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Part 1 of 2 Parts
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PART ONE OF TWO PARTS
REPORT
OF THE ENGINEERING FLIGHT TEST
--STABILITY AND CONTROL PHASE--
OF THE
OH-6A HELICOPTER, UNARMED (CLEAN) AND ARMED WITH THE XM-7 OR XM-8 WEAPON SUBSYSTEM

USATECOM PROJECT NO. 4-3-0250/51/52/53

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U. S. ARMY AVIATION TEST ACTIVITY

63-25
Part I

PART ONE OF TWO PARTS
REPORT
OF THE ENGINEERING FLIGHT TEST
--STABILITY AND CONTROL PHASE--
OF THE
OH-6A HELICOPTER, UNARMED (CLEAN) AND ARMED
WITH THE XM-7 OR XM-8 WEAPON SUBSYSTEM

USATECOM PROJECT NO. 4-3-0250/51/52/53
ATA-TR-63-25-1
DA PROJECT NO. 1R141803D168

August 1964

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USAARSTA, EAFB, CA

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FOREWORD

Essential to an understanding of the results of aircraft testing is an understanding of the differences between engineering and service testing.

Engineering testing, using instrumented aircraft and calibrated instruments, can determine and record the exact performance, control response and limits, engine performance and power available, through accurate measurements and reduction of data to standard conditions. Thus, it is possible to determine when an aircraft is approaching or exceeding design limits or other specified criteria.

Service testing, using aircraft in standard configuration, results in a qualitative evaluation for user-type information. This information is based on a broad scope of pilot experience and technique provided by pilots ranging from those recently out of school to those with considerable field operational experience. The installed instruments and gauges are used to determine significant operating data. These instruments are not usually calibrated but represent typical instruments found in production helicopters. These instruments and gauges are verified for accuracy within acceptable tolerances but do not attain the precision provided by the calibrated equipment used for engineering testing.

The service test-pilot makes qualitative observations on only what he experiences during normal service flying. These observations are not correlated to such factors as the margin of control remaining or exact rates of control response. Exact measurements of such factors are necessarily the responsibility of the engineering test agency. Thus, service testing may show that the aircraft is suitable for performing a mission when, actually, flight has been performed close to, or within, control margins specified by military specifications. What may appear to be discrepancies between service and engineering test reports is actually the difference between qualitative and quantitative reporting.

The Light Observation Helicopter evaluation is the first combined aircraft engineering and service test program that has resulted in coordination of reports and comparison of reports prior to procurement decision. Caution must be exercised, therefore, to preclude taking an item out of context in any one report to establish a particular position. Seeming inconsistencies can be reconciled only by examination of all reports with due regard to the specific conditions under which the test was accomplished.

ABSTRACT

Stability and control tests were conducted on the OH-6A helicopter to determine stability and control characteristics throughout the flight envelope in Federal Aviation Agency Type Inspection Authorization No. OI1205-4DM, 30 January 1964. In addition, XM-7 and XM-8 firing tests were conducted to define the aircraft's suitability for use as a weapons platform.

The U. S. Army Aviation Test Activity (USAATA), Edwards Air Force Base, California, was designated Executive Test Agency for the confirmatory engineering tests in the LOH program and is responsible for test execution and test reporting of its assigned phase.

Engineering flight tests were conducted by the U. S. Army Aviation Test Activity at Edwards Air Force Base, California, and auxiliary test sites near Meadows Field, Bakersfield, California (sea level). One hundred one test flights were conducted for 44:10 productive flight hours. The tests were accomplished between 5 May 1964 and 31 June 1964. Aircraft OH-6A, S/N 62-4214, was used to conduct the program. The test helicopter was extensively instrumented to record all pertinent flight test data.

The OH-6A exhibited satisfactory stability and control characteristics in the majority of conditions tested. The static and dynamic stability characteristics of the OH-6A were normal for a light helicopter not employing stability augmentation devices. Cyclic control sensitivity and response were excellent and a high degree of maneuverability was present. Flight characteristics were not affected by the armament installation nor during firing of the weapons.

The following shortcomings were found: The longitudinal trim change with changes in collective pitch was excessive. There was an excessive pitch attitude change during cyclic-fixed entry into autorotation. There was unsatisfactory longitudinal dynamic stability in the flight envelope area between 2100 and 2300 pounds and between 2000 and 7000 feet density altitudes at speeds above 105 KCAS. Pitch up was experienced in this flight envelope area and excessive longitudinal control forces were required to recover to level flight. Engine response characteristics were found to be marginal in a high temperature and/or high altitude environment. All these shortcomings except the last did not comply with the requirements of Military Specifications for Helicopter Flying and Ground Handling Qualities, MIL-H-8501A.

The following undesirable characteristics were found. The longitudinal collective fixed stability was marginal in autorotation and low powered descents above 65 KCAS. There was insufficient trimming authority at the extremes of C.G. locations. There was barely adequate aft longitudinal control margin in rearward flight and sideward flight to the left at the maximum forward center of gravity location. These characteristics did not comply with MIL-H-8501A. Dynamic directional stability was generally poor, particularly in hovering and low speed flight, and in climb and autorotation. Directional control response was uneven and there was no means of relieving pedal forces; as a result, accurate weapon aiming was difficult. Control harmony was poor and the OH-6A was tiring to fly in turbulence for extended periods.

PHOTO 1 – OH–6A

PHOTO 2 – OH– 6A

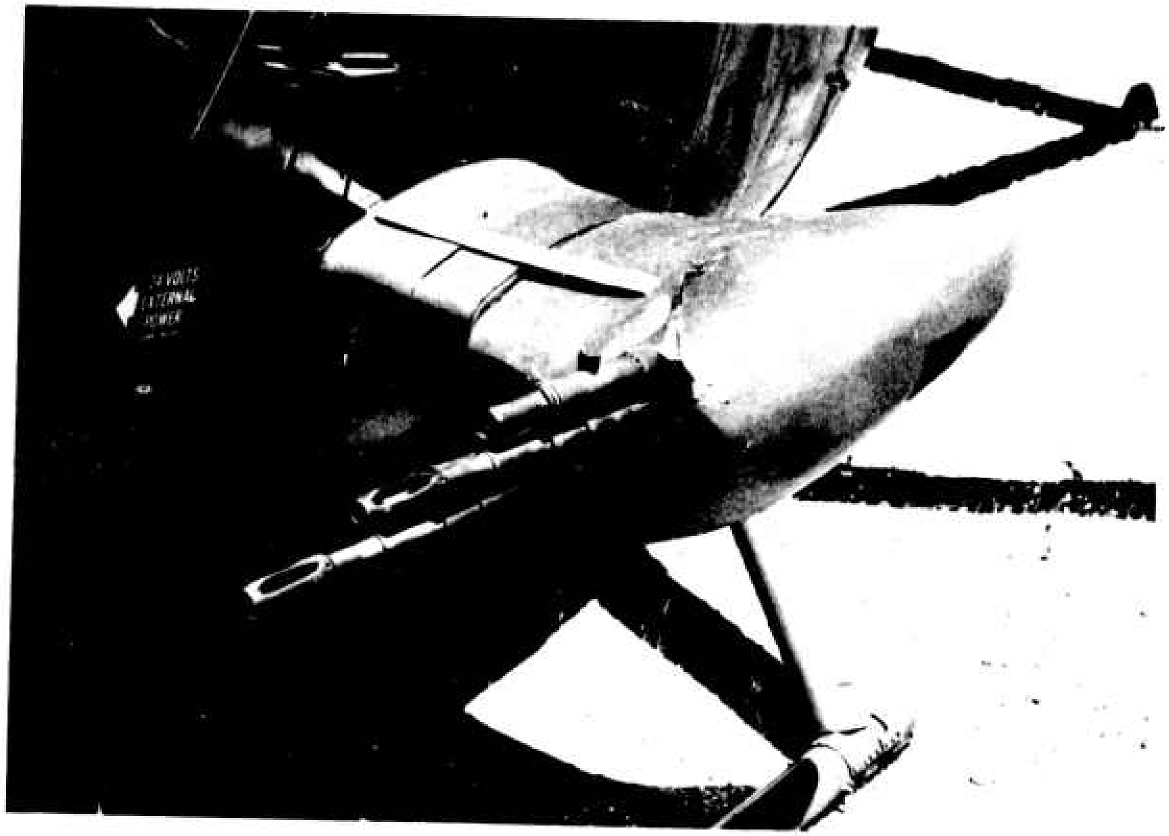


PHOTO 3 – XM-7 ARMAMENT KIT

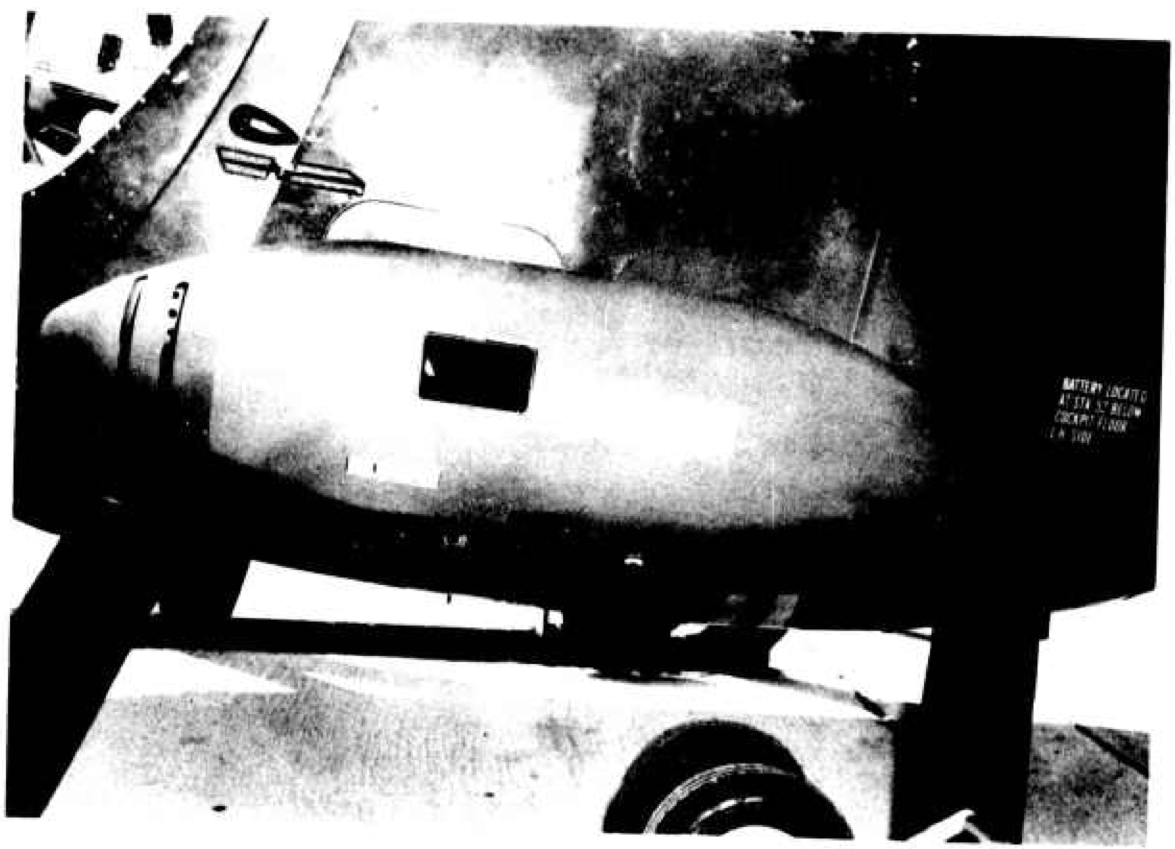


PHOTO 4 – XM-8 ARMAMENT KIT

SECTION 1 - GENERAL

1.1 REFERENCES

a. Military Characteristics, Light Observation Aircraft, TCTC Meeting 128, Item 3408, 20 May 1960.

b. Combat Development Objectives Guide (U) (CDOG), Paragraph 533a(1) as changed 25 March 1963.

c. Letter, AMCPM, Headquarters, U. S. Army Materiel Command, 12 March 1963, subject: "Test Directive, Evaluation of LOH" with 1 inclosure entitles "Test Directive for Flight Evaluation of OH-4/OH-5/OH-6 Aircraft."

d. Letter, AMSTE-BG, Headquarters, U.S. Army Test and Evaluation Command, 23 April 1963, subject: "Test Directive for Light Observation Helicopter."

e. Technical Development Plan, U. S. Transportation Materiel Command, Project No. L-R-1-41803-D-168, "Light Observation Helicopter," 20 February 1963.

f. Military Specification MIL-H-8501A, "General Requirements for Helicopter Flying and Ground Handling Qualities," 7 September 1961.

g. Federal Aviation Agency Type Inspection Authorization No. CH1205-4DM, 30 January 1964.

h. Final Report of "Engineering Test of the Stability and Control Characteristics of the OH-13H Equipped with the XM-1 Armament Kit, "U.S. Army Aviation Test Activity, April 1964.

i. Coordinated Plan of Test, USATECOM Project No. 4-3-0250-31/32/33, "Military Potential Test of the Light Observation Helicopter (LOH), OH-4A, OH-5A, and OH-6A," U.S. Army Aviation Test Board, 17 September 1963.

1.2 AUTHORITY

DIRECTIVE: Letter, AMSTE-BG, Headquarters, U. S. Army Test and Evaluation Command (USATECOM), 23 April 1963, subject: "Test Directive for Light Observation Helicopter."

1.3 OBJECTIVES

The objective of this program was to conduct engineering flight tests of the stability and control characteristics of the Light Observation Helicopter (LOH) OH-6A to (a) confirm contractor compliance with the approved Army Military Characteristics for an unarmed (clean) and armed OH-6A helicopter using Military Specification MIL-H-8501A as a guide, and (b) provide data to assist in selecting an LOH design for possible future production.

1.4 RESPONSIBILITIES

The U. S. Army Aviation Test Activity (USAATA) was designated Executive Test Agency for the confirmatory engineering tests in the LOH program and is responsible for test execution and test reporting of its assigned program phase.

1.5 DESCRIPTION OF MATERIEL

a. Technical Characteristics The OH-6A design incorporates a single main rotor and anti-torque tail rotor. The main rotor is a four-bladed fully articulated system. The main rotor blades can be folded and unfolded. The cockpit configuration is two-place, providing seating for a pilot and an observer. Temporary (stowable) seating is provided in the rear (cargo) area for two passengers. The landing gear is of the skid-type with air-oil dampened shock struts. Two fabric-reinforced rubber bladder fuel cells are located under the flooring in the passenger-cargo compartment and the cells have a usable capacity of 382 pounds. The OH-6A is powered by an Allison T63-A-5 gas turbine engine, de-rated to 250 SHP @ 6000 rpm takeoff power. The flight controls consist of dual rudder pedals, collective and cyclic sticks. The pilot's collective pitch control incorporates the engine starter button. The pilot's cyclic stick grip incorporates switches for cyclic control trimming, weapon elevation, firing trigger, landing light and intercom or radio operating switch.

b. Physical Characteristics

Rotor diameter	26 feet 4 inches
Helicopter overall length	30 feet 3-3/4 inches
Helicopter length (blade folded)	22 feet 9-1/2 inches
Minimum width	6 feet 9-1/4 inches
Maximum height	8 feet 1-1/2 inches
Empty weight	1070 pounds
Design gross weight	2100 pounds
Overload gross weight	2700 pounds

c. OH-6A Armament The armament for the OH-6A helicopter consists of two unitized, quickly detachable armament systems, the XM-7 and XM-8. The installation of both the XM-7 and the XM-8 kits and the ammunition containers in the OH-6A is identical. Both armament pods rotate through the same depression angles, 10 degrees up and 20 degrees down.

The XM-7 7.62 mm machine gun kit consists of two M-60C machine guns, each firing at approximately 600 rounds per minute. The system has an ammunition capacity of 1500 rounds. The ammunition available includes ball, tracer, armor piercing and incendiary ammunition. The unitized construction allows the system to be assembled and loaded prior to installation in the OH-6A.

The XM-8 kit consists of a single 40 mm M-75 grenade launcher, firing at approximately 240 rounds per minute. The system has an ammunition capacity of 150 rounds of inert or high explosive ammunition. The ammunition container, utilizing the same type of quick-disconnect fittings that the XM-7 kit does, may be installed on the kit prior to or after installation of the unit in the OH-6A.

Both kits are provided with quickly attachable and detachable streamline pods which may be installed, depending upon mission requirements. The pods are designed to provide drag reduction and protection for the guns.

The gun sight installation is the same for both the XM-7 and XM-8 armament kits. The sight is located on the bulkhead behind and between the pilot and copilot. With the system energized the sight is held to the right in the pilot's line of vision by a magnet; when the system is de-energized the sight must be returned to the stowed position by hand. The sight moves up and down in elevation through the same angles as the gun pod. The range adjustment knob is marked in yellow for the XM-7 and in white for the XM-8 armament kits.

1.6 BACKGROUND

a. Requirement Paragraph 533a(1) of the Combat Development Objectives Guide (CDOG), 25 March 1963 (Section 1.1, Reference b) and the Military Characteristics (MC's) (Section 1.1, Reference a) describe the light observation helicopter as follows: "The light observation aircraft shall be a light-weight, reliable, easily maintainable, readily air transportable helicopter capable of performing the following missions: visual observation and target acquisition, reconnaissance and command control. The helicopter will be of minimum size consistent with the requirement for a pilot and three passengers, or a pilot and 400 pounds of cargo. Reliability and front line supportability shall be given primary consideration.

b. General:

(1) In October 1959, the Office of Chief, Research and Development, Department of the Army, initiated an Army Aircraft Development Plan which would develop firm guidance for Army aviation for the period 1960 - 1970. As part of this plan three Army Study Requirements (ASR's) describing broad development objectives in the area of light observation, manned surveillance and tactical transport were prepared. The ASR's were presented to industry at Fort Monroe, Virginia, on 1 December 1959.

(2) As a result of the ASR 1-60 study on Army light observation aircraft, a decision was made to use light observation helicopters and to phase light observation aircraft out of Army inventory. The Light Observation Helicopter (LOH) Design Competition was initiated on 14 October 1960 by a letter to industry from the Bureau of Weapons, U. S. Navy. The designs were evaluated jointly by the U. S. Army and U. S. Navy, and three designs were selected for prototype testing. Army model designations for these helicopters are OH-4A, OH-5A and OH-6A.

(3) The contracts for "off-the-shelf" direct procurement were negotiated directly with the manufacturers. Contracts were awarded in November 1961 to each manufacturer for delivery of five prototype helicopters to be type certificated by the Federal Aviation Agency (FAA) in compliance with CAR, part 6. The Army has the option of accepting delivery before certification providing the FAA has issued Type Inspection Authorization (TIA.)

1.7 FINDINGS

a. Static Trim Stability

The static trim stability for the OH-6A was generally positive and satisfactory for most conditions tested with the following exceptions:

The magnitude of the nose-down pitch attitude change following a sudden power reduction by lowering the collective control, with cyclic and directional controls fixed, at speeds above 44 knots calibrated airspeed (KCAS), exceeded the 10 degrees in 2 seconds specified in MIL-H-8501A, paragraph 3.5.5.1.

Under all powered flight conditions tested at speeds above 45 KCAS, the change in longitudinal control position exceeded the allowable 3 inch limit of MIL-H-8501A, paragraph 3.2.10.2 when power was varied through the available range.

At maximum left center-of-gravity (C.G.) location (3 inches) there was insufficient right trim above 50 KCAS. At maximum forward C.G. (Station 97) there was insufficient aft trim in hovering, sideward and rearward flight. At overload gross weight and aft C.G. (Station 103.5) there was insufficient forward trim avilable in climbing flight above 35 KCAS. The lack of longitudinal trim authority under these conditions does not conform to MIL-H-8501A, paragraphs 3.2.3 and 3.3.10.

At speeds above approximately 65 KCAS the control force required to decrease speed in autorotation fell to zero and did not meet the requirements of MIL-H-8501A, paragraph 3.2.10. This characteristic was undesirable but acceptable. The static trim stability in autorotation was neutral.

Installation of the XM-7 or XM-8 armament kits had no significant effect on the static flying qualities. The static longitudinal trim stability characteristics in level flight for the OH-6A were quantitatively better than those of the OH-13H and OH-23D at the maximum forward C.G. location.

b. Static Longitudinal Collective Fixed Stability:

In level flight the longitudinal collective fixed stability was satisfactory. In full power climbing flight at 55 KCAS, trim airspeed was often difficult to maintain. In autorotation at speeds above 65 KCAS, the stick position gradient was neutral and as gross weight was reduced, it became negative; this characteristic was not desirable but was acceptable. During a 55 KCAS maximum power climb at zero angle of sideslip there was a control condition that resulted in a 3 to 5 degree left bank and a left displacement of the slip-ball. Climbing at high power in this attitude resulted in random oscillations about all axes. A high power climb with a 5 to 8 degree right sideslip and zero bank angle (slip-ball centered) moved the longitudinal control to the bottom of the "bucket" on the longitudinal control position versus sideslip curve in a climb. Climbing in this attitude eliminated the random oscillations. The OH-6A and OH-13H have similar magnitudes of static longitudinal collective fixed stability which decreases as airspeed increases. The OH-23D had negative stability that increases as airspeed increases.

c. Static Lateral-Directional Stability:

In powered and autorotational flight at all forward speeds above 35 KCAS, the OH-6A had positive static directional stability and positive effective dihedral. In all level flight conditions, a 10 percent margin of both lateral and longitudinal control travel was avialable at the maximum sideslip angles required by MIL-H-8501A, paragraph 3.3.9. In level flight at 35 KCAS, the very shallow pedal versus sideslip gradient made stabilized sideslip angles difficult to establish.

d. Sideward and Rearward Flight:

A true airspeed of only 5 knots was obtained in left sideward flight before 90 percent of the longitudinal control travel was reached with the C.G. at the forward location (Station 97). This does not meet MIL-H-8501A, paragraph 3.2.1. The aft longitudinal control stop was contacted intermittently at airspeeds between 20 knots true airspeed (KTAS) and 35 KTAS. Sideward flight to the left was directionally unstable and erratic in the speed range from 5 to 20 KTAS. There was no means of trimming out the left pedal forces in sideward flight to the right. This did not meet the requirement of MIL-H-8501A, paragraph 3.3.10.

In sideward flight, the OH-6A did not exhibit longitudinal control characteristics as strong as the OH-13H. The OH-6A and OH-13H exhibited similar lateral control characteristics in sideward flight up to 30 KTAS.

The OH-6A did not meet the requirements of MIL-H-8501A, paragraph 3.2.1 in rearward flight at the forward C.G. location. Ninety percent of the longitudinal control travel was reached at 5 KTAS rearward. Above 15 KTAS the aft stop was intermittently contacted during attitude corrections; and at 29 KTAS the aft stop was reached and no further nose-up corrections could be made. Lateral and directional control inputs were normal.

Both the OH-6A and OH-13H were longitudinal control limited in rearward flight at the forward C.G. location.

e. Dynamic Stability:

Longitudinal dynamic stability in level flight was satisfactory up to 105 KCAS at 5000 feet, at design weight. Above this speed, there was a reduction in angle of attack stability and in aft longitudinal damping that resulted in a "pitch-up" tendency. The sudden increase in load factor caused the immediate onset of blade stall and a rapid increase in 4 per rev vibration. It was not possible to trim the aircraft at 114 KCAS (Vne) due to this instability and pitch-up. Excessive stick force was required to recover from a small nose up disturbance at 114 KCAS and 5000 feet. This unsatisfactory characteristic was confined to a small area in the FAA/contractor's airspeed envelope, which could be modified to avoid this area. The aircraft also exhibited longitudinal dynamic instability in a climb, under the conditions specified previously in these findings.

Lateral dynamic stability was satisfactory in all conditions tested. There was always a coupling effect in pitch and yaw, however, following the lateral pulse type inputs.

Directional stability at low airspeeds (35 KCAS) was poor. Continuous corrections were required in gusty conditions to maintain the desired direction. At 102 KCAS and 5000 feet the directional stability was satisfactory. There was a roll coupling at all speeds following a directional input. The directional damping was low in autorotation and this added to the low static directional stability causing a tendency to over-control. This caused aiming difficulty during the firing tests.

f. Controllability:

In hovering flight longitudinal sensitivity was highly satisfactory. At speeds above 105 KCAS at 5000 feet and design gross weight, the increased load factor during maneuvers or aft longitudinal disturbances, caused pitch-up and rapid onset of blade stall. Reduced response and high stick forces were experienced during recovery. The high stick forces did not meet the requirements of MIL-H-8501A, paragraph 3.2.8. Under all other flight conditions longitudinal controllability was good.

The directional sensitivity was greater to the right than to the left, under all power-on conditions. The unmatched sensitivity between left and right pedals caused difficulty in precise directional control.

Maximum yaw rates to the right were very high in a hover. The time to reach maximum rate was also high (more than 5 seconds), however, and this characteristic was, therefore, satisfactory. In general, directional response was satisfactory.

g. Armament Firings

There was no detectable effect on the basic helicopter stability and control characteristics during the XM-7 and XM-8 firing tests, although poor directional stability, sensitivity, harmony, and uneven pedal forces made accurate aiming difficult.

h. Autorotation Characteristics:

The behavior of the aircraft following a throttle-chop was satisfactory. The rotor decay rates were high, but rotor speed did not decay below the minimum design power-off limit during a 2 second delay. The behavior following the reduction of collective pitch at speeds above 45 KCAS with stick fixed was unsatisfactory. The longitudinal stick movement required to maintain attitude was excessive, particularly at cruise speeds.

Power-off landing characteristics at design gross weight were good. There was sufficient control in all axes and sufficient rotor inertia to cushion the touchdown. A wide variety of satisfactory techniques were employed and the helicopter showed good versatility during autorotational landings.

i Control System:

The flight control system was generally satisfactory. However, shortcomings existed in the following areas:

(1) There was inadequate trim system authority.

(2) There was no provision for relieving rudder forces which were high and uneven.

(3) The friction system was awkward to reach easily and laborious to operate quickly but provided adequate friction.

(4) The turbine speed-select control could not be operated simultaneously with the throttle. This was undesirable because of the N_2 "over-ride" incorporated in the twist grip.

(5) Engine response characteristics were marginal under high temperature and/or high density altitude operating conditions.

j. Airspeed Calibration:

The standard aircraft airspeed system accuracy in level flight was satisfactory. The correction at 102 KIAS was - 1 knot.

1.8 CONCLUSIONS

None

1.9 RECOMMENDATIONS

None

SECTION 2 - DETAILS AND RESULTS OF SUB-TESTS

2.0 INTRODUCTION

The stability and control phase of the engineering flight test of the OH-6A helicopter unarmed (clean) and armed with the XM-7 or XM-8 weapon subsystem, is presented in this report. The tests were conducted by the U. S. Army Aviation Test Activity, Edwards Air Force Base, California, during the period of 5 May 1964 through 31 June 1964. One hundred one flights were flown for a total of 44:10 productive test hours. The stability and control tests were conducted to evaluate the stability and control characteristics throughout the flight envelope specified in Federal Aviation Agency Type Inspection Authorization No. CH1205-4DM.

The stability and control tests were conducted at the following conditions unless otherwise specified:

Gross Weight	Density Altitude Feet	Center of Gravity	Configuration
Design	5000	Aft (Station 103.5)	Clean
Design	5000	Fwd (Station 97.0)	Clean
Overload	5000	Aft (Station 103.5)	Clean
Design	10,000	Aft (Station 103.5)	Clean
Design	5000	Aft (Station 103.3)	Armed (XM-7 or XM-8)

All data was obtained from sensitive instrumentation and hand recorded or recorded on an oscillograph. Fourteen parameters were recorded on the oscillograph and seven additional calibrated instruments were installed in the instrument panel. The complete instrumentation package weighed approximately 70 pounds.

All tests were conducted in non-turbulent atmospheric conditions to obtain accurate data. The design gross weight of the OH-6A is 2100 pounds and the overload gross weight is 2700 pounds. The allowable longitudinal center-of-gravity travel (C.G.) is from Station 97.0 (forward limit) to Station 104.0 (aft limit) at both the design and overload gross weight.

Weapon firing with the XM-7 and XM-8 armament kits installed was conducted at the Edwards Air Force Base firing range to aid in the evaluation of the helicopter as a weapons platform. Representatives from the Springfield Armory, Springfield, Massachusetts, worked with the USAATA personnel in an advisory capacity. During the firing phase the weapons were fired at full elevation and full depression angles with the helicopter in various flight conditions at density altitudes between 3000 and 5000 feet. The pressure altitude at the firing test site was 3000 feet.

Stability and control tests were conducted in a sequence that enabled the static stability tests at the lower altitude (5000 feet) and gross weight conditions to be completed before initiation of the dynamic stability and controllability tests. This sequence provided a safe, logical order of tests.

A complete control system rigging check was made following the manufacturer's rigging specifications and tolerances. No control system components were replaced during the test program and the control system was unchanged from the start to the completion of the program.

The OH-6A stability and control characteristics were checked for conformity with MIL-H-8501A specifications in applicable areas. A comparison of the OH-6A helicopter stability and control characteristics was made to the stability and control characteristics of the OH-13H and OH-23D helicopters where possible. The airspeeds and altitudes referred to in this report are calibrated airspeeds (CAS) and density altitude (H_D) respectively.

2.1 STATIC TRIM STABILITY IN FORWARD FLIGHT

2.1.1 OBJECTIVE

The objectives of the tests were to determine the static longitudinal trim stability and flying qualities at a series of trim airspeeds during level flight, climb and autorotation.

2.1.2 METHOD

The tests were conducted during level flight, climb and autorotation for the flight conditions specified in Section 2.0 and the following flight regimes:

Condition	Airspeed Range KCAS
Climb	25 to 65
Level Flight	20 to 115
Autorotation	20 to 65 (Vmax R/D)
Autorotation	35 to 95 (Vmin Angle/Descent)

The helicopter was stabilized at the trim airspeeds by varying the control positions as required for the flight conditions. Zero angle of sideslip was maintained for all trim conditions. The sideslip indicator was part of the test instrumentation and was not standard equipment.

2.1.3 RESULTS

Graphical test results are presented in Figures No. 3 through 13, Section 3, Appendix I, and summarized in Figures No. 1 and 2, Section 3, Appendix I.

2.1.4 ANALYSIS

2.1.4.1 Quantitative Engineering Analysis of Static Trim Stability

a. Clean Configuration

The static trim stability was generally positive for the conditions tested. Variations of altitude, gross weight and center of gravity (C.G.) location shifted the control position gradients but did not alter the shape of the trim curves. Static longitudinal trim stability was positive for airspeeds up to 45 knots calibrated airspeed (KCAS). At airspeeds between 45 KCAS and 60 KCAS, the longitudinal trim stability was neutral to slightly positive, and for airspeeds above 60 KCAS, the stability became more positive as speed was increased. (See Figures No. 1 and 2, Section 3, Appendix I)

At the forward C.G. location (Station 97) the longitudinal stick position was 3 inches further aft than at the aft C.G. location (Station 103.5) at low speeds and 2 inches further aft at high speeds. Lateral and directional control movements with increased airspeeds were normal and these controls were near their center of travel at high airspeeds. The helicopter in forward flight was neither control nor power limited in any area and there were 10 percent control travel margins for all axes.

