evaluated at the conditions shown in table 3. The long-term (phugoid) dynamic characteristics were evaluated by varying airspeed approximately 10 knots above or below the trim airspeed, then returning the longitudinal control to the trim position. The control fixed and control free long-term responses were evaluated during level flight with the autopilot system on and off. Time histories of representative response characteristics are presented in figures 13 through 17, appendix E. With both controls fixed and free, the long-term response was very lightly damped (damping ratio of approximately 0.02 and period of approximately 50 sec) with the autopilot system off. With the autopilot system on, the long-term response was moderately damped (three over-shoots). The dynamic longitudinal stability characteristics of the RC-12H are satisfactory and meet the requirements of MIL-F-8785C.

Dynamic Lateral-Directional Stability

Dutch Roll Characteristics:

22. The dynamic lateral-directional stability characteristics (lateral-directional damping and dutch roll characteristics) were

evaluated at the condition shown in table 3. These tests were conducted by exciting the aircraft from a coordinated level flight trim condition with rudder doublets and releases from sideslips. Tests were conducted with yaw damper off and with controls fixed and free. A representative time history is presented at figure 18, appendix E. The lateral-directional oscillations (dutch roll mode) with the yaw damper off were lightly damped (damping ratio of approximately 0.07 and period of approximately 4.5 sec). With the yaw damper engaged the dutch roll mode was heavily damped and not easily excited. In light turbulence without pilot inputs, the dutch roll damped out in one to two cycles. The dutch roll characteristics of the RC-12H aircraft are satisfactory and meet the requirements of MIL-F-8785C.

Spiral Stability:

23. The spiral stability characteristics of the RC-12H aircraft were evaluated at the conditions shown in table 3. These tests were conducted by establishing 15 degree bank angles (both left and right) from trim conditions, using aileron only, and after stabilizing at the prescribed bank angle, the control was slowly returned to the trim position. Spiral stability (as indicated by change in bank angle with elapsed time) was neutral to negative for both left and right turns. The spiral stability characteristics of the RC-12H aircraft are satisfactory and meet the requirements of MIL-F-8785C.

Stall Characteristics

General:

24. Dual and single-engine stall characteristics of the RC-12H aircraft were evaluated in conjunction with stall performance testing (para 12) and stall handling qualities at the conditions listed in table 3. Stall warning, stall, and stall recovery characteristics were evaluated.

Unaccelerated Stalls:

25. The RC-12H unaccelerated dual-engine stalls were characterized by: (1) very light buffet onset; (2) artificial stall warning; (3) pitch oscillations (±5 to 7 degrees); and (4) mild wing rock (5 to 10 degrees left and right). At heavy gross weight conditions (15,000 lb) the stall recovery required a steep nose down pitch (approximately 20 degrees) to be held for several seconds for sufficient airspeed to be gained to avoid secondary stalls. This resulted in significant altitude loss, especially for power off stalls where turbine engine lag resulted in a delay in

achieving maximum power. As airspeed was decreased, approaching the stall, the uncommanded nose down pitch could be controlled by applying additional aft elevator control. The aircraft generally could be controlled into deep stall to full aft elevator control by quick pilot reaction with aileron and rudder control to counter rolling and yawing motions. The RC-12H handling qualities in the stall and during stall recoveries were excellent. The ailerons and rudder were effective in controlling the aircraft laterally and directionally, even with full aft elevator control. Stalls conducted at an aft cg resulted in uncommanded pitch-ups which felt uncomfortable to the pilot, but which could always be countered by forward elevator requiring a slight push force. Stalls induced with the autopilot engaged along with an altitude hold mode, resulted in entering deep stall. The aircraft could not be powered out of the stall if power was applied at first warning (usually nose down pitch with simultaneous artificial warning). As a result of the inadequate stall warning previously discussed in paragraph 12, the autopilot had to be disconnected and stall recovery procedures used to regain the operational flight envelope.

26. Unaccelerated single-engine stall characteristics were evaluated with the left engine inoperative and propeller feathered, at the conditions listed in table 3. The single-engine stall characteristics were essentially the same as the dual-engine stall characteristics except that a slight left roll (5 to 10 degrees) accompanied the stall. The single-engine unaccelerated stall characteristics of the RC-12H are satisfactory.

Accelerated Stalls:

27. Dual-engine accelerated (2g) stalls were evaluated at the conditions listed in table 3 using windup turns to the left. At stall, the aircraft exhibited the same characteristics as in the unaccelerated stall, except that the elevator control forces were high (40 to 60 pounds in a 60 degree banked turn). The aircraft had a characteristic roll out of the turn at the stall. This inherent rollout characteristic, as well as a decrease in load factor, initiated the recovery. The dual-engine accelerated stall characteristics of the RC-12H are satisfactory.

Stall Recovery:

28. The RC-12H aircraft was recovered from all dual-engine stalls by relaxing aft longitudinal control force, reducing angle of attack and adding power to minimize altitude loss. At heavy gross weights, secondary stall tendency (recurrence of buffet)

was encountered. Altitude loss during stall recovery was generally 500 to 1500 feet.

29. Single-engine stall recovery was best achieved by slightly reducing power on the operating engine at the pitch break, lowering the nose of the aircraft to the horizon, accelerating to the best single-engine rate of climb airspeed, and coordinating maximum controllable power to minimize altitude loss. Altitude loss during single-engine stall was 800 to 2000 feet.

Single-Engine Characteristics

Static V_{MC}:

30. Static single-engine V_{MC} tests were conducted at the conditions presented in table 3. Tests were conducted with the left (critical) engine inoperative and propeller feathered, decelerating at 1 knot per second while banking 5 degrees into the operating engine in constant heading flight. The operating engine was set at takeoff power with a propeller speed of 2000 rpm. The airspeed at which directional or roll control could not be maintained was defined as static V_{MC}. If single-engine stall occurred prior to V_{MC}, the stall speed defined static V_{MC}.

31. V_{MC} was the single-engine stall speed for all conditions tested except at 8000 feet pressure altitude where V_{MC} was 86 KIAS. A 200 to 300 feet loss of altitude was observed during the maneuver and V_{MC} stall recovery was easily achieved. The single-engine static V_{MC} characteristics are satisfactory.

Dynamic V_{MC}:

32. Dynamic V_{MC} tests were conducted at conditions presented in table 3 by reducing the power lever to idle and feathering the propeller on the left (critical) engine while trimmed in symmetrical full power flight. The controls were held fixed for one second simulating pilot reaction time. All flight controls were then used to return the aircraft to stabilized flight at the trim airspeed without reducing power on the operating engine or adding power from the simulated failed engine. At 12,000 feet H_d, two test methods were used to determine dynamic V_{MC}. One method was to simulate an engine failure (power to flight idle, propeller feathered) and the other method consisted of an actual engine shutdown. No significant differences were observed using either method. The aircraft was tested at the conditions presented in table 3. Dynamic V_{MC} was defined by static V_{MC} (S/E stalls except at 8000 feet pressure altitude (para 31)) at all conditions tested. The dynamic V_{MC} characteristics are satisfactory.

HUMAN FACTORS

Cockpit Evaluation

33. The chaff dispenser button is essentially identical in appearance and feel to the autopilot/yaw damper disengage (AP & YD/TRIM DISC) button (photo 2, app C) on the control yoke of the RC-12H aircraft. These buttons are separated by 2.7 inches and button identification markings are not readable from the design eye position. A pilot may inadvertently activate the wrong button under a high workload condition, possibly delaying deployment of radar countermeasure or disengagement of the autopilot. The essentially identical design of the chaff dispenser and AP & YD/TRIM DISC button is a shortcoming.

34. The autofeather switch is located on the overhead control panel adjacent to environmental control switches. This location requires excessive head movement by the pilot or copilot and disrupts a logical sequence during the "after takeoff" and "before landing" checks. The location of the autofeather switch will increase pilot workload during the most critical flight conditions and is a shortcoming.

MISCELLANEOUS

35. During stalls negative airspeed position errors of approximately 10 knots were observed on the copilot's airspeed indicator just prior to the stall. The excessive airspeed position error that occurs during flight at high angles of attack is a shortcoming. The excessive airspeed position error of the ship's airspeed system at combinations of sideslip, aircraft configuration (takeoff, go-around, power approach) and single-engine operation which was previously reported (ref 11, app A), was again observed and remains a shortcoming.

CONCLUSIONS

GENERAL

Specific

36. The following conclusions were reached based on the PAE of the RC-12H aircraft.

a. Takeoff performance data presented in the operator's manual were verified (para 8).

b. BAC's glide drag polar of the RC-12H aircraft was verified (para 11).

c. The RC-12H aircraft has marginal climb performance capabilities at 15,000 lb with a service ceiling at 22,250 feet (para 9).

d. A previously reported deficiency of main landing gear wheel lockup during landing with maximum braking remains a deficiency (para 13).

e. Excessive airspeed position error of the ship's airspeed system at combinations of sideslip, aircraft configuration (takeoff, go-around, and power approach) and single-engine operation was again observed and remains a shortcoming (para 35).

Deficiency

37. The inadequate stall warning during unaccelerated stalls in the CR configuration and in the S/E PA configuration is a deficiency (paras 12 and 25).

Shortcomings

38. The following shortcomings were identified:

a. The essentially identical design of the chaff dispenser and AP DISC/YD DISC buttons (para 33).

b. The location of the autofeather switch (para 34).

c. Excessive airspeed position error that occurs during flight at high angles of attack (para 35).

Specification Compliance

39. The RC-12H aircraft stall warning system does not meet the requirements of MIL-F-8785C paragraph 3.4.2.1.1 during unaccelerated (1g) stalls, in that, the minimum stall warning onset is

less than 5 knots in the TO (40% flap), CR and PA (S/E) configurations (para 12).

40. The RC-12H aircraft static lateral-directional stability does not meet the requirements of MIL-F-8785C paragraph 3.3.6.1, in that, variation of sideslip angle with yaw control force was not essentially linear for sideslip angles between +10 degrees and -10 degrees (para 19).

RECOMMENDATIONS

41. The deficiency identified during this evaluation should be corrected prior to aircraft delivery to the user (para 12).

42. Incorporate the following WARNING from paragraph 12 of this report in paragraph 8-62 of the flight manual.

WARNING

> The RC-12H stall warning system does not provide adequate warning of impending stall. When operating under conditions where altitude loss is critical and stall recovery and aircraft control is difficult such as night, IMC and autopilot operations, the pilot must closely monitor airspeed.

43. A brake anti-skid system should be installed to optimize landing performance and prevent wheel lockup.

APPENDIX A. REFERENCES

1. Letter, AVSCOM, AMSAV-8, 20 March 1987, subject: Preliminary Airworthiness Evaluation of the RC-12H. (Test Request)

2. Technical Manual, TM 55-1510-221-10, *Operator's Manual for Army RC-12H Aircraft*, unpublished.

3. Beech Specification, BS-23938, Rev B, *Model Specification Model RC-12H Guardrail/Common Sensor*, 20 September 1985.

4. Military Specification, MIL-F-8785C, *Flying Qualities of Piloted Airplanes*, 5 November 1980.

5. Letter, AVSCOM, AMSAV-E, 26 May 1987, with revision 1, 4 June 1987, subject: Airworthiness Release, RC-12H (S/N 83-24314) Preliminary Airworthiness Evaluation, AEFA Project No. 87-11.

6. Flight Test Manual, Naval Air Test Center, FTM No. 104, *Fixed Wing Performance*, July 1977.

7. Flight Test Manual, Naval Air Test Center, FTM No. 103, *Fixed Wing Stability and Control*, 1 January 1975.

8. Final Report, USAAEFA Project No. 75-08, *Airworthiness and Flight Characteristics Evaluation C-12A Aircraft*, October 1976.

9. Type Inspection Report 200-86, Model No. A200CT (RC-12H), 1 May 1987.

10. Training Circular, TC No. 1-145, *Aircrew Training Manual (Utility Airplane)*, 10 October 1980 through change 1, 27 July 1982.

11. Final Report, AEFA Project No. 84-02, *Airworthiness and Flight Characteristics Test of the RC-12D Guardrail V*, July 1984.

APPENDIX B. DESCRIPTION

GENERAL

1. The RC-12H aircraft is a modified RC-12D utility aircraft configured for the GUARDRAIL/COMMON SENSOR mission. Four views of the test aircraft are shown in photos 1 through 4. A sensor pod is shown in photo 5. Aircraft drawings are presented in figures 1 through 3. Dimensions and general data are presented in table 1. A detailed description of the RC-12H aircraft is contained in the Model Specification (Beech Specification BS 23938, dated 20 September 1985).

FLIGHT CONTROL SYSTEM

2. The aircraft primary flight control system is reversible and consists of conventional rudder, elevator, and aileron as on the standard RC-12D except that the size of the rudder trim tab has been increased. A Sperry Corporation SPZ-4000 Digital Automatic Flight Control System (AFCS) is installed. Aileron servo torque has been tailored (increased) to accommodate the high roll inertia created by the heavy DF/ELINT pods.

3. The Sperry AFCS is a completely integrated autopilot/flight director/air data system which has a full complement of horizontal and vertical flight guidance modes. Horizontal modes include: heading hold (HDG); navigation tracking of VOR, localizer, and INS courses (NAV); approach tracking of VOR and localizer courses (APR); and approach tracking of back course localizers (BC). Vertical modes include: altitude hold (ALT); altitude capture with automatic switch to altitude hold (ALT SEL); vertical velocity hold (VS); and indicated airspeed hold (IAS). In the APR mode the AFCS will automatically capture and track the glide slope beam. When the autopilot is coupled to the flight director commands, the instruments act as a means to monitor the performance of the autopilot. When the autopilot is not engaged, the same modes of operation are available for flight director only. The pilot maneuvers the aircraft to satisfy the flight director commands. One additional mode, which is available for uncoupled flight director commands only, is the go-around (GA) mode. When the GA mode is selected, by pressing a button on the left power lever, the autopilot will disengage and the flight director command cue will command a wings level, 7 degree pitch-up attitude.

4. A yaw damper is engaged whenever the autopilot is engaged. When the autopilot is not engaged, the yaw damper may be utilized separately at altitudes below 17,000 feet. The operator's manual requires use of the yaw damper at 17,000 feet and above. The yaw

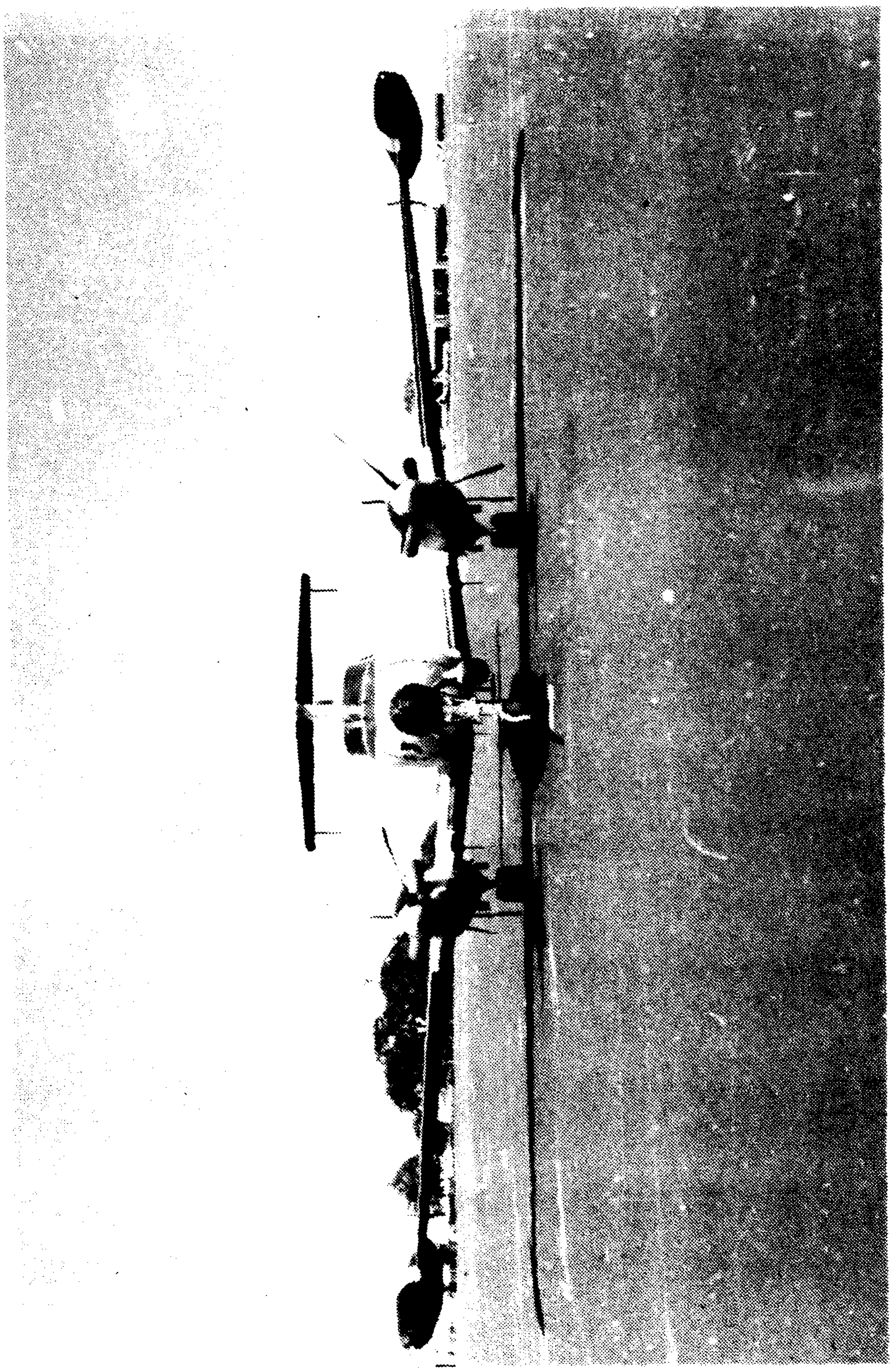


Photo 1. Front View

Photo 2. Left Front Quartering View

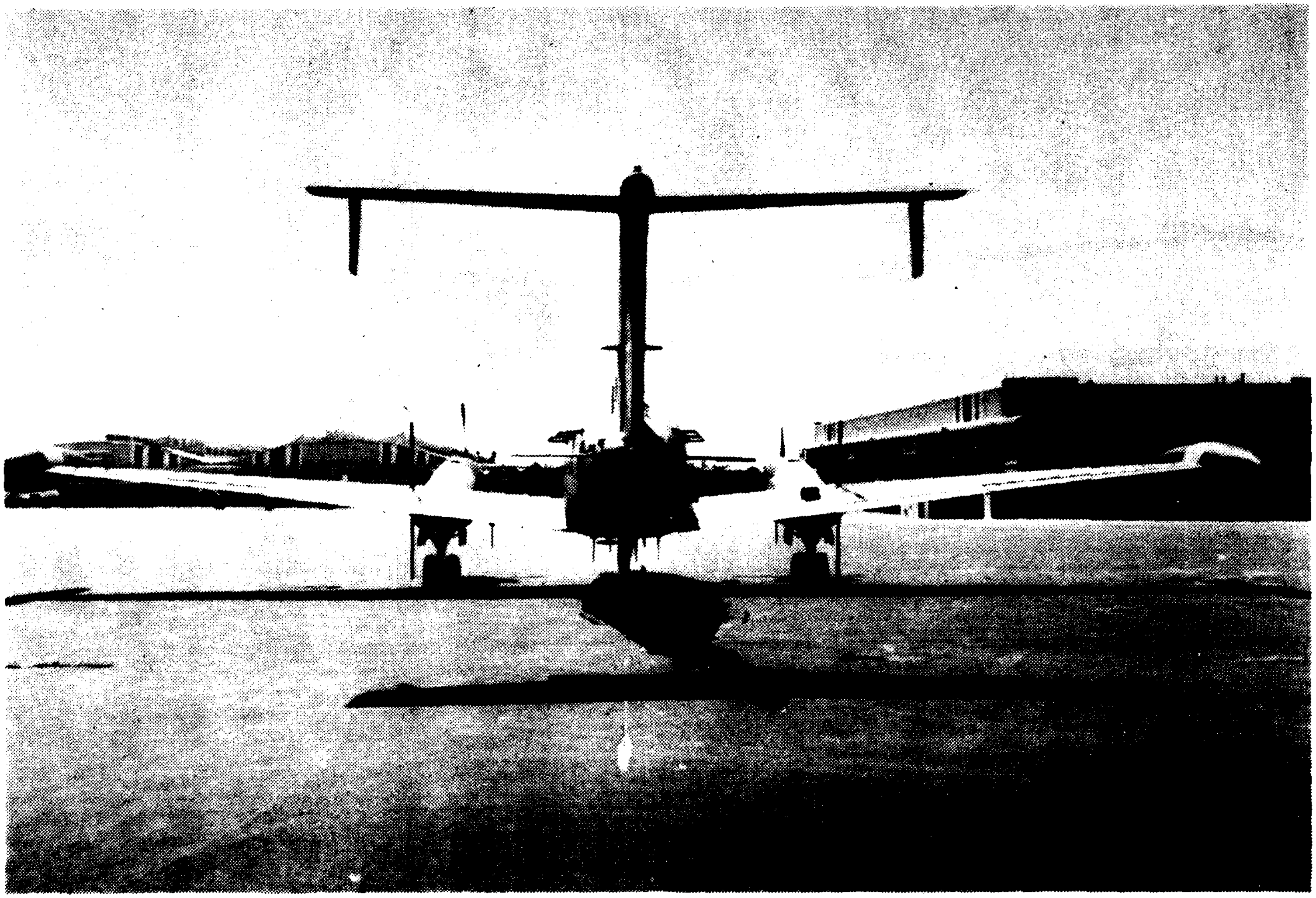


Photo 3. Rear View

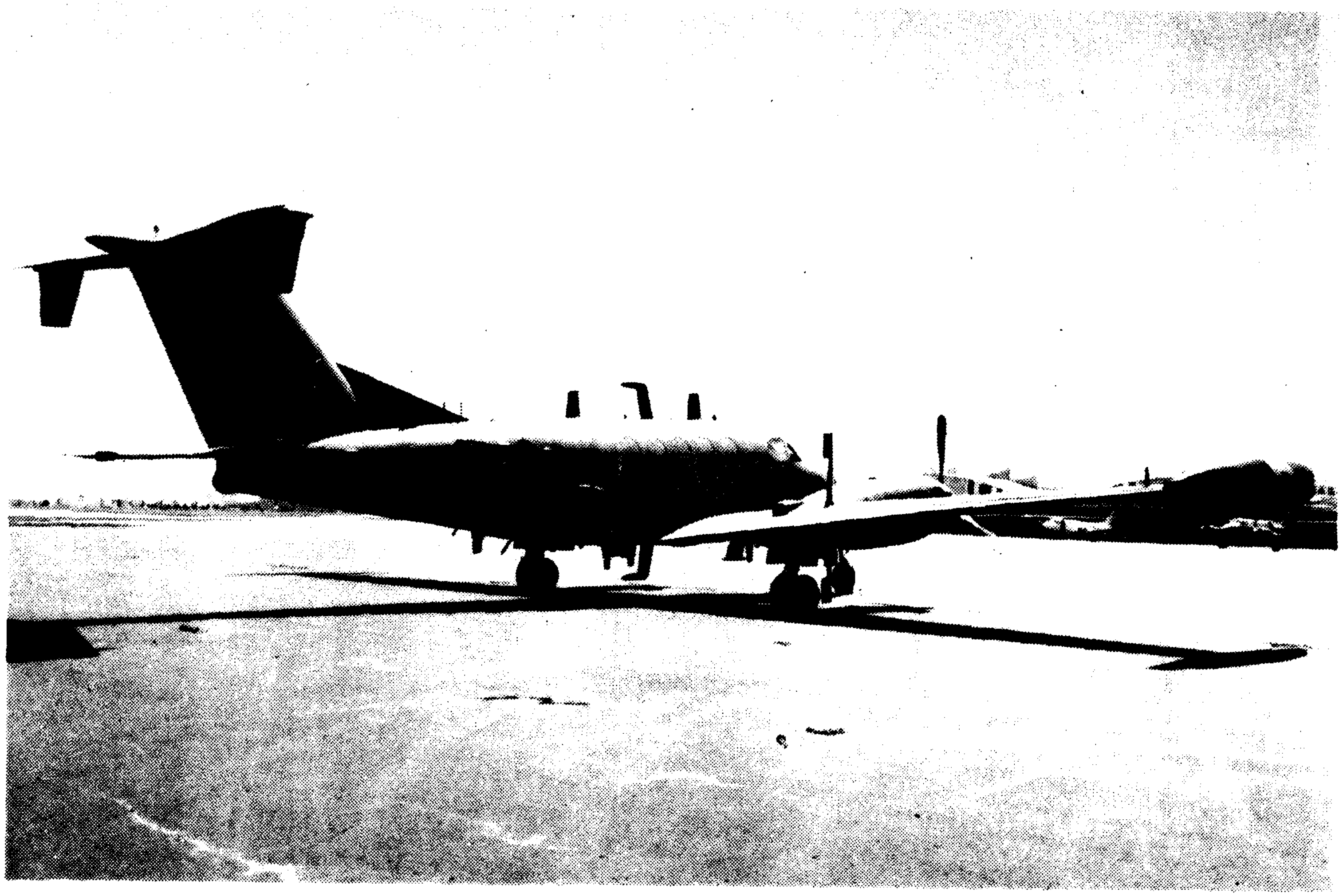


Photo 4. Right Rear Quartering View

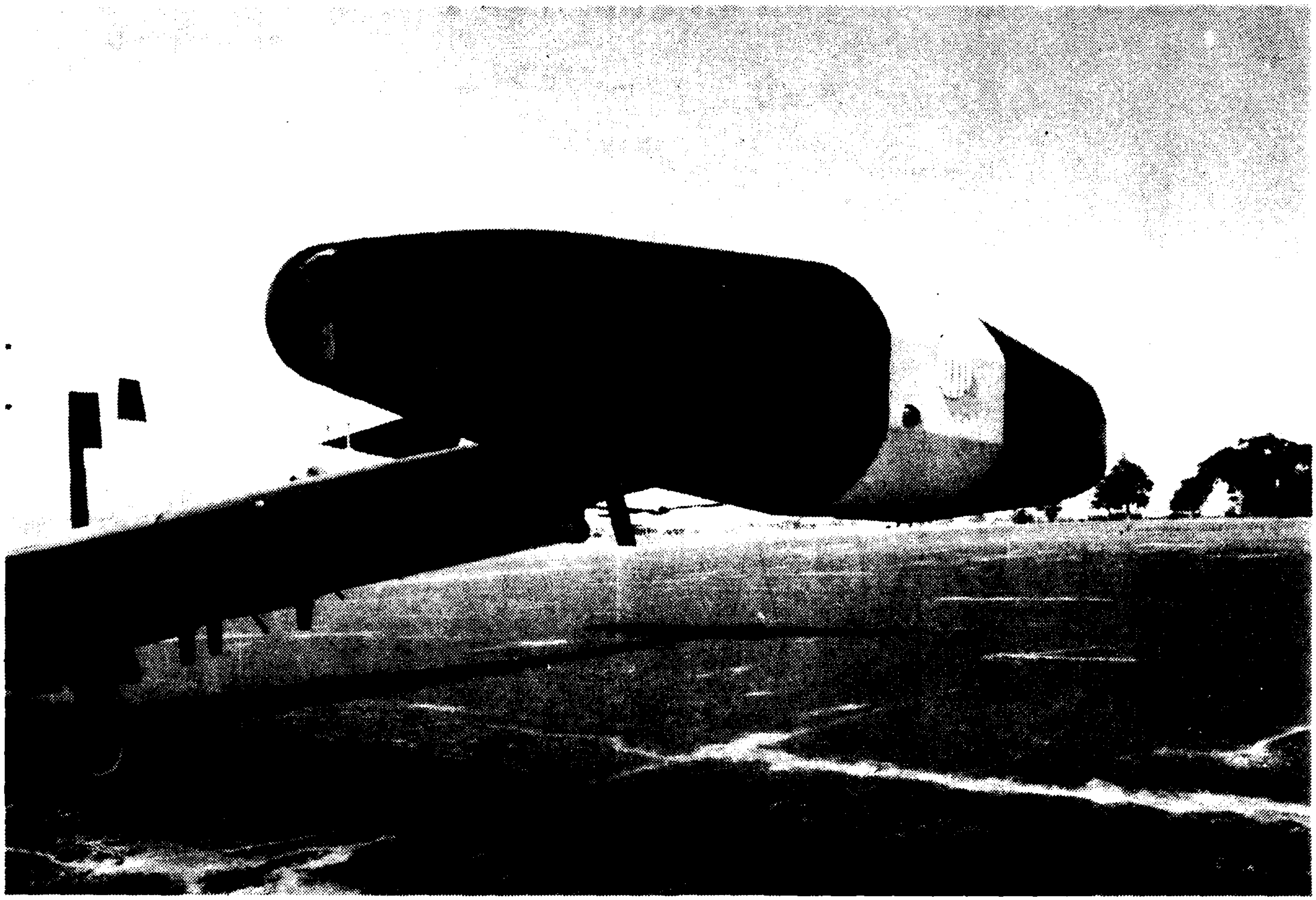
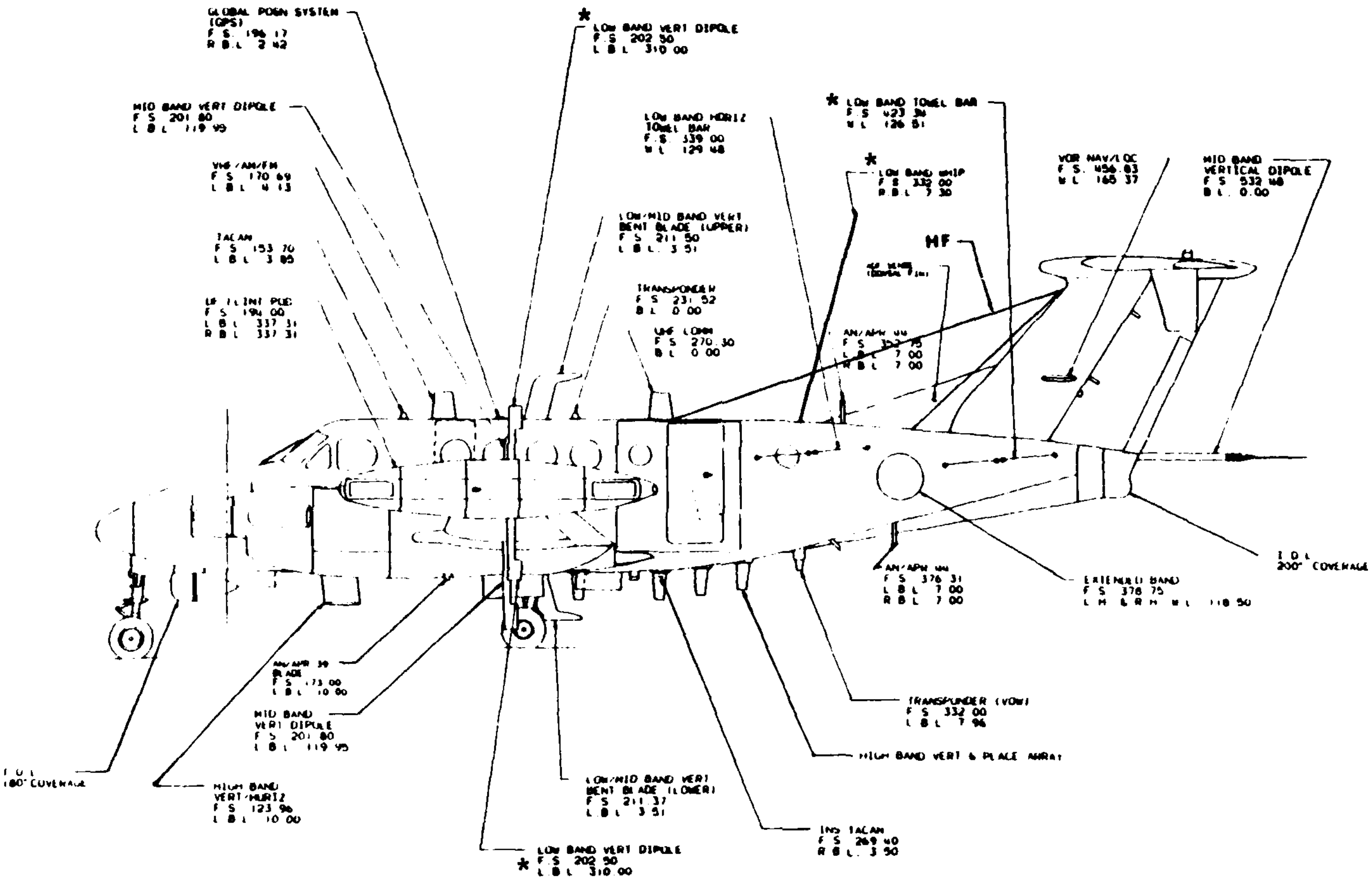
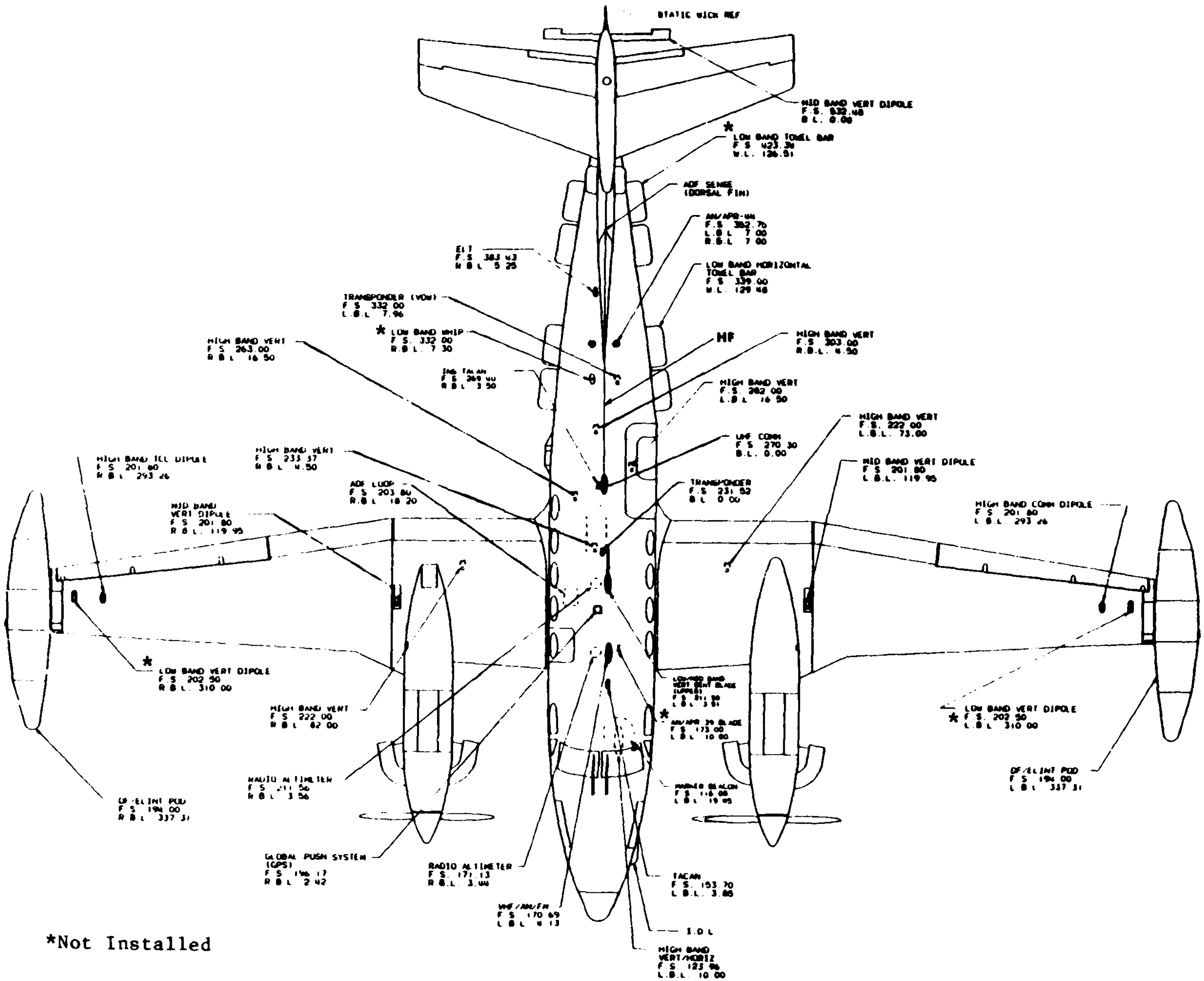


Photo 5. Right Antenna Pod



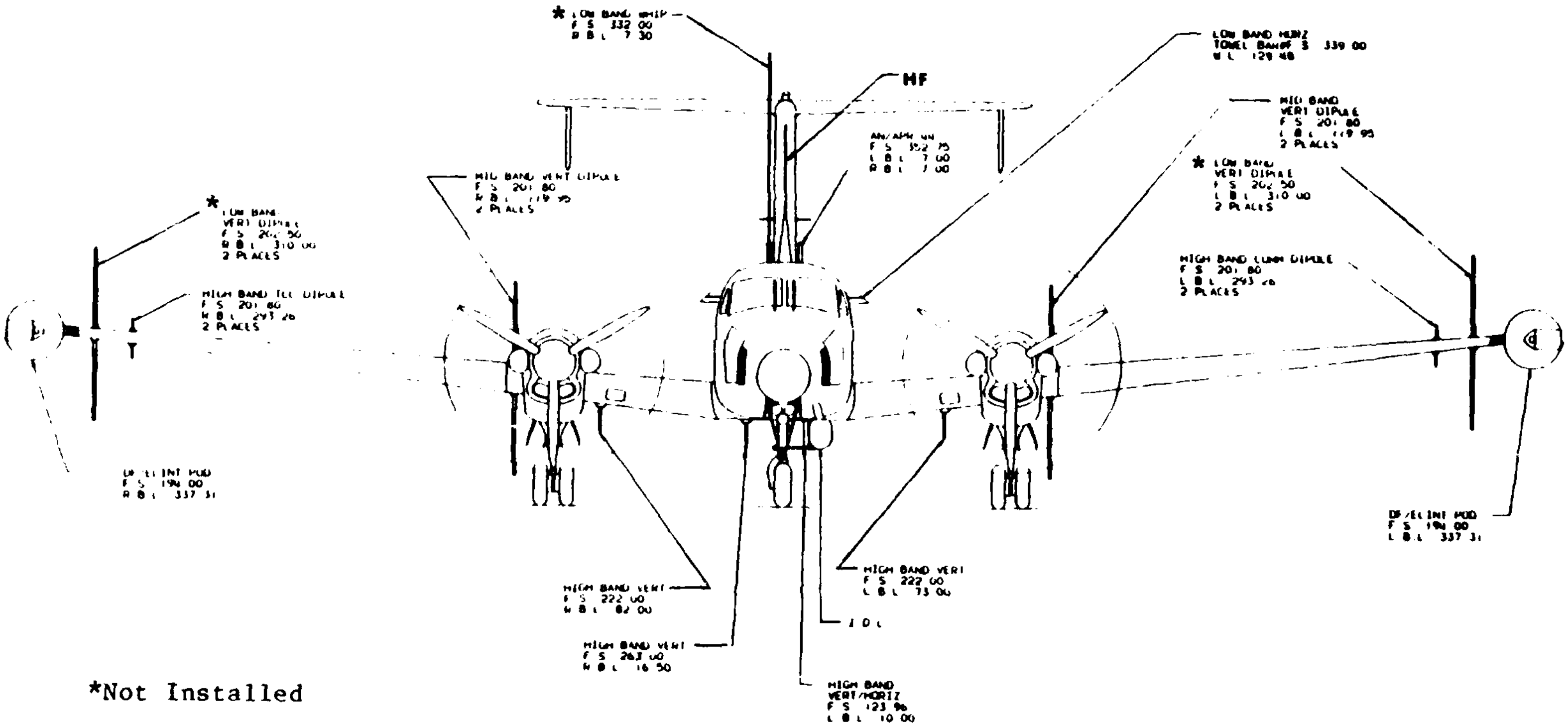
*Not Installed

Figure 1. RC-12H Side View



*Not Installed

Figure 2. RC-12H Plan View



*Not Installed

Figure 3. RC-12H Front View

rate signal used for yaw damping is derived from the directional gyro. Yaw damping decreases as roll rate and bank attitude are increased and is locked out if the aircraft roll rate exceeds 7 deg/sec or the bank attitude exceeds 45 deg, but the rudder pedal position will be held fixed by the rudder servo.