The static stability during climbs at 2100 pounds (design gross weight) was positive for all altitudes and C.G. locations. At overload weight in climbing flight, the longitudinal trim stability became neutral at 70 KCAS. Moving the C.G. from full forward (Station 97) to full aft (Station 103.5) required a longitudinal control position change of 2 inches aft. The longitudinal control position moved slightly forward (0.6 inch) as gross weight was increased from design to overload. Lateral and directional control positions were essentially the same for climbs at altitudes of 5000 and 10,000 feet. Under all powered flight conditions tested at speeds above 45 KCAS, the change in longitudinal control position exceeded 3 inches when power was varied throughout the available range (See Figure No. 13, Section 3, Appendix I). This change in longitudinal trim exceeded the limits of MIL-H-8501A, paragraph 3.2.10.2.

The attitude change following a sudden power reduction by lowering the collective pitch control with cyclic and directional controls fixed, at airspeeds below 45 KCAS, complied with the requirements of MIL-H-8501A, paragraph 3.5.5.1. The magnitude of the pitching became progressively worse as airspeed increased and was 17 degrees nose down 2 seconds after the power reduction at 70 KCAS, in level flight. (See Figure 14, Section 3, Appendix I.) This exceeds the maximum of 10 degrees allowed by MIL-H-8501A.

In autorotation, the static trim stability was slightly positive below 65 KCAS and became less positive as speed was increased. Lateral and directional control positions during autorotation were normal and no discontinuities occurred.

b. Armed Configuration

Test results show that the static trim stability for the armed configuration was essentially the same as for the clean configuration, for all conditions tested. Longitudinal trim stability was slightly more positive in the middle speed range. The right lateral control movement required to compensate for the 2.8 inch left lateral C.G. location with the XM-8 armament installed was 1 inch. Slight control position changes were required as the armament was moved from full up (+10 degrees) to full down (-20 degrees) elevation angles.

2.1.5 QUALITATIVE PILOT'S COMMENTS ON STATIC TRIM STABILITY

a. Clean Configuration

In forward level flight, control position changes were normal and no objectionable or unusual discontinuities were noticed. At high speed (115 KCAS at 5000 feet, 2100 pounds gross weight) the high degree of control sensitivity and the dynamic longitudinal instability made it difficult to maintain a trimmed condition. These characteristics are discussed in detail under paragraph 2.5, "Dynamic Stability."

In full-power climbing flight, although the longitudinal stick position gradient was positve, the static flying qualities were poor. Stable climbs were often difficult to maintain under certain combinations of airspeed, rate of climb, and angle of sideslip. The dynamically unstable conditions resulting from this type of climb are discussed in paragraph 2.5.4.5 and illustrated in Figure No. 73, Section 3, Appendix I. To avoid this characteristic, it was necessary to alter either the rate of climb, airspeed or sideslip angle until the random disturbances were removed, enabling a stable climb to be maintained. The attitude of the aircraft was uncomfortable during maximum power, high rate of climb conditions because of the unbalanced conditions at zero sideslip; i.e., 3 degrees left bank and the slip-indicator on the gyro horizon displaced two ball-widths to the left. If the lateral and directional controls were moved to center the slip-ball and level the bank angle, a more stable and comfortable trimmed attitude was achieved. This condition produced 8 degrees sideslip at 91 percent torque.

At overload gross weight and an aft C.G. (Station 103.5), there was insufficient forward trim available above 35 KCAS. At 55 KCAS a 2 to 4 pound push force was required to maintain trim. At design gross weight and an aft C.G. (Station 104), there was insufficient forward trim available at heights above 12,000 feet density altitude, requiring 2 to 4 pounds push force to maintain climb speed. There were no means for trimming out the pedal forces during hover and climbs. The pedal forces varied according to the power used with an average left pedal force of 15 pounds in full power climb. There was insufficient aft longitudinal trim in a hover at design weight and a forward C.G. with a pull force of 1 to 2 pounds being required to maintain attitude and position. The lack of trim authority for the above conditions is contrary to MIL-H-8501A, paragraphs 3.2.3 and 3.3.10 and was an annoyance to the pilot.

In autorotation, the longitudinal trim stability was the same as the collective fixed speed stability and became neutral or slightly negative at high speeds. This instability was considered acceptable but gave the pilot an uncomfortable feeling during high speed, low powered descents. The longitudinal stick appeared to move aft as trim speed was increased, particularly at light weights, although the data did not always show this to the same extent. The control force gradient required to decrease speed fell to zero, thus accentuating the unstable feeling. This control force characteristic does not meet the requirements of MIL-H-8501A, paragraph 3.2.10, which requires positive static longitudinal control force stability with respect to speed.

The variation of cyclic stick positions for trim as power (collective) was varied throughout the range was excessive for all conditions tested at speeds above 40 KCAS. This is contrary to the requirements of MIL-H-8501A, paragraph 3.2.10.2. This variation is plotted in Figure No. 13, Section 3, Appendix I. It was considered to be a marginally acceptable flying quality which should be brought to the attention of all pilots. The effect of lowering the collective, with the cyclic stick held fixed at speeds above 45 KCAS, was a rapid nose-down pitch from which immediate recovery was required, contrary to MIL-H-8501A, paragraph 3.5.5.1. The variation of lateral control position during this maneuver was slightly in excess of MIL-H-8501A requirements of 2 inches but was not considered to be either excessive or objectionable.

b. Armed Configuration

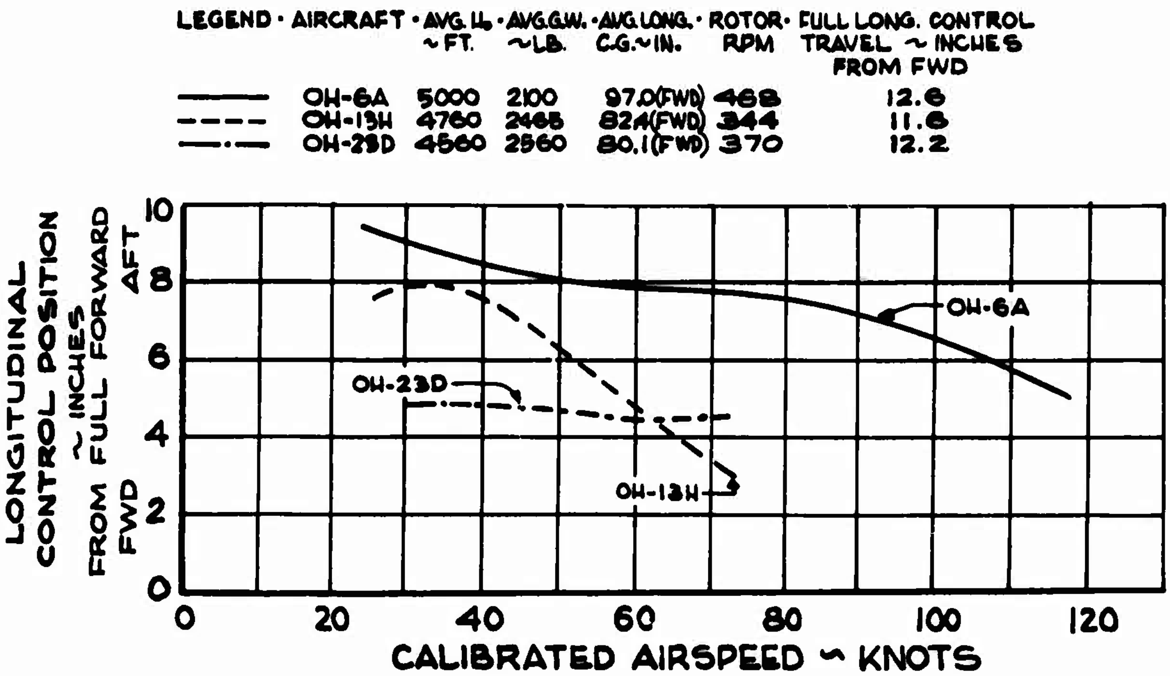
The static flying qualities of the aircraft with the XM-7 or XM-8 installed on the left side were not appreciably affected except for the shift in lateral cyclic control position. The additional right lateral cyclic control required was not excessive, but there was not sufficient control trim available at the maximum left C.G. for airspeeds above 50 KCAS. The armament position (elevation) altered the lateral cyclic and the pedal positions slightly. In autorotation at speeds below 45 KCAS, there was a noticeable amount of left stick required to prevent the aircraft from rolling to the right. In hovering flight in ground effect (IGE), the aircraft attitude was estimated to be 2 to 3 degrees left side down.

2.1.6 COMPARISON OF THE STATIC TRIM STABILITY OF THE OH-6A AND THE OH-13H AND OH-23D

The static longitudinal trim stability characteristics in level flight for the OH-6A were quantitatively better than for both the OH-13H and OH-23D at the maximum forward C.G. location. The OH-6A shows no longitudinal stick position reversals with respect to speed from zero to 120 KCAS. The OH-13H has a reversal below 32 KCAS and the OH-23D has a reversal above 60 KCAS. The OH-13H control position gradient is excessively steep with respect to speed. The OH-23D is uncommonly shallow. The following plot illustrates these characteristics:

FIG. A

STATIC LONGITUDINAL TRIM STABILITY



2.2 STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

2.2.1 OBJECTIVE

The objective of the static longitudinal collective fixed stability tests was to measure quantitatively the static stability characteristics and flying qualities as airspeed was varied about a given trim airspeed at a fixed collective setting.

2.2.2 METHOD

Static longitudinal collective fixed stability tests were conducted at trim speeds and configurations specified in Section 2.0 and the following conditions and flight regimes:

Condition	Airspeed Range KCAS
Climb	35 to 75
Level Flight	20 to 120
Autorotation	35 to 95

The aircraft was trimmed at each specific condition and the collective control was friction-locked. The airspeed was then varied through the specified range by using cyclic and pedal controls only. At each stabilized point the control positions and aircraft attitudes were recorded. All points were recorded at a sideslip angle of zero degrees. The sideslip indicator was part of the test instrumentation and was not standard equipment.

2.2.3 RESULTS

Graphical test results are presented in Figures No. 17 through 34 and summarized in Figures No. 15 and 16, Section 3, Appendix I.

2.2.4 ANALYSIS

2.2.4.1 Quantitative Engineering Analysis of Static Longitudinal Collective Fixed Stability

a. Clean Configuration

The static longitudinal collective fixed stability summarized in Figures No. 15 and 16, Section 3, Appendix I, was generally positive for all flight conditions tested. (See Summary in Figures No. 15 and 16, Section 3, Appendix I.) The stability was most strongly positive, measured at the trim point, at low airspeeds in level flight and became less positive at higher speeds. Between 90 and 114 KCAS the longitudinal collective fixed stability about the trim points was neutral.

With a forward C.G. location (Station 97) the same trend was apparent, but more positive control gradient values were obtained and the stability did not become neutral at high speed.

The effect of increasing gross weight to overload gross weight was similar to the effect of moving the C.G. location forward, but the increase in stability was not as large.

At 10,000 feet the longitudinal collective fixed stability at low airspeeds was greater but there was a greater decrease in stability as airspeed was increased above the trim speed.

In all configurations at 35 KCAS in level flight, the slope of longitudinal stick position curve decreased as airspeed was increased away from trim and the slope normally increased slightly as airspeed was reduced from trim. At high speeds the slope of the stick position curve was essentially constant as speed was reduced or increased from trim.

In climbing flight, strongly positive longitudinal collective fixed stability data were obtained which, in all configurations, exceeded the level flight condition by at least 100 percent.

The effect of C.G., weight and altitude on speed stability in the climbs was opposite to that found in level flight and a reduction in longitudinal control gradient was found at each configuration. The slope of the stick position curves, as airspeed was varied from trim, showed more discontinuities than in level flight. With the exception of the 10000 foot and overload conditions, the stability varied more as airspeed was changed from trim.

In autorotation, speed stability was of a similar magnitude and trend as during level flight. At high trim airspeeds (75 KCAS) the stability was neutral or only very slightly positive. Airspeed could be increased 40 KCAS above trim speed with no change in the static longitudinal stick position. Extrapolation of trim curves and reference to Figure No. 13, Section 3, Appendix I, indicate that when weight is reduced to approximately 1800 pounds the collective fixed speed stability is negative at speeds above 60 KCAS, due to reduced collective position at reduced weight.

The effect of forward C.G. on longitudinal collective fixed stability was to increase the stability during autorotation. The effect of increased weight was the same but less pronounced.

b. Armed Configuration

The longitudinal collective fixed stability was essentially unchanged in level flight with XM-7 or XM-8 armament installed. The longitudinal stick position displacement curves show the same trends and variations as for the clean configuration.

2.2.5 QUALITATIVE PILOT'S COMMENTS ON STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

In level flight the collective fixed stability was satisfactory. Trimmed speeds were easy to maintain, except in the range from 30 to 60 KCAS where the power required curve was quite flat, and at never-exceed airspeed (Vne) at 5000 feet, 2100 pounds gross weight, where longitudinal dynamic instability was apparent. The latter characteristic is discussed later in the report.

In climbing flight at 55 KCAS, trim airspeed was difficult to maintain, in spite of a positive longitudinal stick gradient, due to the random interference mentioned in paragraph 2.1.5.

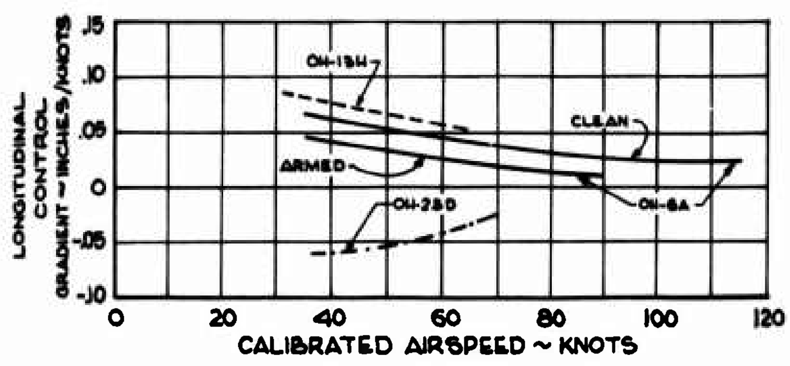
In autorotation, particularly at speeds above 65 KCAS, the collective fixed stability was neutral at design gross weight and as weight was reduced it became negative. This is also discussed in paragraph 2.1.5. As airspeed was increased above trim speed, the static stick position moved slightly aft to a position that felt uncomfortable. Since no re-trimming of the stick was required, the slight aft control position contributed to the impression of instability.

2.2.6 COMPARISON OF THE STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY OF THE OH-6A AND THE OH-13H AND OH-23D

The OH-6A and OH-13H have similar magnitudes of static longitudinal collective fixed stability that decrease as airspeed increases. The OH-23D has negative collective fixed stability that increases as airspeed is increased. The following plot illustrates these characteristics:

FIG. B
STATIC LONGITUDINAL
COLLECTIVE FIXED STABILITY
- LEVEL FLIGHT -

LEGEND	AIRCRAFT	AVG. H_p ~ FT.	AVG. G.W. ~ LB.	AVG. C.G. ~ INCHES	ROTOR RPM	CONFIGURATION
———	OH-6A	5000	2130	87.0(FWD)	468	NOTED
----	OH-13H	5100	2475	[illegible](FWD)	344	ARMED
—·—	OH-23D	4650	2560	80.1(FWD)	370	CLEAN



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2.3 STATIC LATERAL-DIRECTIONAL STABILITY

2.3.1 OBJECTIVE

The objectives of the static lateral-directional tests were to determine the directional stability and the effective dihedral characteristics throughout the flight envelope.

2.3.2 METHOD

Static lateral-directional stability was measured by recording the amount of directional control required to produce a given amount of sideslip angle. Effective dihedral was determined from the bank angle and lateral control relationships. The tests were conducted at the conditions specified in Section 2.0 and at the following sideslip angles:

Condition	Trim Airspeed KCAS	Sideslip Angle Degrees
Climb	55	45 Right & 45 Left
Level Flight	35	45 Right & 45 Left
Level Flight	90 (.8Vne)	25 Right & 25 Left
Level Flight	113 (Vne) (Clean Configuration Only)	10 Right & 10 Left
Autorotation	55 (Vmin R/D)	45 Right & 45 Left
Autorotation	75 (Vmin Angle/Descent)	25 Right & 25 Left

2.3.3 RESULTS

Graphical test results are presented in Figures No. 37 through 62 and summarized in Figures No. 35 through 36, Section 3, Appendix I.

2.3.4 ANALYSIS

2.3.4.1 Quantitative Engineering Analysis of Static Lateral-Directional Stability

a. Clean Configuration

The helicopter had positive, control fixed, directional stability and positive effective dihedral in powered and autorotational flight at all forward flight speeds above 35 KCAS. For all level flight conditions, a 10 percent margin of both lateral and longitudinal control travel was available at the maximum sideslip angles required by MIL-H-8501A, paragraph 3.3.9. The variation of pedal displacement and lateral cyclic control with sideslip angle was stable (left pedal and right stick displacement for right sideslip.)

In level flight at 35 KCAS and 35 degrees right sideslip, the helicopter entered a self-excited divergent oscillation about all axes (see Figure No. 126, Section 3, Appendix I.) The oscillations started by yawing left, rolling right and pitching up. These oscillations continued with the period and magnitude increasing with time. The motion was not particularly uncomfortable and only a small amount of input was required to stop the oscillations. For all other conditions, the lateral-directional stability was positive. The pedal and lateral stick required per degree of sideslip angle increased with airspeed.

The static lateral-directional stability was positive during climbs at maximum continuous power. The longitudinal control requirements were not symmetrical with sideslip angle. This change in longitudinal control requirements contributed a small pitching change with small variations in sideslip angle about zero. The base of the longitudinal stick position curve occurred at 7 to 9 degrees right sideslip and this corresponded to the normal climb condition, i.e., level bank angle. Altitude and gross weight did not significantly affect the stability characteristics although at overload gross weight the directional stability was slightly more positive in right sideslip at the higher sideslip angles. During autorotation, the static lateral-directional stability was only slightly positive.

b. Armed Configuration

The static lateral-directional stability characteristics in the armed configuration were essentially the same as those for the clean configuration.

2.3.5 QUALITATIVE PILOT'S COMMENTS ON STATIC LATERAL-DIRECTIONAL STABILITY

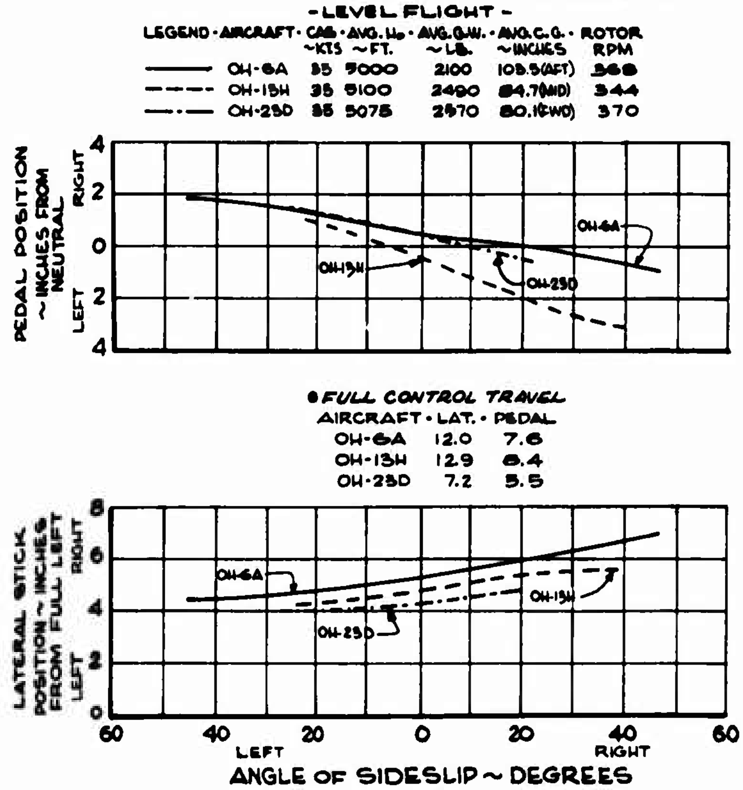
Clean and Armed Configurations

The aircraft was difficult to stabilize directionally during autorotation at 55 KCAS, or less, and in level flight at 35 KCAS. During climbs at 55 KCAS, the interference previously mentioned in paragraphs 2.1.5 and 2.2.5 was felt as random disturbances. In level flight at 35 KCAS, the very shallow pedal versus sideslip gradient made stabilized sideslip angles difficult to establish. During left sideslips, this condition was present from zero to 10 - 12 degrees sideslip angle, beyond which stabilized sideslips were easier to maintain. During right sideslips, the shallow pedal gradient caused difficulty out to 15 degrees sideslip. From 15 to 30 degrees stabilized conditions could be maintained but from 30 to 45 degrees the aircraft became dynamically unstable (see paragraph 2.3.4.1.) These characteristics were virtually independent of altitude, weight, configuration or center of gravity.

2.3.6 COMPARISON OF THE STATIC LATERAL-DIRECTIONAL STABILITY OF THE OH-6A AND THE OH-13H AND OH-23D

The dihedral effect as indicated by the lateral stick position versus sideslip angle is similar for the three helicopters. The directional stability gradient for the OH-6A as indicated by the pedal position versus sideslip angle, was only slightly positive at 35 KCAS for both left and right sideslip angles of 20 degrees. The OH-23D has the same gradients for the left sideslips and is slightly more positive at right sideslip angles. The OH-13H is more strongly positive for both left and right sideslip angles. The following plot shows the comparison of static lateral-directional stability at 35 KCAS:

FIG. C
STATIC LATERAL-DIRECTIONAL STABILITY
-LEVEL FLIGHT-



2.4 SIDEWARD AND REARWARD FLIGHT

2.4.1 OBJECTIVE

The objectives of the sideward and rearward flight tests were to determine the control positions required to hover under cross-wind and tail-wind conditions at various C.G. locations and to examine the flying qualities resulting from the armament installations.

2.4.2 METHOD

Cross-wind and tail-wind in ground effect (IGE) hovering conditions were simulated by flying the helicopter sideward to the left and right and rearward in calm air. A ground vehicle was calibrated for pacing and was used to determine the helicopter's speed during stabilized flight for each of the conditions specified in Section 1.1, Reference a. and as tabulated below:

Center of Gravity Long Lat	Weight	Speed Range	Configuration
Sideward Flight			
Fwd Mid	Design	Vmax Rt - Vmax Lt	Clean
Aft Left	Design	Vmax Rt - Vmax Lt	Clean
Rearward Flight			
Fwd Mid	Design	20 Kt Fwd - Vmax Rear	Clean

2.4.3 RESULTS

Graphical results are presented in Figures No. 63 and 64, Section 3, Appendix I.

2.4.4 ANALYSIS

2.4.4.1 Quantitative Engineering Analysis of Sideward and Rearward Flight

a. Sideward Flight: Clean Configuration, Forward C.G. Location (Station 97), Mid Lateral C.G.

In sideward flight, the forward C.G. location was the most critical in terms of control margins. In sideward flight to the left, less than 10 percent of aft longitudinal control was available above 5 knots true airspeed (KTAS), and at speeds above 13 KTAS, the longitudinal control intermittently contacted the aft limit. A longitudinal control reversal, however, occurred at 15 KTAS and a maximum speed of 33 KTAS was obtained. Sideward flight to the right did not cause any of the controls to come within 10 percent of their limits, but extrapolation of the data indicated that maximum left pedal would be reached at 38 KTAS. Between 5 and 15 KTAS to the left there was a 1/2 inch reversal of pedal displacement and between 12 and 26 KTAS there was a 3/4 inch pedal position reversal. Lateral control positions were nearly linear, with no undesirable discontinuities.

b. Sideward Flight: Clean Configuration, Aft C.G. Location (Station 102.5), Left Lateral C.G. (2.9 inches left)

This configuration was used to satisfy the test plan requirements and to simulate the most extreme C.G. locations likely to be encountered in the armed configuration. The trend of all the control positions was identical to the forward C.G. configuration. The longitudinal control position was displaced approximately 1-1/2 inches forward and the lateral control was approximately 1-1/2 inches further right in flight to the left and 2 to 3 inches further right in flight to the right. All control margins were in excess of 10 percent of travel in sideward flight for both directions at airspeeds up to 30 KTAS. The pedal reversal characteristics in left sideward flight, paragraph 2.4.4.1.a., were more pronounced at the forward C.G. location.

c. Rearward Flight: Clean Configuration, Design Gross Weight, Forward C.G. (Station 97), Mid Lateral C.G.

Ten percent of longitudinal control remaining was reached at 5 KTAS rearward. The aft control stop was contacted intermittently at all speeds above 29 KTAS. This airspeed and control required is in violation of MIL-H-8501A, paragraph 3.2.1. Lateral and directional control margin requirements were met, and there were no signs of any abnormal control positions or objectionable discontinuities.

2.4.5 QUALITATIVE PILOT'S COMMENTS ON SIDEWARD AND REARWARD FLIGHT

2.4.5.1 Sideward Flight

a. Clean Configuration, Design Gross Weight, Forward Longitudinal C.G., Mid Lateral C.G.

In calm air, it was possible to reach approximately 35 KCAS in either direction, but to the left the margin of longitudinal control remaining to correct for gusts or make flight path corrections was insufficient above about 13 KTAS. Although only 10 percent of the longitudinal control travel remained above 5 KTAS, there was still sufficient control power to provide adequate control in relatively smooth air. In the speed range from 20 to 35 KTAS to the left, the cyclic stick intermittently contacted the aft stop, and under gusty conditions it was not possible to prevent the aircraft from moving forward occasionally. In addition, sideward flight to the left was directionally unstable and erratic in the speed range from 5 to 20 KTAS. Adequate directional control power was available to maintain heading, but pilot effort was high. This characteristic was not present to the right. There were no means of trimming out the left pedal forces in sideward flight to the right; this is contrary to requirements of MIL-H-8501A, paragraph 3.3.10. It was not possible to trim out the aft longitudinal stick force at any time during the hover or sideward flight in either direction; this does not comply with the requirements of MIL-H-8501A, paragraph 3.3.10.

b. Clean Configuration, Aft C.G. (Station 102.5), Left Lateral C.G. (2.9 inches left)

Control limits were not reached in this configuration, but the directional instability noted during flight to the left between 5 and 20 KTAS was still present.

2.4.5.2 Rearward Flight:

Clean Configuration, Forward C.G. (Station 97), Left Lateral C.G. (2.9 inches left)

Although less than 10 percent of total longitudinal control travel remained above about 5 KTAS, sufficient control power was available up to approximately 15 KTAS in rearward flight. Above this speed the aft control stop was intermittently contacted during attitude corrections. At 29 KTAS, in calm air, the aft stop was reached so that no further nose-up corrections could be made. There was insufficient forward stick trim available to trim out the aft stick forces from hover to maximum rearward speed; this is contrary to MIL-H-8501A, paragraph 3.3.10. A continuous pull force of approximately 2 to 3 pounds was required at all times during these conditions.

2.4.5.3 General Assessment of Hovering Capabilities in Strong Winds

At normal operating C.G. locations, the requirements of MIL-H-8501A were met, although the pilot effort tends to be higher than desirable. Under gusty conditions, the continuous stick and pedal corrections (mostly less than 1 inch in magnitude) became tiresome, particularly since there was no means of trimming out the pedal forces. When hovering in a 30 to 40 degree right crosswind of 25 knots or more, it was found that the directional instability encountered during steady sideslip test was also present for this condition (see Figure No. 126, Section 3, Appendix I). This oscillation was not difficult to prevent and was not considered to be a safety-of-flight hazard.

2.4.6 COMPARISON OF THE SIDEWARD AND REARWARD FLIGHT CHARACTERISTICS OF THE OH-6A AND THE OH-13H

a. Sideward Flight

At the maximum forward C.G. location in sideward flight the OH-13H exhibits better longitudinal control characteristics. The OH-6A is within the 10 percent control margin above 5 KTAS to the left and the OH-13H reaches the 10 percent control margin at 20 KTAS. The OH-13H reaches 30 KTAS in the left sideward flight without actually contacting the aft longitudinal stops, whereas the OH-6A intermittently contacts the aft stops above 13 KTAS. Both aircraft have at least 10 percent control margin remaining at 30 KTAS in right sideward flight.

The OH-6A and OH-13H exhibit similar lateral control characteristics in sideward flight up to 30 KTAS. The OH-6A lateral control movement has fewer discontinuities in the sideward flight airspeeds up to 30 KTAS. Both helicopters have similar directional control movements in left and right sideward flight. The OH-6A has less right pedal displacements to maintain stabilized left sideward flight.

The comparison of control positions in sideward flight is shown in the Figure on Page 27.

b. Rearward Flight

Both the OH-6A and OH-13H were longitudinal control limited in rearward flight at the forward C.G. location. Airspeed in rearward flight was reduced to 5 KTAS for the OH-6A and 10 KTAS for the OH-13H, when maintaining the required 10 percent margin of aft longitudinal control effectiveness (reference MIL-H-8501A, paragraph 3.2.1).

Rearward true airspeeds of 30 KTAS were flown with the OH-6A and 20 KTAS with the OH-13H. In the OH-6A, the aft control stop was contacted intermittently at all speeds above 29 KTAS. Both helicopters exhibit satisfactory lateral and directional control displacements during rearward flight.

The comparison of control positions in rearward flight is shown in the Figure on Page 28.

FIG. D

CONTROL POSITION IN SIDEWARD FLIGHT

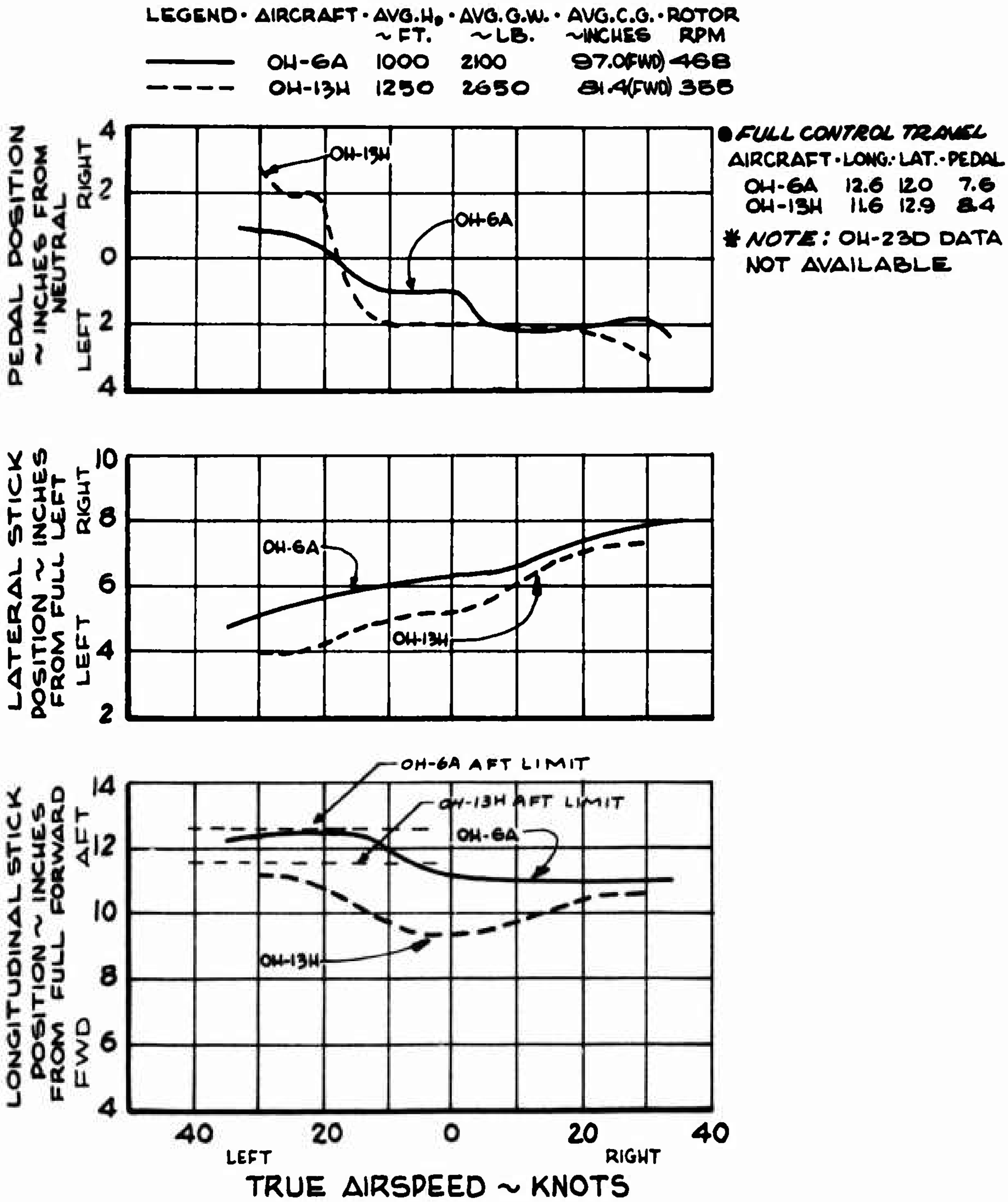
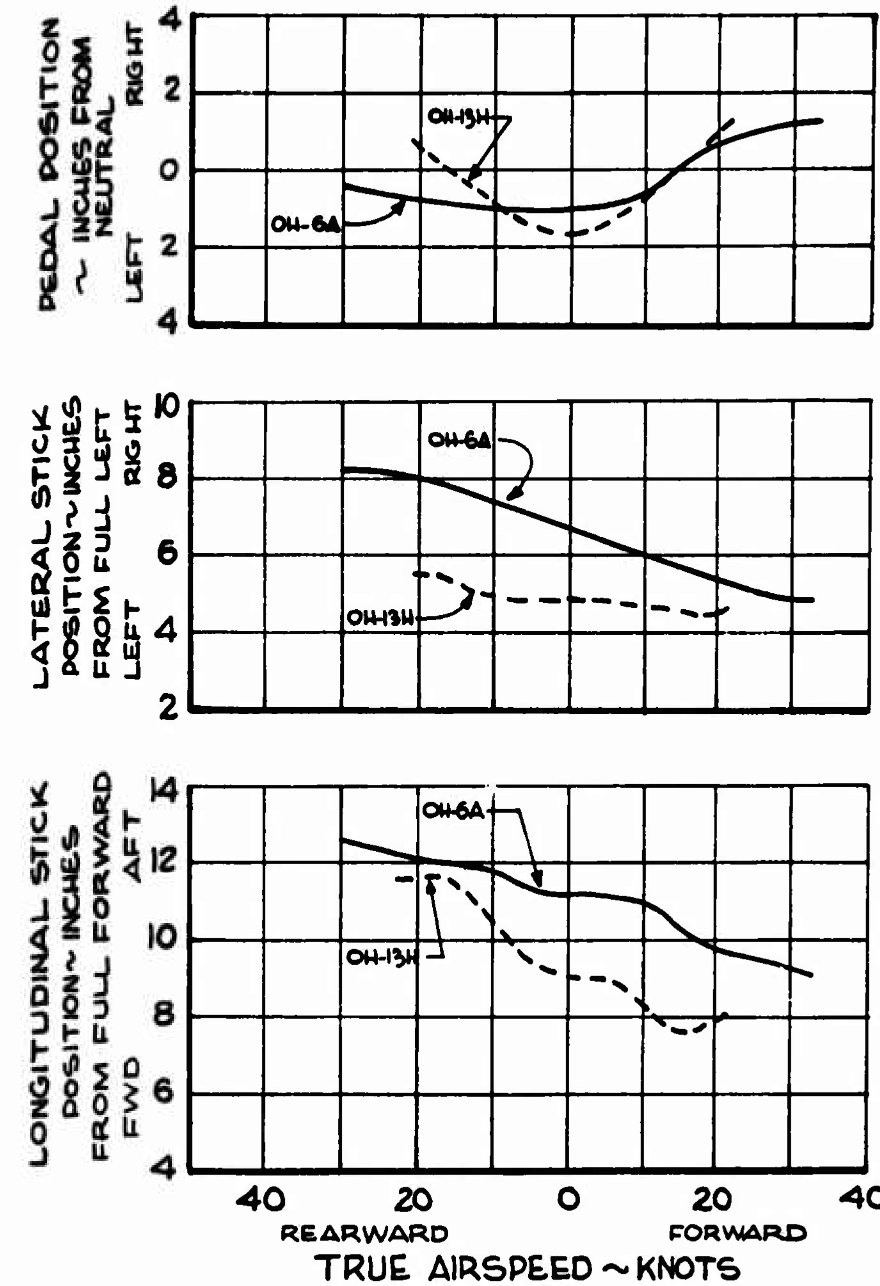


FIG. E

CONTROL POSITIONS IN REARWARD FLIGHT

LEGEND	AIRCRAFT	AVG. H_0 ~FT.	AVG. G.W. ~LB.	AVG. C.G. ~INCHES	ROTOR RPM
———	OH-6A	850	2140	97.0(FWD)	468
– – – –	OH-13H	1250	2455	83.9(FWD)	355



● *FULL CONTROL TRAVEL*

AIRCRAFT	LONG.	LAT.	PEDAL
OH-6A	12.6	12.0	7.6
OH-13H	11.6	12.9	8.4

✱ *NOTE*: OH-23D DATA NOT AVAILABLE

2.5 DYNAMIC STABILITY

2.5.1 OBJECTIVE

The objective of the dynamic stability tests was to determine the oscillatory motion of the aircraft when disturbed from a trimmed flight condition. Tests were also conducted to evaluate the change in dynamic stability with the armament kits installed.

2.5.2 METHOD

The dynamic stability characteristics were obtained by recording the helicopter motions that resulted from pulse-type control inputs. A control stop fixture was used to insure that the inputs were uniform and of the desired magnitude. The pulse input was accomplished by displacing the control for the desired axis approximately 1 inch displacement for 0.5 to 1.0 second, then returning it to the trim position. This trim position was held until the aircraft restabilized or recovery was necessary. Control positions, aircraft attitudes and rates were recorded for each pulse input. The tests were conducted about all axes for the conditions specified in Section 2.0 and the following flight regimes:

Condition	Airspeed Range KCAS
Hover	0
Climb	55
Level Flight (Design Weight)	35, 90, 102
Level Flight (Overload Weight)	35, 69, 86
Autorotation	55

2.5.3 RESULTS

Time histories are presented in Figures No. 65 through 127, Section 3, Appendix I.

2.5.4 ANALYSIS

2.5.4.1 Quantitative Engineering Analysis of Dynamic Longitudinal Stability

a. Clean Configuration

During hovering flight, the dynamic longitudinal stability was satisfactory. Following an aft longitudinal disturbance (1 inch input), the rate response was a heavily damped oscillation with a period of 3 seconds. No small residual oscillations were present. The pitch attitude change was small and returned to trim after 1/2 cycle. The response to a forward disturbance was initially nose down, returning through trim in 2 seconds, then going slightly divergent nose up. The directional rate resulted in a small yaw attitude change. Test results are shown in Figures No. 65 through 88 , Section 3, Appendix I.

In forward flight, the longitudinal dynamic stability deteriorated slightly as airspeed was increased. At 35 KCAS, response to an aft longitudinal disturbance was a nose-up pitching rate that became nose down after 2 seconds and increased with time. The pitch attitude change was nose up, then passed through trim and continued downward. The response to a forward pulse was a heavily damped oscillation with a period of 2-1/2 seconds. This oscillation was damped to zero in 1/2 cycle. The rate response passed through trim after 2 seconds and continued to go slightly divergent nose down. The pitch attitude change was small and did not return to trim. The directional rate resulted in a small yaw attitude change 1-1/2 seconds after the input.

The response to a forward pulse at 90 KCAS (.8Vne) was a deadbeat oscillation that returned to trim 1 second after the control input. No control coupling was noticeable.

The short-period pitching rate response to an aft disturbance at 102 KCAS (.9 Vne) was heavily damped. However, the long period rate did not return to zero but passed through zero after 4 seconds and continued to increase in a direction opposite to the control input. The resulting attitude change was initially in the direction of the control input, and then developed into a long period, divergent, pitching oscillation. The longitudinal disturbance caused small, lightly damped yawing and rolling oscillations. These did not result in significant attitude changes. Following a forward longitudinal disturbance, the pitch rate response was heavily damped. The initial nose-down pitch rate returned to trim in 1/2 cycle, with no residual oscillations. The change in pitch attitude was small and returned to trim after 2 seconds. The forward longitudinal disturbance did not noticeably change the roll or yaw attitude. In level flight at airspeeds above 102 KCAS (.9Vne), consistent data could not be obtained due to the pitch-up tendency of the aircraft in this part of the flight envelope. This is discussed in detail in paragraph 2.5.5.

During climb the helicopter exhibited weak longitudinal dynamic stability (see paragraph 2.5.5.). Following a longitudinal disturbance (1 inch pulse input), the rate response was a lightly damped oscillation with a period of 4 seconds. This oscillation damped to zero in 2 cycles with no small residual oscillations present. A small initial opposite yaw followed the pitching motion after 1/2 cycle. The resulting pitch attitude change was very small and returned to trim after 1/2 cycle (2 seconds). The directional rate resulted in little or no change in yaw attitude.

The aircraft motion following an aft longitudinal disturbance in autorotation was a heavily damped oscillation with a period of 4 seconds. After the initial pitch up of 10 degrees, the pitch rate went through zero to 3 degrees nose down after 2 seconds. The resulting pitch attitude was an initial pitch up of 10 degrees that slowly returned to trim after 5 seconds. The longitudinal disturbance caused a slightly damped rolling and yawing oscillation that did not result in a significant attitude change. The motion following a forward disturbance was an initial pitch down of 10 degrees that returned to zero in 1 second. The pitching rate was a heavily damped oscillation that had a period of 4 seconds. The resulting attitude change was an initial pitch down to 5 degrees that returned to trim after 3 seconds. Although the forward disturbance caused a slightly damped rolling and yawing oscillation, the aircraft attitude was not significantly changed.

The effect on longitudinal dynamic stability of moving the C.G. from the aft limit to the forward limit was small. The climb stability was slightly improved.

The effect on longitudinal dynamic stability of increasing the gross weight from design to overload was small. The damping characteristics deteriorated slightly as gross weight was increased.

No altitude effect was detectable on the longitudinal dynamic stability over the range of altitudes tested.

b. Armed Configuration

No significant change in the longitudinal dynamic stability occurred with either the XM-7 or XM-8 armament kits installed.

2.5.4.2 Quantitative Engineering Analysis of Dynamic Lateral Stability

a. Clean Configuration

The lateral dynamic stability in hovering flight was satisfactory. Following a left lateral pulse, roll and yaw in the direction of the control input were observed. The roll rate was heavily damped. The yaw rate rached a maximum in 2 seconds. The resulting attitude change was a slight roll left and yaw left, with a slight pitch up. The motion following a right lateral pulse was a heavily damped roll rate with the yaw rate reaching a maximum in 3.5 seconds. As airspeed was increased from a hover the attitude change was a roll right with a slight pitch up.

The lateral dynamic stability in level flight was satisfactory. The initial response following a left lateral pulse at low airspeed (35 KCAS) was a roll left and yaw left with a slight pitch up. The roll rate was heavily damped and the yaw rate reached a maximum in 1/2 cycle. The pitch rate was slightly damped with a period of 3 seconds. The attitude change was small. The response to a right lateral pulse was a roll right, small right yaw and a slight nose-down pitch rate. The roll rate was heavily damped and the yaw rate reached a maximum after 2 seconds. The coupling effect noticeable in the pitch and yaw axis was not apparent at this airspeed. At 90 KCAS, the roll rate response to a left lateral 1 inch pulse was a 10 degree roll left that was heavily damped with a period of 2 seconds. In addition, there was an initial pitch up that returned to trim after 2 seconds. The initial attitude change was a 10 degree left bank angle that returned to 5 degrees and remained constant for 2 seconds before returning toward trim. There was a slight pitch up attitude that remained constant at 5 degrees. The yaw attitude stabilized at 5 degrees left after 4 seconds. The lateral dynamic stability following a right lateral pulse was a heavily damped roll rate of 12 degrees per second (deg/sec) maximum, with a period of 3 seconds. The yaw rate was a lightly damped oscillation that reached a maximum of 6 deg/sec in 2 seconds. The attitude change was a right bank angle of 10 degrees that increased to 15 degrees after 5 seconds. The change in pitch attitude was initially a small nose-down attitude that increased to 15 degrees after 5 seconds. The yaw attitude change was small and followed the bank angle. Pitch and yaw coupling that was more pronounced in the pitch axis was present with either a left or right lateral disturbance.

At 102 KCAS the aircraft response following either a left or right lateral 1 inch pulse was essentially the same as at 90 KCAS. The roll rates were heavily damped with short period oscillations. The pitch and yaw coupling that followed a roll attitude change was of the same magnitude as at 90 KCAS. Time histories are presented in Figures No. 89 through 101, Section 3, Appendix I, "Test Data."

The lateral dynamic stability in a climb was satisfactory. The roll rate response to a left lateral pulse was a lightly damped oscillation with a period of 3 seconds. The lateral disturbance caused a pitch rate that was slightly damped with a period of 3 seconds. The aircraft returned to trim after 4 seconds following an initial left roll, left yaw and pitch up. The resulting attitude change following a right lateral disturbance was a right bank and slight pitch up that returned to trim after 5 seconds. The pitch and yaw coupling, although present, was small. A time history of a climb is presented in Figure No. 94, Section 3, Appendix I.

Lateral dynamic stability in autorotation was satisfactory. The helicopter exhibited positive damping response and the magnitude of the rates was small. The pitch and yaw axis coupling following a lateral disturbance was present but the effect was not objectionable.

The effect of moving the C.G. location from the aft limit to the forward limit on lateral dynamic stability for any of the conditions tested was negligible. The response rates and attitude changes were essentially the same. The pitch and yaw axis coupling was not as high as in the aft C.G. in level flight.

The effect of increasing gross weight from 2100 pounds to 2700 pounds was that of marked deterioration of the lateral dynamic stability damping response. The lateral dynamic stability response to a left or right lateral 1 inch pulse disturbance at 70 KCAS level flight and 55 KCAS climb resulted in an undamped rolling, yawing and pitching oscillation that continued until the pilot initiated the recovery motion. At airspeeds above 35 KCAS and in autorotation the motion was lightly damped. The magnitude of the oscillation was relatively small and returned to trim immediately upon recovery action. The pitch and yaw coupling was still present with a pitch up with a left lateral disturbance and pitch down with a right lateral disturbance.

Altitude had little or no effect on the lateral dynamic stability. Rate responses were positive and attitude changes following a left or right lateral disturbance were small. The amount of pitch and yaw axis coupling at 10,000 feet density altitude was less than at 5000 feet density altitude.

b. Armed Configuration

Installation of the XM-7 or XM-8 armament kit did not appreciably change the lateral dynamic stability under all conditions tested; the basic stability characteristics were the same as those for the clean configuration. Test results are presented in Figures No. 102 through 106, Section 3, Appendix I.

2.5.4.3 Quantitative Engineering Analysis of Dynamic Directional Stability

a. Clean Configuration

The directional dynamic stability in a hover was satisfactory. The motion following a right directional 1 inch pulse was a lightly damped oscillation with a period of 3 seconds. The initial yaw rate was 25 deg/sec and passed through zero after 2 seconds. The attitude change was small and there was no lateral-directional coupling in evidence.

The motion of the helicopter following a 1 inch pulse in level flight at 35 KCAS was a rolling, yawing oscillation that was lightly damped. The yaw rate reached a maximum in .75 seconds and returned through zero after 1.25 seconds. The roll rate lagged the yaw by .5 second. There was a long period, lightly damped, pitching motion. The pitch and roll coupling were the same as mentioned in lateral dynamic stability, i.e., right roll, pitch down or left roll, pitch up. The attitude change was small and returned to a level condition 5 seconds after the disturbance. The response to a left directional pulse at 90 KCAS was lightly damped yawing oscillations. The first oscillation had a period of .75 seconds with a magnitude of 5 deg/sec; the second oscillation had a period of 1.75 seconds. Lateral-directional coupling of roll and yaw was apparent; however, attitude change was small. The directional response to a right pedal pulse at 90 KCAS was a rolling and yawing oscillation for a period of 2 seconds. There was a slight pitching oscillation that was lightly damped. The aircraft returned to the level attitude in 3 seconds. At 102 KCAS the directional stability was markedly improved. Following a directional pulse, the yaw rate was a lightly damped, short period oscillation. A roll and yaw coupling was present with the roll rollowing yaw after .5 second. The pitching motion was slight and followed the roll rate as mentioned previously. The resulting attitude change was small. Time histories of directional pulses are presented in Figures No. 107 through 121, Section 3, Appendix I.

During climb at design gross weight and at an aft C.G. (Station 103.5), the motion following a directional disturbance was a roll opposite to yaw and a slight pitching motion. Lateral-directional coupling was present for both left and right pedal pulses. The motion following a left pedal pulse was a slightly damped yaw rate oscillation with a period of 2 seconds. The roll rate followed after .5 second and was also a lightly damped oscillation. The yaw rate reached a maximum in .75 second. The pitch rate was nose up with a left roll and nose down with a right roll. The pitch rate oscillation was small with a period of 3 seconds. The maximum yaw rate was 12 deg/sec on the first oscillation and damped to 6 deg/sec on the second oscillation. The attitude change was a small left yaw, left roll and a slight pitch up. After 5 seconds, there was a 12 degree left yaw and 5 degree left roll with no pitching. An 8-degree right sideslip angle resulted from a left pulse that oscillated through 9 degrees left sideslip in 2 seconds and back to zero in 3 seconds. The motion following a right pulse was an undamped oscillation that increased in magnitude with each cycle.

The helicopter's motions in roll and yaw following a directional pulse in autorotation were larger than in climb or level flight. The rate response following a right pulse was a lightly damped yawing oscillation with a period of 3 seconds. The roll was small and opposite to yaw and followed after .5 second as an undamped oscillation. The pitch rate change was small and insignificant. The resulting attitude change was a 10 degree right yaw, 15 degree left sideslip, with no change in pitch angle. As the yaw angle returned through zero, it continued and diverged. The roll angle remained zero until 2 seconds after the right pulse and then rolled right and diverged.

The helicopter exhibited no significant directional dynamic stability changes with the C.G. moved from the forward limit to the aft limit. (See Figures No. 113 and 114, Section 3, Appendix I.)

Increasing the gross weight from design to overload had a significant effect on the directional dynamic stability. In level flight the lateral-directional coupling was present to a greater extent than at design gross weight. At all level flight airspeeds tested, the roll, pitch, and yaw oscillations resulting from the 1 inch pedal pulses were markedly less damped at the overload gross weight. During climb, the motion following a 1 inch pedal pulse was a slightly damped yawing, rolling, pitching motion that was divergent in the yaw axis. This motion is discussed further in paragraph 2.5.5.3. In autorotation, the directional dynamic stability was unchanged.

In level flight, the directional dynamic stability was not significantly altered with an increase in altitude. There was a slight deterioration in the rate damping. During climb the same yaw, roll and pitch oscillations were encountered. These oscillations were of no difference in dynamic stability in autorotation. Test results are presented in Figures No. 107 through 121, Section 3, Appendix I.

b. Armed Configuration

The installation of the XM-7 or XM-8 armament kit had no significant effect on the directional dynamic stability.

2.5.5 QUALITATIVE PILOT'S COMMENTS ON DYNAMIC STABILITY

2.5.5.1 Qualitative Pilot's Comments on Dynamic Longitudinal Stability

a. Clean Configuration

There was positive longitudinal damping following a disturbance in the hover. There was no long period (over 5 seconds) stability and all stick-fixed disturbances resulted in unpredictable divergent motion following the initial corrective motion. The longitudinal long period instability, however, was neither objectionable nor difficult to control. Hovering in turbulence presented no longitudinal control problem although continuous small corrections (less than 1 inch) were required. This is common to most helicopters not employing stability augmentation systems (SAS), particularly in hovering flight. In calm air, the pitch attitude of the aircraft was easy to maintain.

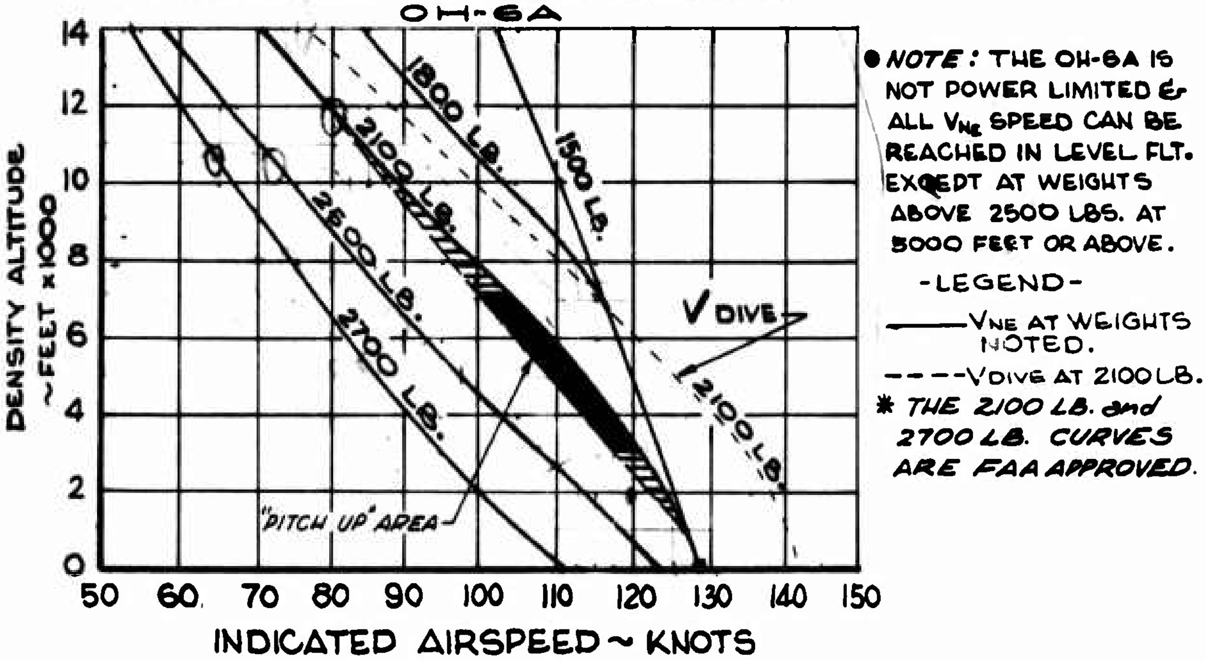
The forward C.G. location had no noticeable effect on the longitudinal dynamic stability of the aircraft in a hover.

Longitudinal dynamic stability in level flight was better than in climbing flight. In turbulence, adequate longitudinal dynamic stability was present at speeds up to 105 KCAS at 5000 feet density altitude. Above this speed, the approach of blade stall, and an apparent reduction in angle of attack stability, had an adverse effect on aft longitudinal damping that was manifested as a pitch-up tendency. It was not possible to trim the aircraft at 114 KCAS (Vne) at 5000 feet density altitude even in smooth air due to the proximity of blade stall and pitch up. A small nose-up disturbance was sufficient to cause a divergent nose-up pitch that involved a large increase in 4 per rev vibration, a high pitch rate and excessive increase in forward stick force required to recover. The "uni-lock" in the control system prevented the stick from being moved aft by the high feed back force. The forward control movement necessary to control the pitch up required 20 to 30 pounds push force, depending on the severity of the disturbance, and/or the delay before initiating the recovery. (See Figures No. 218 through 220, and Fig. 243, Appendix I) At 102 KCAS (.9 Vne at this loading, altitude and configuration) this tendency was far less pronounced and accurate longitudinal trimming was possible. Pulses were, therefore, made at 102 KCAS (.9 Vne) instead of 113 KCAS (Vne). This characteristic was a result of a nonlinear relationship between gross weight and airspeed in the contractor's FAA flight envelope. At 5000 feet density altitude this envelope allowed a 6 knot increase in airspeed between 2100 and 1800 pounds, a 10 knot increase between 2700 and 2400 pounds, and a 17 knot increase between 2500 and 2100 pounds. The shaded area in the following plot was the only area in which the pitch-up characteristic was unsatisfactory. In the striped area the pitch up was present, but acceptable:

FIG. E

CONTRACTORS' FLIGHT ENVELOPE *

OH-6A



Quantitative tests were not made at light weights (less than 2000 pounds) and the presence of pitch up at lighter weights was not established. During non-planned flights, however, at 1800 to 1900 pounds it was found that the pitch-up characteristic did not occur at 5000 feet until speeds in excess of the envelope speeds were reached.

Movement of the C.G. to the forward location had little effect on any of the qualitative longitudinal stability characteristics.

The effect of increasing gross weight from 2100 pounds to 2700 pounds was primarily that of increasing the margin between Vne and blade stall at 5000 feet density altitude, since the TIA flight envelope limit at 2700 pounds was more conservative than at 2100 pounds (see previous body plot.) The effect of aft longitudinal disturbances at Vne did not result in pitch up and trimmed flight was, therefore, easier to maintain. Longitudinal dynamic stability characteristics in level flight at speeds less than Vne were similar to the results obtained at 2100 pounds. Reducing gross weight below 2100 pounds had a favorable effect and allowed higher speeds to be attained before encountering pitch up.

The effect of altitude on the longitudinal dynamic stability was similar to that of increased weight. The TIA airspeed limit at 10,000 feet was 89 KCAS; this left an adequate margin of speed before reaching the pitch-up tendency encountered at 5000 feet density altitude.

The longitudinal dynamic stability characteristics in a climb varied according to the speed, rate of the climb and steady-state sideslip angle. Under certain conditions an unstable, random pitching, yawing and roll disturbance occurred. This is shown in Figure No. 73, Section 3, Appendix I. In general, the following conditions always resulted in this type of disturbance: (a) high rates of climb at speeds from 30 to 55 KCAS with zero sideslip (the slip ball was then displaced 1-1/2 widths to the left of center and 3 to 4 degrees left bank was recorded); (b) high rates of climb at speeds from 25 to 45 KCAS with zero bank (slip ball centered and 5 to 7 degrees of right sideslip). If, in case (a) above the speed was increased, the instability stopped. If, in case (a) above, the rate of climb was reduced by reducing power, the instability also stopped. If, in case (a) above, the controls were altered to give the conditions of (b), then the instability stopped, uless speed was reduced to 45 KCAS or below. Normally, this instability could be avoided, if encountered, by either flying at slightly increased airspeed (60 KCAS) or reduced power (maximum continuous - 77 percent torque). Longitudinal dynamic stability, under conditions at which the above instability was not present, was still not very good in turbulence and longitudinal disturbances usually resulted in a rapid speed change. There was little or no C.G. or altitude effect, but increased weight reduced damping slightly. The armament installations had no detectable effect.

Longitudinal stability in autorotation was qualitatively similar to stable climbing flight. There were no observed C.G., weight, altitude or armament effects.

b. Armed Configuration

There was no apparent difference in longitudinal dynamic stability with either the XM-7 or XM-8 installed.

2.5.5.2 Qualitative Pilot's Comments on Dynamic Lateral Stability

a. Clean Configuration

Dynamic lateral stability in a hover was better than the longitudinal or directional dynamic stability, and lateral disturbances in rough air were damped satisfactorily. Long period divergence in roll normally occurred only after a speed change following a longitudinal disturbance. These motions were not objectionable and were easy to control.

Lateral damping in level flight was good and in gusty conditions did not involve any unusual lateral problems. Following a 1 inch pulse, however, there was a coupling effect in pitch and yaw, the former being the most pronounced. A nose-down pitch accompanied a right lateral pulse and a nose-up pitch followed a left lateral pulse. The magnitude of the pitch coupling increased as airspeed was increased. This coupling may have contributed to the unpleasant longitudinal characteristics experienced at high speed in turbulence. The yaw coupling was normally delayed slightly and was a result of the airspeed change following the pitch change. At 113 KCAS (Vne) it was not possible to make a left lateral pulse without causing the pitch up described in paragraph 2.5.5.1. In all cases except above 100 KCAS, the pitching motion was controllable requiring small corrections and light forces. The control of the pitch up is discussed in paragraph 2.5.5.1.

Lateral dynamic stability in a stabilized climb (see paragraph 2.5.4.2) was good, but the longitudinal coupling referred to in the preceding paragraph, was still present. In rough air, lateral disturbances required less attention than longitudinal or directional disturbances. All motions were easy to control.

In autorotation, lateral dynamic stability was similar to that in the climb and the pitch coupling still persisted. All motions were easy to control.

Center of gravity had no qualitatively discernable effects on lateral dynamic stability in any of the flight conditions tested.

At overload gross weight (2700 pounds), the rate of climb was sufficiently reduced to eliminate the unstable disturbances referred to in paragraph 2.5.4.2. In a stabilized climb at 2700 pounds, however, a lateral disturbance caused an undamped lateral, directional and longtidinal oscillation, resembling a "dutch roll," which continued, undamped, until stopped by the pilot. The same motion occurred in level flight and autorotation, but was slightly damped and did not normally start without a large disturbance. The motion was easy to control and stop, but in the climb only the slightest gust was necessary to start it. See Figure No. 127, Section, Appendix I. In this figure it can be seen that no control input was required to initiate the motion and only small corrections were needed to stop it.

Altitude had no qualitatively discernable effects on the lateral dynamic stability of the aircraft.

b. Armed Configuration

The XM-7 and XM-8 armament installations had no effect on the qualitative lateral dynamic stability.

2.5.5.3 <u>Qualitative Pilot's Comments on Dynamic Directional Stability</u>

Directional disturbances in a hover were lightly damped to the left and neutrally damped to the right, and normally required pilot correction to return the aircraft to the original heading. A directional pulse, however, resulted in a motion that followed the sense of the control input but did not necessarily return the aircraft to its original heading.

At low airspeeds (35 KCAS), directional stability was the weakest qualitative feature of the aircraft and continuous pilot corrections were required in gusty conditions to maintain the desired direction. Even in smooth conditions, there was some small angle dynamic instability at speeds below 35 KCAS; as speed was increased the directional oscillations were well damped. There was a noticeable amount of roll coupling at all speeds, with roll following yaw after 1/2 second or so. This motion was not objectionable and was not difficult to control. It was considered that the subsequent coupling of pitch with the roll (paragraph 2.5.4.2) was probably responsible for the overall poor dynamic stability of the aircraft in gusty conditions and the high pilot effort required in turbulence.

During the climbs at maximum power when the unstable conditions described in paragraph 2.5.5.1 and illustrated in Figure No. 73, Section 3, Appendix I, were encountered, the directional oscillations were large and difficult to correct accurately, since they were unpredictable and random in nature. During climbs at slightly increased speed, or reduced power, or 5 to 7 degrees right sideslip without this random interference, the directional disturbances were lightly damped but easy to correct quickly.

Directional disturbances in autorotation caused larger changes in angular displacement than similar disturbances in the climb and level flight. The damping was also low; this resulted in pilot overcontrolling due to the very weak static directional stability in autorotation. Thus, a small gust could cause a fairly large, weakly damped yaw that only required a small pedal correction. Lateral coupling added to the tendency to overcontrol, since lateral control inputs were effective in correcting directional errors.