ELECTRICAL

5. The RC-12H uses both direct current (DC) and alternating current (AC) electrical power. The primary DC power source consists of two engine-driven 28 volt, 400 ampere generators. The output of each generator passes to a respective generator bus, then power is distributed to DC buses. When a generator is not operating, reverse current and over-voltage protection is automatically provided. Two inverters (750 volt-amperes, 115 volts and 26 volts, 400 hertz (Hz)) operating from DC power produce the aircraft required single phase AC power. The three phase mission AC (3000 volt amperes 400 Hz) electrical power for inertial navigation and mission avionics is supplied by two DC powered inverters. Battery voltage is displayed on an independent meter located on the mission control panel.

ENVIRONMENTAL

6. The environmental system consists of the bleed air pressurization and heating system with associated controls. A conventional automotive type freon air conditioning system is also installed. The air conditioning compressor is belt-driven by the right-hand engine.

DEICING

7. The windshield panel in front of each pilot is electrically anti-iced and defogged by air from the cabin heating system. Aircraft surface deicing for the leading edge of the wings, horizontal stabilizer, and taillets is by pneumatic deicer boots. Certain mission antennas are deiced by pneumatic boots. Separate selector switches for surface and antenna deicing allow manual boot inflation or automatic single cycle operation. Data link antenna anti-ice is provided for the forward data link radome and wheel brakes through the use of engine bleed air. Automatically cycled electrothermal anti-icing boots are installed on the propeller blades. Ice protection for the engines are provided by inertial separation and air inlet leading edge lip heating by engine exhaust bleed.

Table 1. Dimensions and General Data

1. The following dimensions and data are for descriptive purposes and are not to be used for inspection.

Wing	
Span, maximum	58.5 ft
Chord:	
At root (centerline of fusleage)	85.75 in.
At root Station 123.99 (disregarding leading edge extension)	79.07 in.
At Station 328.74	35.64 in.
Mean aerodynamic	70.41 in.
Leading edge of mean aerodynamic chord	Fus Sta 171.23
Airfoil section designation:	
At Station 25	NACA 23018 (Modified)
At Station 298.74	NACA 23012
Incidence (degrees)	
At root (theoretical centerline of fuselage)	3.48 degrees
At Station 328.74	-1.07 degrees
Sweepback:	
Outer panel at 25 percent chord	0 degrees
Center section at 100 percent chord	0 degrees
Dihedral, degrees	6.0 degrees
Aspect ratio	9.8
Height over highest fixed part of aircraft (tail) (airplane in normal-ground attitude)	14.67 ft
Length, maximum (normal-ground attitude)	45.67 ft
Distance from wing MAC quarter chord point to vertical tail MAC quarter chord point	25.19 ft
Angle between reference line and wing zero-lift line	-2 degrees
Ground angle, degrees	1.72 degrees
Propeller clearance, (normal design) loading condition reference line level	14.04 in.
Propeller diameter	98.5 in.
Wheel size	
Main wheels	6.50 x 10
Nose wheel	6.50 x 10
Tire size	
Main wheels	22 x 6.75 - 10
Nose wheel	22 x 6.75 - 10
Tread of main wheels	17.2 ft
Wheel base	14.9 ft
Vertical travel of axle from extended to fully compressed position	
Main wheels	17.95 in.
Nose wheel	10.11 in.
Distance from main wheel contact point to center of gravity	
Horizontal distance	
At most forward cg at gross weight	25.34 in.
At most aft cg at gross weight	11.34 in.

2. The following control surfaces and control movements information are for descriptive purposes and are not to be used for inspection.

Control Movement and Corresponding Control Surface Movements

Control and control surface movements on each side of neutral position for full movement, as limited by stops.

Rudder	25 degrees right, 25 degrees left
Rudder pedals	3.82 inches forward, 3.46 inches aft
Rudder tab or trim surface	15 degrees right, 15 degrees left
Rudder tab or trim surface control	4 turns for 30 degrees of tab or trim surface movement
Elevators	20 degrees above, 14 deg below
Elevator control	4.35 degrees aft, 2.00 inches forward
Elevator tab	3.5 degrees above, 13 deg below
Elevator tab control	2.75 turns for 47 seconds of time to time through full range, 16.5 deg movement
Ailerons	24 degrees trailing edge up 16 degrees trailing edge down
Aileron control wheel	70 degrees right, 70 degrees left
Aileron tab control	4 turns for 30 degrees tab movement
Wing flap (maximum)	35 degrees
Aileron tab or trim surface	15 degrees trailing edge up 15 degrees trailing edge down

INTERIOR ARRANGEMENT

8. The interior arrangement consists of the crew compartment and the mission equipment area. The crew compartment is separated from the mission equipment area by a curtain which may be opened or closed. The total interior space available for mission equipment is 299 cubic feet. Provisions for the stowage of two chest parachutes is incorporated near the emergency exit door.

MISSION ANTENNAS

9. Mission antennas are provided as depicted in figures 1 through 3. A detailed description of mission equipment and operation is contained in the operator's manual (ref 4, app A).

APPENDIX C. INSTRUMENTATION

1. Flight test data were recorded on magnetic tape using pulse code modulation and by hand from cockpit instruments located in the pilot's panel. Aileron, elevator, and rudder positions were measured using linear variable differential transducers. Control forces were measured using a strain gaged control yoke and pedals. A test boom pitot-static system was installed on the nose radome to measure airspeed.

2. Instrumentation and related special equipment installed are presented below. Photos 1 through 6 show the cockpit instrument panel, instrumented control yokes, instrumented pedals, cabin instrumentation, ballast locations, and test boom installation.

Airspeed (boom system)
Airspeed (standard system)
Altitude (standard system)
Propeller speed (left and right)
Gas producer speed (left and right)
Engine torque (left and right)
Fuel flow (left and right)
Fuel quantity (left and right)
Outside air temperature

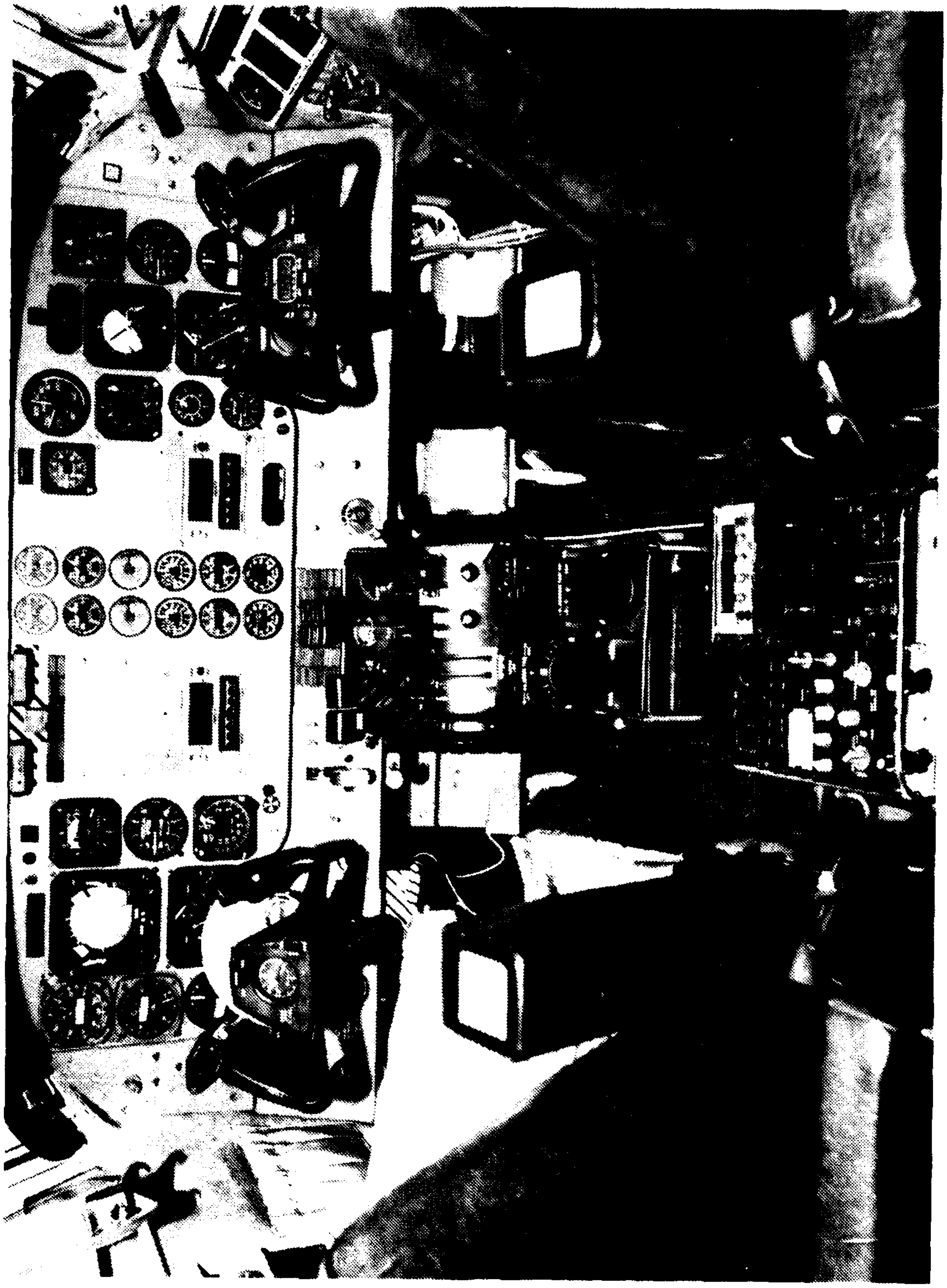


Photo 1. Cockpit View

Photo 2. Pilot Side

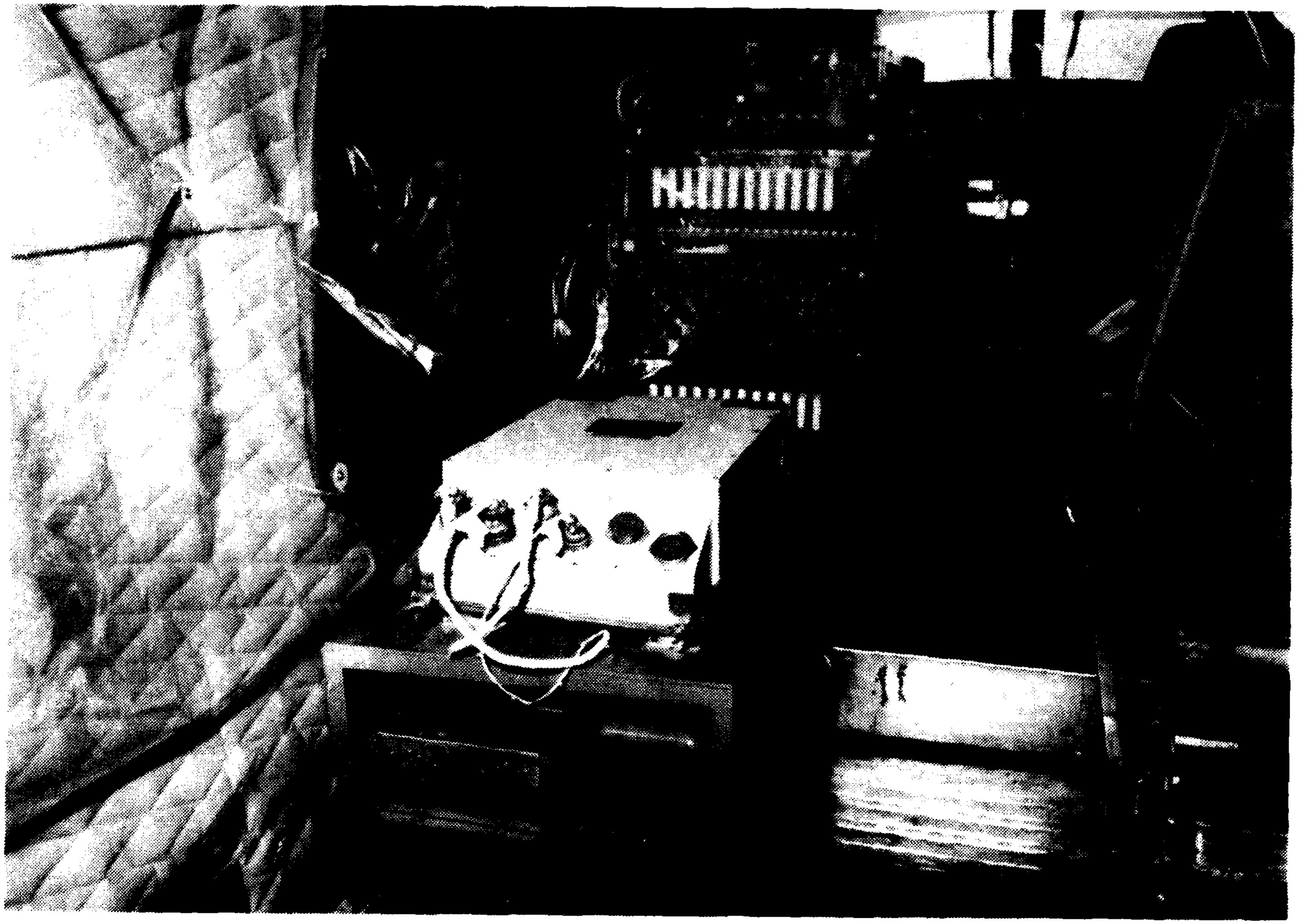


Photo 3. Instrumentation

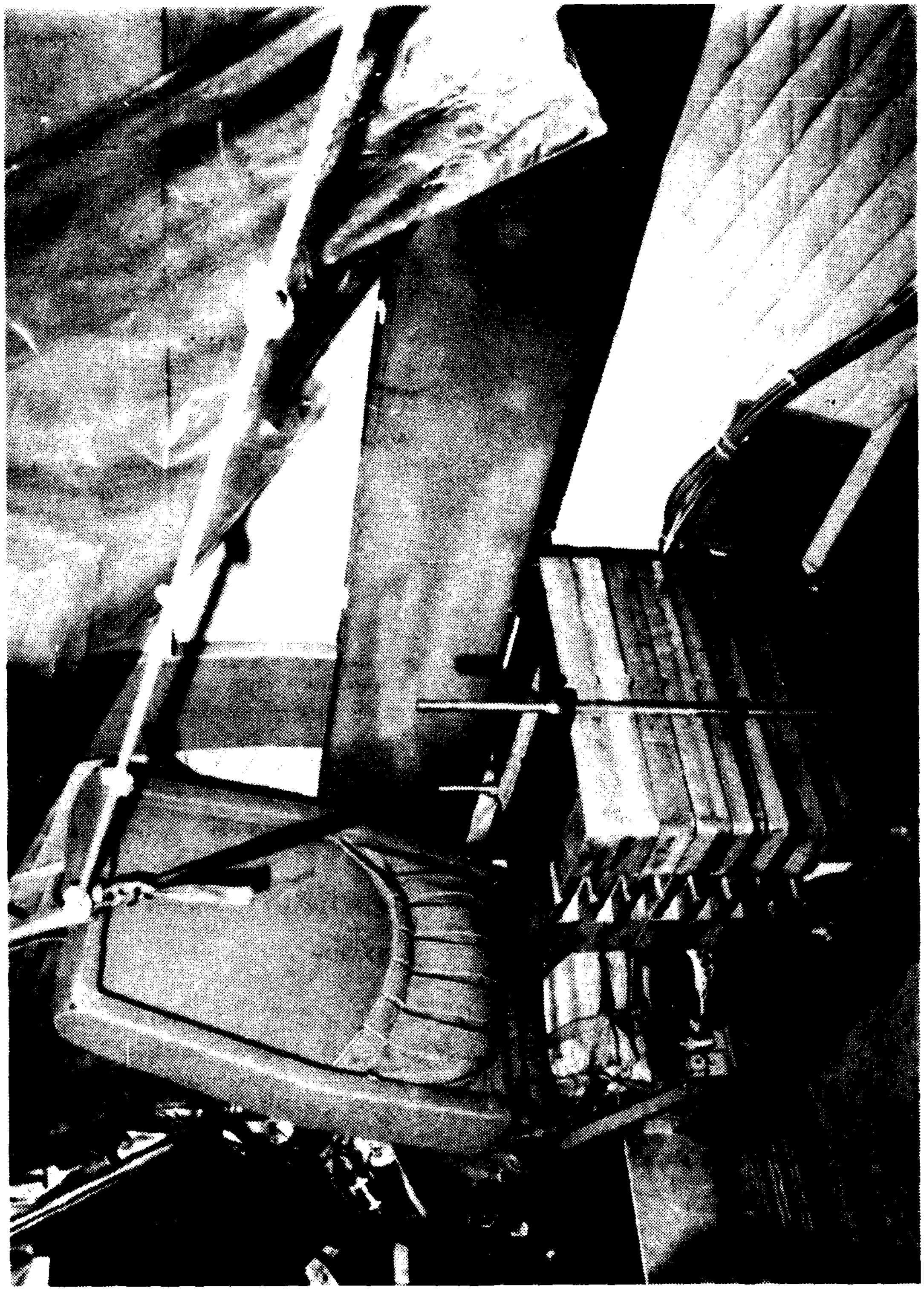


Photo 4. Ballast and Egress Rope

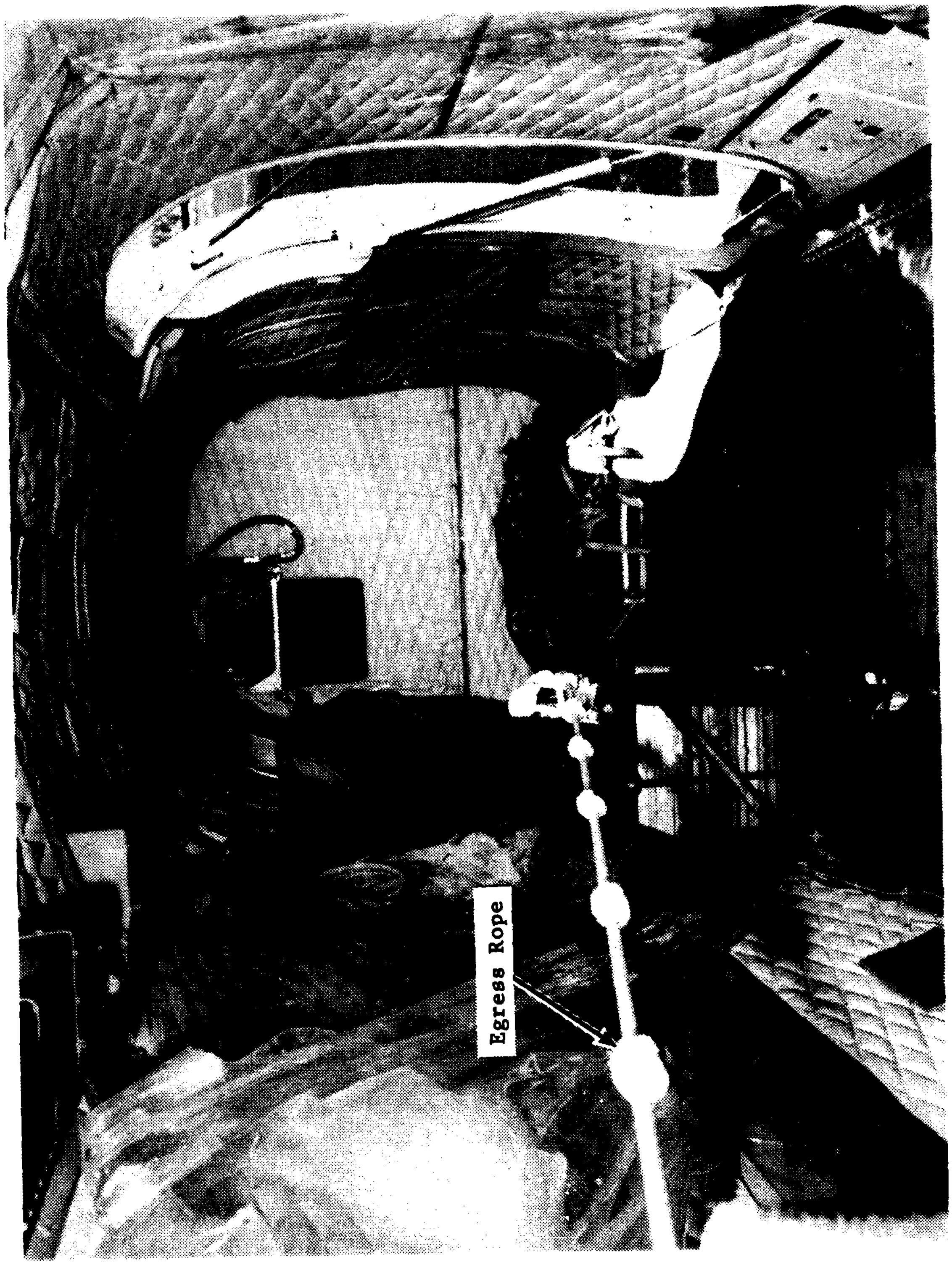


Photo 5. Egress Rope

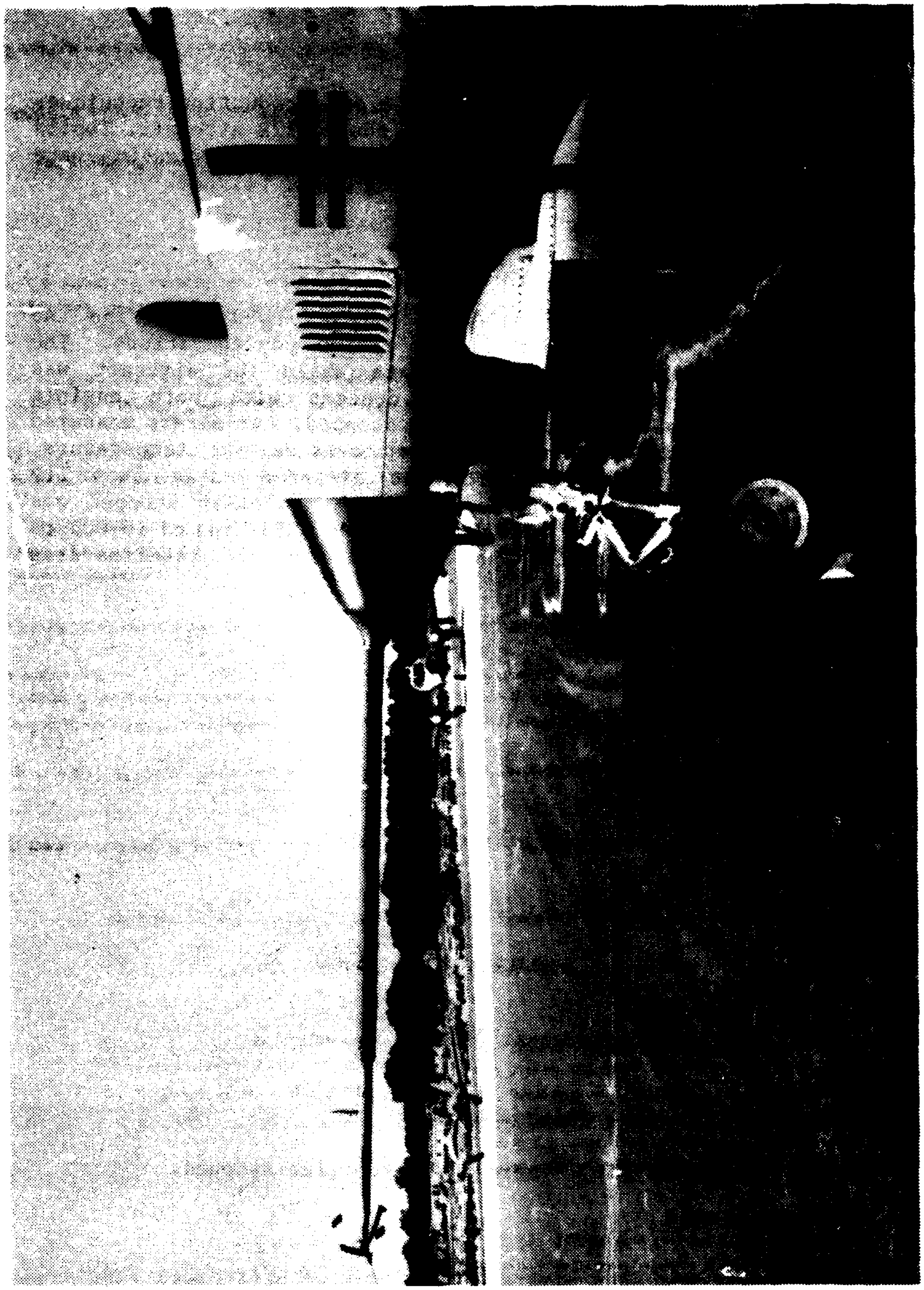


Photo 6. Data Link

APPENDIX D. TEST TECHNIQUES AND DATA ANALYSIS METHODS

GENERAL

1. This appendix contains some of the data reduction techniques and analysis methods used to evaluate the RC-12H aircraft. Topics discussed include glide, level flight, takeoff and landing performance, airspeed calibration, and weight and balance.

GLIDE

2. The propeller stopped glide method was used to define the drag of the RC-12H aircraft in the cruise configurations. The method involved obtaining flight data while the aircraft was stabilized in a constant-airspeed descent with both engines shutdown and propellers feathered and stopped. Parameters measured included airspeed, pressure altitude, outside air temperature, gross weight, and elapsed time. The airspeed range from 110 to 220 knots indicated airspeed with the propeller stopped was investigated for a target pressure altitude (HP) band of 16,000 to 14,000 feet. The technique used to develop the baseline-drag equation is shown below.

$$L = W \cos \theta \quad (1)$$

$$D = T + W \sin \theta \quad (2)$$

$$DV_T = TV_t + WV_t \sin \theta \quad (3)$$

$$-V_T \sin \theta = \frac{dh}{dt} = \frac{TV_t - DV_t}{W} \quad (4)$$

Where:

L = Lift force (lb)

W = Aircraft gross weight (lb)

θ = Descent angle (deg) = $\sin^{-1} \frac{dhp/dt}{V_T}$

T = Net thrust (lb) = zero with propeller stopped.

D = Drag force (lb)

V_t = Aircraft true airspeed on flight path (ft/sec)

$$\frac{dh}{dt} = \text{Tapeline rate of descent (ft/sec)} \; \frac{dHp}{dt} \; \frac{T_{a_t}}{T_{a_s}} \qquad (5)$$

$\frac{dHp}{dt}$ is measured

where:

T_{a_t} = test day ambient temperature (°K)

T_{a_s} = standard day ambient temperature (°K)

Considering the drag and lift force equations and applying power-off glide conditions, the following non-dimensional relationships can be developed:

$$C_D = \frac{D}{qs} \qquad (6)$$

$$C_D = \frac{W \sin \theta}{qs} \qquad (7)$$

$$C_L = \frac{L}{qs} \qquad (8)$$

$$C_L = \frac{W \cos \theta}{qs} \qquad (9)$$

Where:

C_D = Coefficient of drag

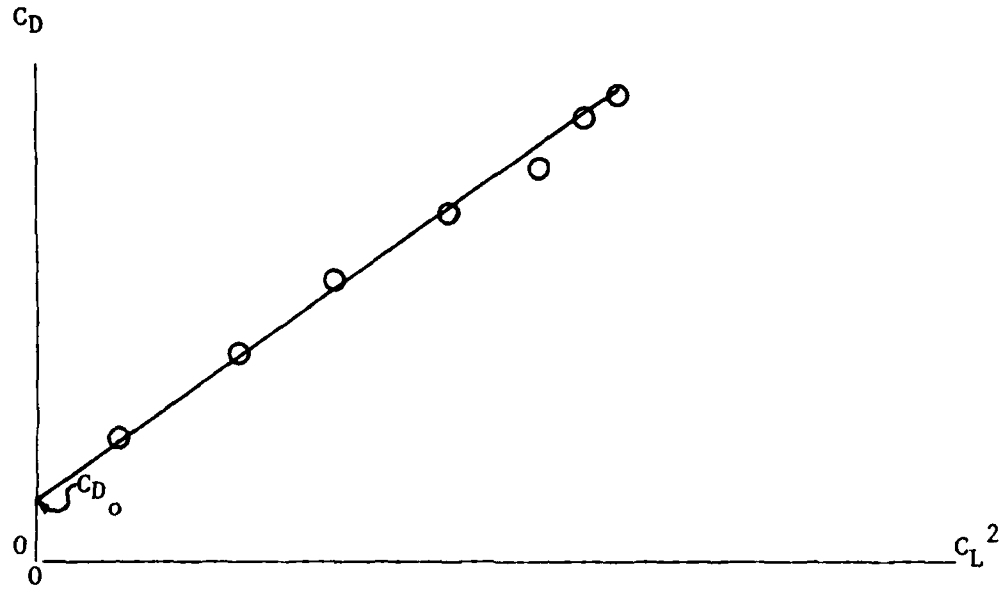
$q = 1/2 \; \rho \; V_T^2$ (lb/ft^2) dynamic pressure

S = Total wing area (ft^2)

C_L = Coefficient of lift

ρ = Air density ($slug/ft^3$)

The base-line drag equation ($C_{D_{BL}}$) was then developed by plotting C_D versus $C_L{}^2$ and fitting a first-order equation to the test points.



$$C_{D_{BL}} = C_{Do} + \frac{\Delta C_D}{\Delta C_L{}^2} C_L{}^2 \qquad (10)$$

3. During powered flight (either level flight or climbing flight), the drag of the aircraft was increased due to thrust. To reflect the change, the base-line drag equation was modified as follows:

$$C_{D_{TC'}} = C_{D_o} + \frac{\Delta C_D}{\Delta C_L{}^2} C_L{}^2 + A\,T_C{}' + BT_C{}' + C \qquad (11)$$

A coefficient of thrust (T_C') was defined as:

$$T_C' = \frac{2\ T}{\rho S\ V_T^2} \qquad (12)$$

Where:

$$T = \frac{550 \times THP}{V_T} \qquad (13)$$

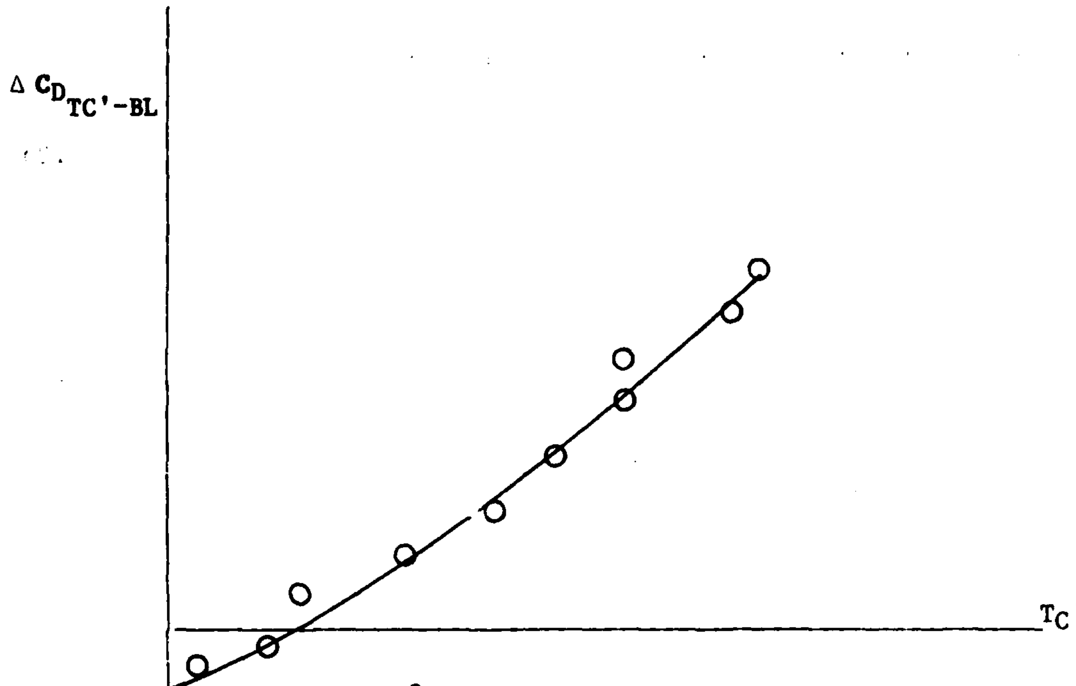
$$THP = \eta p \times SHP + \frac{F_n \times V_T}{550} \qquad (14)$$

$$SHP = \frac{Q \times N_p \times 2\pi}{33{,}000} \qquad (15)$$

Subtracting equaton 10 from 11 and defining the difference as the increased drag due to thrust effect ($\Delta C_{D_{TC'-BL}}$) results in the following relationship:

$$\Delta C_{D_{TC'-BL}} = C_{D_{TC'}} - C_{D_{BL}} = A\ T_C'^2 + BT_C' + C \qquad (16)$$

$C_{D_{BL}}$ is calculated from the power-off glide drag polar for each powered flight test point. $C_{D_{TC'}}$ is calculated from the powered flight thrust horsepower (equation 14). The values of $\Delta C_{D_{TC'-BL}}$ and T_C' are plotted to develop a generalized equation that represents the change in drag due to thrust. An equation of the second order was fit to the data.



$$\Delta C_{D_{TC'BL}} = AT_C'^2 + BT_C' + C$$

Where A, B, and C are coefficients which are constant for each flight condition.

Equation 11 represents the generalized equation for all level flight and climb performance in dual-engine operation. The constant coefficients A, B, and C are tabulated in tables in the Results and Discussion section of this report.

TAKEOFF AND LANDING PERFORMANCE

4. Takeoff roll distance was obtained by noting and measuring the start and liftoff points with ground observers. Tower reported wind speed and direction were used to calculate predicted ground roll distance. The measured ground roll distance was then compared to the predicted ground roll.

5. Landing performance was evaluated similar to takeoff performance except that touchdown and stop points were noted and measured.

AIRSPEED CALIBRATION

6. The ship's standard pitot-static system and test boom airspeed system was calibrated by Beech Aircraft Corporation (BAC) using the ground speed course method to determine the airspeed position error. The RC-12H was also flown in formation with the U.S. Army Aviation Engineering Flight Activity (AEFA) pace T-34C aircraft prior to the start of the Preliminary Airworthiness Evaluation (PAE).

Weight and Balance

7. Prior to flight testing, a weight and balance determination was conducted on the aircraft using calibrated mechanical scales located at the BAC test facility. The aircraft basic weight and cg were 11,785 lb at fuselage station (FS) 190.9. With full fuel and crew, the aircraft was ballasted to an engine start gross weight of 15,750 lb at FS 189.5 (fwd) for performance testing and FS 195.1 (aft) for handling qualities testing.

Rigging Check

8. Mechanical rigging of engine and flight controls was checked for compliance with applicable BAC documents. Control surface travels are presented in table 1.

DEFINITIONS

9. Results were categorized as deficiencies or shortcomings in accordance with the following definitions.

Deficiency

10. A defect or malfunction discovered during the life cycle of an item of equipment that constitutes a safety hazard to personnel; will result in serious damage to the equipment if operation is continued, or indicates improper design or other cause of failure of an item or part, which seriously impairs the equipment's operational capability.