Center-of-gravity location had no qualitatively discernable effects on the directional stability of the aircraft.

Increasing gross weight to 2700 pounds had a marked effect on directional stability, particularly in the climb. The motion encountered appeared to be self induced during stable climbing flight (see Figure No 127, Section 3, Appendix I.). The motion is also shown as a result of a pulse type control input in Figure 117, Section 3, Appendix I. In some cases there was very slight damping; in other cases the motion was neutrally damped and in still other cases it was slightly divergent. The motion was not difficult to control and required only small corrections to prevent. In level flight there was also a noticeable reduction in damping. In autorotation the directional characteristics at overload weight were qualitatively unchanged.

The effect of altitude in the climb was similar to the effect of increased weight described in the preceeding paragraph although all directional motions encountered eventually damped out if left long enough. In level flight at speeds near minimum power speed (45 to 70 KCAS) there seemed to be a slight reduction in damping and in autorotation there was little difference between 5000 and 10,000 feet.

The XM-7 and XM-8 installation appeared to have little effect upon the qualitative directional dynamic stability of the aircraft.

2.6 CONTROLLABILITY

2.6.1 OBJECTIVE

The objectives of the controllability tests were to determine the maximum accelerations and rates that result per inch of rapid step control input. Tests were also conducted to investigate any changes contributed by the armament installations.

2.6.2 METHOD

The controllability was evaluated by recording the motions that resulted from step type control inputs. A control jig was used to control the varying magnitudes of the step inputs. The step inputs were made by rapidly displacing the control to the desired position, then holding this position until the maximum rate was obtained or recovery was necessary. The tests were conducted for each control axis.

Control positions, aircraft attitudes and rates were recorded for each step input. The tests were conducted in the clean and armed configurations at average density altitudes of 5000 and 10000 feet with an aft (Station 103.5) center-of-gravity location in the following conditions of flight:

Condition	Airspeed KCAS
Hover (IGE)	Zero
Climb	55
Level Flight	35 (.8 Vne)
Level Flight	(Clean Configuration Only) Vne
Autorotation	55

2.6.3 RESULTS

Graphical test results are presented and summarized in Figures No. 128 through 214, Section 3, Appendix I.

2.6.4 ANALYSIS

2.6.4.1 Quantitative Engineering Analysis of Longitudinal Controllability

a. Clean Configuration

(1) Longitudinal Control Sensitivity

The longitudinal pitching acceleration characteristics were satisfactory. The angular acceleration was in the proper direction and occurred within 0.2 seconds after the control displacement. The curves of maximum acceleration versus control displacement were linear with no discontinuities. Following an aft longitudinal step displacement, the normal acceleration increased within .2 second and became concave downward within 2 seconds after the initial control movement. The characteristics fulfill the requirements of MIL-H-8501A, paragraph 3.2.11.1.

During hover at design gross weight, the maximum angular pitching acceleration occurred at 0.4 second after the control input and the control sensitivity was 10 deg/sec^2/inch forward and 20 deg/sec^2/inch aft. As gross weight was increased from design to overload the pitching acceleration was 21 deg/sec^2/inch for a forward longitudinal input and 18 deg/sec^2/inch for an aft input. The time required to reach maximum acceleration was .9 second.

The longitudinal control sensitivity was satisfactory for the low speed flight regime. The average time required to reach the maximum pitching acceleration was 0.5 second for all flight conditions. The acceleration characteristics were not symmetrical and the control sensitivity was 25 deg/sec^2/inch for aft steps and 12 deg/sec^2/inch for forward steps. Increasing the gross weight from design to overload decreased the sensitivity to 15 deg/sec^2/inch for an aft step and increased sensitivity to 14 deg/sec^2/inch for a forward step. The longitudinal control sensitivity increased with altitude and was 28 deg/sec^2/inch aft and 18 deg/sec^2/ inch forward at a density altitude of 10,000 feet and design gross weight.

As airspeed was increased above 35 KCAS, the sensitivity following a forward input increased and reached a maximum of 24 deg/sec^2/inch at 102 KCAS. The sensitivity for an aft displacement above 35 KCAS decreased and reached a minimum at 90 KCAS of 19 deg/sec^2/inch. At the maximum airspeed that data were recorded (102 KCAS), design gross weight, and a density altitude of 5000 feet, the maximum acceleration was 25 deg/sec^2 for a 1 inch aft control input. The high acceleration and the rapid attitude changes required that recovery action be initiated within 2 seconds after the control input. At 102 KCAS step control inputs larger than 0.7 inch were not practical. The longitudinal control sensitivity appeared to increase further with airspeed, however, data were not obtained above 102 KCAS because recovery was necessary before the maximum accelerations were reached. The longitudinal control sensitivity increase became more pronounced at higher altitudes. At 10,000 feet density altitude, 89 KCAS, a 1 inch forward step resulted in a maximum pitching acceleration of 33 deg/sec^2.

The longitudinal control sensitivity during a 55 KCAS climb at 5000 feet density altitude was 19 deg/sec^2/inch for both forward and aft control displacements. The time to reach the maximum acceleration was 0.5 second. Increasing density altitude from 5000 feet to 10,000 feet increased the aft control sensitivity to 23 deg/sec^2/inch but the forward sensitivity was unchanged. There was no significant change as a result of increasing the gross weight.

During autorotation, at a density altitude of 5000 feet and an airspeed of 55 KCAS, the longitudinal control sensitivity was the same as during climb (19 deg/sec^2/inch). In autorotational flight, however, an increase in altitude changed the forward longitudinal control sensitivity to 22 deg/sec^2/inch. The time required to reach the maximum acceleration was approximately 0.6 second for all conditions.

(2) Longitudinal Control Response

The longitudinal control response (maximum rate response per inch of control displacement) was satisfactory and met the requirements of MIL-H-8501A, paragraph 3.2.11.1. In a hover (IGE) a maximum pitch rate of 14 deg/sec for a forward step and 20 deg/sec for an aft step was reached in an average time of 1.2 seconds. The motion following a longitudinal disturbance in a hover was an immediate pitch, in the direction of the input. The pitch rate was initially high and decreased with time. An increase of gross weight from design to overload condition did not change the pitch rate response; however, the time to reach maximum rate increased from 1.2 seconds to 1.6 seconds.

The longitudinal control response was satisfactory at airspeeds below 35 KCAS in level flight. The maximum pitch rate was reached in .9 second following a longitudinal step input. The response to an aft input was generally greater than to a forward input. A maximum pitch rate of 10 deg/sec was reached for a forward input and 14 deg/sec for an aft input. As gross weight was increased to the overload condition, the rate response decreased. The response to an aft input decreased from 18 deg/sec to 14 deg/sec. Increasing the altitude had no effect on the longitudinal pitch response at 35 KCAS. The maximum pitch rates and time to reach them were essentially the same.

As airspeed was increased above 35 KCAS the pitch rate response characteristics were similar in all configurations. The pitch rate response curve was flat from 35 KCAS to 90 KCAS. As airspeed was increased above 90 KCAS the rate response increased. The maximum pitch rates and times were essentially the same throughout the speed range for clean, overload, and 10,000 feet density altitude conditions. The only exception was the time to reach maximum pitch rate increased from 1.0 to 1.9 seconds as altitude was increased.

The longitudinal control response during a 55 KCAS climb at 5000 feet density altitude was 9 deg/sec for a forward input and 11 deg/sec for an aft input. The time to reach maximum pitch rate was 1 second. Increasing the gross weight from design to overload and increasing density altitude from 5000 feet to 10,000 feet had no significant effects on the control response characteristics.

During autorotation at 5000 feet density altitude and 55 KCAS the longitudinal control response was 13 deg/sec for a forward 1 inch step and 9 deg/sec for an aft 1 inch step. The maximum rate was reached in 1 second. The rate response characteristics did not change as gross weight was increased. As the density altitude was increased from 5000 feet to 10,000 feet the control response was the same.

(3) Angular Pitch Displacement

The angular displacement (pitch attitude change in degrees per inch of control displacement) was satisfactory and met the requirements of MIL-H-8501A, paragraph 3.2.13. Following a longitudinal disturbance the helicopter would pitch in the direction of the control input. The angular displacement would increase until recovery was initiated.

The angular displacement in a hover following a 1 inch control displacement was 6.5 degrees nose down and 10 degrees nose up after 1 second. The pitch angle increased with time until recovery action was taken. The angular displacement was essentially the same as gross weight was increased from the design weight of 2100 pounds to an overload of 2500 pounds. Recovery from the forward and aft disturbances was made approximately 2 seconds after the input.

The angular displacement at 35 KCAS in level flight was satisfactory. The angular displacement was 6 degrees nose down and 11 degrees nose up following a 1 inch input. As airspeed was increased, the change in angular displacement was small. At 103 KCAS the angular displacement was 7.5 degrees nose down and 9 degrees nose up 1 second after the input. The pitch angle increased with time until recovery was made. There was no significant change in the angular displacement characteristics as gross weight and altitude were increased.

During climb and autorotation at 55 KCAS the angular displacement following a 1 inch input was essentially the same, 8.0 degrees nose down and 6.5 degrees nose up after 1 second. Increasing the gross weight from design to overload and density altitude from 5000 to 10,000 feet had no noticeable effect on the angular displacements in a climb. In autorotation an increase in gross weight increased the angular displacement to 12 degrees nose down after 1 second following a forward input and no increase following an aft input. Increasing the altitude had no significant effect on the angular displacements.

b. Armed Configuration

(1) Longitudinal Control Sensitivity

The longitudinal control sensitivity in a hover with the XM-7 armament kit installed was the same as for the clean configuration with aft step inputs. A maximum pitch acceleration of 20 deg/sec^2/inch was reached .8 second following a 1 inch aft control step input. Installation of the XM-7 armament kit increased the maximum acceleration from 15 to 20 deg/sec^2 for a 1 inch forward control step input.

During level flight, at design gross weight, the forward longitudinal control sensitivity with the XM-7 or XM-8 armament kit installed was generally the same as for the clean configuration. At an airspeed of 35 KCAS, the maximum aft longitudinal control sensitivity was decreased approximately 5 deg/sec^2/inch with the addition of the XM-8 armament kit and continued to decrease up to approximately 70 KCAS, above which it began to increase. At 102 KCAS sensitivity was 34 deg/sec^2/inch with the XM-8 compared to 25 deg/sec^2/inch for the clean configuration. A maximum pitch acceleration of 34 deg/sec^2 was reached in 1.3 seconds following a 1 inch aft longitudinal displacement and 20 deg/sec^2 for a 1 inch forward displacement at 103 KCAS. An average maximum control sensitivity of 25 deg/sec^2/inch was reached in .5 second in the clean configuration.

There were no significant changes in the longitudinal control sensitivity characteristics during climb and autorotation with either the XM-7 or XM-8 armament kit installed.

(2) Longitudinal Response

The longitudinal control response in the armed configuration was satisfactory. During hover with the XM-7 armament kit installed, the maximum pitch rate of 13 deg/sec was reached in 1.2 seconds.

In level flight the difference in control response between the XM-7 and XM-8 armament kits following a forward longitudinal input was not significant. Following an aft input the response with the XM-8 was higher, 4 to 9 deg/sec/inch, than the XM-7 (see Figure No. 138, Section 3, Appendix I). There was no significant longitudinal control response characteristic change between the clean configuration and the armed configuration.

During climb and autorotation the control response following a longitudinal disturbance at 55 KCAS was essentially the same for both the XM-7 and XM-8 armament kits. A maximum pitch rate of 11 deg/sec was reached in an average time of 1.0 second. There were no significant changes in the longitudinal control response during climb or autorotation with the armament installed.

(3) Angular Pitch Displacement

The angular displacement in a hover with the XM-7 armament kit installed was generally the same as for the clean configuration. In level flight the angular displacements were similar to those of the clean configuration throughout the speed range tested.

At 102 KCAS the angular displacement was 7 degrees nose down and 13 degrees nose up after 1 second. The nose-up displacement was 4 degrees greater than the results of the same displacement for an aft disturbance in the clean configuration. The pitch angle increased with time until recovery was initiated. There was no significant change in the angular displacement during climb and autorotation between the XM-7 and XM-8 configurations and the clean configuration. There were no major differences or effects resulting from an increase of gross weight or altitude.

2.6.4.2 Quantitative Engineering Analysis of Lateral Controllability

a. Clean Configuration

(1) Lateral Control Sensitivity

The lateral control sensitivity was highly satisfactory and met the requirements of MIL-H-8501A, paragraphs 3.3.15, 3.3.16 and 3.3.18. The angular acceleration was in the proper direction and occurred within .2 second after the control displacement. The curves of angular acceleration versus control displacement are linear with no discontinuities.

Lateral control sensitivity in a hover was highly satisfactory. A maximum angular acceleration resulting from a 1 inch left step input was 29 deg/sec^2 and 26.5 deg/sec^2 for a right lateral step. The time required to maximum acceleration was .75 second. The angular acceleration was apparent immediately after the control displacement. Increasing the gross weight from design to an overload of 2500 pounds had no significant effect on the lateral sensitivity.

In level flight at airspeeds below 40 KCAS the lateral control sensitivity was high but satisfactory. A maximum acceleration of 25 deg/sec^2 resulted from a 1 inch left control input and 40 deg/sec^2 for a right input. As airspeed was increased the maximum acceleration resulting from a 1 inch left lateral control input increased to 43 deg/sec^2 at 102 KCAS. Right lateral control sensitivity was not affected by increases in airspeed. As gross weight was increased to overload, the sensitivity decreased. At 35 KCAS the sensitivity was 22 deg/sec^2/inch for both a left and right lateral input. The sensitivity for a right lateral input reached a maximum of 36 deg/sec^2/inch at 60 KCAS and decreased to 30 deg/sec^2/inch at 86 KCAS. The time to reach maximum acceleration was .3 second, the same as that required for the design weight. Increasing altitude had no significant effect on the lateral control sensitivity.

The lateral control sensitivity during a climb at 55 KCAS and 5000 feet density altitude was 32 deg/sec^2/inch for both a left and right lateral control displacement. The time to reach maximum acceleration was .3 second . Increasing the gross weight and altitude had no noticeable effects on the lateral control sensitivity.

Lateral control sensitivity during autorotation was similar to that in a climb (approximately 32 deg/sec^2/inch). Increasing the gross weight from design to overload had no noticeable effect on the sensitivity. As altitude was increased from 5000 to 10,000 feet the maximum acceleration characteristics did not change, however, the time to reach maximum acceleration increased from .3 second to .7 second.

(2) Lateral Control Response

Lateral control response (maximum initial angular velocity per inch of control displacement) was satisfactory and met the requirements of MIL-H-8501A. Following a left or right lateral control displacement the roll rate was immediate and in the direction of the input. The roll rate was initially high and decreased with time.

During hover at design gross weight, a maximum roll rate of 12 deg/sec/inch was reached in .7 second following both a left and right lateral control displacement. As gross weight was increased from design to near overload (2500 pounds) the maximum roll rate reached for a left control input was 11 deg/sec/inch and 16 deg/sec/inch for a right control input. The time to reach maximum roll rate was .9 second.

The lateral control response during level flight at 5000 feet for low airspeeds (35 KCAS) was satisfactory. The motion following a lateral control displacement was an immediate roll in the direction of the input coupled with a small pitch up with a left input and pitch down with a right input. Both the roll rate and pitch angle decreased with time. A maximum roll rate of 10 deg/sec/inch was reached with a left control input and 14 deg/sec/inch for a right input. The time to reach maximum roll rate was .75 second. As airspeed was increased, the roll rate for a left control input increased to a maximum of 18 deg/sec/inch at 90 KCAS and then decreased to 16 deg/sec/inch at 102 KCAS. The time to reach maximum roll rate was the same as for 35 KCAS (.75 seconds). The maximum roll rate for a right lateral control input increased only slightly as airspeed was increased (14 deg/sec at 35 KCAS to 16 deg/sec at 102 KCAS). Increasing the gross weight from design to overload had no significant effect on the lateral control response. A maximum roll rate of 18 deg/sec/inch was reached at 69 KCAS and decreased to 15 deg/sec/inch at 86 KCAS. The time to reach maximum roll rate was .75 seconds. As density altitude was increased to 10,000 feet a maximum roll rate of 12 deg/sec/inch was constant for a left lateral control displacement throughout the speed range tested (35 KCAS to 89 KCAS). A maximum roll rate of 15 deg/sec/inch reached at 35 KCAS decreased to 14 deg/sec/inch at 71 KCAS, and increased to 15 deg/sec/inch at 89 KCAS. The time to reach maximum rate was .65 second. There was no significant changes in rate response characteristics with an increase in altitude.

During climb through 5000 feet at 55 KCAS, a maximum roll rate of 12 deg/sec/inch was reached in .7 second for both a left and right lateral control displacement. There were no significant lateral control response changes as gross weight and altitude were increased.

The maximum roll rates in autorotation were the same as those reached in the climb (12 deg/sec/inch). Gross weight and altitude did not significantly affect the lateral control response in autorotation.

(3) Lateral Angular Displacement

The angular displacements resulting from lateral step type control inputs were satisfactory and met the requirements of MIL-H-8501A, paragraph 3.3.18. The angular displacements referred to in this section were read 1 second after the lateral control input.

During hover at design gross weight, the roll angle resulting from a 1 inch left lateral control input was 10.5 degrees and that resulting from a 1 inch right lateral input was 12 degrees. Increasing the gross weight had no significant effect on the roll angles.

During level flight at 35 KCAS and 2080 pounds and 5000 feet density altitude the roll angle for a left 1 inch lateral control input was 12 degrees and the roll angle for a right 1 inch lateral input was 14 degrees. As airspeed was increased the angular displacement increased for both left and right control displacements. The angular displacement for a 1 inch left lateral control input reached a maximum of 15 degrees at 90 KCAS and decreased to 12.5 degrees at 102 KCAS. The angular displacement for a right 1 inch lateral control input increased as airspeed was increased throughout the speed range tested. A maximum roll angle of 16.5 degrees was reached at 102 KCAS. As gross weight was increased from design to overload, angular displacement versus control displacement was similar to that for the design weight for a 1 inch left lateral control input. The angular displacement at low airspeeds was 11 degrees, and increased to a maximum of 13 degrees at 69 KCAS, then decreased to 9.5 degrees at 86 KCAS. As altitude was increased from 5000 to 10,000 feet density altitude the angular displacement for a 1 inch left lateral control input decreased from 12 degrees to 11.5 degrees at 35 KCAS, reached a maximum of 12.5 degrees at 71 KCAS and decreased to 9 degrees at 89 KCAS. The angular displacement for a right 1 inch lateral control input was 13 degrees at 35 KCAS, went to a minimum of 11.5 degrees at 71 KCAS and increased to 15 degrees at 89 KCAS.

During climb at 55 KCAS the angular displacement for a 1 inch left lateral control input was 12.5 degrees and 15 degrees for a 1 inch right lateral input. As gross weight and altitude were increased there were no significant changes in the angular displacements.

b. Armed Configuration

(1) Lateral Control Sensitivity

The lateral control sensitivity in a hover was higher in the armed configuration than in the clean configuration. A maximum acceleration of 20 deg/sec^2 was reached in .4 seconds following a 1/2 inch lateral control displacement in both the left and right directions. Lateral step inputs larger than 1/2 inch were not practical; however, extrapolation of the data revealed that an acceleration of 40 deg/sec^2 would be reached with a 1 inch control displacement.

The maximum acceleration reached in level flight with the XM-8 armament kit installed was 28 deg/sec^2/inch. The time required to reach maximum acceleration for both a left and right lateral control displacement was .4 second . Throughout the speed range tested with the XM-8 kit, the maximum acceleration remained constant at 28 deg/sec^2/inch. The sensitivity with the XM-7 armament kit was essentially the same as with the XM-8 except that acceleration increased at 102 KCAS. A maximum acceleration of 37 deg/sec^2/inch was reached in .4 seconds.

During climb at 55 KCAS, an average maximum acceleration of 34 deg/sec^2 was reached with a 1 inch left lateral control input and 26 deg/sec^2 following a 1 inch right lateral input with the armament kits installed. The average time to reach maximum acceleration was .4 second . This was an increase of 2 deg/sec^2/inch for a left lateral displacement and a decrease of 6 deg/sec^2/inch for a right lateral displacement as compared to the clean configuration.

During autorotation at 55 KCAS, a maximum acceleration of 24 deg/sec^2 was reached in .4 second following a 1 inch left lateral input with the XM-7 armament installed, and 28 deg/sec^2/inch with the

XM-8 armament installed. The longitudinal sensitivity following a 1 inch right lateral input was 30 deg/sec^2 for either the XM-7 or XM-8 armament kits.

(2) Lateral Control Response

In a hover the lateral response characteristics with the XM-7 or XM-8 armament installed showed an increase over those of the clean configuration. A maximum roll rate of 9 deg/sec was reached in .6 second following a 1/2 inch lateral control displacement in both the left and right directions in a hover. The average maximum roll rate in low speed level flight was 12 deg/sec/inch and was reached in .65 second for both left and right control inputs. The control response increased with airspeed and reached an average maximum of 16 deg/sec/inch at 102 KCAS. The increase in response was gradual and unlike the clean configuration, did not reach a maximum until the highest airspeed tested was reached.

The control response during a 55 KCAS climb was the same for the XM-7 and XM-8, and there was no significant change compared to the clean configuration. A maximum roll rate of 14 deg/sec/inch was reached in .45 second for the XM-7. During autorotation there was no signivicant change in the control response characteristics with the armament kits installed.

(3) Angular Roll Displacement

During hover with the XM-7 armament kit installed, the angular displacements were higher than in the clean configuration. A roll angle of 8 degrees for a 1/2 inch left lateral input, armed, compared to 10.5 degrees for 1 inch input, clean.

There were no significant changes in the angular displacement characteristics in level flight with the armament kits installed.

In a climb and autorotation at 55 KCAS the curves of angular displacement versus control displacement are positive and linear. A roll angle of 12 degrees resulted from both a left and right lateral input of 1 inch.

In autorotation at 55 KCAS the angular displacement for a left lateral control input of 1 inch was 9 degrees and that for a 1 inch right lateral control input was 19 degrees. As gross weight was increased to 2520 pounds the angular displacement remained the same for a left lateral control input and decreased from 19 degrees to 14 degrees for a right input. As altitude was increased the angular displacements were 10.5 degrees for a 1 inch left lateral control input and 12.5 degrees for a 1 inch right lateral control input. The angular displacements during autorotation were higher at heavier gross weights and high altitudes.

2.6.4.3 Quantitative Engineering Analysis of Directional Controllability

a. Clean Configuration

(1) Directional Sensitivity

The directional control sensitivity (deg/sec^2/inch) in hovering flight at design gross weight was non-symmetrical with maximum values of 34 left and 43 deg/sec^2/inch right. Acceleration was immediate and the time required to reach the maximum was .4 second. Increasing gross weight to overload resulted in a control sensitivity of 52 deg/sec^2/inch to the right but the sensitivity to the left was unchanged. Time required to reach a maximum was .65 second at the heavier gross weight.

The directional sensitivity decreased as airspeed was increased to 35 KCAS. At this airspeed for design gross weight at 5000 feet density altitude, a 1 inch pedal step input resulted in an acceleration of 30 deg/sec^2 both right and left. Increasing airspeed further caused the directional sensitivity also to decrease. At airspeeds of 90 KCAS and 102 KCAS the directional control sensitivity was 25 left and 28 deg/sec^2/inch right.

Increasing gross weight to the overload condition greatly changed the directional control sensitivity at low airspeeds (32 KCAS). At this gross weight condition, the directional control sensitivity characteristics were considerably different for left and right control displacements. Left 1 inch pedal steps caused an acceleration of 8 deg/sec^2 and right pedal steps resulted in an acceleration of 33 deg/sec^2. In addition to this magnitude of the control sensitivity variation, the variation with airspeed was also different. For left pedal steps the sensitivity increased with airspeed and reached a maximum of 24 deg/sec^2/inch at 86 KCAS. For right pedal steps, increasing airspeed resulted in decreasing sensitivity, and the sensitivity was 28 deg/sec^2/inch at 86 KCAS.

Increasing altitude to 10,000 feet, at the design gross weight condition generally resulted in an increase of directional control sensitivity. For this condition the left control sensitivity was 31 deg/sec^2/inch as airspeed was varied from 35 KCAS to 89 KCAS and for the same airspeed range the right directional control sensitivity remained constant at 30 deg/sec^2/inch.

Directional control sensitivity at 5000 feet, design gross weight and 55 KCAS was slightly higher for climbs and autorotation than a similar level flight condition. The control sensitivity was 36 deg/sec^2/inch left and 44 deg/sec^2/inch right. The time required to reach maximum acceleration was .45 second.

Increasing altitude to 10,000 feet decreased the left control sensitivity to 32 deg/sec^2/inch. Right directional control sensitivity was 46 deg/sec^2/inch for autorotation and 28 deg/sec^2/inch during climb.

(2) <u>Directional Control Response</u>

The directional control response (maximum initial angular velocity per inch of control displacement) was satisfactory and fulfills the requirements of MIL-H-8501A, paragraph 3.3.7.

During hover, the yaw rates continued to build with time and the maximums were often not reached prior to necessary recovery action. To obtain more consistent and realistic values, the rate at 1 second was used to evaluate the hovering control response. At design gross weight and aft C.G. (Station 103.5), yaw rates of 23 deg/sec left and 40 deg/sec right were reached 1 second after the control inputs of 1 inch. As gross weight was increased to overload, the control response for right pedal input of 1/2 inch was 24 deg/sec after 1 second. The control response for a left pedal 1/2 inch input was 11-1/2 deg/sec after 1 second.

The motion following a left or right directional step input at 35 KCAS in level flight at 5000 feet was an immediate yaw rate in the input direction that was initially high and decreased with time. A maximum yaw rate of 17 deg/sec was reached .9 second following a 1 inch left pedal input and a maximum yaw rate of 5 deg/sec was reached in .9 second following a 1/2 inch right pedal input. As gross weight was increased to overload, an unsymmetrical yaw rate response existed. Maximum yaw rates of 9 left and 20 deg/sec/inch right was reached in .9 second. The unbalanced response was also present as altitude was increased from 5000 to 10,000 feet density altitude at design gross weight. Maximum yaw rates of 12 left and 21 deg/sec right were reached in an average of .7 second following a 1 inch left and right pedal input.

As airspeed was increased to 90 KCAS, maximum yaw rates of 12 left and 14 deg/sec right were reached in .5 second following 1 inch pedal inputs and increased to 24 deg/sec in .5 second for 1 inch pedal inputs at 102 KCAS. Maximum yaw rates of 6 left and 14 deg/sec right were reached in .65 second following 1 inch control inputs at 69 KCAS. As airspeed was increased to 86 KCAS, the unsymmetrical rate response in the overload condition was not significant. Maximum rates of 11 left and 14 deg/sec right were reached at 86 KCAS in .65 second following 1 inch control inputs.

As airspeed was increased at 10,000 feet density altitude, the rate response decreased. The rate response difference between a left and right directional input noted during low speed control inputs did not exist noticeably at higher airspeeds. At 89 KCAS, maximum yaw rates of 11 left and 13 deg/sec right were reached in .7 second following 1 inch control inputs.

During a 55 KCAS climb at 5000 feet density altitude and design gross weight, a maximum yaw rate of 19 deg/sec resulted from a 1 inch left pedal input and 26 deg/sec for a 1 inch right pedal input. The time to reach maximum acceleration was .75 second. The directional control response decreased as gross weight was increased from design to overload for the climb. Maximum yaw rates of 8 deg/sec left and 12 deg/sec right were reached in .3 second following 1 inch control inputs. Increasing the climb altitude from 5000 feet to 10,000 feet density altitude had no significant effect on the rate response characteristics.

The directional control response during autorotation at 5000 feet, design gross weight and aft C.G. (Station 103.2) was the same as the response during a 5000 foot climb. As gross weight was increased to overload, the rate response decreased. The maximum yaw rate resulting from a 1 inch left and right control input was 16 and 20 deg/sec respectively. During autorotation through 10,000 feet, a maximum response of 10 deg/sec resulted from a 1 inch left pedal input and 12.5 deg/sec from a 1 inch right pedal input. The average time to reach maximum rate was .4 second .

(3) Angular Yaw Displacement

The angular displacements resulting from step type control inputs were satisfactory and met the requirements of MIL-H-8501A, paragraph 3.3.5 and 3.3.7.

During hover, at design gross weight, the curve of angular displacement versus control input is positive and linear. A yaw angle of 20 degrees was reached 1 second after either a left or right 1 inch pedal input. Increasing the gross weight from design to overload had no effect on the yaw angle displacement.

In level flight, at 5000 feet density altitude, aft C.G. (Station 103.5), and design gross weight, the angular displacements were higher at low speeds and decreased as airspeed increased. The yaw angular displacements at 35 KCAS were 12 degrees for a 1 inch left pedal input and 16 degrees for a 1 inch right pedal input. The higher yaw angle resulting from right pedal inputs was characteristic at design gross weight and 5000 feet density altitude, throughtout the airspeed range tested. At 102 KCAS, the yaw angles after 1 second were 5 degrees for a left pedal input and 8 degrees for a right pedal input. As gross weight was increased from design to overload, the yaw angle displacements at 35 KCAS were 7 degrees and 9.5 degrees for a left and right pedal displacement respectively. Increasing airspeed had no effect on the yaw angle for a left pedal input. The yaw angle was 7 degrees throughout the airspeed range tested. Following a 1 inch right pedal input at 86 KCAS the resulting yaw angle was 11 degrees (an increase of 1.5 degrees over the 35 KCAS yaw angle).

An increase in the level flight altitude at design gross weight, produced the same yaw angle characteristics as the overload gross weight condition. An average yaw angle of 8.5 degrees was reached 1 second after both a left and right 1 inch pedal input througout the airspeed range tested.

During a 55 KCAS climb at design gross weight and aft C.G. (Station 103.5), the yaw angle resulting from a left pedal input was 10 degrees after 1 second and 11 degrees for a right pedal input. Increasing the gross weight from design to overload, and altitude from 5000 to 10,000 feet, resulted in no significant changes in the yaw angular displacements during a climb.

During autorotation at 55 KCAS, design gross weight and aft C.G. (Station 103.5), a maximum yaw angle of 8 degrees resulted from a 1/2 inch left pedal input and 3-1/2 degrees for a 1/2 inch right pedal input. As gross weight was increased from design to overload, a maximum yaw angle of 13 left and 10 degrees right followed a 1 inch left and right pedal input. With altitude increased from 5000 feet to 10,000 feet density altitude the yaw angle 1 second after the pedal input was 6-1/2 degrees for both a left and right 1/2 inch pedal input.

b. Armed Configuration

(1) <u>Directional Control Sensitivity</u>

Directional control sensitivity in a hover with the XM-7 armament kit installed was 38 deg/sec^2/inch for a left pedal input and a maximum yaw acceleration of 25 deg/sec^2 resulted from a 1/2 inch right pedal input. The time required to maximum acceleration was .5 second .

As airspeed increased to 35 KCAS, the directional control sensitivity decreased for a left directional input but increased for a right directional input. Following a left pedal input, maximum yaw accelerations of 20 deg/sec^2/inch for the XM-7 and 28 deg/sec^2/inch for the XM-8 were reached in .7 second . At airspeeds above 35 KCAS there were no significant differences in the control sensitivity between the XM-7 and XM-8 armament kit configurations. At 90 KCAS average maximum directional control sensitivities of 26 left and 30 deg/sec^2/inch right were reached in .45 second . This is comparable to the average 26 deg/sec^2/inch at 90 KCAS for the clean configuration. At 102 KCAS the directional control sensitivity was 24 deg/sec^2/inch for both a left and right pedal input with the XM-7 kit installed. The time required to reach maximum acceleration was .4 seconds.