Shortcoming

11. An imperfection or malfuntion occurring during the life cycle of equipment which must be reported and which should be corrected to increase efficiency and to render the equipment completely serviceable. It will not cause an immediate breakdown, jeopardize safe operation, or materially reduce the usability of the material or end product.

Table 1. Control Surface Travels and Cable Tensions Per B.S. 4759

Drawing No. 101-524000 Rev. ______ Last Co F60962 Rev. A Date 6/4/87

Model A200CT (RC-12H) Ship Serial GR-15 Temperature 81

	Ships Control Travels		Print Control Travel and Tolerance		Ships Cable Tension	Print Cable Tension and
Wing Flap LH & RH	LH---Down--RH		LH---Down---RH			
Full UP	Q	0	0 to 1°Dn	0 to 1°Dn		
Takeoff	N/A	N/A	N/A	N/A		
Approach	15	15	14+1	14+1		
Full Down	35	35	35+1,-0	35+1,-0		
Aileron LH	Up 24	Dn 16	Up 24+2,-1	Dn 16+2,-0	75 lb	75+5 lb
Aileron RH	Up 24	Dn 16	Up 24+2,-1	Dn 16+2,-0	75 lb	75+5 lb
Aileron Trim Tab	Up 15	Dn 15	Up 15+ 1 1/2	Dn 15+1 1/2	8 lb	9+3,-0 lb
Aileron Servo Tab LH	Up 0	Dn 15	Up 0+1/2	Dn 0+1/2		
Aileron Servo Tab RH	Up N/A	Dn N/A	Up N/A	Dn N/A		
Elevator LH	Up 20	Dn 14	Up 20+1,-0	Dn 14+1,-0	44 Lb	36+8,-0 lb
Elevator RH	Up 21 1/2	Dn 14 1/2	Up 20+1,-0	Dn 14+1,-0	44 lb	36+8,-0 lb
Elevator Trim Tab LH	Up 4	Dn 14	Up 3 1/2+1/2,-0	Dn 13+1,-0	13 lb	14+3,-2 lb
Elevator Trim Tab RH	Up 4	Dn 14	Up 1 1/2+1/2,-0	Dn 13+1,-0	13 lb	14+3,-2 lb
Elevator Servo Tab LH	Up 0	Dn 0	Up +1/2 Max	Dn +1/2 max		
Elevator Servo Tab RH	Up 0	Dn 0	Up +1/2 Max	Dn +1/2 max		
Rudder	Left 25 1/2	Right 26	Left 25+1,-0	Right 25+1,-0	77 lb	70+15,-0 lb
Rudder Trim Tab	Left 15	Right 15	Left 15+1 1/2,-0	Right 15+1 1/2,-0	10 lb	9+3,-2
Rudder Servo Tab	Left 12	Right 10	Left 11+1,-0	Right 10+1,-0		

APPENDIX E. TEST DATA

FIGURE 1
DUAL ENGINE CLIMB DRAG POLAR
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
15920	189.3 (FWD)	16450	-2.0	1700	CRUISE	CLIMB

NOTES: 1. MAXIMUM CONTINUOUS POWER
2. AVERAGE THRUST COEFFICIENT = 0.12

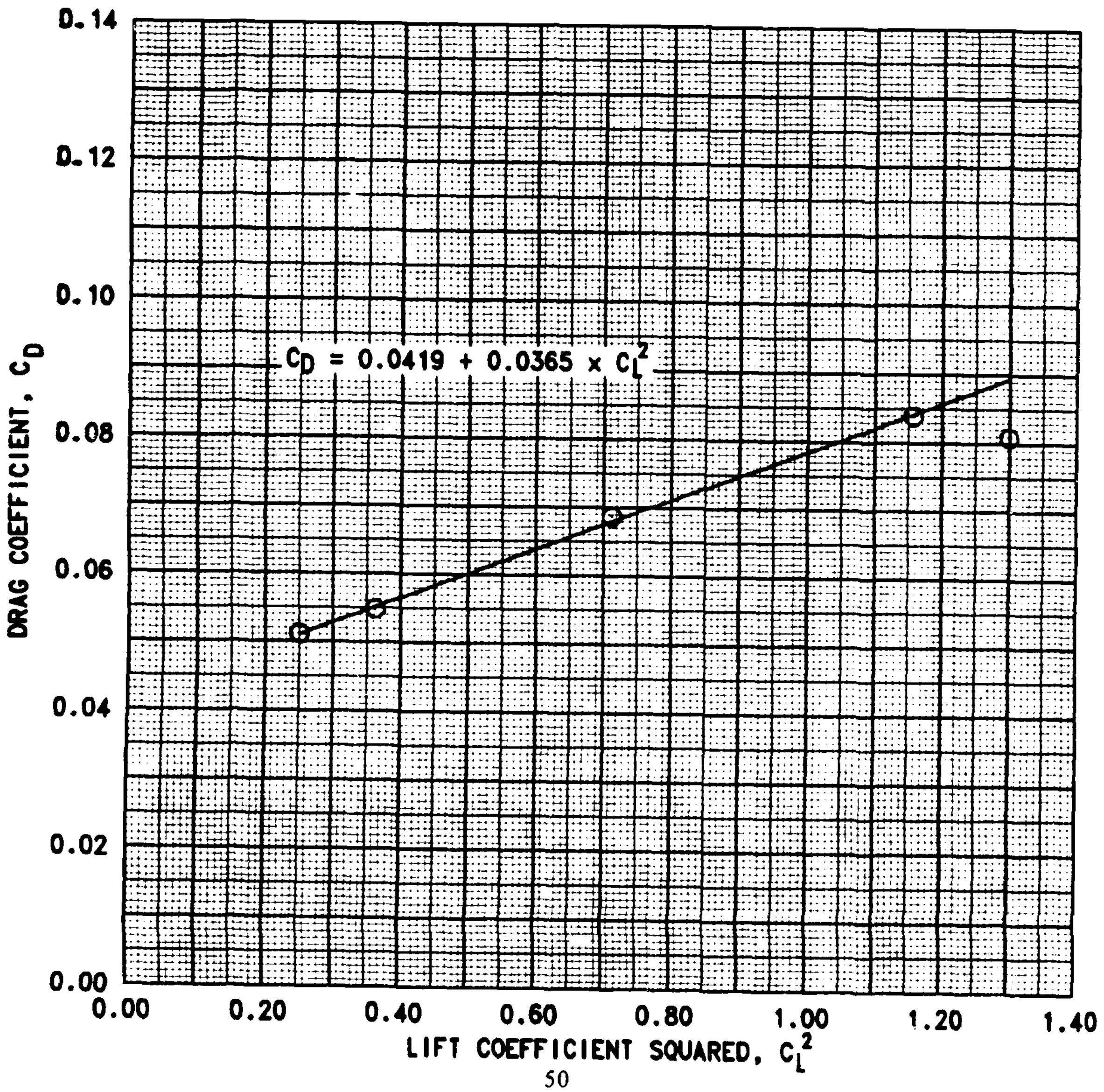


FIGURE 2
PROPELLER STOPPED GLIDE DRAG POLAR
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
14300	189.1 (FWD)	16140	-2.5	CRUISE	GLIDE

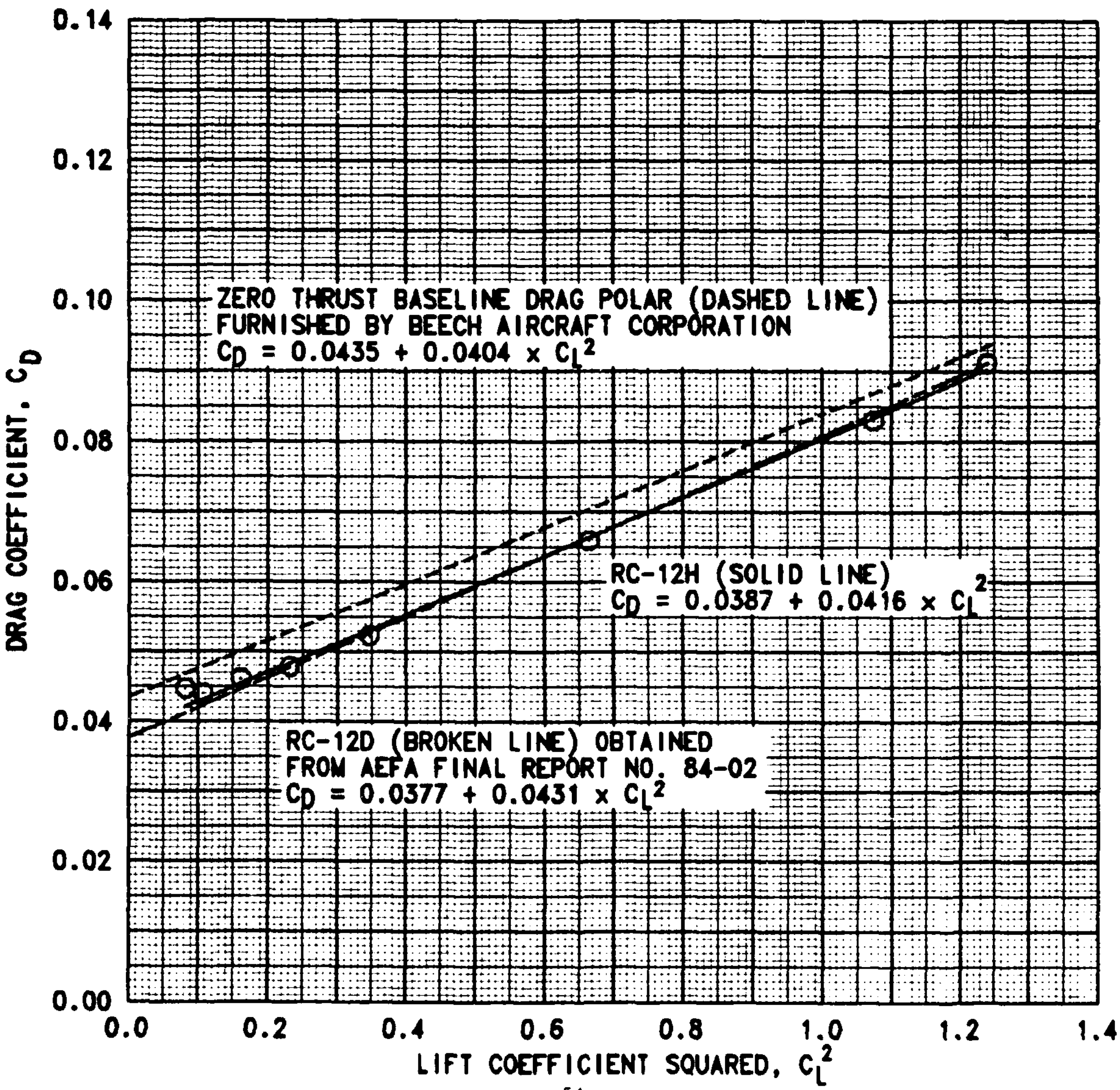


FIGURE 3
DUAL ENGINE LEVEL FLIGHT DRAG POLAR
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
14550	189.1 (FWD)	16400	-2.5	1700	CRUISE	LEVEL

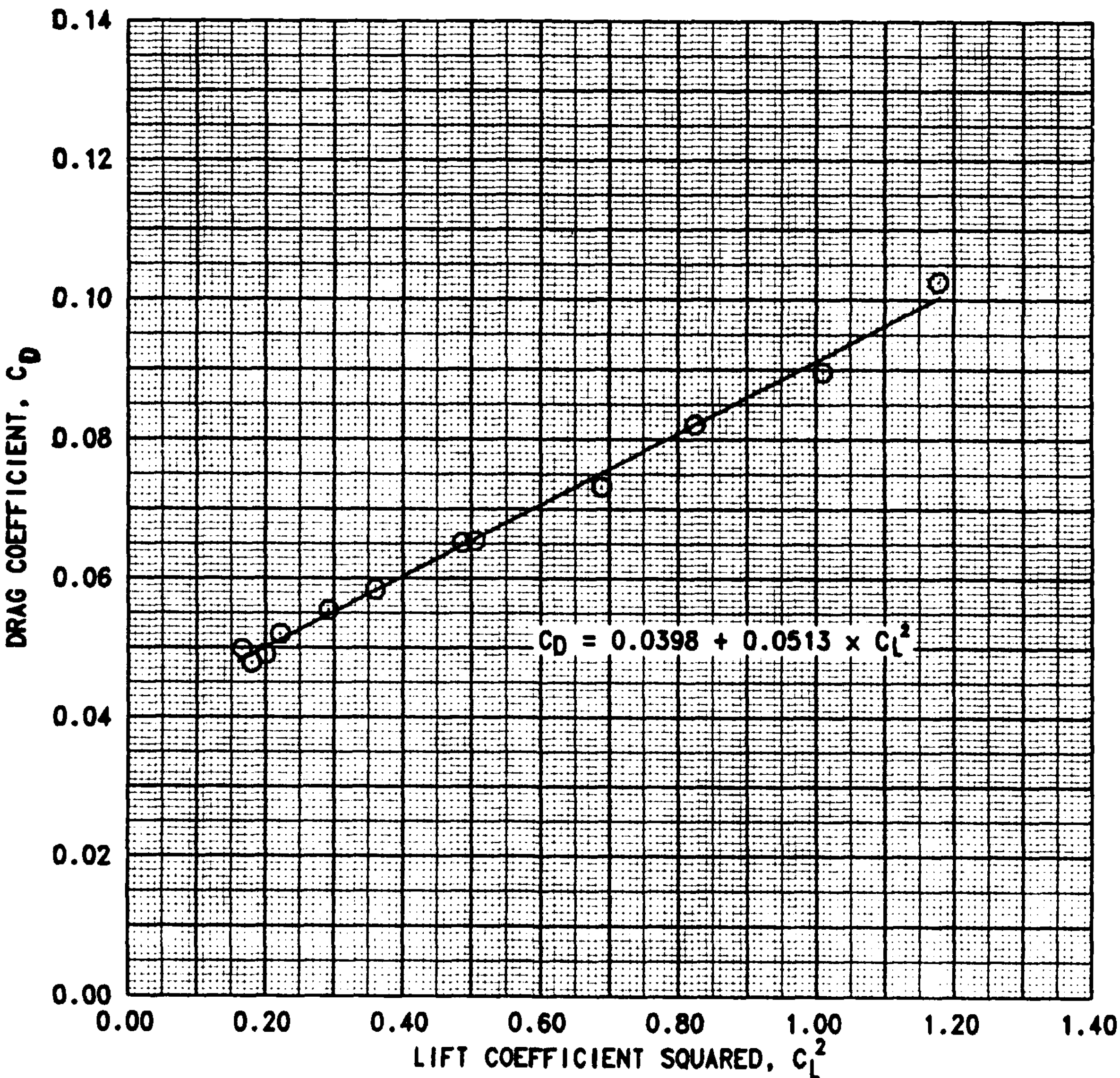


FIGURE 4
DUAL ENGINE LEVEL FLIGHT PERFORMANCE
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
14550	189.3 (FWD)	16400	-2.5	1700	CRUISE	LEVEL

NOTE: FUEL FLOW DATA NOT AVAILABLE

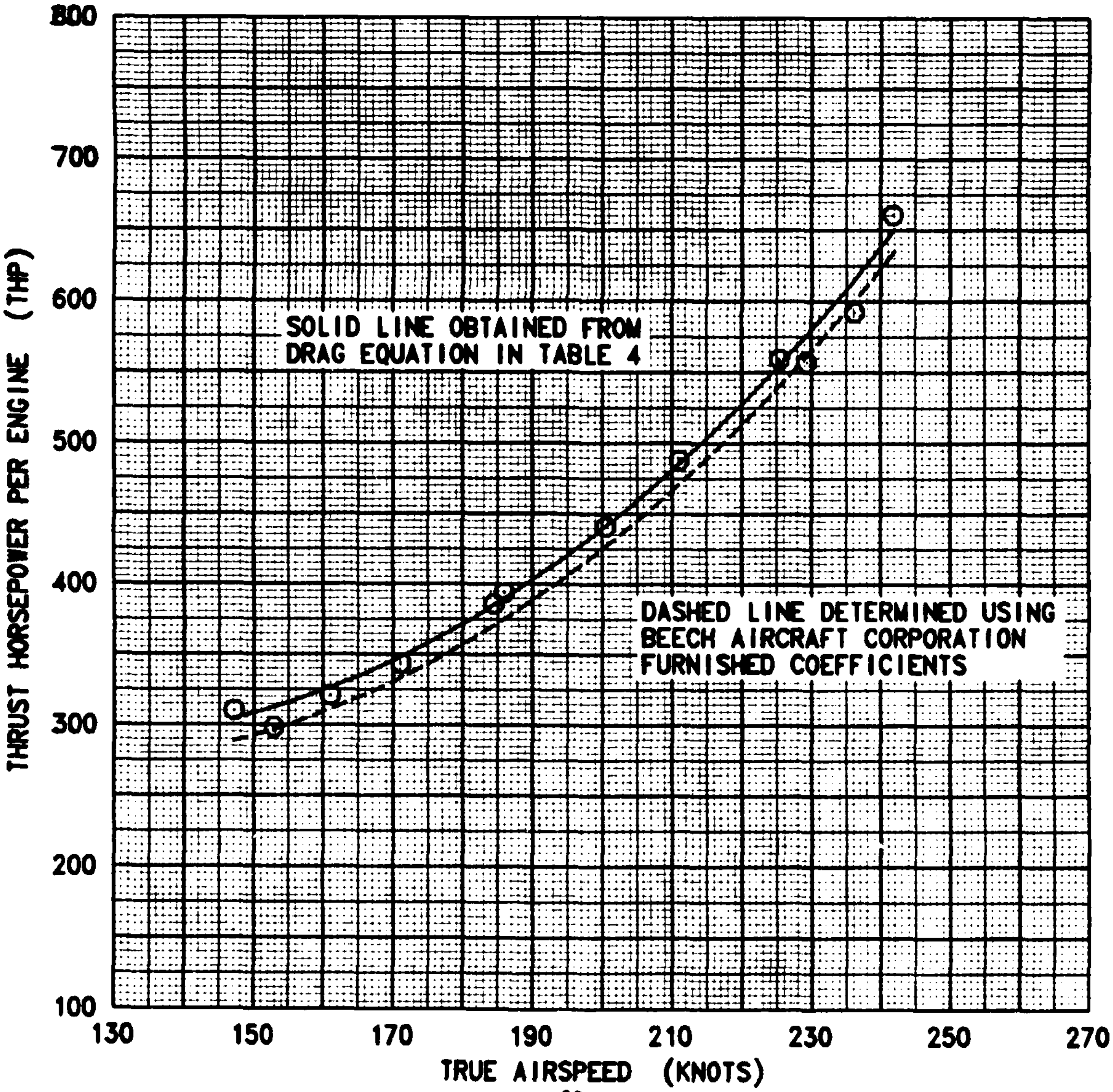
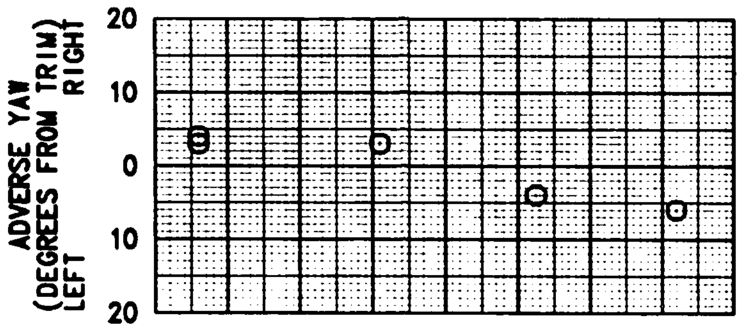