During a 5000 foot density altitude,design weight, 55 KCAS climb a maximum acceleration of 20 deg/sec^2 for a 1 inch left control input and 30 deg/sec^2 for a 1 inch right control input were reached in .5 second with the XM-7 kit installed and 32 and 38 deg/sec^2 for a 1 inch left and right control input respectively were reached in .45 second with the XM-8 kit installed.

During a 55 KCAS autorotation, the directional control sensitivity was essentially the same for both the XM-7 and XM-8 armament kits. Average maximum accelerations of 30 left and 38 deg/sec^2 right for 1 inch control inputs were reached in .7 second .

(2) Directional Control Response

During a hover with the XM-7 armament kit installed the curve of maximum yaw rate versus control displacement was positive and linear. The yaw rates were measured at 1 second after the pedal step input due to yaw rates not reaching a maximum before recovery was initiated. A yaw rate of 28 deg/sec was reached in 1 second following a left 1 inch pedal input and 15 deg/sec following a 1/2 inch right input. The disharmony in rate response that was so predominate during hover for the clean configuration, did not exist for the armed configuration.

Throughout the level flight airspeed range tested the directional rate responses for the XM-7 and XM-8 armament kits were essentially the same. During low speed level flight an average maximum yaw rate of 17 deg/sec/inch and 22 deg/sec/inch resulted from a left and right directional input. The average time to reach maximum yaw rate was 1 second. As airspeed was increased the rate response decreased and the curves of maximum yaw rate versus control displacement were linear. The disharmony between the left and right pedal response that existed at low airspeeds did not exist at the higher airspeeds.

During climb and autorotation the directional response was essentially the same for both the XM-7 and XM-8 armament kits. During a 55 KCAS climb an average maximum yaw rate of 16 deg/sec/inch was reached in .7 second following a left or right pedal input.

During autorotation, an average maximum yaw rate of 22 deg/sec/inch was reached in an average time of 1 second.

(3) Directional Angular Displacement

There were no significant changes in the angular displacement characteristics resulting from pedal inputs with the XM-7 and XM-8 armament kits installed.

2.6.5 QUALITATIVE PILOT'S COMMENTS ON CONTROLLABILITY

2.6.5.1 Qualitative Pilot's Comments on Longitudinal Controllability

a. Clean Configuration

(1) Longitudinal Control Sensitivity

There was little noticeable difference in longitudinal control sensitivity resulting from changes in configuration, C.G., weight or altitude. Acceleration in pitch was as high as possible without causing a tendency to overcontrol, and was considered to be good with the following exception. During maneuvers at speeds above 105 KCAS at 5000 feet density altitude and 2100 pounds, the increased loading caused rapid onset of blade stall that required a forward stick correction. Under conditions of pitch up, nose-down longitudinal sensitivity was reduced to an extent that was marginal. In hovering flight, longitudinal sensitivity was considered good.

(2) Longitudinal Control Response

Angular pitch rates in response to longitudinal control inputs were generally high and did not vary qualitatively with changes in configuration, C.G., weight or altitude. Angular pitch displacement, following a 1 inch step in a hover, was such that the input could not be held for more than 1 or 2 seconds. At high forward airspeeds (above 105 KCAS), the nose-up and nose-down pitch rate and angular displacements appeared similar, but aft response was sufficiently high to cause rapid onset of blade stall, requiring immediate recovery (see paragraph 2.5.5.1). Under all other conditions of flight, longitudinal response was considered good. In autorotation, particularly at speeds above 75 KCAS, there was a feeling of reduced response due to the increased time taken to reach maximum rates.

b. Armed Configuration

There was no noticeable differences in controllability with the armament kits installed.

2.6.5.2 <u>Qualitative Pilot's Comments on Lateral Controllability</u>

a. Clean Configuration

(1) <u>Sensitivity</u>

Lateral sensitivity was high under all conditions tested and any effects of C.G., weight, height or configuration were not noticed. There was no tendency to over-control and in a hover, lateral sensitivity was excellent.

(2) <u>Response</u>

Angular rates of roll in response to lateral control stick inputs were high under all conditions tested and maximum rates appeared to be reached quickly. There was a consistent pitch coupling associated with lateral step inputs that was nose up following a left step and nose down following a right step. The resultant pitch was small and easy to control. This motion did not occur in a hover in-ground-effect (IGE) or out-of-ground effect (OGE).

b. Armed Configuration

There was no noticeable difference in lateral controllability with the armament kits installed.

2.6.5.3 <u>Qualitative Pilot's Comments on Directional Controllability</u>

a. Clean Configuration

Under all power-on conditions tested, directional sensitivity appeared to be greater to the right than to the left. In autorotation, there was little difference between left and right. In all forward flight cases, however, directional sensitivity appeared less than lateral and longitudinal. In a hover, the unmatched sensitivity between left and right pedals caused inaccuracies in directional control. In addition, the higher force required to the left added to the poor harmony (see Control System Evaluation, paragraph 2.9.5(b)). Increased weight accentuated the mismatch, particularly in hover and climbing flight. Maximum angular yaw rates took longer to reach to the left than to the right, except in autorotation, but the rates achieved were satisfactory. In a hover, IGE, the maximum yaw rate to the right, following a 1/2 inch step was not achieved before an excessive rate was reached which required recovery. To the left, a stabilized maximum rate of yaw was normally reached after a few seconds. In general, directional response was adequate, but the disharmony between left and right response was undesirable.

b. Armed Configuration

The uneven directional sensitivity, response, and pedal forces were present in the armed configurations and caused difficulty in aiming the weapons accurately.

2.6.6 COMPARISON OF THE CONTROLLABILITY OF THE OH-6A AND THE OH-13H AND OH-23D

The tabulated data on pages 60 and 61 presents the control sensitivity and response for the pitch, roll and yaw axes, resulting from step-type control inputs, for the OH-6A, OH-13H and OH-23D.

2.7 ARMAMENT FIRINGS

2.7.1 OBJECTIVE

The objectives of the tests were to determine the effect of the armament on the basic helicopter stability and control during a firing sequence.

2.7.2 METHOD

The effect of the armament was obtained by recording the aircraft motions that resulted from a firing sequence. The firings were conducted from a stabilized condition and were from 2 to 4 seconds in duration. The helicopter was stabilized and the controls held fixed to determine the helicopter motion during the firing sequence; and also, the controls were moved to determine the control inputs required to hold a stabilized condition during the firing. All control positions, aircraft attitudes and rates were recorded during each firing sequence. Firing tests were conducted with both the XM-7 and XM-8 armament kits installed. Firings were conducted with the armament kit elevation angle in the full up and full down positions under the following conditions:

a. Rearward Flight

b. Sideward Flight (left and right)

c. Hovering Flight

d. Transition from Hover to Forward Flight and from Forward Flight to Hover

e. Level Flight (both yawed and unyawed) at Trim Speeds of 35 KCAS, 50 KCAS, .8Vne, Vne

f. Accelerated Flight at Trim Speed of .8Vne (rolling pullout)

2.7.3 RESULTS

Time histories of the firing sequences are presented in Figures No. 223 through 236, Section 3, Appendix I.

CONTROL SENSITIVITY COMPARISON

Aircraft	Approximate Density Altitude ft	Approximate Gross Weight lb	ROTOR rpm	Approximate Center of Gravity in.
OH-6A	5000	2100	465	103.5 (aft)
OH-13H	5000	2500	344	85 (mid)
OH-23D	5000	2500	355	82.7 (mid)

Aircraft	Airspeed KCAS	PITCH Acceleration Up deg/sec²/in.	PITCH Acceleration Down deg/sec²/in.	PITCH Time to Maximum Acceleration Up sec	PITCH Time to Maximum Acceleration Down sec	ROLL Acceleration Left deg/sec²/in.	ROLL Acceleration Right deg/sec²/in.	ROLL Time to Maximum Acceleration Left sec	ROLL Time to Maximum Acceleration Right sec	YAW Acceleration Left deg/sec²/in.	YAW Acceleration Right deg/sec²/in.	YAW Time to Maximum Acceleration Left sec	YAW Time to Maximum Acceleration Right sec
OH-6A	Hover IGE	20	10	.35	.35	28	27	.7	.7	34	46	Read at 1 sec	
	102	25	24	.5	.5	43	40	.3	.3	25	28	.4	.4
OH-13H	Hover IGE	10	12	.43	.43	15	16	.33	.33	35	25	.47	.47
	65	15	16	1.05	1.05	16.5	17.5	.36	.36	25	23		
OH-23D	69	13.5	14	.64	.64	27	25	.31	.31	49	49	.28	.28

CONTROL RESPONSE COMPARISON

Aircraft	Approximate Density Altitude ft	Approximate Gross Weight lb	ROTOR rpm	Approximate Center of Gravity in.
OH-6A	5000	2100	465	103.5 (aft)
OH-13H	5000	2500	344	85 (mid)
OH-23D	5000	2500	355	82.7 (mid)

Aircraft	Airspeed KCAS	PITCH Response Up deg/sec/in.	PITCH Response Down deg/sec/in.	PITCH Time to Maximum Rate Up sec	PITCH Time to Maximum Rate Down sec	ROLL Response Left deg/sec/in.	ROLL Response Right deg/sec/in.	ROLL Time to Maximum Rate Left sec	ROLL Time to Maximum Rate Right sec	YAW Response Left deg/sec/in.	YAW Response Right deg/sec/in.	YAW Time to Maximum Rate Left sec	YAW Time to Maximum Rate Right sec
OH-6A	Hover IGE	20	14	1.2	1.2	12	12	.75	.75	23	40	Read at 1 sec	
	102	19	15	.9	.9	16	16	.78	.78	24	24	.5	.5
OH-13H	Hover IGE	6.5	6.5	1.96	1.96	8.0	7.5	.86	.86	33	28	Read at 1 sec	
	65	6	6	1.05	1.05	8	7	.98	.98	10	9	.87	.87
OH-23D	69	17.5	11	1.51	1.51	11	10	.69	.69	24	19	.86	.86

2.7.4 ANALYSIS

2.7.4.1 Quantitative Engineering Analysis of the XM-7 and XM-8 Armament Firings

The OH-6A helicopter was designed for armament installations to be mounted on the left side only. Ballast was used in addition to the armament kits and ammunition to simulate the most critical C.G. loading. With the XM-7 armament kit installed, a lateral C.G. of 2.8 inches left and a longitudinal C.G. of 102 inches aft was flown for tests (TIA limits are 3 inches left and 104 inches aft for the design gross weight). The same lateral C.G. and a longitudinal C.G. of 101 inches aft was flown with the XM-8 kit installed.

Although no vibration instrumentation was installed for the stability and control tests, the vibration level with the XM-8 grenade launcher firing was noticeably higher than that with the XM-7 machine gun firing.

a. XM-7 Armament Installation

With the XM-7 firing, the pressure distribution around the helicopter was disturbed and resulted in a fluctuation of the airspeed system. The fluctuation of ± 15 knots was more pronounced at airspeeds below 40 KCAS. During all conditions tested, except the rolling pullout, the ejected cartridge cases cleared the helicopter with a safe margin. During rolling pullouts to the right, at 80 KCAS, there was a wide scatter of ejected cases and only minimum clearance between the cases and the tail rotor existed.

The stability and control characteristics were not affected during the XM-7 firings. With the controls fixed in a stabilized flight condition, there was no significant motion resulting from the firings. The time histories of the firings, during hover and low airspeeds show that the helicopter yawed slightly left when the XM-7 was firing. As stated in Pilot's Comments, the yaw was slight and barely distinguishable from the normal small angle directional disturbances.

The XM-7 was fired at both the full up elevation angle (10 degrees) and full-down elevation angle (20 degrees). The elevation angle did not affect the stability and control characteristics of the helicopter during firing.

b. XM-8 Armament Installation

The stability and control characteristics were not affected during the XM-8 firings. Firing in the full-up elevation (10 degrees) could not be accomplished due to malfunctioning of the XM-8 installation.

2.7.5 QUALITATIVE PILOT'S COMMENTS ON ARMAMENT FIRINGS

a. XM-7 Armament Installation

The flying qualities of the OH-6A were not affected by firing the XM-7 under all conditions tested. Control positions were normal and firing did not require any significant compensating control corrections. There was a very slight tendency to yaw 1 or 2 degrees left during hover and low speed flight, but this was barely distinguishable from the normal small angle directional disturbances experienced in the OH-6A.

The noise level in the cockpit was high during firing, but not to the point of discomfort. Smoke and fume ingestion was moderate during hover, sideward flight to the left, and yawed flight to the right (left sideslip) but cleared quickly after firing ceased. Directional aiming control of the weapon in hovering or low speed flight was difficult due to the poor directional stability, uneven directional response and pedal forces. Elevation control was accomplished by a two way thumb trimmer switch on the top right side of the stick. It was difficult to operate the elevation control while firing and still maintain a firm grip due to the distance between the control and the trigger. The speed of the pod elevation actuator was such that approximately full travel (30 degrees) was accomplished in 3 seconds. This was too fast for accurate adjustments and several attempts were required to obtain the desired sighting elevation.

b. XM-8 Armament Installation

The flying qualities of the OH-6A were not affected by firing the XM-8 under all the conditions tested. Control positions requirements were normal and no significant compensating corrections were required. The slight yawing tendency was still apparent.

The noise level was high and the vibration and aircraft "shake" caused by the firing was very high. Smoke and fumes entered the cockpit during all firing; however, they were most pronounced in a hover, sideward and rearward flight and slow speed forward flight. The fumes dispersed within a few minutes after the firing stopped. The control of the weapons was the same as for the XM-7 armament installation.

2.8 AUTOROTATIONAL CHARACTERISTICS

2.8.1 OBJECTIVE

The objectives of the autorotational entries were to investigate quantitatively the attitude change and the control inputs required to stabilize the helicopter in case of a sudden loss in power.

2.8.2 METHOD

The autorotational entries were performed by first stabilizing the aircraft for a given trim condition and then rapidly reducing power. The collective pitch control trim position was maintained for at least 2 seconds after the power reduction, at which time the collective control was then lowered. All other flight controls were held in the trim position until the helicopter was in stabilized autorotation or until corrective action was necessary. Control positions, aircraft attitudes and rates were recorded for each autorotational entry. The tests were conducted for the conditions specified in Section 2.0 over an airspeed range of 15 KCAS to V_{ne} level flight.

2.8.3 RESULTS

Time histories of the autorotational entries are presented in Figures No. 237 through 240, Section 3, Appendix I.

2.8.4 ANALYSIS

2.8.4.1 Quantitative Engineering Analysis of Autorotational Characteristics

Entries into autorotation during all conditions tested were satisfactory and met the requirements of MIL-H-8501A, paragraph 3.5.5. In each case, movement of the collective pitch control was delayed for at least 2 seconds and sometimes longer, after a sudden reduction in engine power.

During 5000 feet density altitude level flight at 30 KCAS, design weight and clean configuration, the aircraft motion following a sudden reduction of engine power was a slight left yaw that started immediately after the power reduction. Collective pitch control was lowered 2-1/2 seconds after the power reduction and 2.0 inches of aft longitudinal control input were required to hold a level attitude. The rotor decay was rapid but did not fall below the safe minimum transient autorotative value (380 rpm, TIA limits).

Entry into autorotation from a 55 KCAS climb, design gross weight and a forward (Station 97.0) C.G. location resulted in a left yaw that started .75 second after power reduction. The yaw angle was small and required a minimum input to correct. The rotor rpm decay after 2 seconds was rapid and the collective pitch control was lowered to zero in .4 second. The aircraft pitched down due to lowering of the collective and approximately 4 additional inches of aft longitudinal control were required to hold a level attitude.

In level flight at 100 KCAS, overload gross weight, 5000 feet density altitude and aft C.G., there was slow rotor decay following a sudden power reduction which permitted a 2 second delay and gradual lowering of the collective pitch.

At 10,000 feet, level flight, 89 KCAS and a clean configuration, collective pitch control position was held for 3 seconds after a simulated power failure. The rotor decay was slow and allowed to reach 350 rpm before lowering the collective pitch control. The erratic longitudinal control trace on the time history indicates the vibration level was high until rotor rpm was increased.

2.8.5 MISCELLANEOUS QUALITATIVE PILOT'S COMMENTS

a. Takeoff and Landing with Power On (Clean and Armed Configurations)

Control during takeoff and landing (power on) was satisfactory and no unusual or large control movements were required. At the maximum forward C.G. location (97.0 inches) the longitudinal stick position required for the hover was only 2-1/2 inches from the aft stop and was, therefore, uncomfortable during takeoff.

b. Autorotative Landings at 2100 Pounds, Aft C.G. (Clean and Armed Configurations)

Controllability during autorotative landings was satisfactory in all axes and accurate positioning, flare and touchdown control were possible. No control limits were reached prior to touchdown and sufficient rotor inertia was available to cushion the landing without reaching the collective pitch limit. The landing skids allowed a wide range of touchdown attitudes and speeds to be used without causing any undesirable or sudden attitude changes. Ample directional control during the flare and landing runs, on smooth prepared surfaces, was available.

c. Power Recoveries IGE (Clean and Armed Configurations)

During power recoveries IGE after autorotational descents, or during flat pitch quick-stop maneuvers (twist-grip fully open) engine response characteristics were often unpredictable and sufficiently slow to require considerably more anticipation than acceptable for an aircraft of this class and maneuverability. Power demands made with the needles split (twist grip open) often resulted in excessive transient rotor rpm droop (below 90 percent) before power was delivered. This resulted in excessive sinking of the aircraft and overtorquing of the transmission unless the aircraft was allowed to land. This characteristic was normally confined to high temperature (100 degrees Fahrenheit (F)) and/or high density altitude conditions where extra care and anticipation was required if trouble was to be avoided.

d. Throttle Chops and Transition to Autorotation

Throttle chops were made at speeds from less than 20 knots to the maximum speed appropriate to the weight and altitude. Time histories of a selected number of these throttle chops are presented in Figures No. 237, 238, 239 and 240, Section 3, Appendix I. In all cases it was possible to delay 2 seconds before lowering the collective lever. The characteristics indicated in the following were consistantly noted:

(1) Yawing reaction to the power loss was small and no other significant attitude changes were observed. (See No. (4) below).

(2) Rotor decay rates were high but the allowable transient power-off rotor speed range was adequate. Rotor rpm recovery was rapid.

(3) When the collective control was lowered it was necessary to move the stick aft in order to maintain attitude. This relationship is shown in Figures No. 13 and 14 and can be seen on the time histories in Figures No. 237 through 240, Section 3, Appendix I.

(4) At 10,000 feet, 89 KCAS, the collective pitch control position was held for 3 seconds. At 350 rotor rpm, the aircraft had a tendency to roll left, the vibration level increased and the force required to resist the roll increased. The condition was alleviated as soon as the collective was lowered.

(5) When minimum collective pitch was reached rotor rpm recovery was sufficiently rapid at high weights and/or high altitudes to cause an overspeed unless checked by raising collective. Raising the collective to retain rpm within limits was normally accompanied by a heavy feed back force and increased vibration, which required a control force of approximately 25 pounds to overcome.

2.9 FLIGHT CONTROL SYSTEM EVALUATION

2.9.1 OBJECTIVE

The objective of this test was to make an overall evaluation of the control system as it appeared to the pilot, based mainly on qualitative opinion, but supported to some extent by quantitative data obtained during the program. The function of the following assessment was to complete the qualitative evaluation of the flying qualities of the OH-6A in conjunction with the pilot assessments in the preceeding paragraphs.

2.9.2 METHOD

This evaluation was a qualitative assessment of the control system after 100 hours of stability and control test flying. The opinions of other qualified engineering test pilots were used from time to time. Control forces quoted were measured with a hand-held calibrated force gauge. Any other figures quoted were obtained from oscillograph data or from wire-recorded data read from cockpit instrumentation.

2.9.3 RESULTS

Not applicable.

2.9.4 ANALYSIS

Not applicable.

2.9.5 QUALITATIVE PILOT'S COMMENTS ON FLIGHT CONTROL SYSTEM

a. Cyclic Control System

The cyclic control system was a non-boosted, manual control system, employing an electrically operated spring trimmer in both axes. Trimming was accomplished by 4-way beeper switch on the top of the cyclic stick. Considering the high disc loading, high rpm, large speed range and unboosted system, the cyclic controls were considered to be remarkedly free from major shortcomings. Lateral-longitudinal harmony was satisfactory. There were areas, however, where improvements could be made, and these are enumerated in the following paragraphs.

(1) Trim System

There was insufficient trim authority under the various conditions of flight quoted in paragraph 2.1.2. It was found that the force required to move the stick from trim (breakout force) was light, less than 2 pounds under most conditions. In order to provide an adequate degree of stick support for good hands-off trimming, a certain amount of cyclic friction had to be used. This amount was, however, usually more than that needed for comfortable breakout forces during hovering and maneuvering flight.

(2) Friction System

The cyclic friction system employed manually operated 1-1/4 inch diameter threaded wheels, mounted in both axes and located below the pilot's thighs at the base of the cyclic stick. These friction wheels provided adequate friction but were sometimes awkward to operate in flight without prejudice to pilot performance, particularly under turbulent conditions. It was felt that an unnecessarily large number of turns was required to adjust friction from full on to full off or vice versa.

(3) Cyclic Grip

The cyclic grip was positioned slightly too far aft for a large pilot, particularly when a parachute was worn. Even at the maximum aft C.G. location the stick position was normally further aft than comfortable. The controls on the grip itself included the 4-way trim switch, the intercom/radio button, the landing light on/off switch, the armament elevation control and the firing trigger. It was not possible to fire the weapon accurately and operate the elevation control at the same time due to the relative positions of the two controls. The landing light on/off switch was readily accessible, but was liable to inadvertent operation. The copilot's cyclic grip was uncomfortable to hold and no trimmer or transmit facility was provided.

(4) Cyclic Control Forces

As previously mentioned, the breakout forces of the cyclic were less than 2 pounds when measured from a trimmed condition in flight, with several exceptions. At or near speeds approaching the onset of blade stall, the force required to move the stick forward from trim increased markedly, and during maneuver this force increased in proportion to speed and the severity of the maneuver. These forces are shown in Figure No. 243, Section 3, Appendix I. The level flight speed which corresponded to the onset of pitch up was 110 knots at 5000 feet density altitude, 2100 pounds aft C.G. The forces required to make a small nose down correction under these conditions exceeded the requirements of MIL-H-8501A, paragraph 3.2.8,at speeds above 90 KCAS.

The forces required to hold the stick with the maximum adverse trim selected were recorded in flight as follows: Mid C.G. location,2000 pounds.

Flight Condition	Trim Condition	Force to Hold and Direction Applied
Hover	Full fwd	7 lb aft
Hover	Full aft	Nil -
Level Flt 35 KCAS	Full fwd	2 lb aft
Level Flt 35 KCAS	Full aft	1 lb fwd
Level Flt 35 KCAS	Full left	3 lb right
Level Flt 35 KCAS	Full right	3 lb left
Level Flt 90 KCAS	Full fwd	4 lb aft
Level Flt 90 KCAS	Full aft	1 lb fwd
Level Flt 90 KCAS	Full left	4 lb right
Level Flt 90 KCAS	Full right	3 lb left

The trimmer force gradient could not be measured accurately; however, the following ground tests were made with the rotor at 100 percent N_2 and the cyclic trimmed to approximately neutral:

Control Axis	Displacement In.	Force Required
Long	2.6 fwd	7 lb
Long	1.9 aft	7 lb
Lateral	4.0 left	6 lb
Lateral	3.0 right	7 lb

The above two sets of figures show that the longitudinal stick force versus displacement was in the order of 2.3 pounds per inch (lb/in.) and that the lateral stick force versus displacement was in the order of 1.5 lb/in., after allowing for breakout forces in both cases. There were not normally any discontinuities, unless the aircraft was out of trim, and in general the requirements of MIL-H-8501A, paragraph 3.2.4 were met; however, the requirement of paragraph 3.2.8 that the force resisting a longitudinal displacement shall not fall to zero, was not met during high speed, low powered or autorotational descents. Under this condition of flight, an aft stick displacement required an uncomfortably low force compared to the force required at other conditions tested.

b. Directional Control System

Control of tail-rotor pitch was obtained manually by conventional pedal controls and push-rod linkage. There was no evidence of slop in the system. There was no method of trimming pedal forces or of relieving residual in-flight forces.

(1) Pedal Adjustment

Three pedal positions that provided an adequate margin of adjustment for average pilots were available. The adjustment could not be safely altered in the air without the assistance of a copilot. The range of adjustment was 3 inches.

(2) Pedal Forces

With the aircraft on the ground with the rotor at 100 percent, the balanced trim position of the pedals was 1-1/2 inches right pedal To hold neutral pedal required a force of 4 pounds. The breakout force to the right was, therefore, negative under this condition, and approximately 5 pounds total force to the left. At trim, breakout force in both directions was less than 2 pounds.

Residual pedal forces in flight varied according to the power condition and the maximum forces were in the order of 20 pounds in hovering at high weights (i.e., high power) and during high power climbs. These forces were tiring and a source of annoyance. During level flight cruise the pedals were normally in trim.

c. Collective Control

The collective pitch control was manually operated and incorporated a friction device, twist grip, N_2 slip-ring control switch, throttle friction ring and starter button. The twist grip included a fuel cut-off device which, when moved forward, allowed the twist grip to be closed to the cut-off position.

(1) Friction System

The friction system on the collective pitch had several undesirable features. The friction lever was poorly constructed and gave the pilot no "feel" for the amount of friction he was applying. The mechanism itself was subject to undue amounts of residual friction, which on the test aircraft were nearly as high fully off as fully on. A 4 pound force was required to overcome this friction. The position of the friction lever was satisfactory.

(2) Control Forces

Apart from the greater frictional force mentioned above, collective pitch control forces were well balanced. (The aircraft used for the performance testing did not exhibit these residual frictional forces). During all flight conditions tested the control forces were satisfactory, with the one exception: Following a throttle chop, and after the collective had been lowered to recover rotor rpm, there was a large transient increase in the force required to raise the lever to prevent the rotor from overspeeding.

(3) Engine Control System

All engine controls were located on the collective pitch control except the fuel pump, low pressure fuel cock and ignition test switch. The following features were objectionable:

(a) The N_2 governor slip-ring controller, located at the base of the twist grip, was impossible to operate simultaneously with the twist grip. This was necessary on all occasions when the twist grip was used, due to the N_2 override feature incorporated in the twist grip. In order to prevent N_2 overspeed during throttle opening, it was necessary to "juggle" with the two controls by sliding the hand back and forth.

(b) The stability and response characteristics of the T63 engine and fuel control system were considered unacceptable for a helicopter of the size, performance and maneuverability of the OH-6A. A complete series of tests are required to enable a quantitative evaluation of this system to be made, but it was evident from the tests already made that there were several difficiencies in the existing installation. In particular, many possible failures could result in loss of fuel flow (equivalent to an engine failure when there is no emergency fuel control system). Governing stability under certain flight conditions was only marginally stable and the response characteristics of the engine were marginally acceptable under adverse operating conditions of weight, altitude and temperature, with particular emphasis on the erratic and slow power response from compressor speeds of 70 percent and below.

d. "Uni-Lock" Mechanism

The irreversable "uni-lock" mechanism was effective in eliminating aft feed back in the longitudinal control system during flight. An adequate demonstration of the "fail-safe" nature of the device should be given with particular reference to any flight hazard resulting from loss of hydraulic fluid, a hydraulic lock or a mechanical seizure in the "uni-lock."

e. Control Harmony

Control harmony was generally satisfactory. The following undesirable characteristics were noted:

(1) There was poor force harmony between left and right pedal during maneuver and hovering flight.

(2) There was poor fore and aft longitudinal harmony at high speed due to the high feed back forces during maneuver or turbulence.

(3) There was excessive residual collective friction which detracted from overall control harmony.

The correction of these items would help to reduce pilot fatigue and improve the flying qualities.

2.10 AIRSPEED CALIBRATION

2.10.1 OBJECTIVE

The objective of the tests was to determine the airspeed position error for the standard and test airspeed systems.

2.10.2 METHOD

The airspeed calibration of the standard and test airspeed system was determined by using the ground speed course method. The helicopter was flown over a measured ground course at a stabilized airspeed on reciprocal headings from 30 knots indicated airspeed (KIAS) to 120 KIAS with 10 knot increments.

The tests were conducted in the clean configuration at design gross weight and a density altitude of 550 feet.

2.10.3 RESULTS

Test results are presented in Figures No. 241 and 242, Section 3, Appendix I.

2.10.4 ANALYSIS

The standard and test systems indicated high throughout the speed range. The error in the standard airspeed system due to static pressure error was 5 knots at the low end (30 knots) and 1 knot at the high end (120 knots). The test airspeed system indicated a constant 4 to 5 knots high at all airspeeds.

SECTION 3 - APPENDICES

APPENDIX I - TEST DATA

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FIGURE No 1
SUMMARY OF CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A USA S/N 62-4214

SYM	AVG H_p ~ FT	AVG GW ~ LB	AVG C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	5000	2100	103.5 AFT	.5 RT.	465	CLEAN	LEVEL FLIGHT
□	5000	2080	97.0 FWD	.5 RT.	465	CLEAN	LEVEL FLIGHT
△	5000	2640	103.5 AFT	.4 RT.	465	CLEAN	LEVEL FLIGHT

DATA OBTAINED FROM CROSSPLOT OF FIGURES 3 THROUGH 12

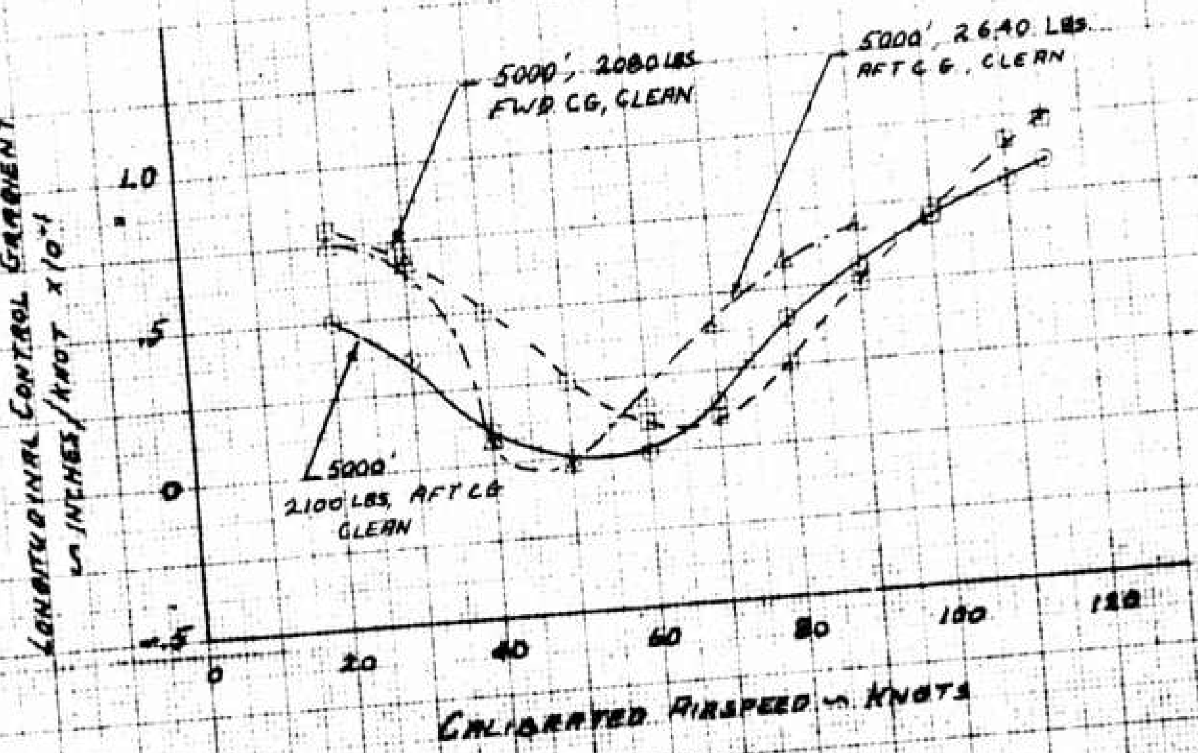

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FIGURE No 2

SUMMARY OF CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_P ~ FT	AVG GW ~ LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
– – – –	5,000	2100	103.5 AFT	5 RT.	465	CLEAN	LEVEL FLIGHT
◇	10,000	2040	103.5 AFT	5 RT.	465	CLEAN	LEVEL FLIGHT
○	5,000	2090	103.3 AFT	5 RT.	465	XM-7	LEVEL FLIGHT
□	5,000	2120	101.5 AFT	2.8 LT	465	XM-8	LEVEL FLIGHT

DASHED LINE OBTAINED FROM FIG.