FIGURE 5
ROLL PERFORMANCE
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	TRIM CALIBRATED AIRSPEED	AIRCRAFT CONFIGURATION
14550	195.0 (AFT)	24400	-2.5	1700	130	CRUISE

NOTE: DF/ELINT PODS BALLASTED WITH 400 POUNDS



TOTAL LATERAL CONTROL TRAVEL: 144 DEGREES

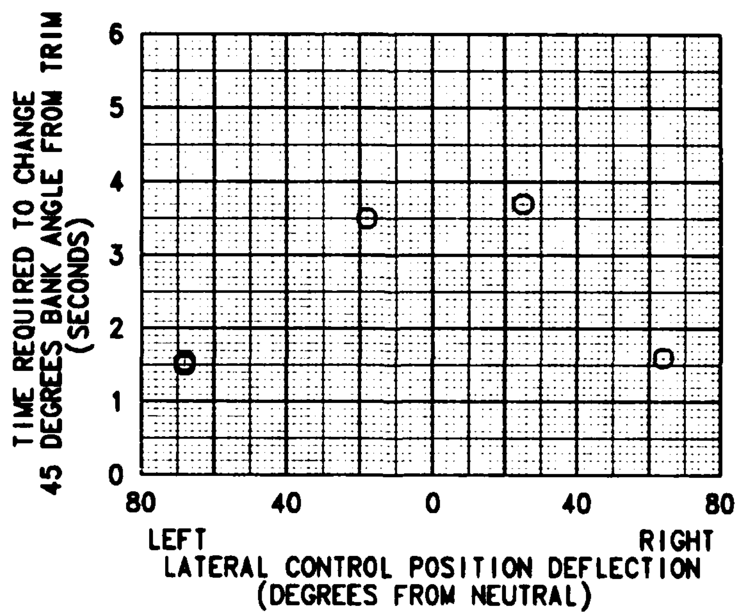


FIGURE 6
ROLL PERFORMANCE
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)	TRIM FLIGHT CONDITION
13870	194.8 (AFT)	25210	-20.5	130	CRUISE	ZERO	30 DEG RT TURN

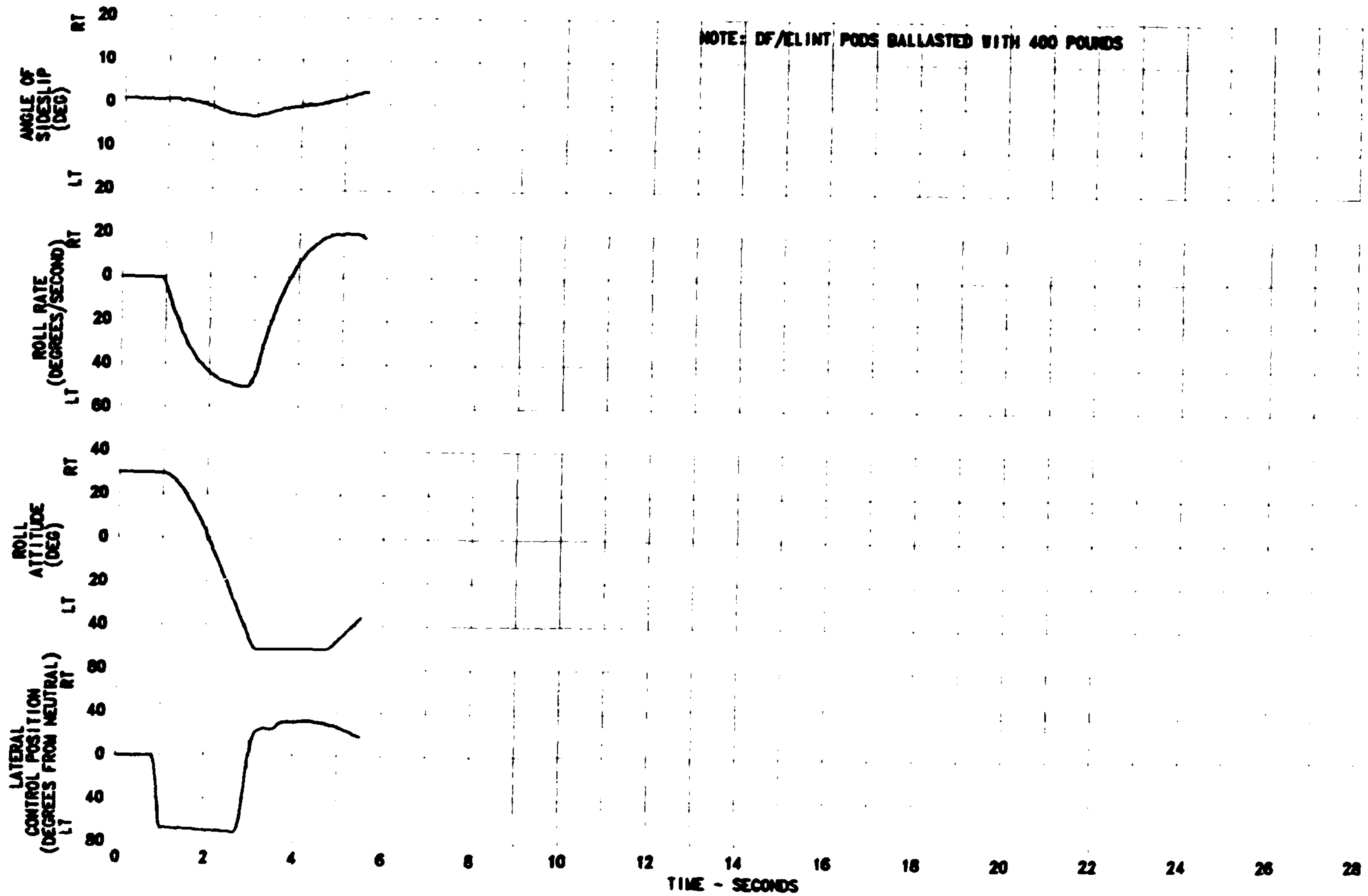


FIGURE 7
ROLL PERFORMANCE
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)	TRIM FLIGHT CONDITION
13870	194.8 (AFT)	24870	-21.0	129	CRUISE	ZERO	30 DEG LT TURN

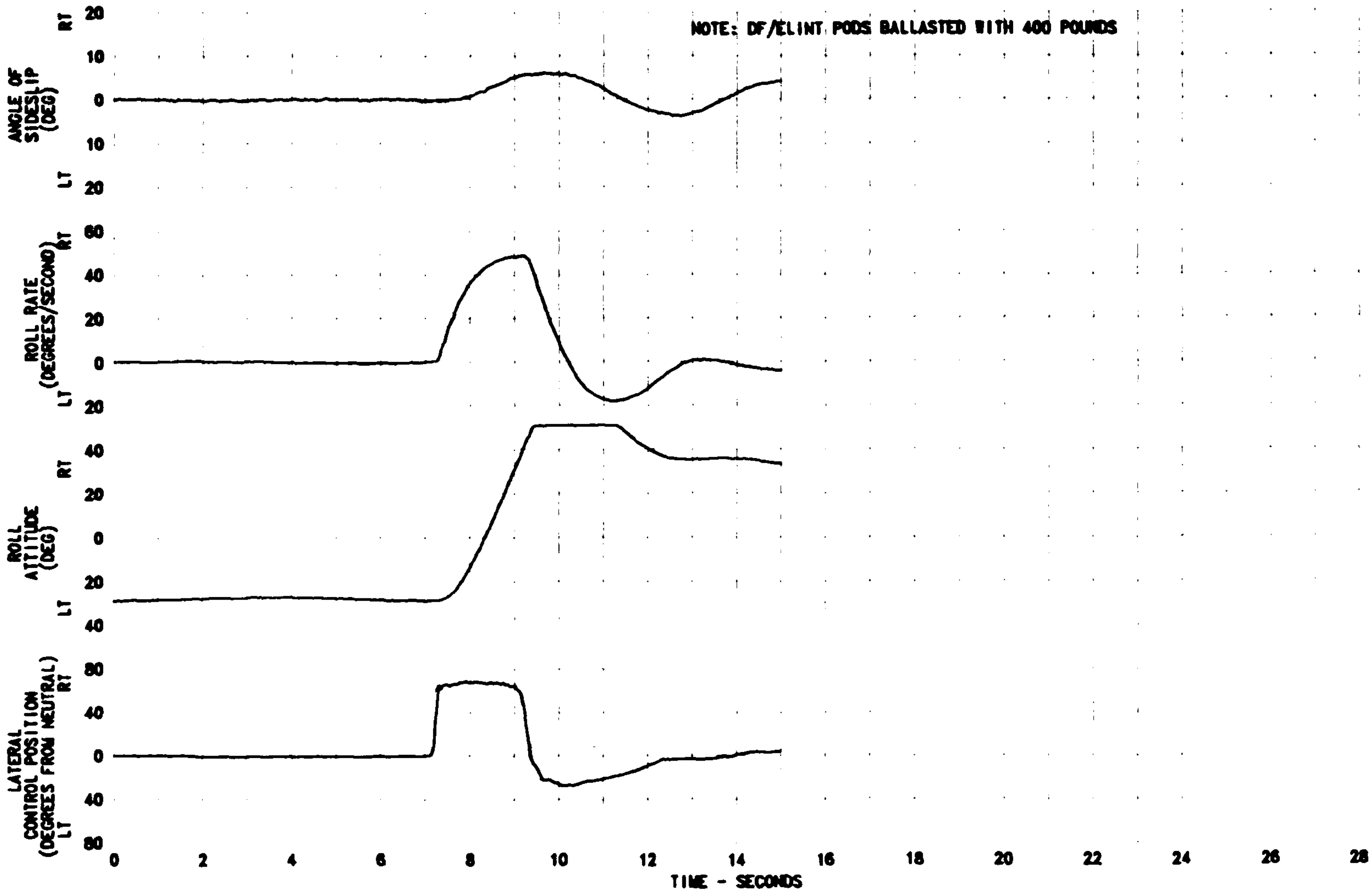


FIGURE 8
COCKPIT CONTROL/CONTROL SURFACE RELATIONSHIP
RC-12H USA S/N 83-24314

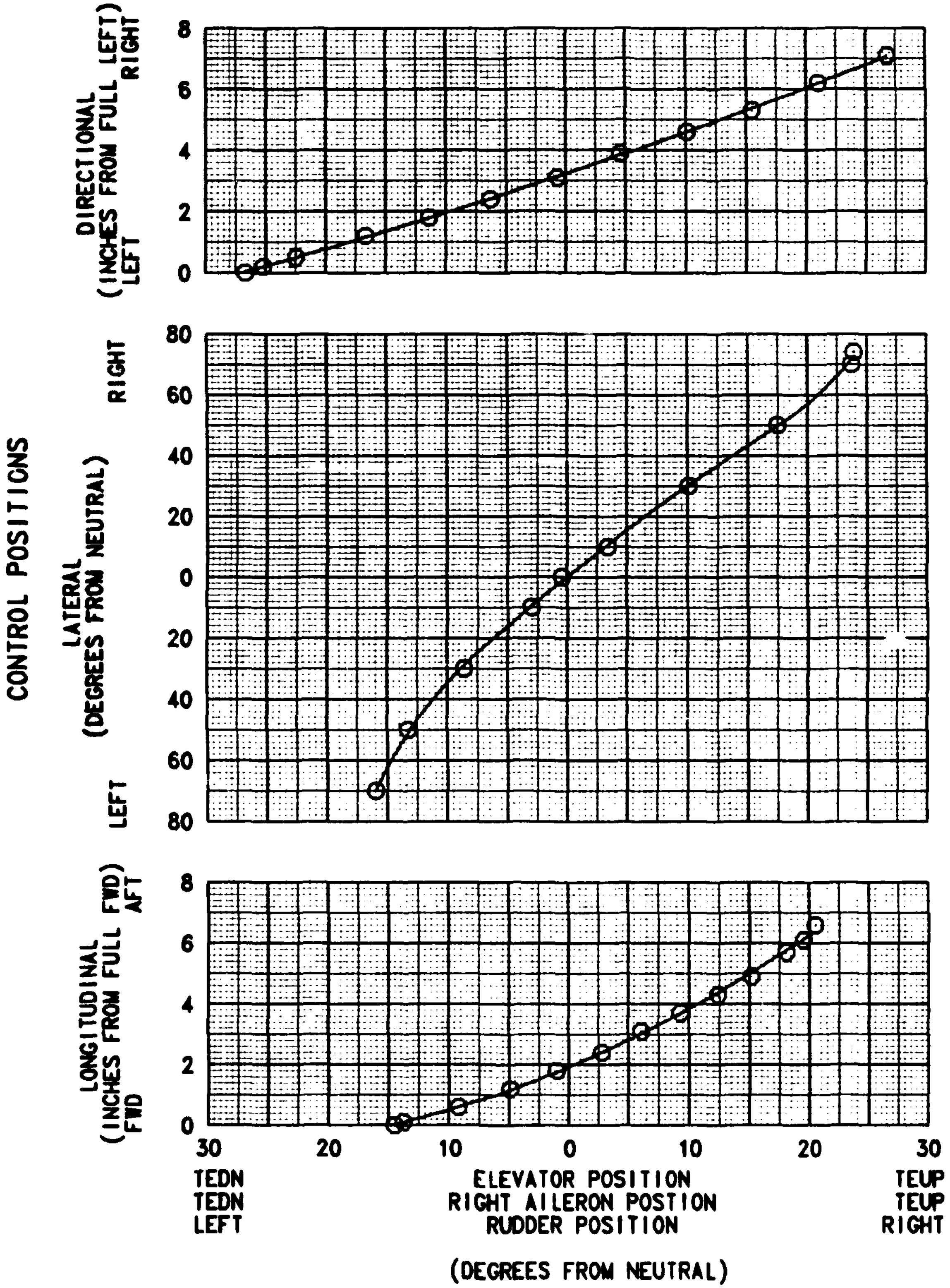


FIGURE 9
CONTROL POSITIONS IN TRIMMED FORWARD FLIGHT
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
14550	189.3 (FWD)	16400	-2.5	1700	CRUISE	LEVEL

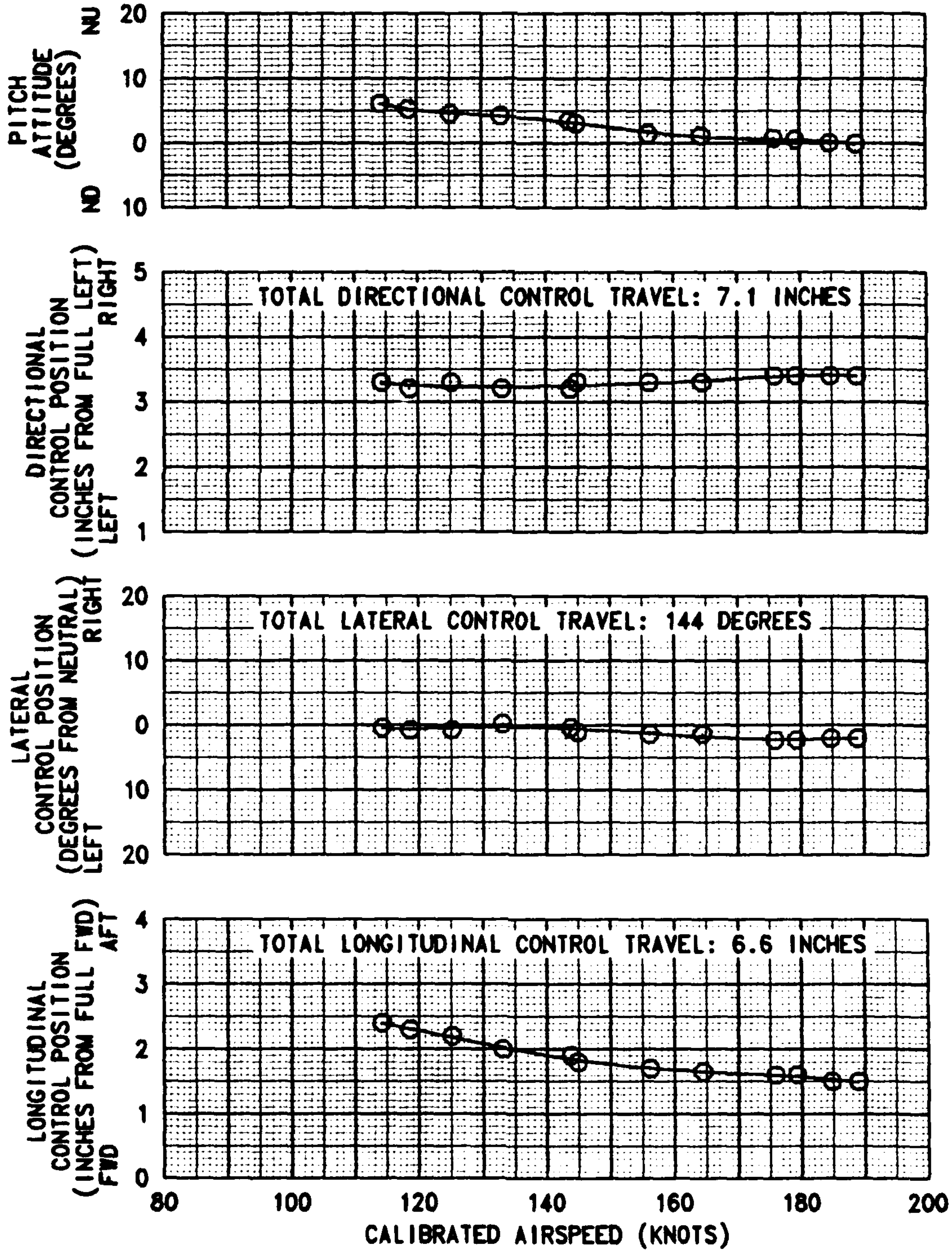


FIGURE 10
STATIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

SYM	AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
○	14180	195.0 (AFT)	24000	-15.5	1700	CRUISE	LEVEL
□	15290	194.8 (AFT)	7110	20.0	2000	POWER APPROACH	DESCENT

NOTE: SHADED SYMBOLS DENOTE TRIM

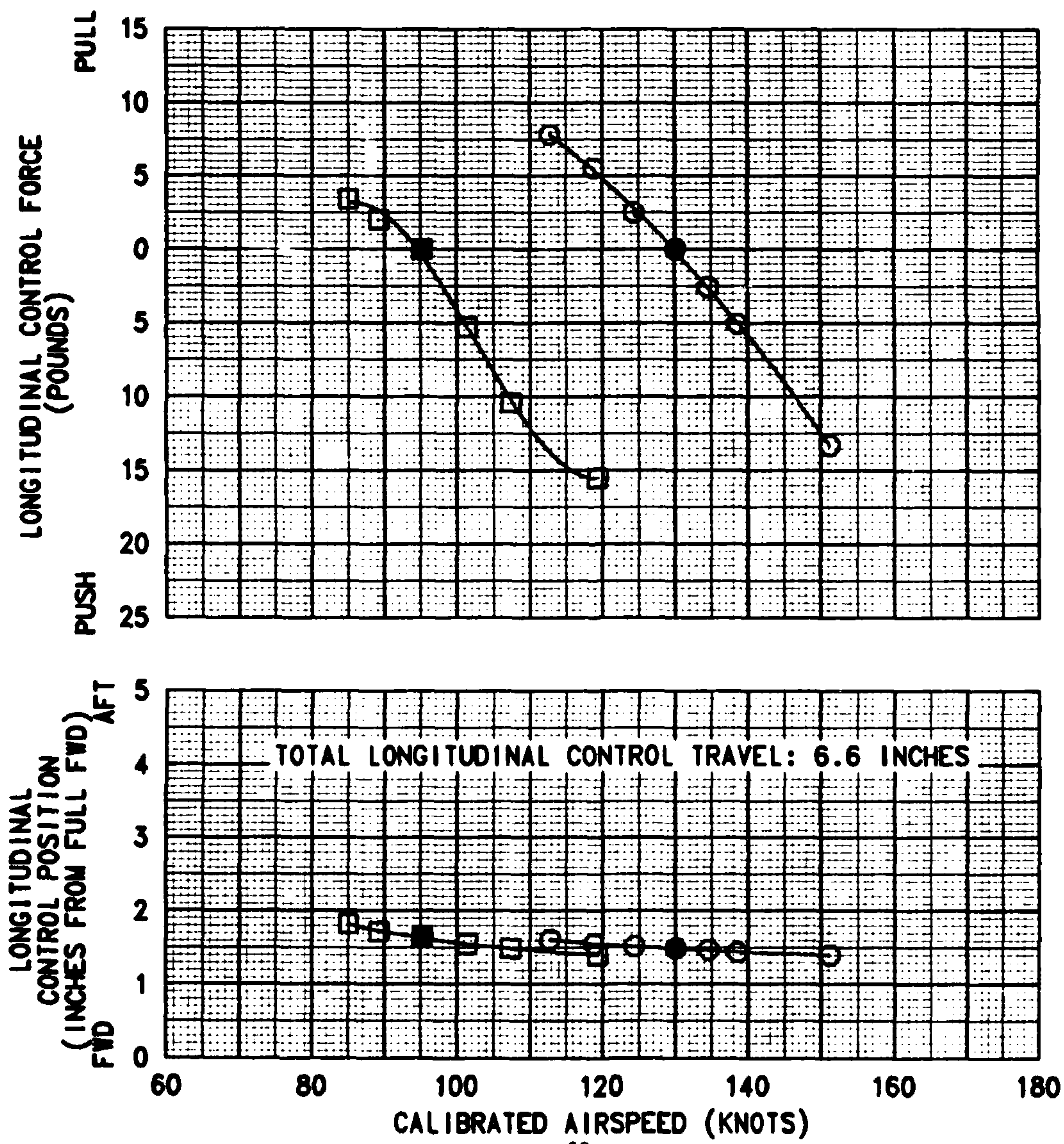


FIGURE 11
STATIC LATERAL-DIRECTIONAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIB AIRSPEED (KT)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
14660	194.8 (AFT)	6460	18.5	93	2000	POWER APPROACH	LEVEL

NOTE: SHADED SYMBOLS DENOTE TRIM

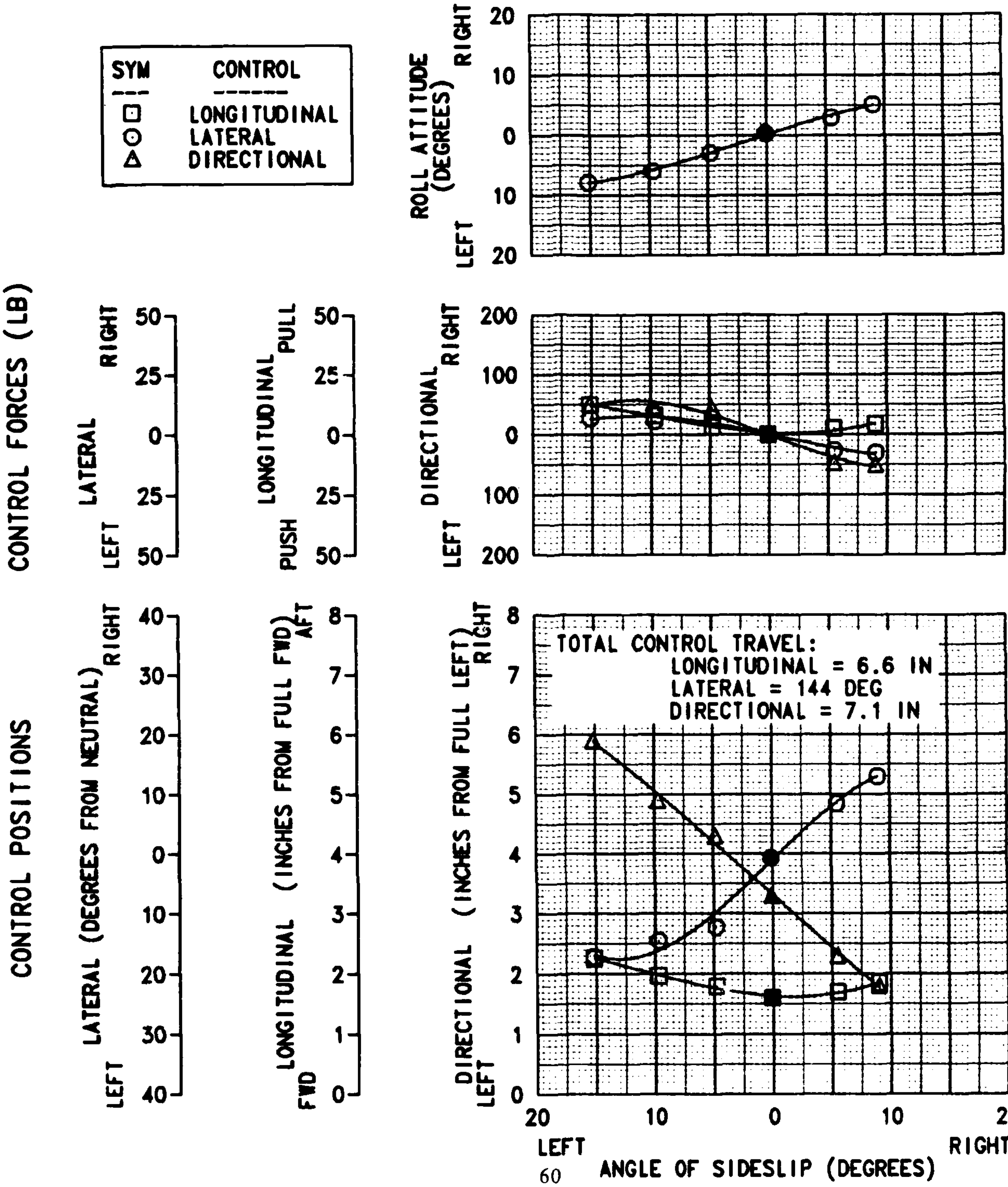


FIGURE 12
STATIC LATERAL-DIRECTIONAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG (FS)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIB AIRSPEED (KT)	AVG PROPELLER SPEED (RPM)	AIRCRAFT CONFIGURATION	TRIM FLIGHT CONDITION
13760	195.1 (AFT)	26000	-15.0	129	1700	CRUISE	LEVEL

NOTE: SHADED SYMBOLS DENOTE TRIM

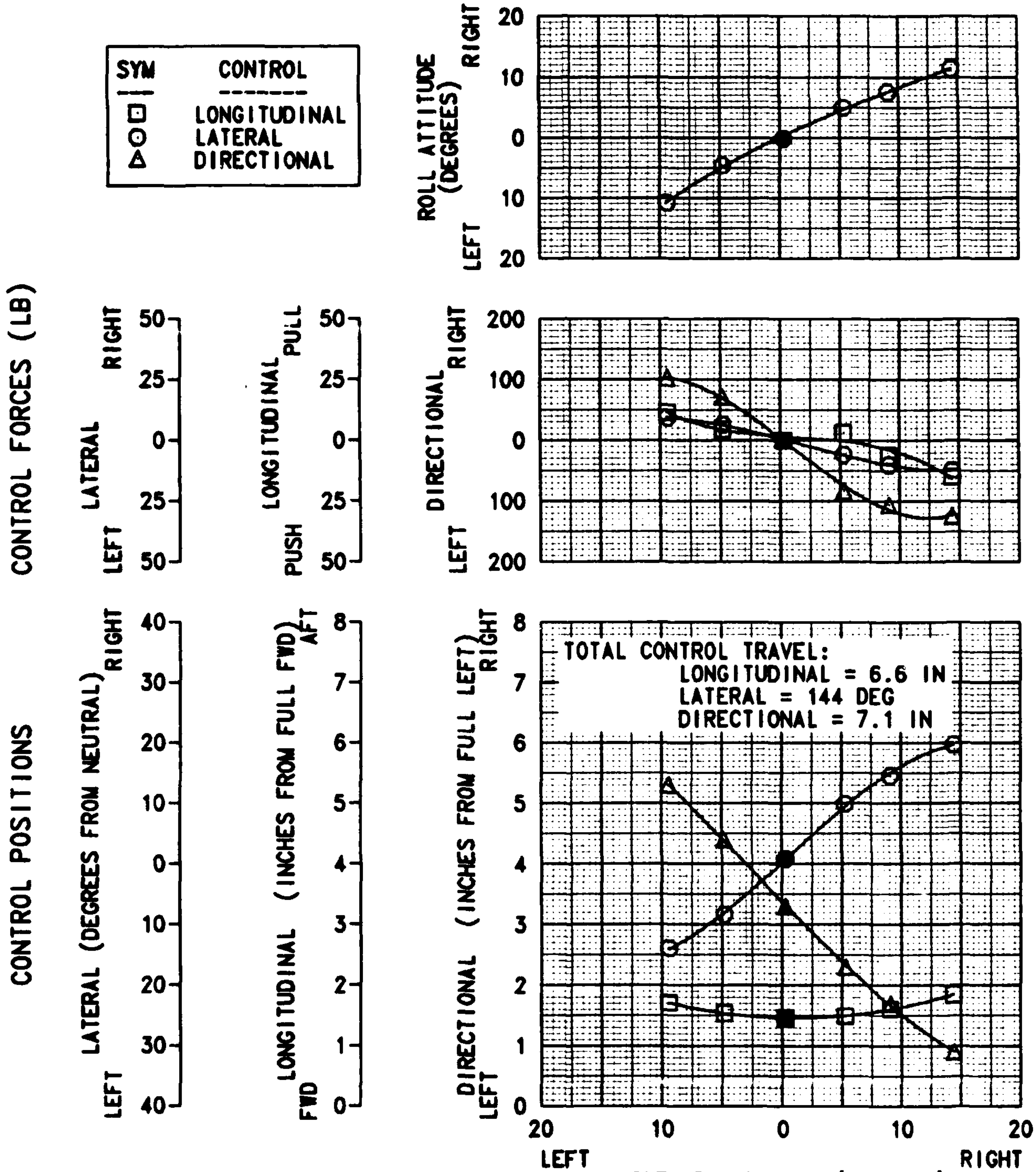


FIGURE 13
DYNAMIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)
15320	194.8 (AFT)	6730	16.5	95	POWER APPROACH	100

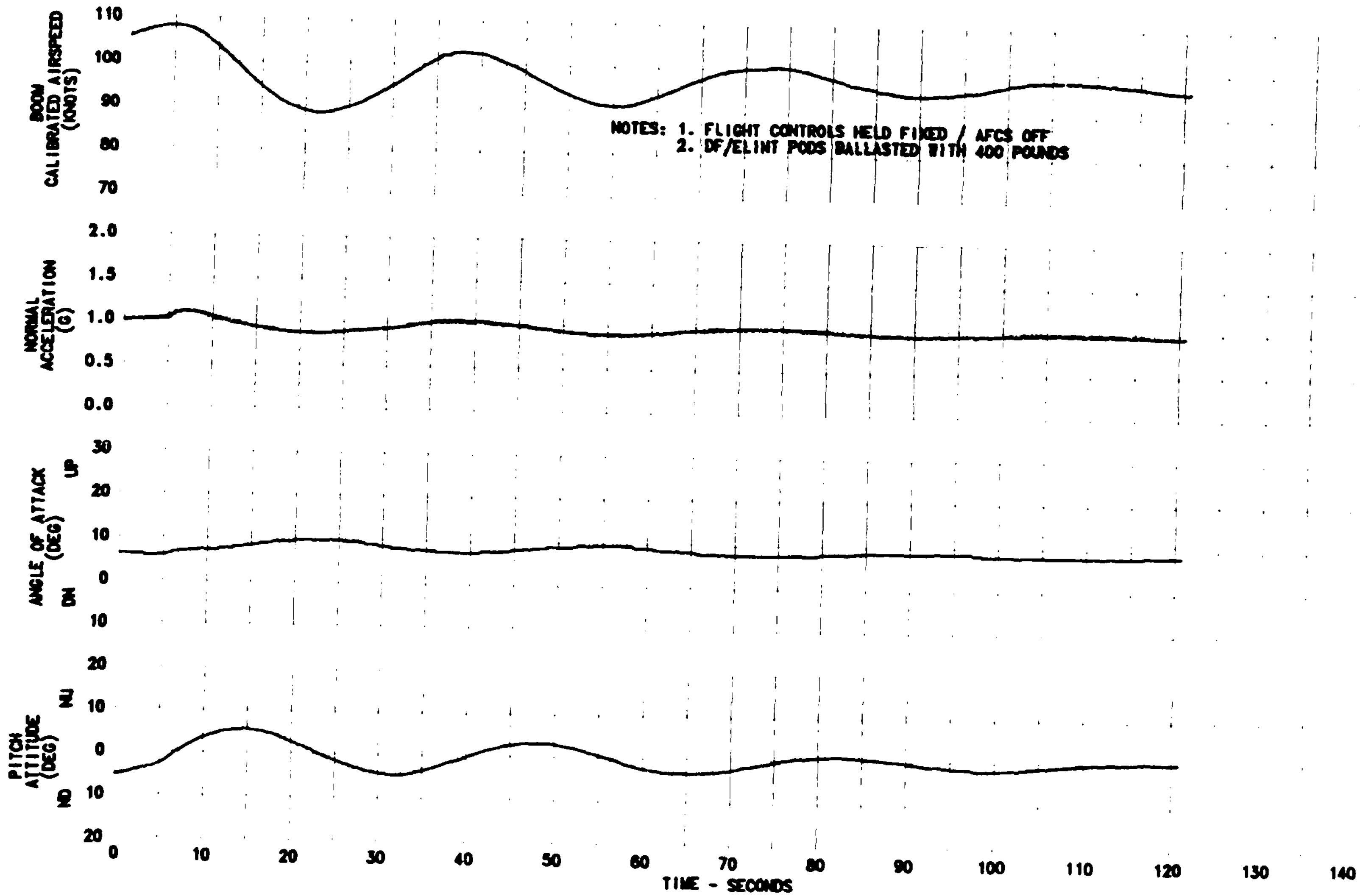


FIGURE 14
DYNAMIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)
15130	194.8 (AFT)	7530	15.0	96	POWER APPROACH	100

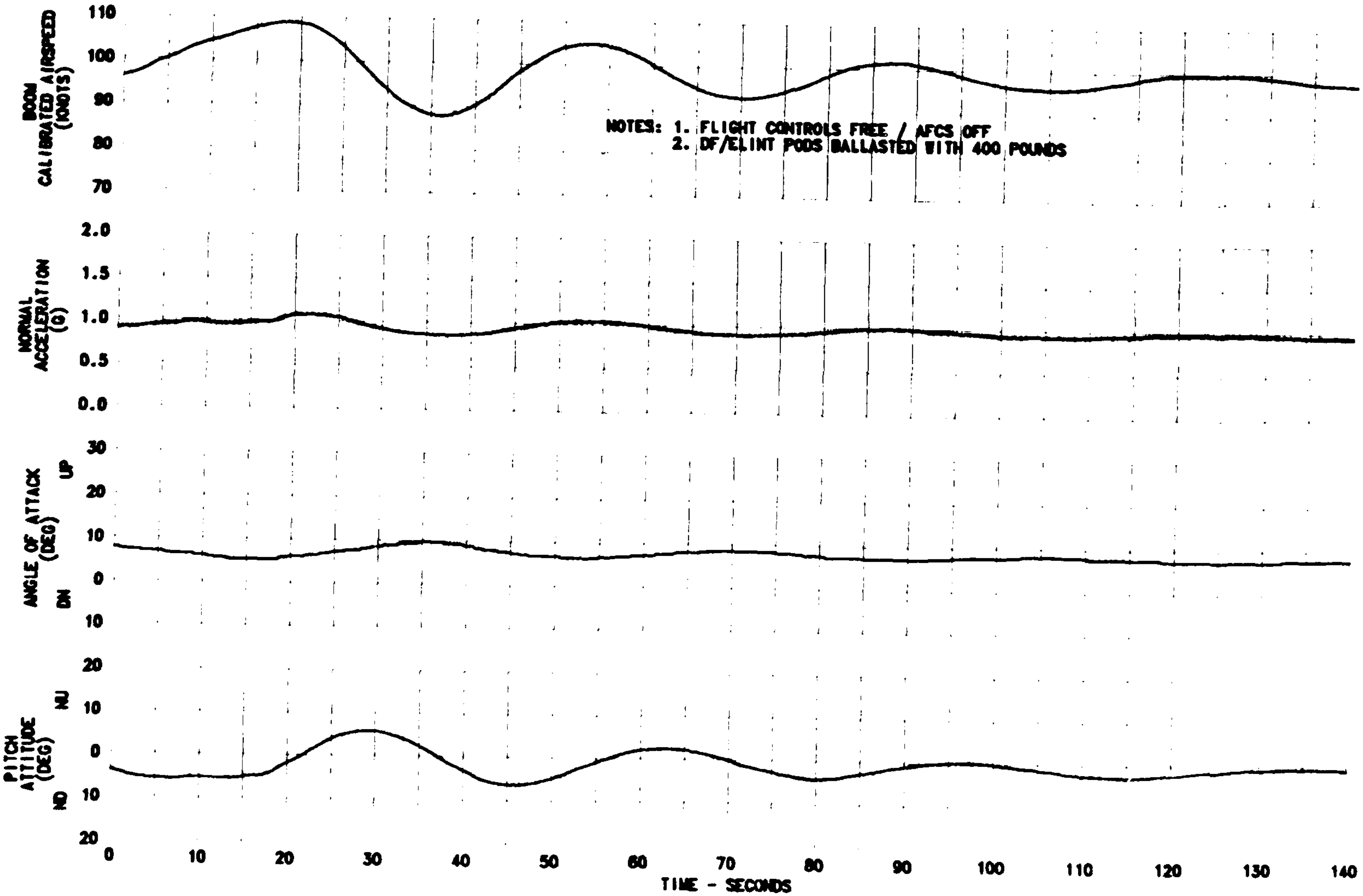


FIGURE 15
DYNAMIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)
15060	194.8 (AFT)	7140	15.5	95	POWER APPROACH	100