DATA OBTAINED FROM CROSSPLOT OF FIGURES 3 THROUGH 12

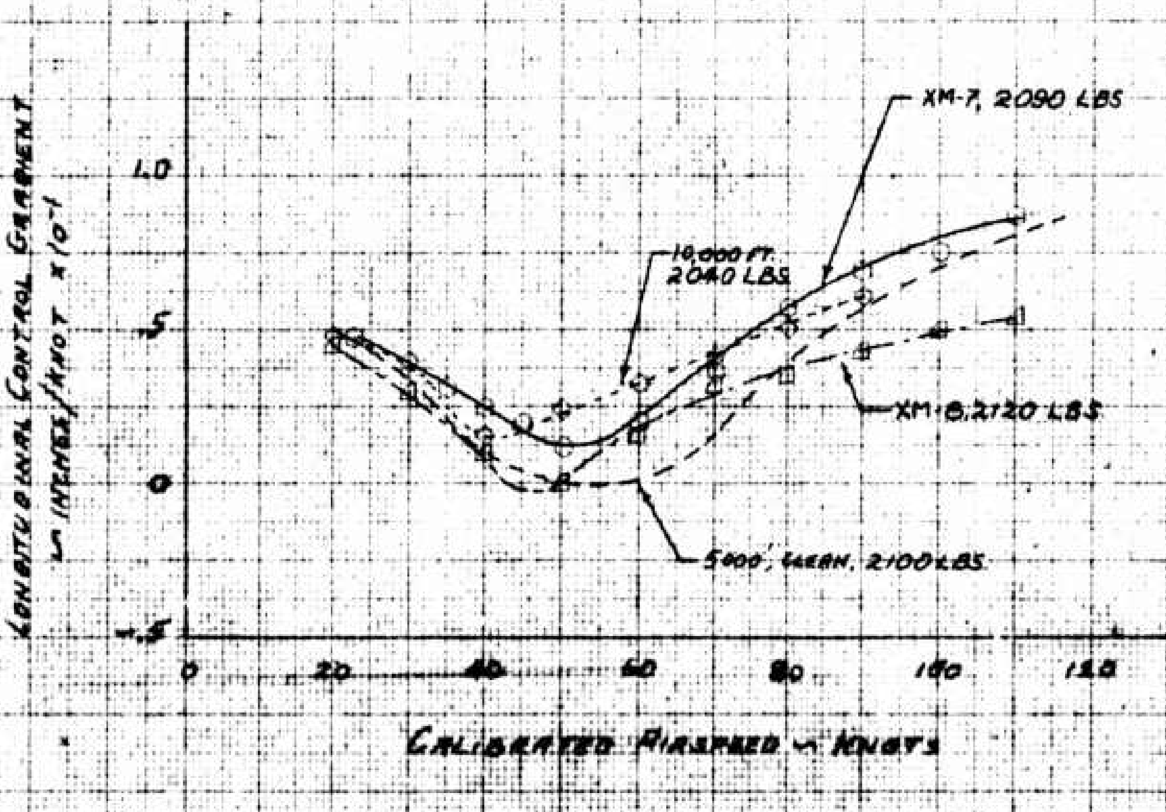

FIGURE NO 3

CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
- - - -	5000	2080	97 FWD	.5 RT	465	CLEAN	LEVEL FLIGHT
———	5000	2100	103.5 AFT	.5 RT	465	CLEAN	LEVEL FLIGHT

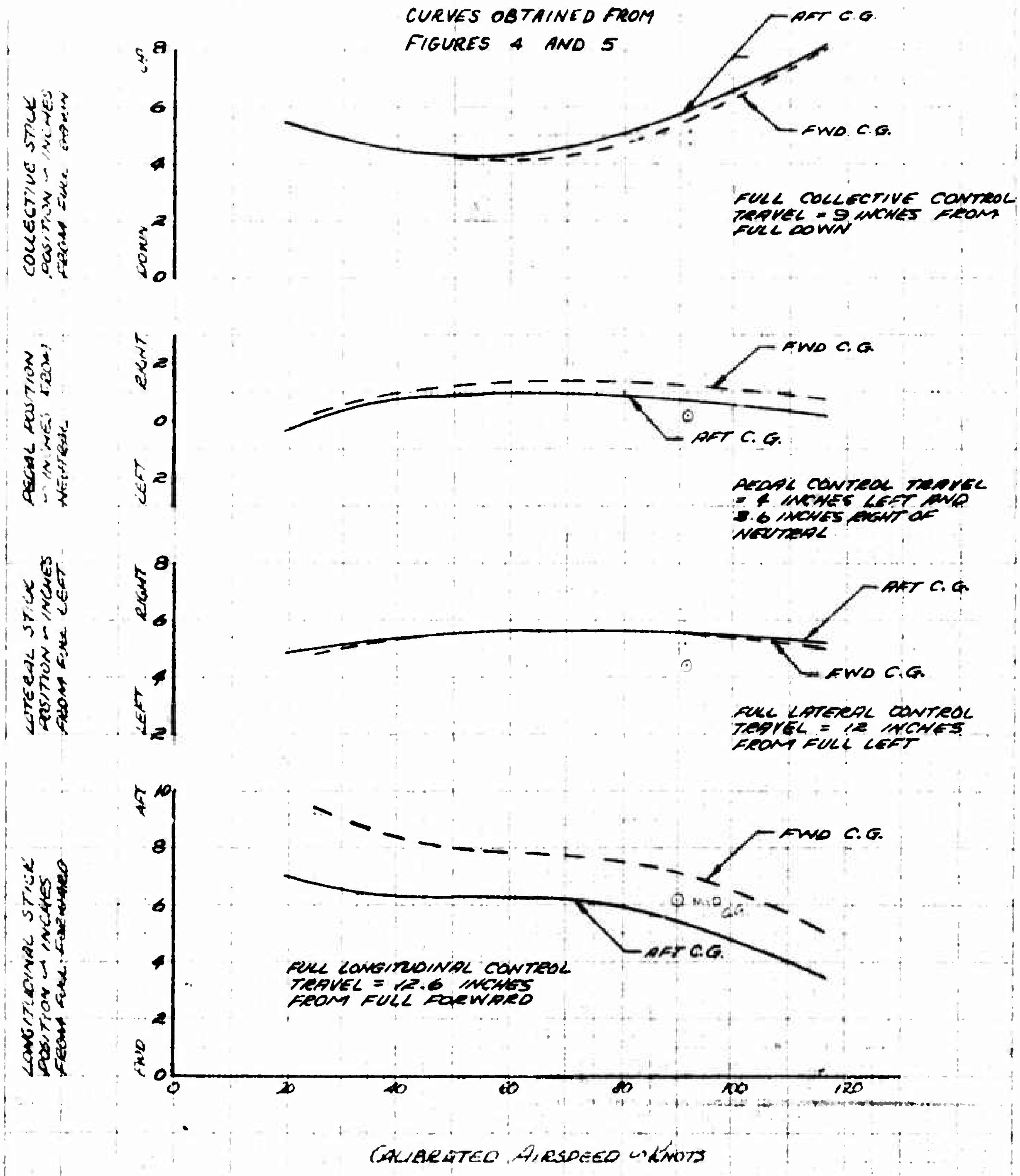

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Figure No. 4
Control Positions in Forward Flight
OH-6A USA S/N 62-4212A

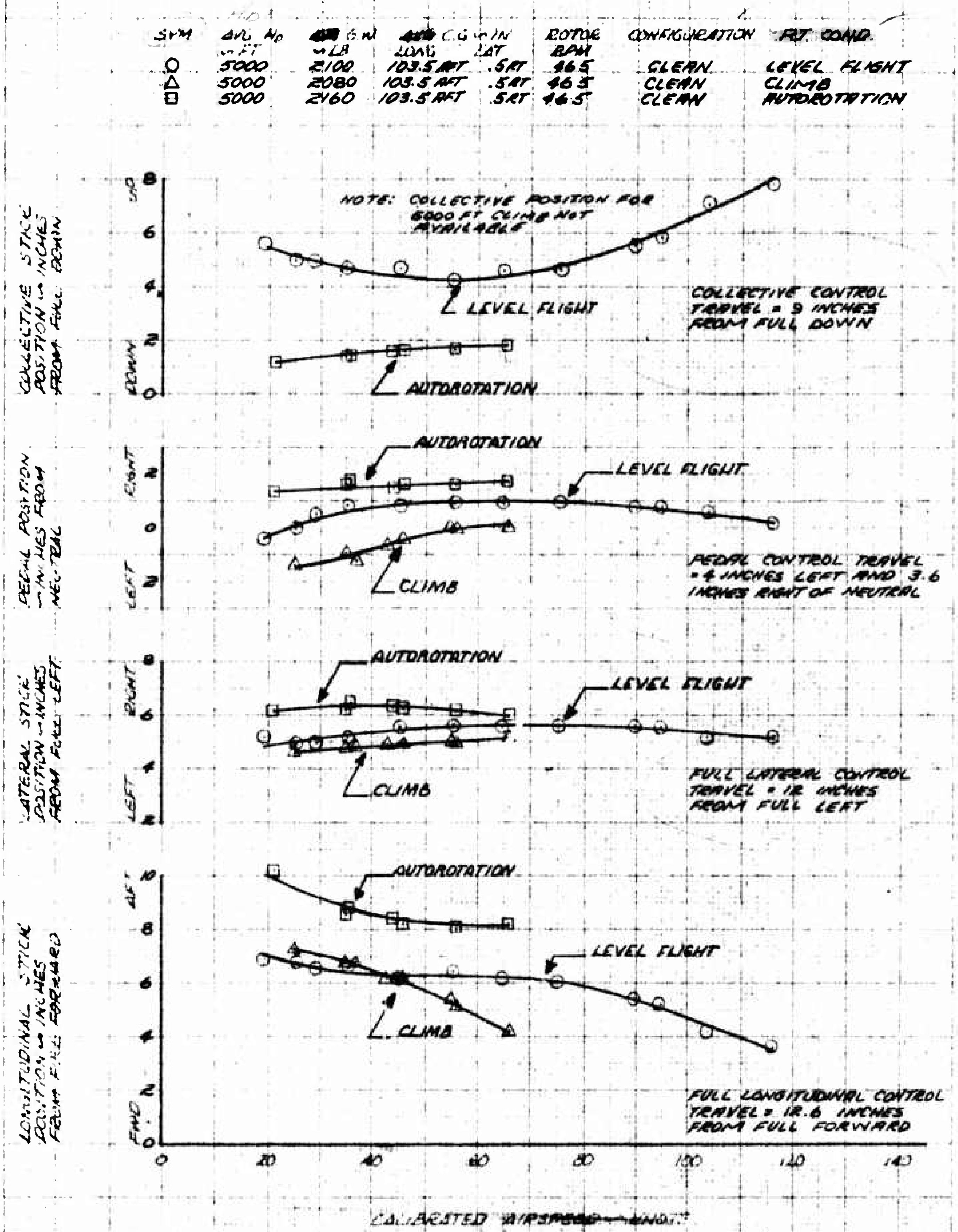

FIGURE No. 5
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A USA S/N 62-4214

SYM	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	5000	2080	97 FWD	.5RT	465	CLEAN	LEVEL FLIGHT
△	5000	2170	97 FWD	.5RT	465	CLEAN	CLIMB
□	5000	2120	97 FWD	.5RT	465	CLEAN	AUTOROTATION

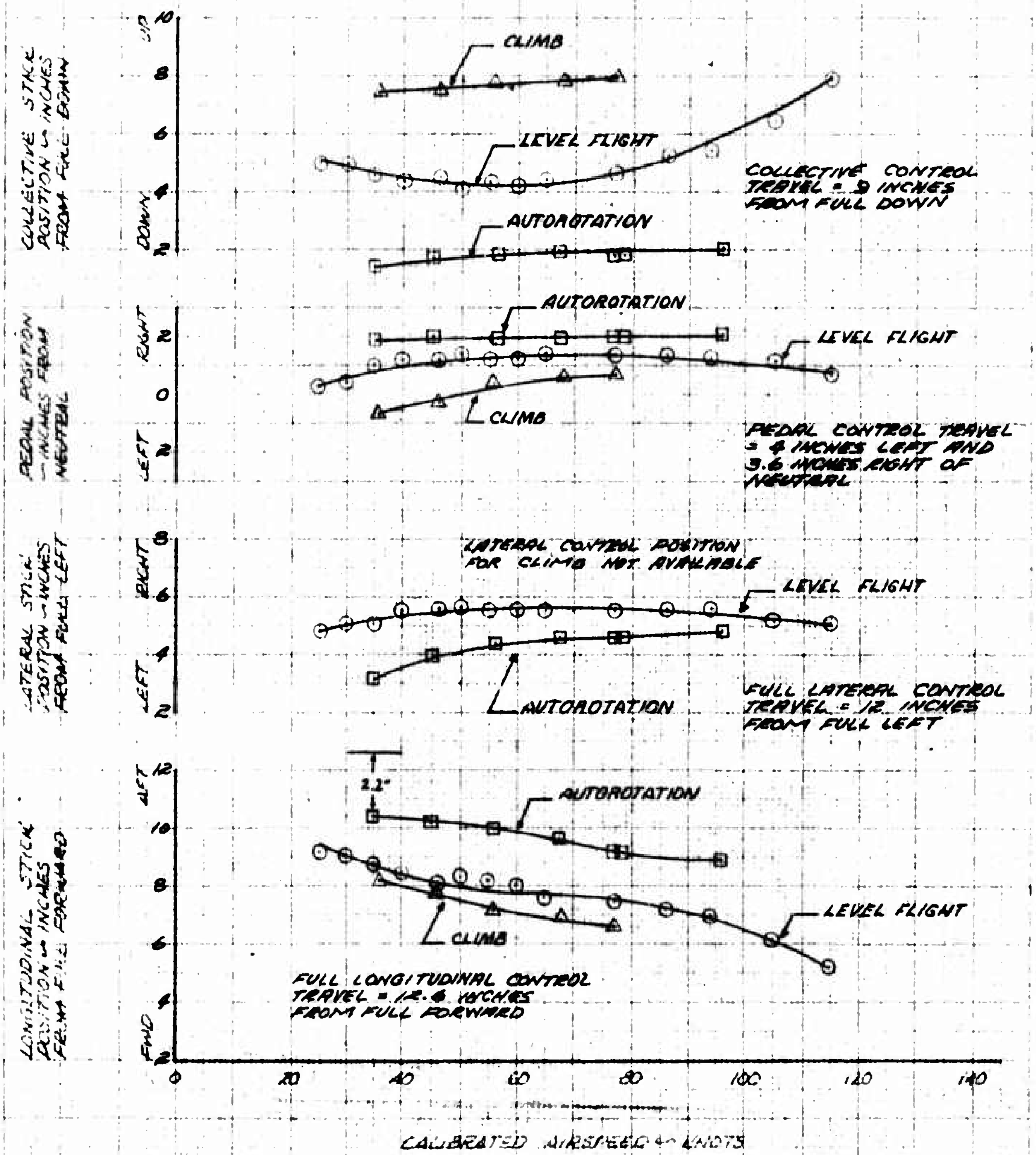

FIGURE NO 6

CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_p ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
△	900	2000	97. FWD	.5 RT	465	CLEAN	LEVEL FLIGHT
—	5000	2080	97. FWD	.5 RT	465	CLEAN	LEVEL FLIGHT
○	10000	2100	97. FWD	.5 RT	465	CLEAN	LEVEL FLIGHT

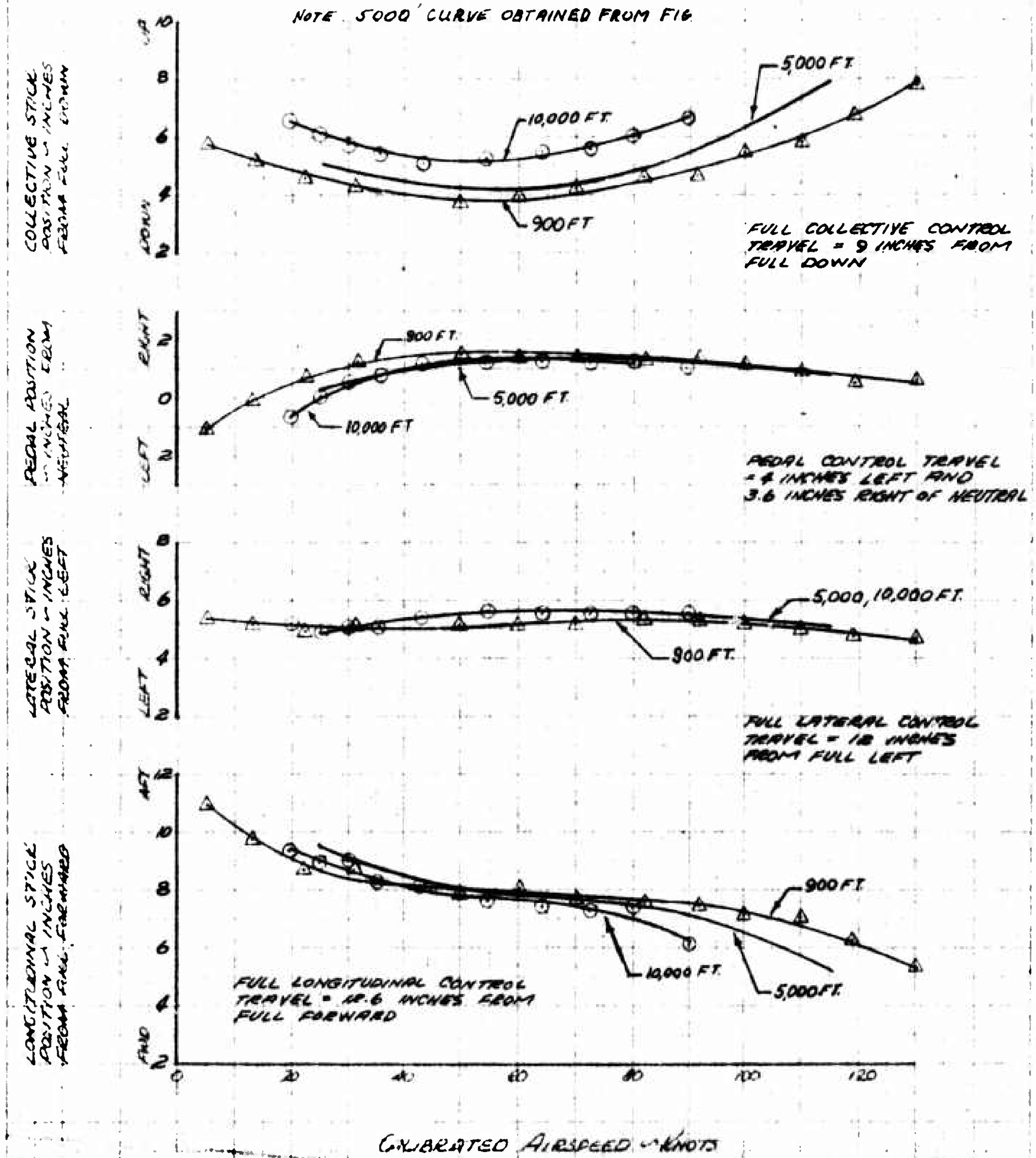

FIGURE NO 7
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A USA S/N 62-4214

SYM	AVG HD FT	AVG GW LB	AVG CG LONG	IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
———	5000	2100	103.5 AFT	.5RT	465	CLEAN	LEVEL FLIGHT
– – –	5000	2640	103.5 AFT	.4RT	465	CLEAN	LEVEL FLIGHT
– – – –	10000	2040	103.5 AFT	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: CURVES OBTAINED FROM FIGURES AND AND

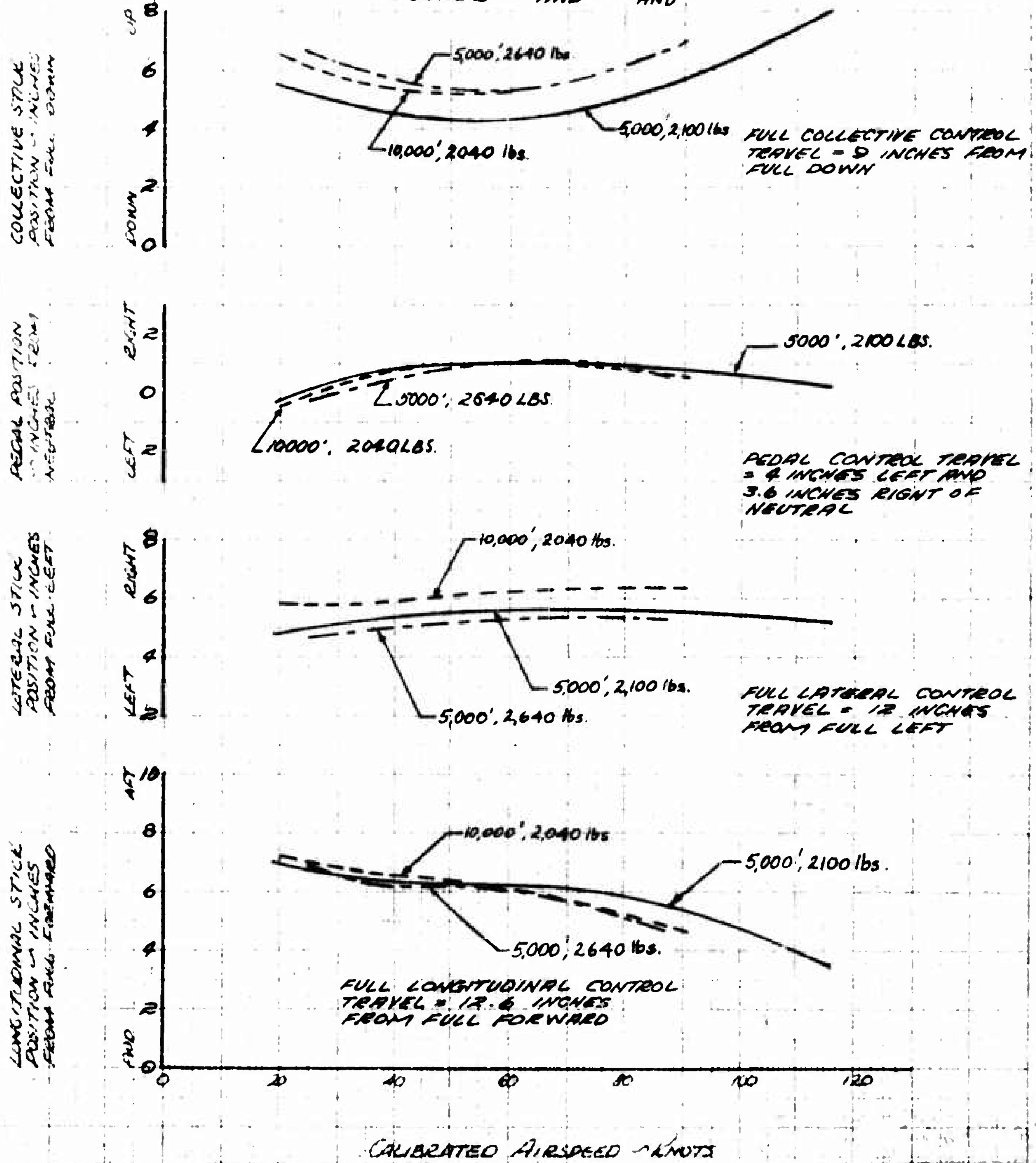

FIGURE NO. 8
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A USA S/N 62-4214

SYM	AVG Hp ~ FT	AVG GW ~ LB	AVG C.G ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	5000	2640	103.5 AFT	.4 RT	465	CLEAN	LEVEL FLIGHT
△	5000	2570	103.5 AFT	.4 RT	465	CLEAN	CLIMB
□	5000	2600	103.5 AFT	.4 RT	465	CLEAN	AUTOROTATION

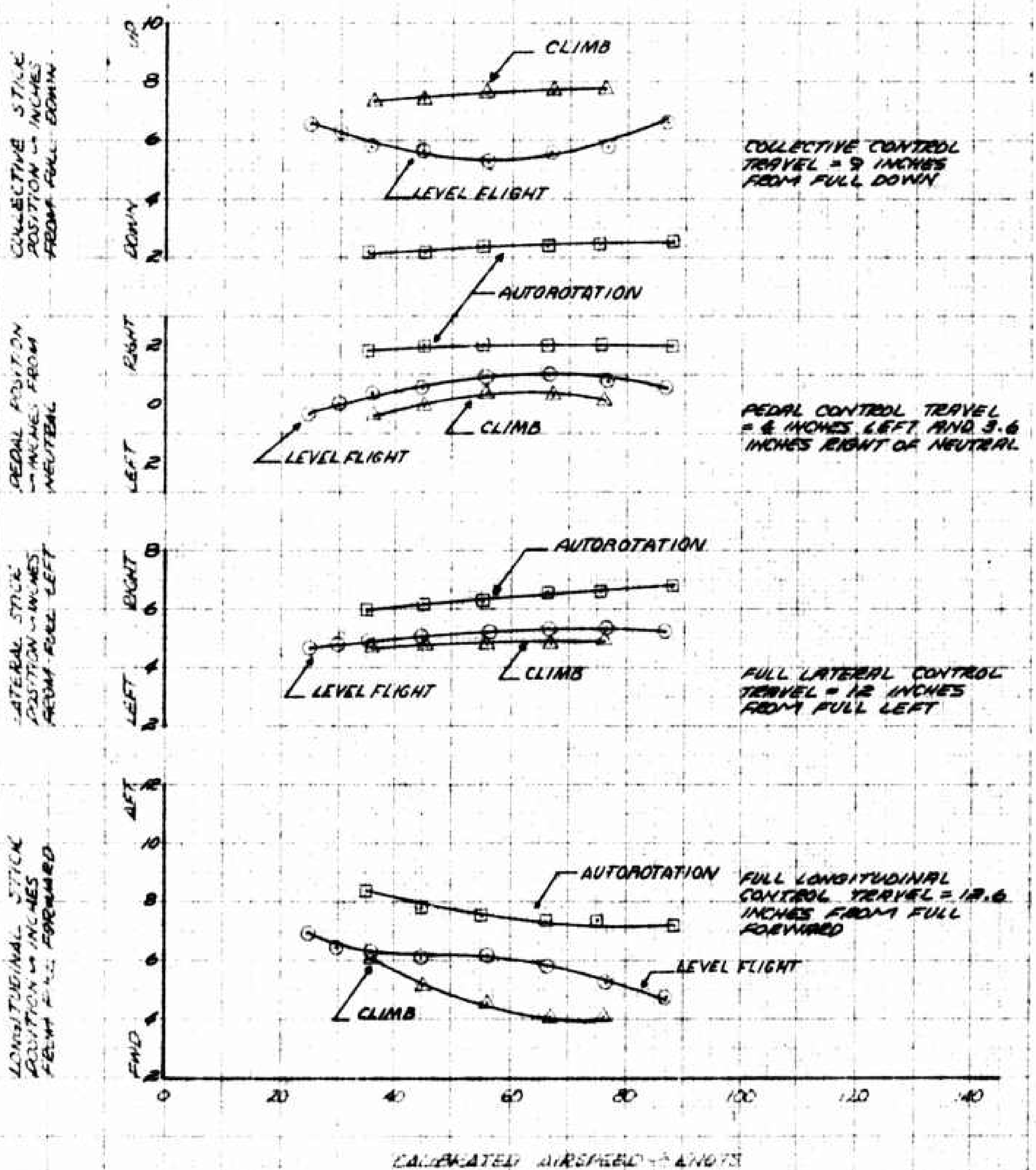

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FIGURE No 9

CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_D ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	10000	2040	103.5 AFT	.5 RT	465	CLEAN	LEVEL FLIGHT
△	10000	2100	103.5 AFT	.5 RT	465	CLEAN	CLIMB
□	10000	2130	103.5 AFT	.5 RT	465	CLEAN	AUTOROTATION

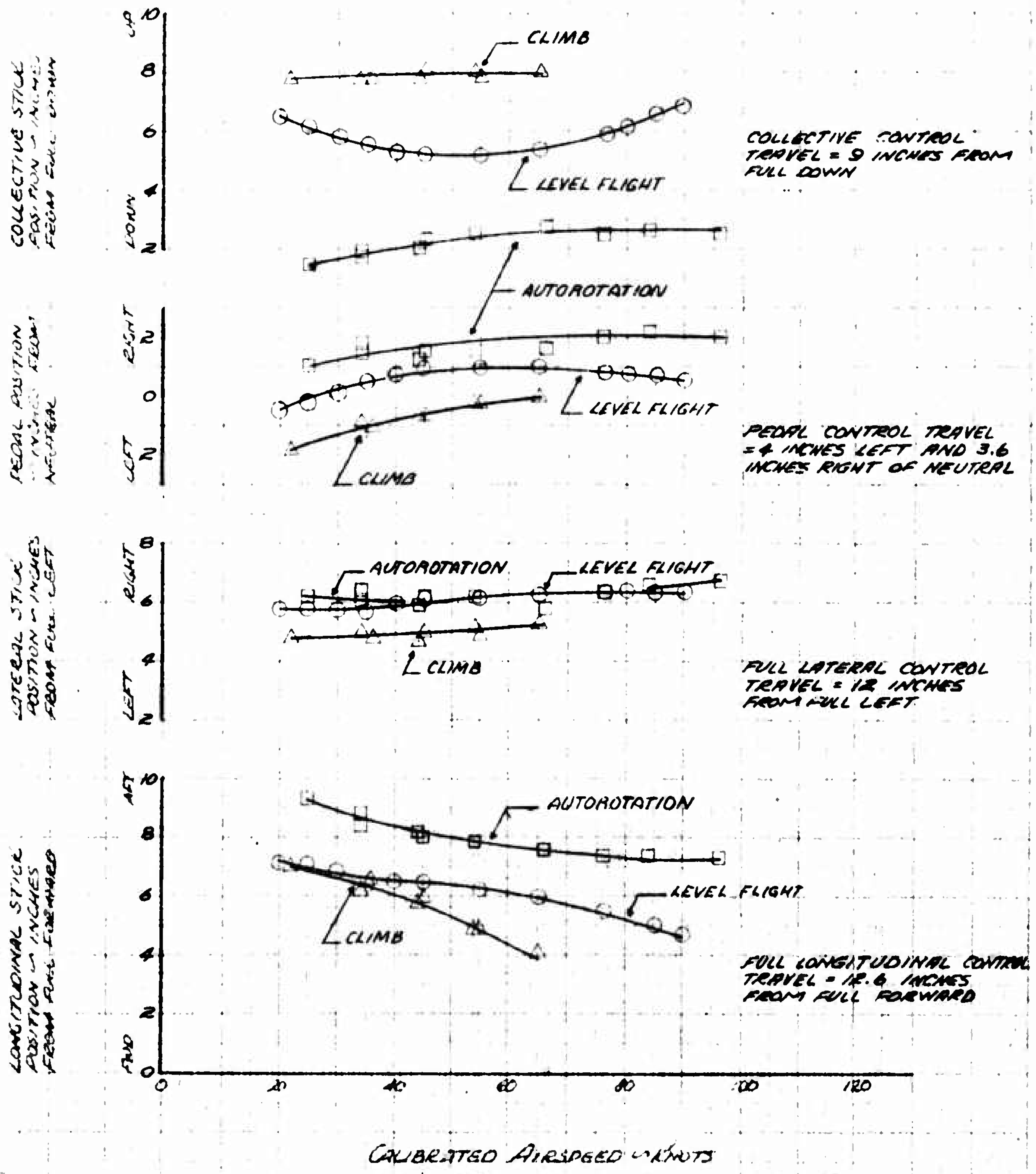

FIGURE NO 10

CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_p ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
————	5000	2100	103.5 AFT	.5 RT	465	CLEAN	LEVEL FLIGHT
—·—·—	5000	2090	103.5 AFT	.5 RT	465	XM-7	LEVEL FLIGHT
— — —	5000	2120	103.3 AFT	2.8 LT	465	XM-8	LEVEL FLIGHT