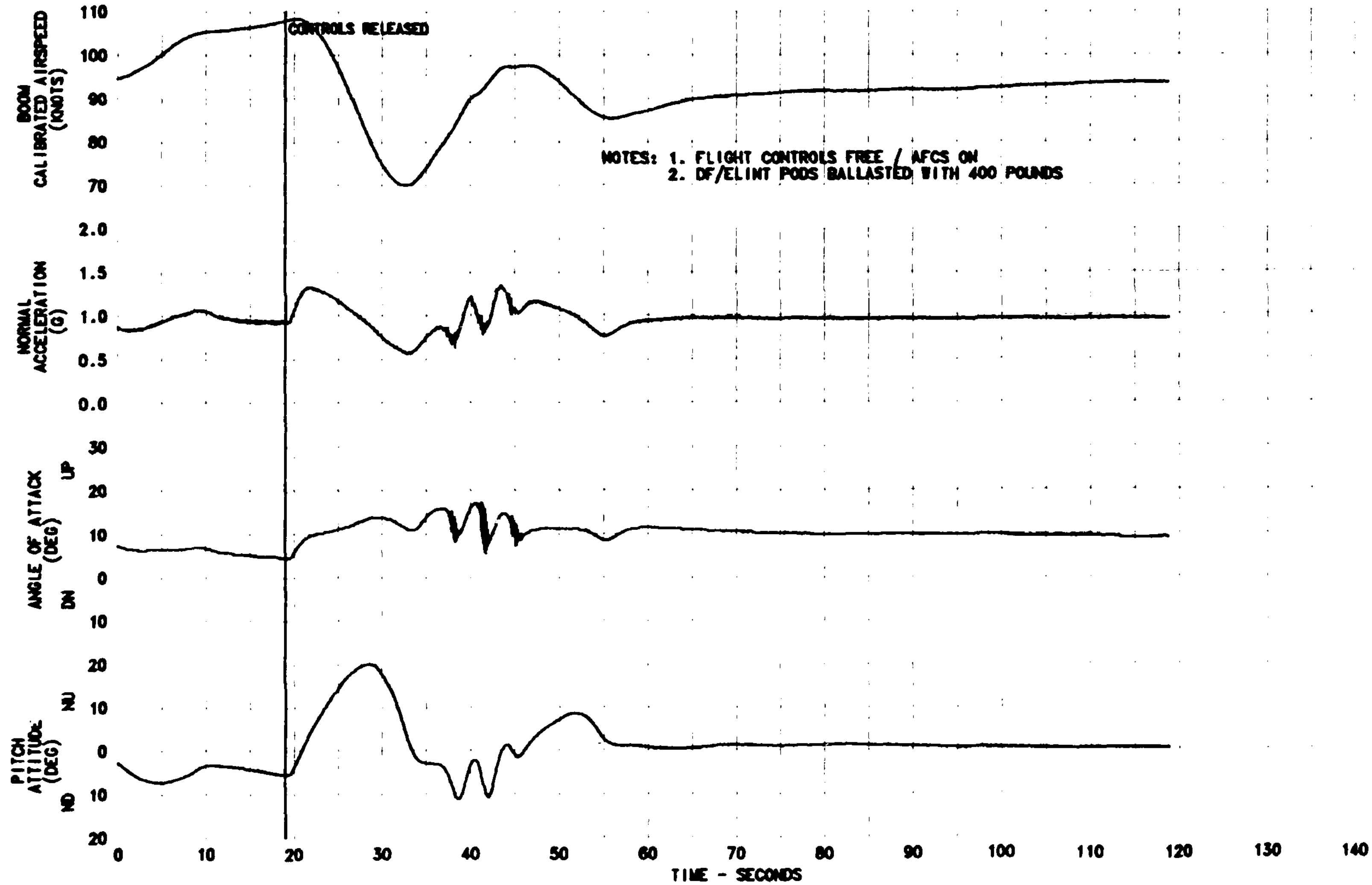


FIGURE 16
DYNAMIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)
14470	194.8 (AFT)	25580	-21.0	133	CRUISE	ZERO

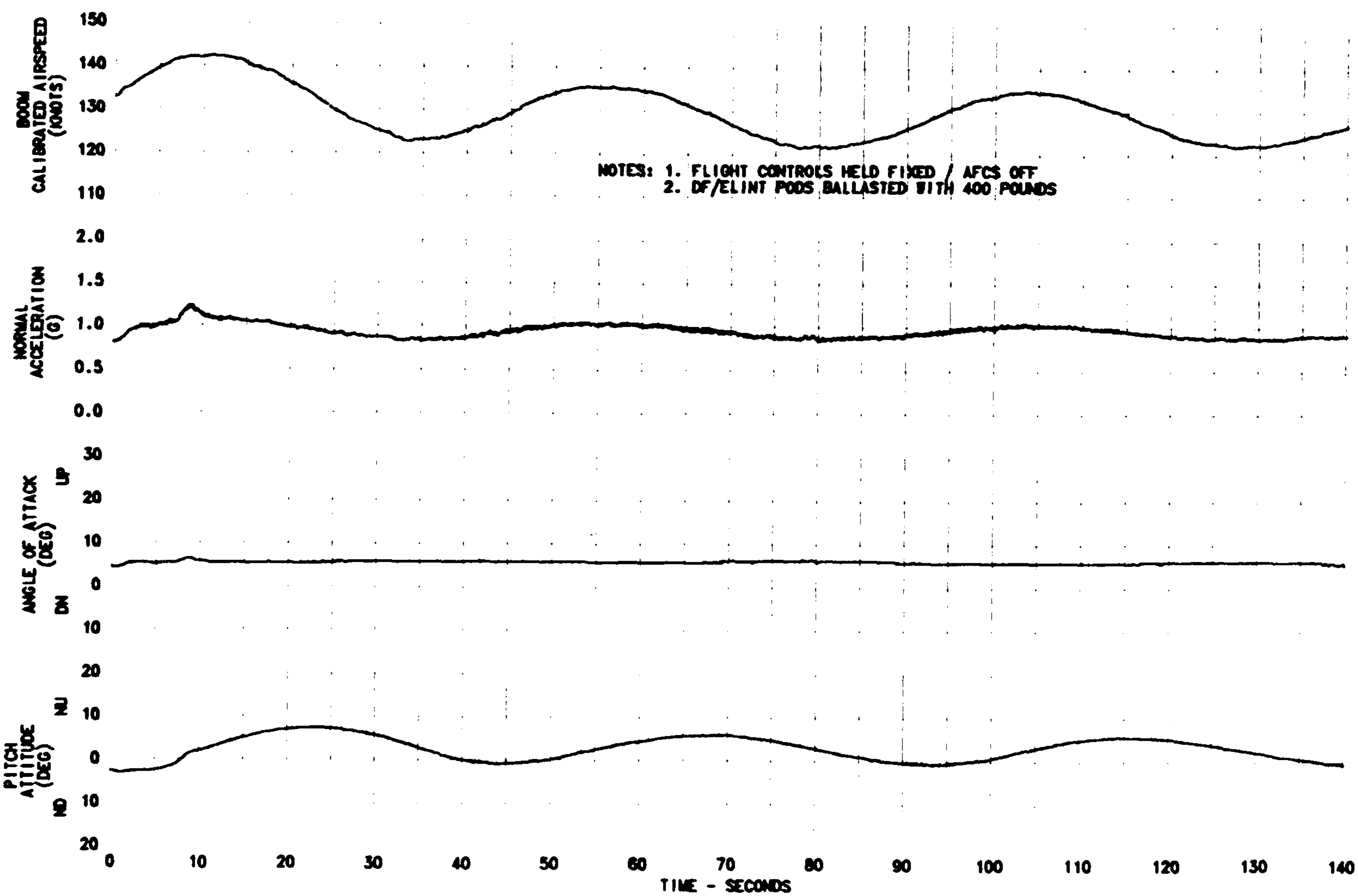


FIGURE 17
DYNAMIC LONGITUDINAL STABILITY
RC-12H USA S/N 83-24314

AVG GROSS WEIGHT (LB)	AVG LONGITUDINAL CG LOCATION (FS)	TRIM DENSITY ALTITUDE (FEET)	AVG OAT (DEG C)	TRIM CALIBRATED AIRSPEED (KT)	AIRCRAFT CONFIGURATION	FLAP POSITION (PERCENT)
14360	194.8 (AFT)	25630	-21.0	130	CRUISE	ZERO

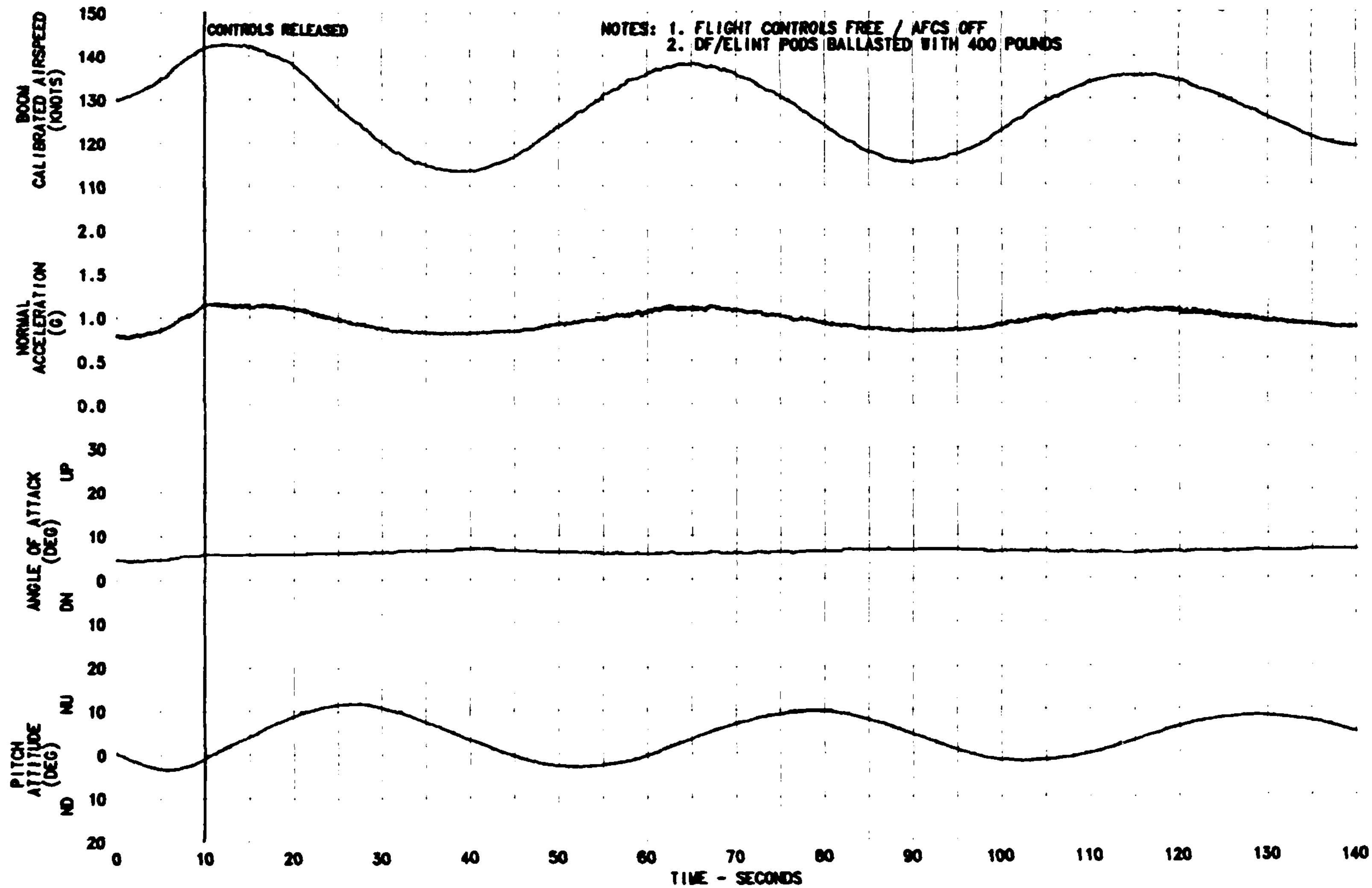
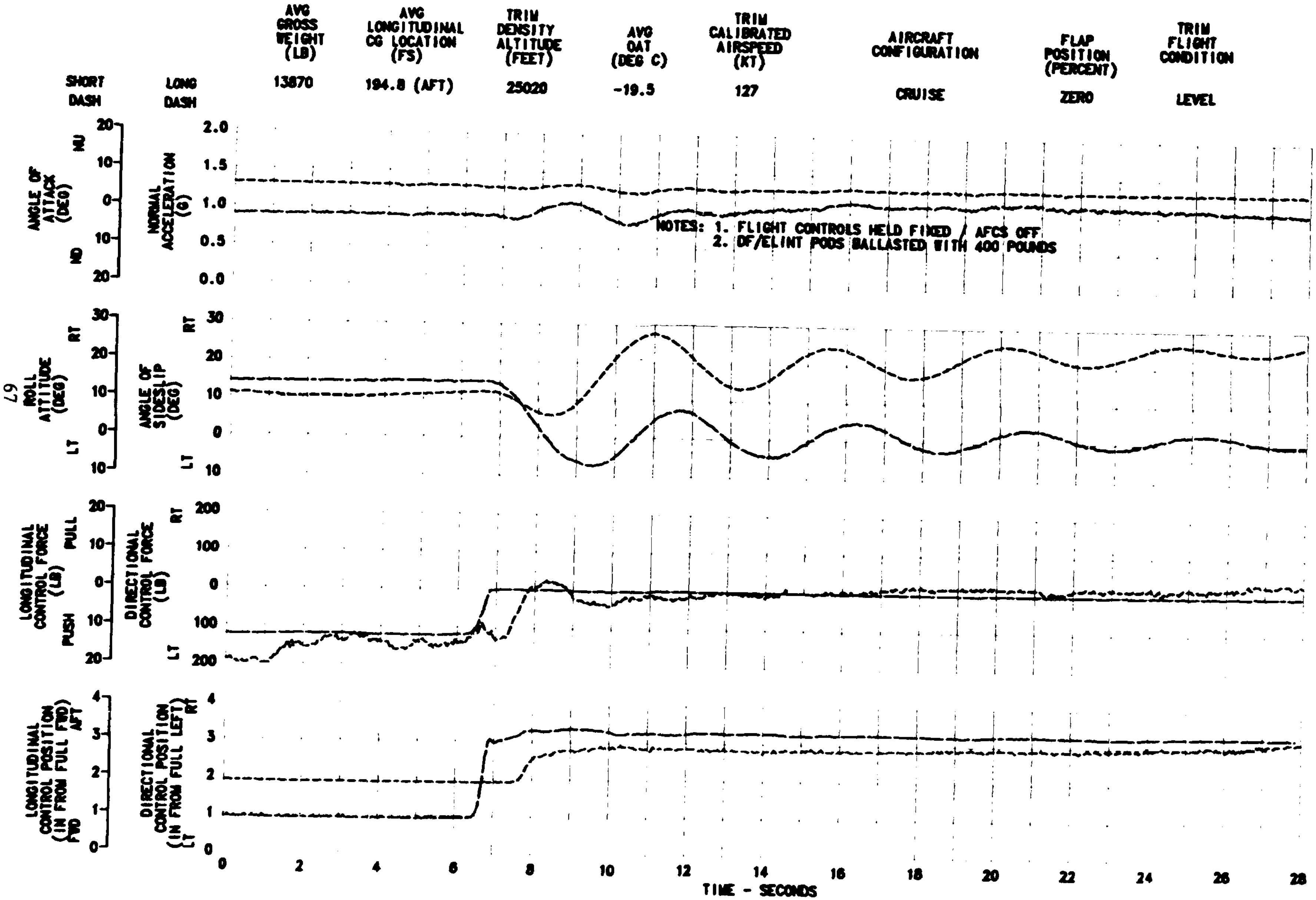


FIGURE 18
DUTCH ROLL RESPONSE
RC-12H USA S/N 83-24314



DISTRIBUTION

HQDA (DALO-AV)	1
HQDA (DALO-FDQ)	1
HQDA (DAMO-HRS)	1
HQDA (SARD-PPM-T)	1
HQDA (SARD-RA)	1
HQDA (SARD-WSA)	1
US Army Material Command (AMCDE-SA, AMCDE-P, AMCQA-SA, AMCQA-ST)	4
US Training and Doctrine Command (ATCD-T, ATCD-B)	2
US Army Aviation Systems Command (AMSAV-8, AMSAV-Q, AMSAV-MC, AMSAV-ME, AMSAV-L, AMSAV-N, AMSAV-GTD)	8
US Army Test and Evaluation Command (AMSTE-TE-V, AMSTE-TE-O)	2
US Army Logistics Evaluation Agency (DALO-LEI)	1
US Army Materiel Systems Analysis Agency (AMXSY-RV, AMXSY-MP)	8
US Army Operational Test and Evaluation Agency (CSTE-AVSD-E)	2
US Army Armor School (ATSB-CD-TE)	1
US Army Aviation Center (ATZQ-D-T, ATZQ-CDC-C, ATZQ-TSM-A, ATZQ-TSM-S, ATZQ-TSM-LH)	5
US Army Combined Arms Center (ATZL-TIE)	1
US Army Safety Center (PESC-SPA, PESC-SE)	2
US Army Cost and Economic Analysis Center (CACC-AM)	1
US Army Aviation Research and Technology Activity (AVSCOM) NASA/Ames Research Center (SAVRT-R, SAVRT-M (Library)	3

US Army Aviation Research and Technology Activity (AVSCOM) Aviation Applied Technology Directorate (SAVRT-TY-DRD, SAVRT-TY-TSC (Tech Library)	2
US Army Aviation Research and Technology Activity (AVSCOM) Aeroflightdynamics Directorate (SAVRT-AF-D)	1
US Army Aviation Research and Technology Activity (AVSCOM Propulsion Directorate (SAVRT-PN-D)	1
Defense Technical Information Center (FDAC)	2
US Military Academy, Department of Mechanics (Aero Group Director)	1
ASD/AFXT, ASD/ENF	2
US Army Aviation Development Test Activity (STEBG-CT)	2
Assistant Technical Director for Projects, Code: CT-24 (Mr. Joseph Dunn)	2
6520 Test Group (ENML)	1
Commander, Naval Air Systems Command (AIR 5115B, AIR 5301)	3
Defense Intelligence Agency (DIA-DT-2D)	1
School of Aerospace Engineering (Dr. Daniel P. Schrage)	1
Headquarters United States Army Aviation Center and Fort Rucker (ATZQ-ESO-L)	1
Commander, US Army Aviation Systems Command (AMSAV-EA)	1
Commander, US Army Aviation Systems Command (AMSAV-ECF)	1
Commander, US Army Aviation Systems Command (AMCPM-AE-T)	2