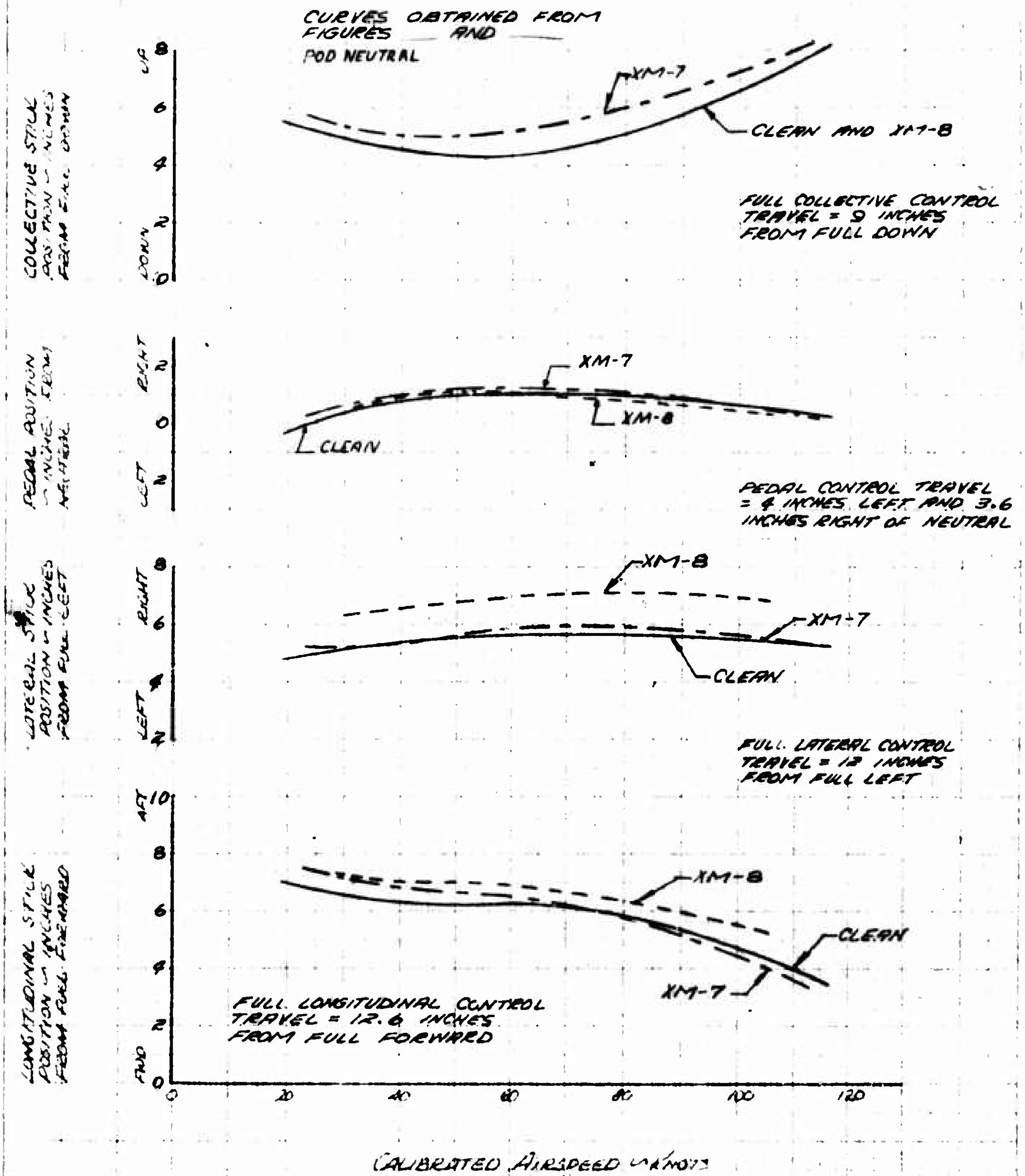

FIGURE No 11

CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A USA S/N 62-4214

SYM	AVG H_D ~ FT	AVG G W ~ LB	AVG C G ~ IN LONG	AVG C G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
NOTED	5000	2090	102 AFT	.5RT	465	XM-7	LEVEL FLIGHT

○ ~ POD ELEVATION = 0 DEGREES (NEUTRAL)
△ ~ POD ELEVATION = +10 DEGREES (FULL UP)
□ ~ POD ELEVATION = -20 DEGREES (FULL DOWN)

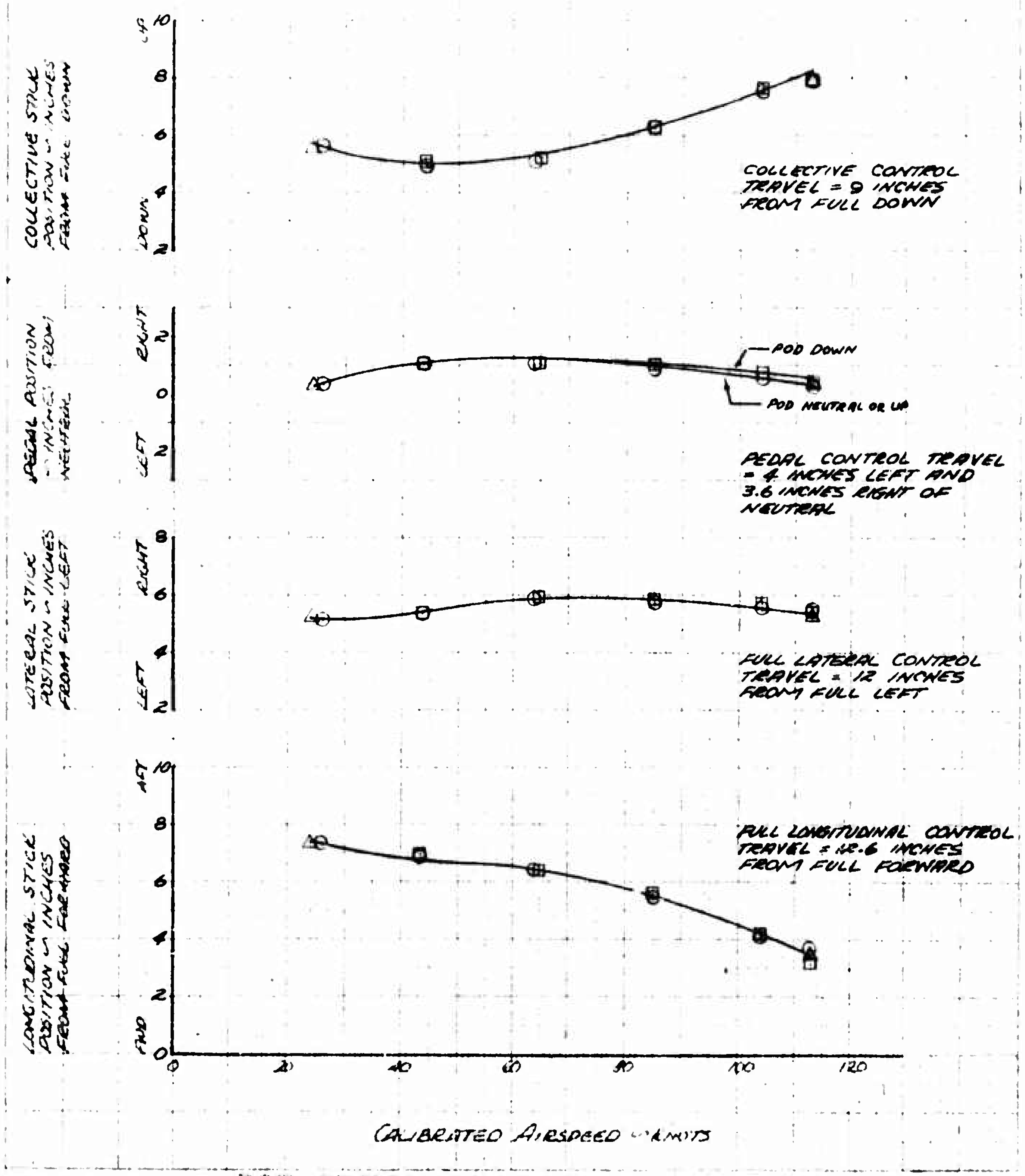

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FIGURE No 12
CONTROL POSITIONS IN FORWARD FLIGHT
OH-6A USA S/N 62-4214

SYM	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
NOTED	5000	2120	103.5 AFT	2.89 LT	465	XM-8	LEVEL FLIGHT

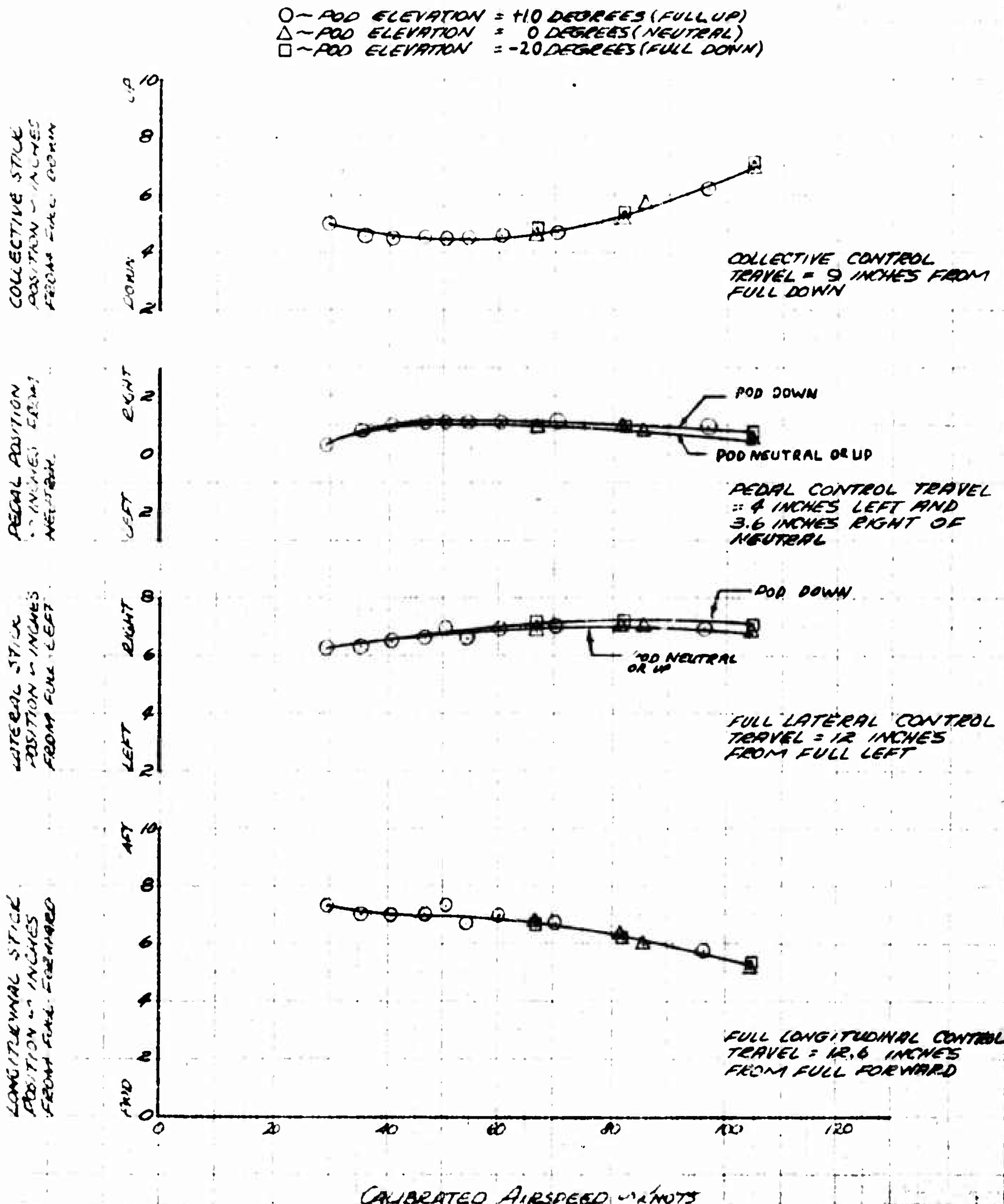
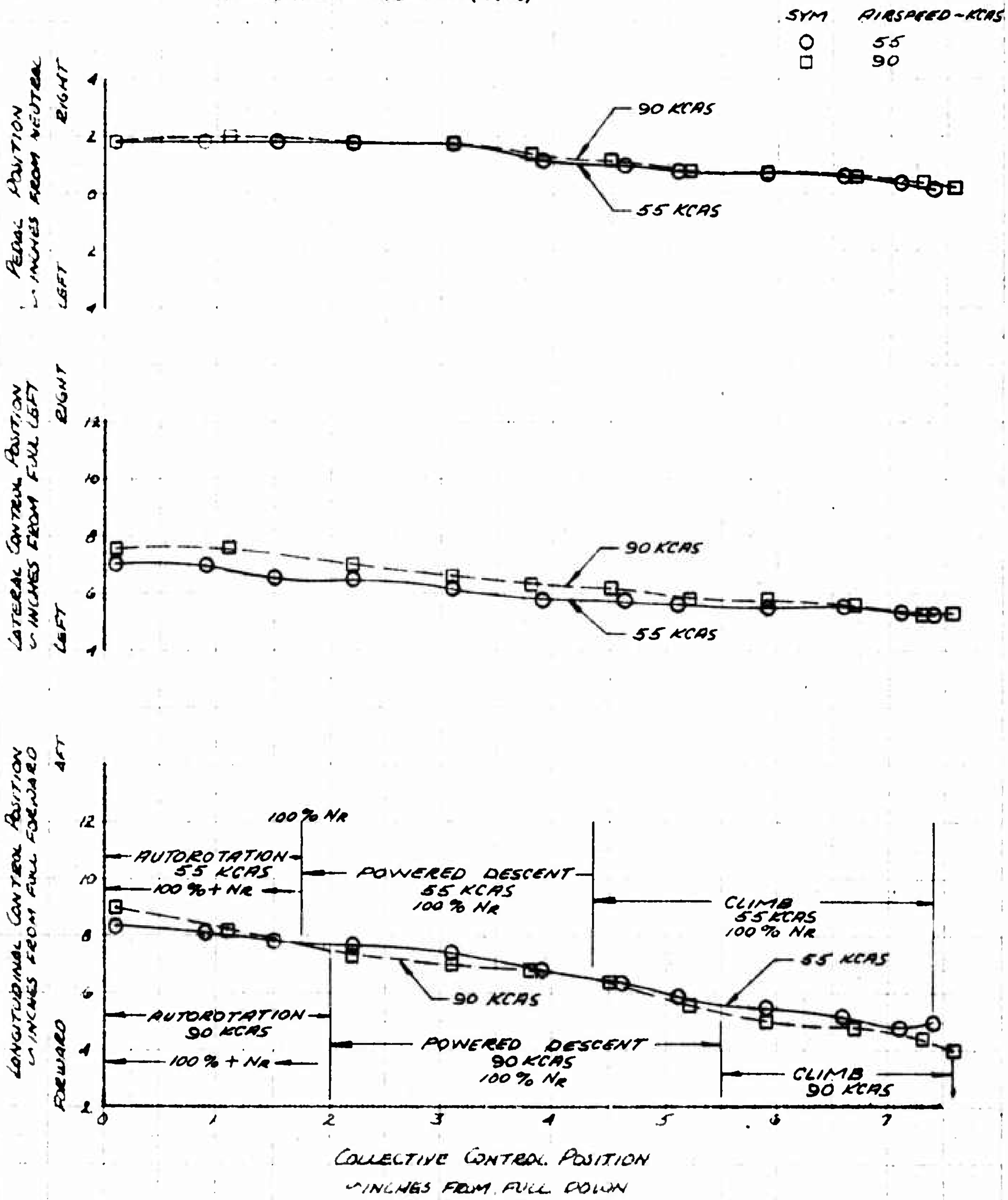


FIGURE NO 13
TRIM CHANGE WITH VARIATION IN
COLLECTIVE PITCH CONTROL POSITION
OH-6A USA S/N 62-4214

GROSS WEIGHT 2100 LB
LONGITUDINAL CG 104.0 IN (AFT)
ROTOR SPEED 468 RPM (100%)

DENSITY ALT 5000 FT
CONFIGURATION CLEAN



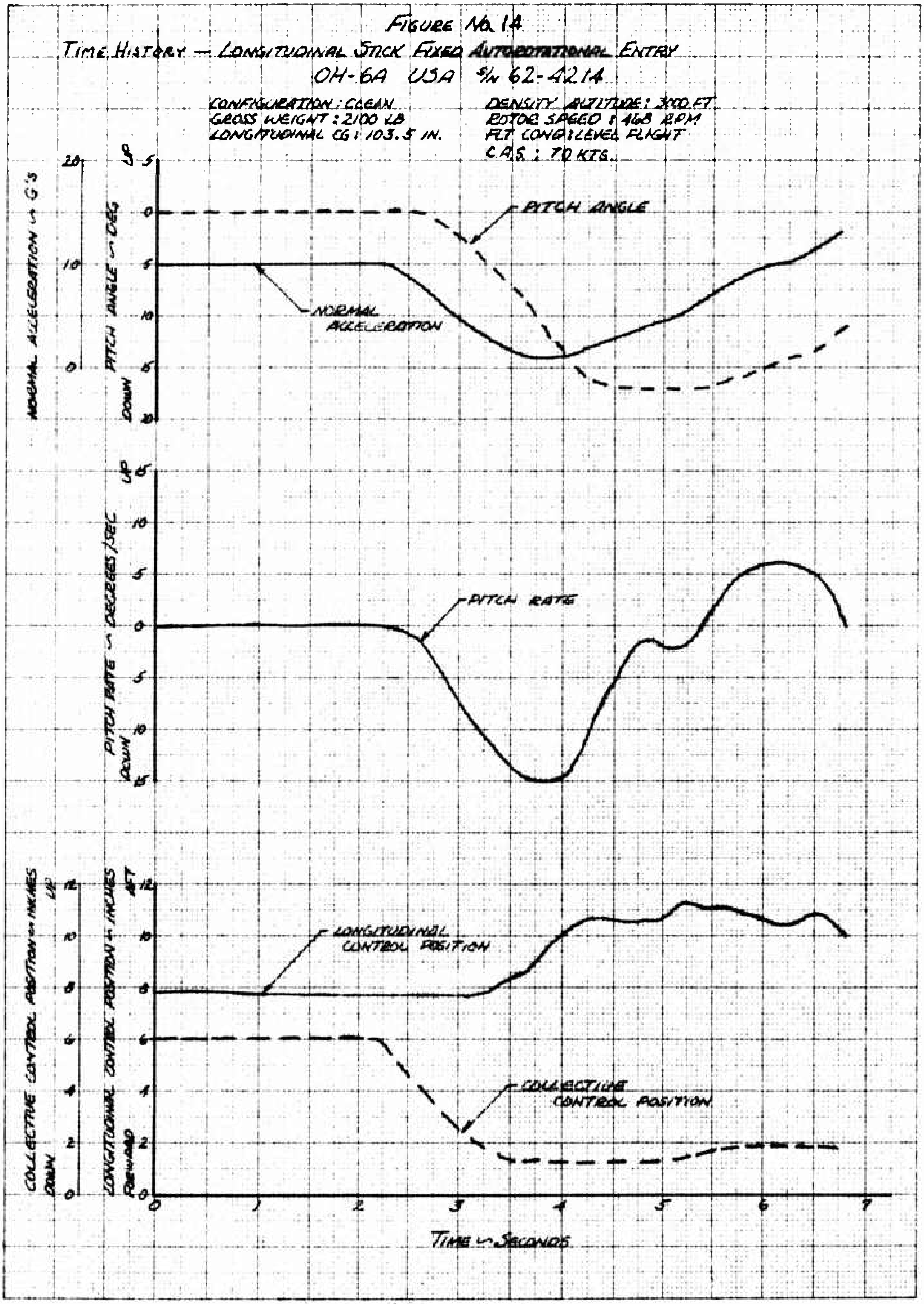


FIGURE No. 1A
TIME HISTORY — LONGITUDINAL STICK FIXED AUTOROTATIONAL ENTRY
OH-6A USA S/N 62-4214
CONFIGURATION: CLEAN
GROSS WEIGHT: 2100 LB
LONGITUDINAL CG: 103.5 IN.
DENSITY ALTITUDE: 3000 FT
ROTOR SPEED: 468 RPM
FLT COND: LEVEL FLIGHT
C.A.S.: 70 KTS.
NORMAL ACCELERATION ~ G'S
PITCH ANGLE ~ DEG
UP
DOWN
PITCH ANGLE
NORMAL ACCELERATION
PITCH RATE ~ DEGREES/SEC
PITCH RATE
COLLECTIVE CONTROL POSITION ~ INCHES
LONGITUDINAL CONTROL POSITION ~ INCHES
AFT
FORWARD
LONGITUDINAL CONTROL POSITION
COLLECTIVE CONTROL POSITION
TIME ~ SECONDS

FIGURE NO. 15

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY SUMMARY

OH-6A USA S/N 62-4214

SYM	AVG Hp ~FEET	AVG GW ~LBS	AVE CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLIGHT COND
○	5000	2140	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLIGHT
△	5000	2100	103.5 (AFT)	.5 RT	465	CLEAN	CLIMB
□	5000	2120	103.5 (AFT)	.5 RT	465	CLEAN	AUTOROTATION
◺	5000	2130	97. (FWD)	.5 RT	465	CLEAN	LEVEL FLIGHT
◇	5000	2120	97. (FWD)	.5 RT	465	CLEAN	CLIMB
⬡	5000	2120	97. (FWD)	.5 RT	465	CLEAN	AUTOROTATION
☆	5000	2660	103.5 (AFT)	.4 RT	465	CLEAN	LEVEL FLIGHT
✡	5000	2570	103.5 (AFT)	.4 RT	465	CLEAN	CLIMB
⏢	5000	2600	103.5 (AFT)	.4 RT	465	CLEAN	AUTOROTATION

NOTE: THE SLOPE FOR LONGITUDINAL CONTROL GRADIENT WAS TAKEN AT THE SPEED STABILITY TRIM POINT

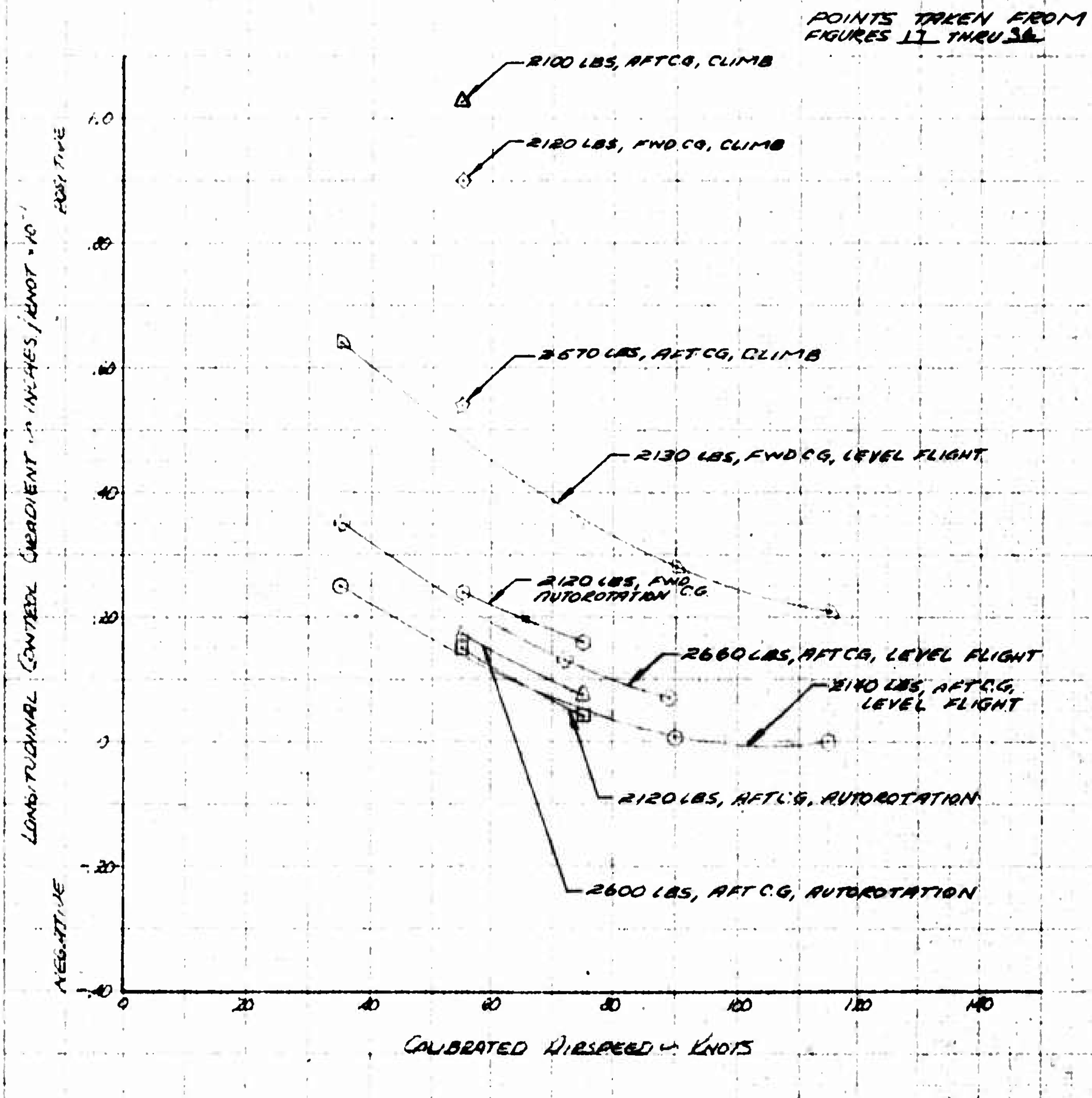


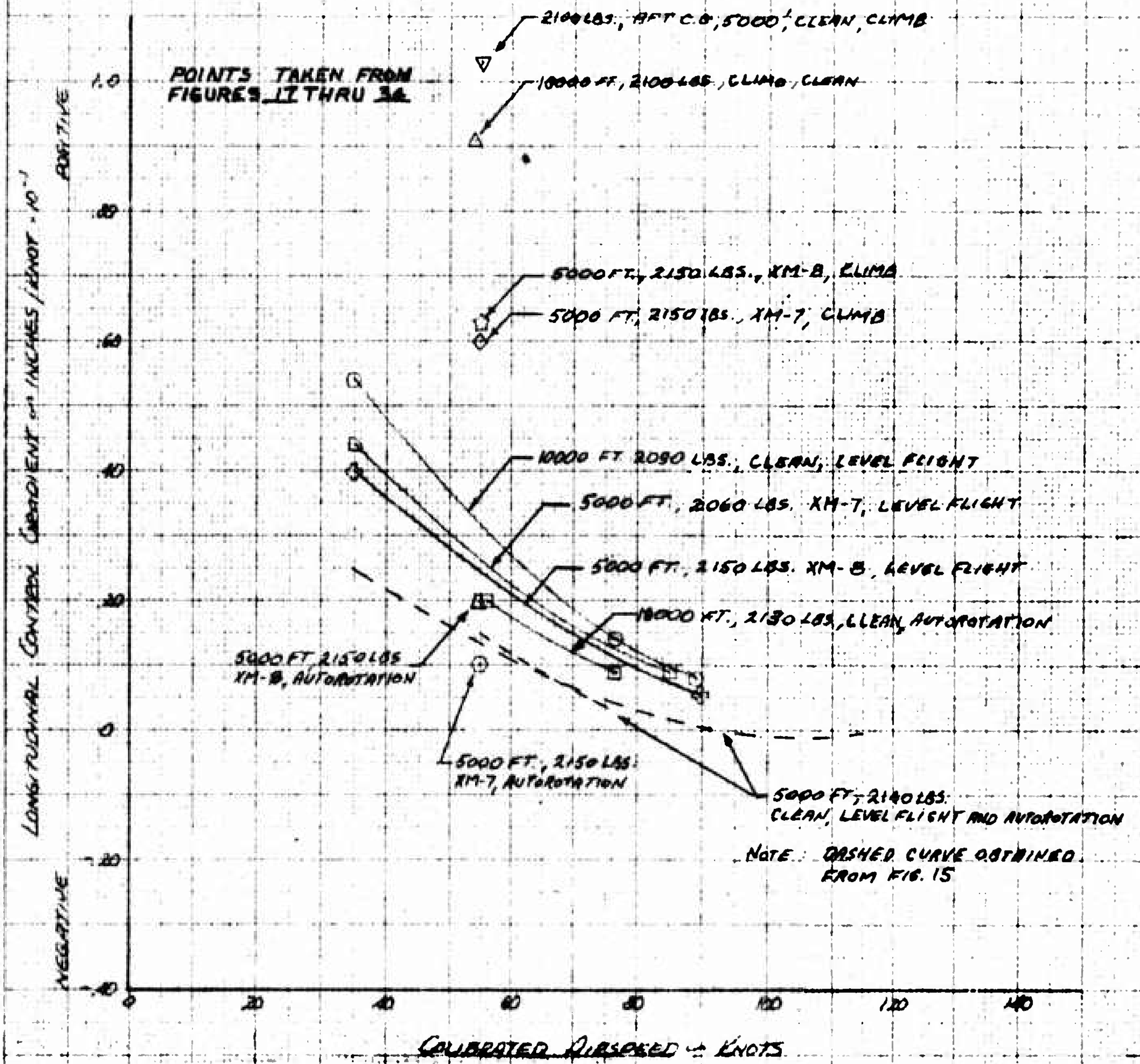
FIGURE NO. 16

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY SUMMARY

OH-6A USA S/N 62-4214

SYM	AVG Hp ~FEET	AVG G.W ~LBS	AVG C.G. - IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLIGHT COND
○	10000	2090	103.5 (AFT)	.5RT.	465	CLEAN	LEVEL FLIGHT
△	10000	2100	103.5 (AFT)	.5RT.	465	CLEAN	CLIMB
□	10000	2130	103.5 (AFT)	.5RT	465	CLEAN	AUTOROTATION
□	5000	2060	103.3 (AFT)	.7LT.	465	XM-7	LEVEL FLIGHT
◇	5000	2150	103.3 (AFT)	.7LT.	465	XM-7	CLIMB
○	5000	2150	103.3 (AFT)	.7LT.	465	XM-7	AUTOROTATION
○	5000	2150	101.5 (AFT)	2.8 LT.	465	XM-8	LEVEL FLIGHT
◇	5000	2150	101.5 (AFT)	2.8 LT.	465	XM-8	CLIMB
△	5000	2150	101.5 (AFT)	2.8 LT.	465	XM-8	AUTOROTATION

NOTE: THE SLOPE FOR LONGITUDINAL CONTROL GRADIENT WAS TAKEN AT THE SPEED STABILITY TRIM POINT



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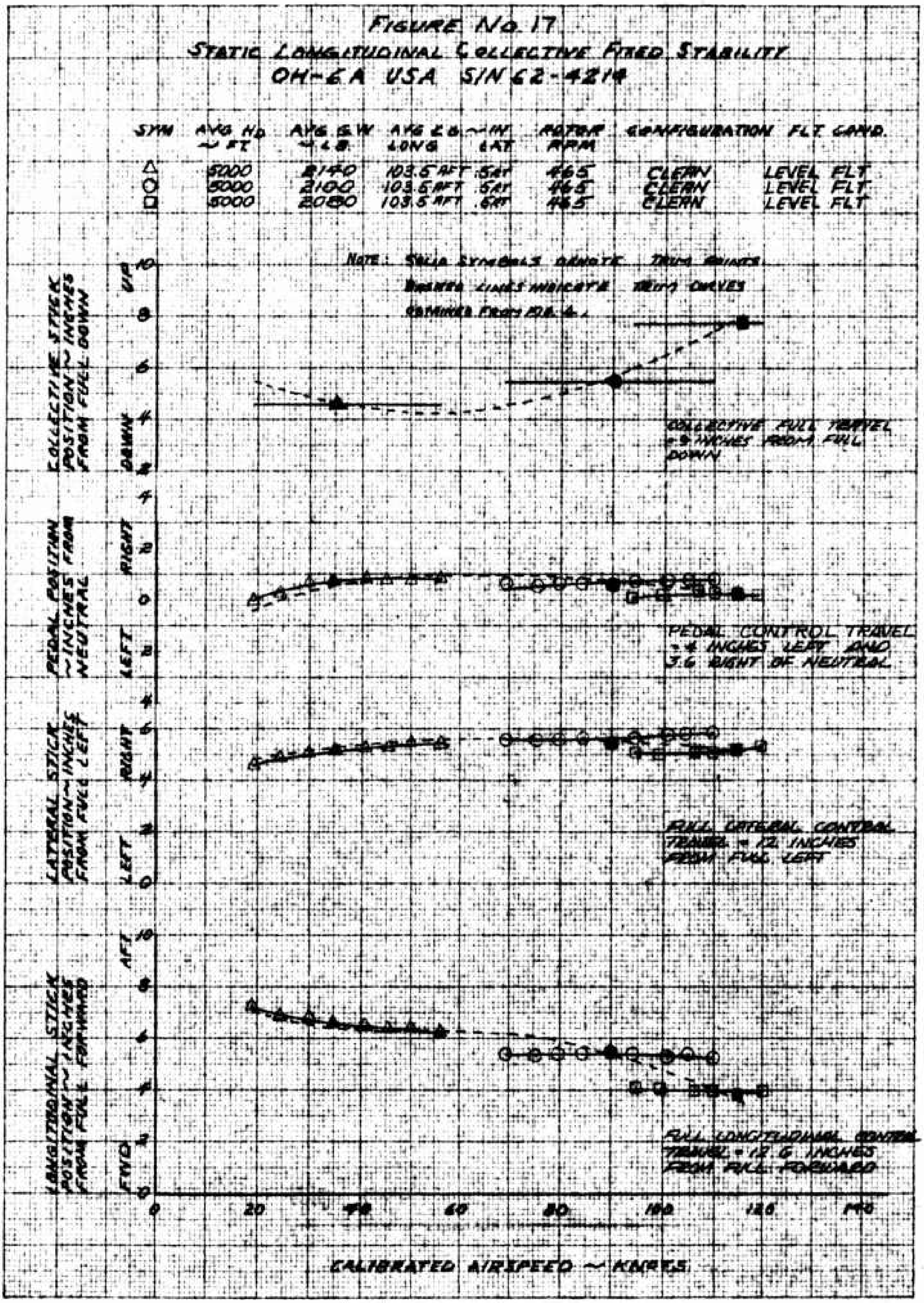
FIGURE No. 17
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214
SYM AVG Hp ~ FT AVG G.W ~ LB. AVG C.G. ~ IN LONG LAT ROTOR RPM CONFIGURATION FLT COND.
5000 2140 103.5 AFT .5 AT 465 CLEAN LEVEL FLT
5000 2100 103.5 AFT .5 AT 465 CLEAN LEVEL FLT
5000 2080 103.5 AFT .6 AT 465 CLEAN LEVEL FLT
COLLECTIVE STICK POSITION ~ INCHES FROM FULL DOWN
PEDAL POSITION ~ INCHES FROM NEUTRAL
LATERAL STICK POSITION ~ INCHES FROM FULL LEFT
LONGITUDINAL STICK POSITION ~ INCHES FROM FULL FORWARD
PEDAL CONTROL TRAVEL = 4 INCHES LEFT AND 3.6 RIGHT OF NEUTRAL
CALIBRATED AIRSPEED ~ KNOTS

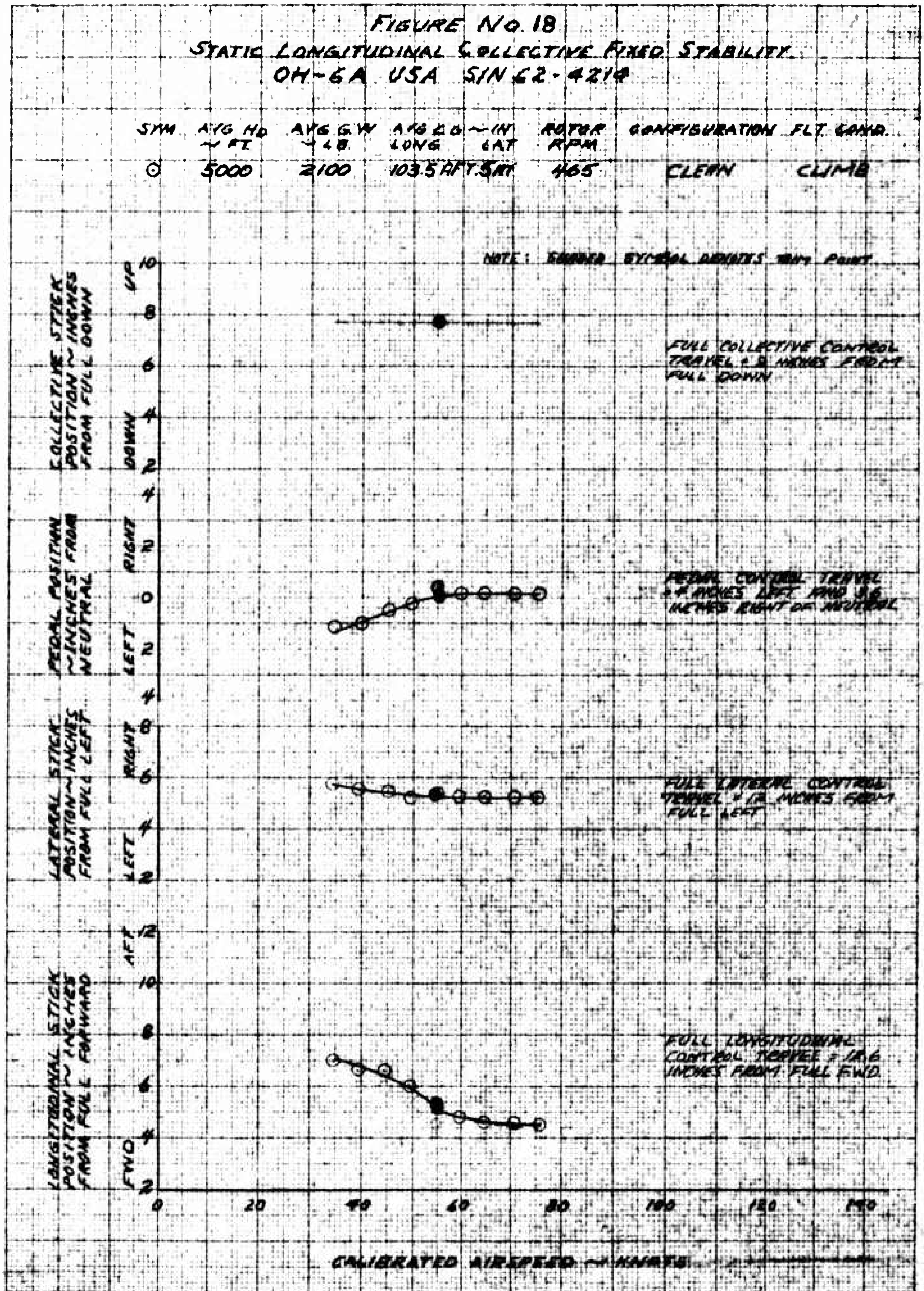
FIGURE NO. 18
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214
SYM AVG HD ~FT AVG G.W ~LB AVG C.G ~IN LONG LAT ROTOR RPM CONFIGURATION FLT COND.
5000 2100 103.5 AFT .5 RT 465 CLEAN CLIMB
NOTE: SHADED SYMBOL DENOTES TRIM POINT
COLLECTIVE STICK POSITION ~ INCHES FROM FULL DOWN
UP
DOWN
FULL COLLECTIVE CONTROL TRAVEL = 10 INCHES FROM FULL DOWN
PEDAL POSITION ~ INCHES FROM NEUTRAL
RIGHT
LEFT
PEDAL CONTROL TRAVEL = 4 INCHES LEFT AND 3.6 INCHES RIGHT OF NEUTRAL
LATERAL STICK POSITION ~ INCHES FROM FULL LEFT
RIGHT
LEFT
FULL LATERAL CONTROL TRAVEL = 12 INCHES FROM FULL LEFT
LONGITUDINAL STICK POSITION ~ INCHES FROM FULL FORWARD
AFT
FWD
FULL LONGITUDINAL CONTROL TRAVEL = 12.6 INCHES FROM FULL FWD.
0 20 40 60 80 100 120 140
CALIBRATED AIRSPEED ~ KNOTS

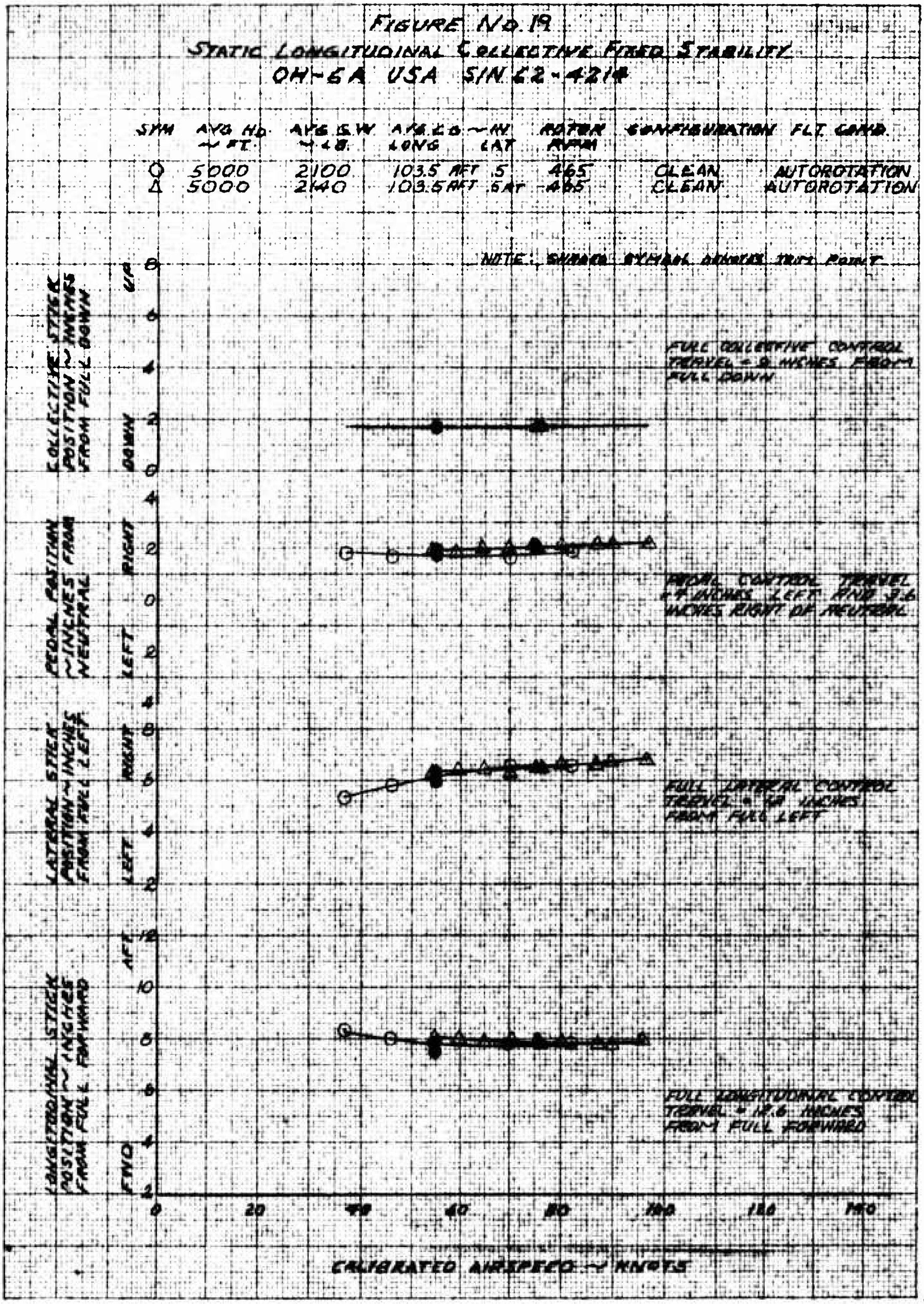
FIGURE NO. 19
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214
SYM | AVG Hd ~ FT. | AVG G.W. ~ LB. | AVG C.G. ~ IN. LONG | LAT | ROTOR RPM | CONFIGURATION | FLT COND
○ 5000 2100 103.5 AFT .5 465 CLEAN AUTOROTATION
Δ 5000 2140 103.5 AFT .5 AT 465 CLEAN AUTOROTATION
NOTE: SHADED SYMBOL DENOTES TRIM POINT
COLLECTIVE STICK POSITION ~ INCHES FROM FULL DOWN
UP
DOWN
FULL COLLECTIVE CONTROL TRAVEL = 9 INCHES FROM FULL DOWN
PEDAL POSITION ~ INCHES FROM NEUTRAL
RIGHT
LEFT
PEDAL CONTROL TRAVEL 4.4 INCHES LEFT AND 3.6 INCHES RIGHT OF NEUTRAL
LATERAL STICK POSITION ~ INCHES FROM FULL LEFT
RIGHT
LEFT
FULL LATERAL CONTROL TRAVEL = 10 INCHES FROM FULL LEFT
LONGITUDINAL STICK POSITION ~ INCHES FROM FULL FORWARD
AFT
FWD
FULL LONGITUDINAL CONTROL TRAVEL = 12.6 INCHES FROM FULL FORWARD
0 20 40 60 80 100 120 140
CALIBRATED AIRSPEED ~ KNOTS

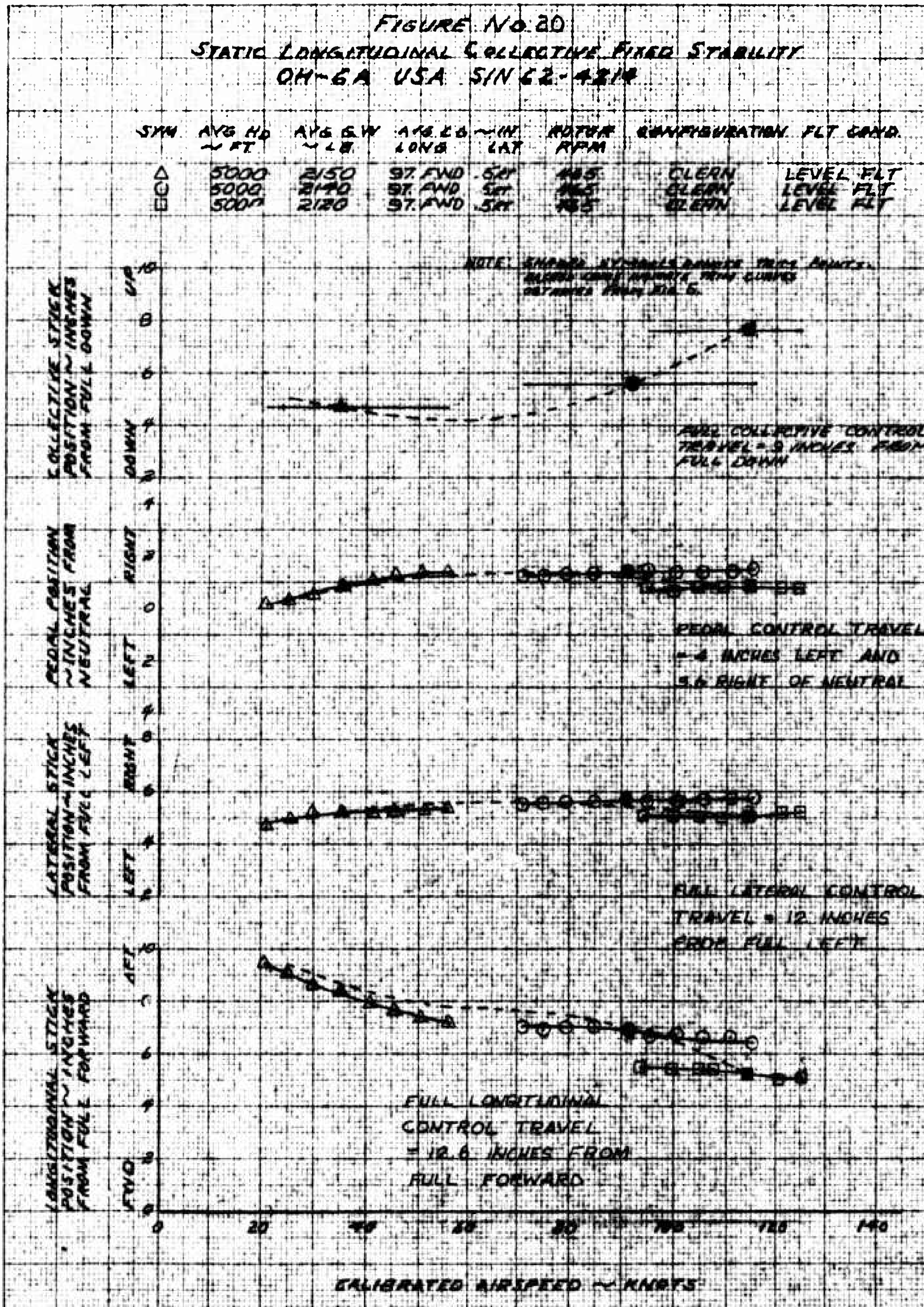

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FIGURE No. 21
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214

SYM	AVG H_D ~ FT	AVG G.W. ~ LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
O	5000	2120	97. FWD	.5 RT	466	CLEAN	CLIMB

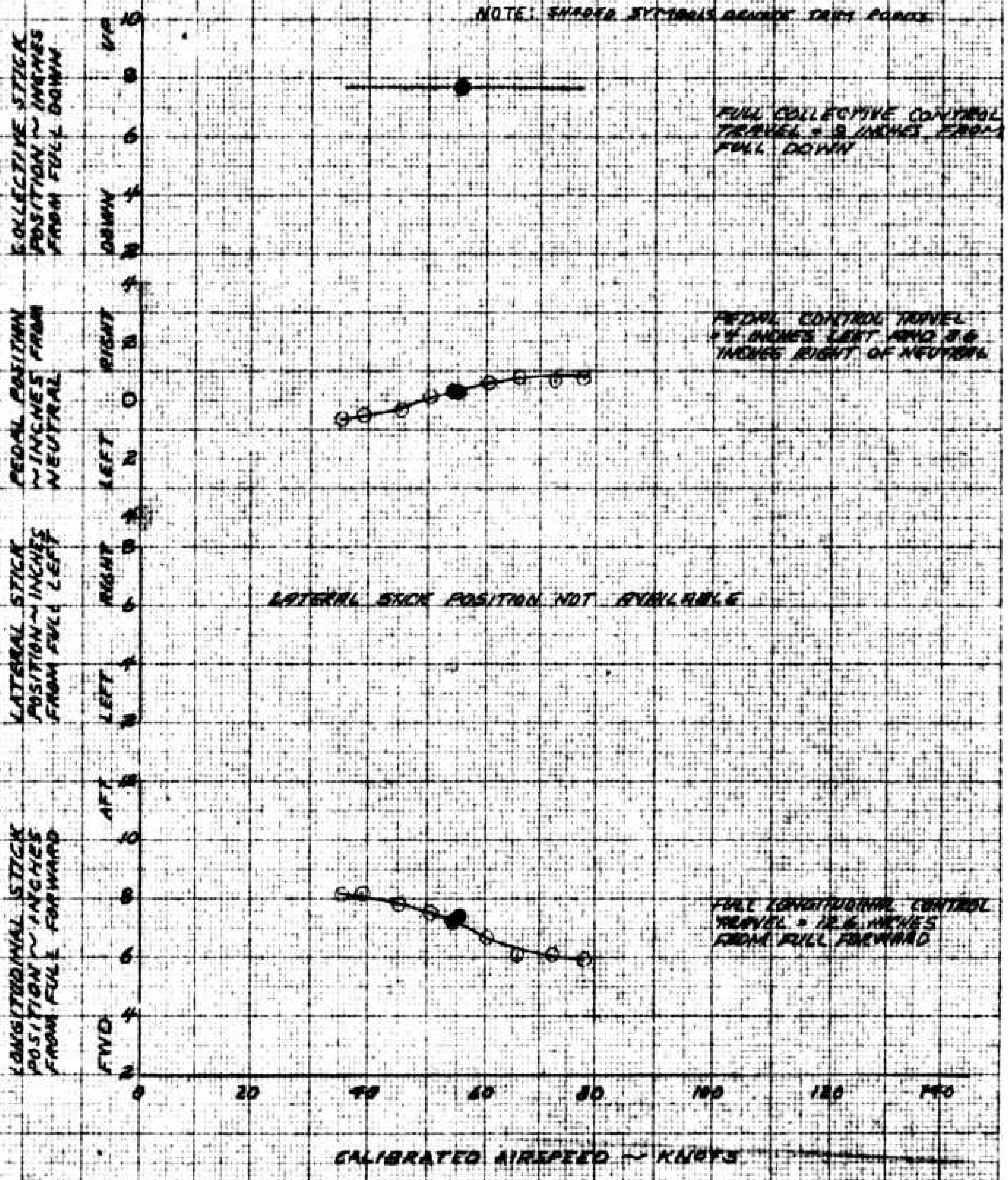

FIGURE NO. 22
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214

SYM	AVG Hp ~ FT	AVG G.W. ~ LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	5000	2110	97. FWD	.5 RT	465	CLEAN	AUTOROTATION
△	5000	2130	97. FWD	.5 RT	465	CLEAN	AUTOROTATION

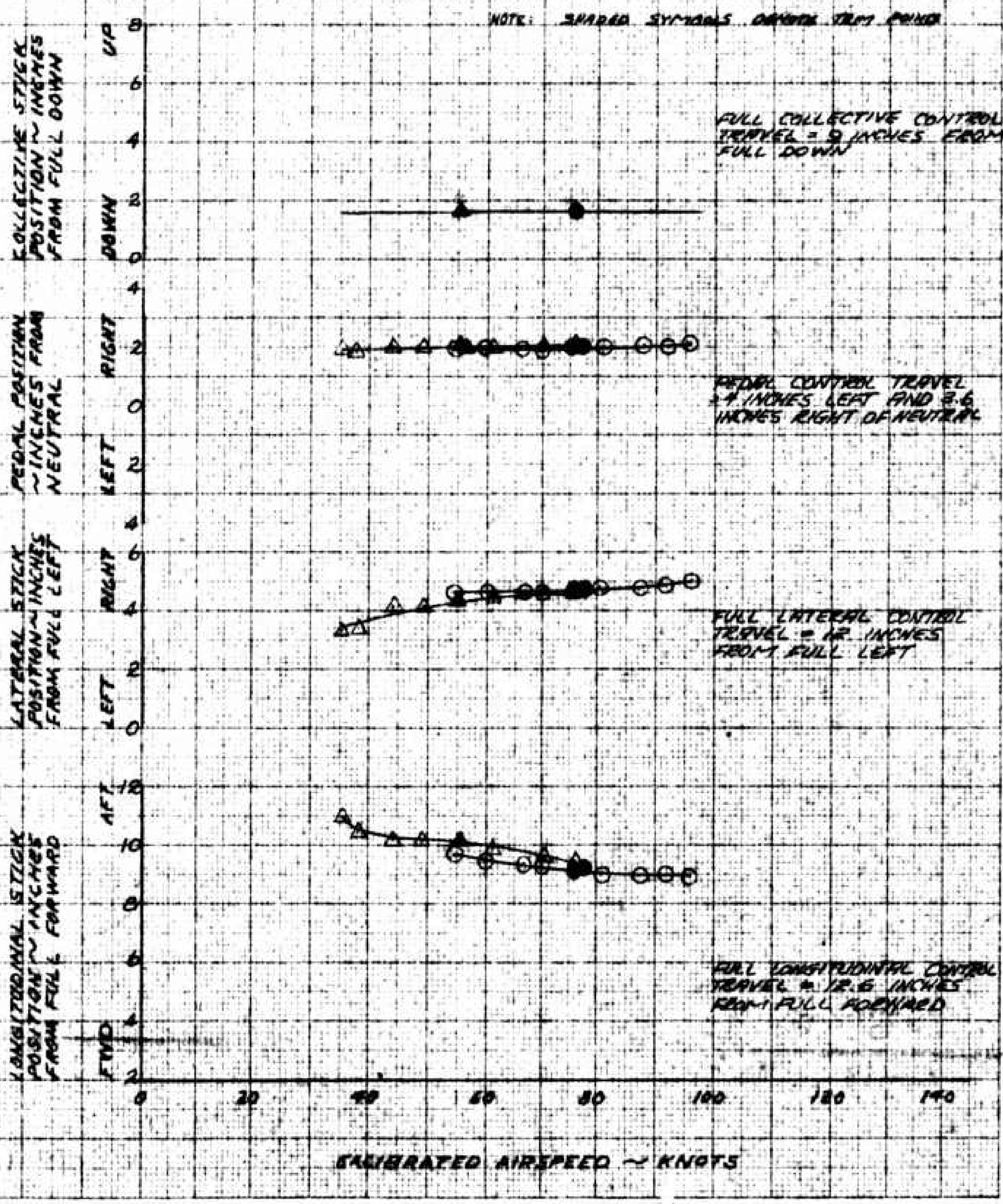

FIGURE No. 23
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214

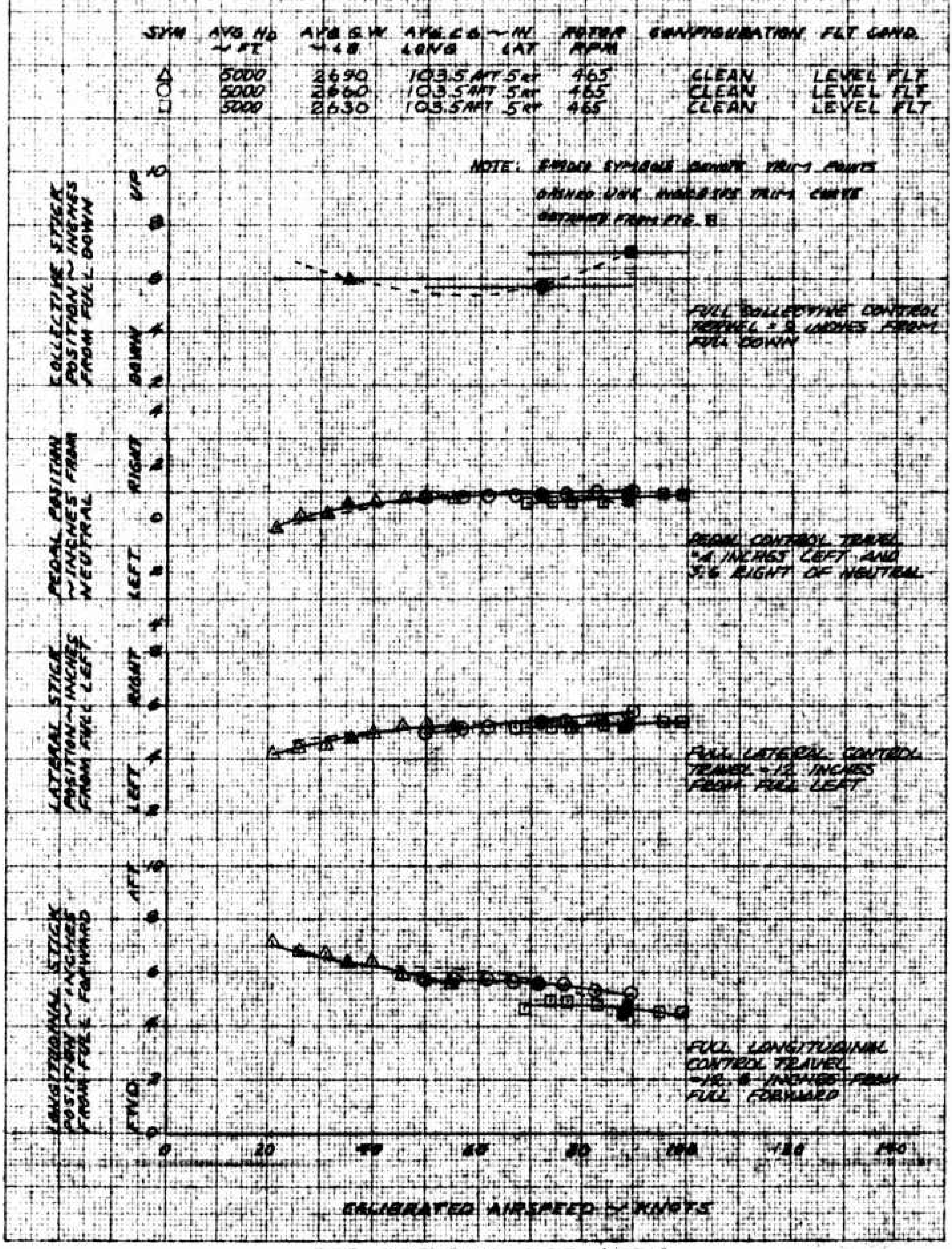

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FIGURE NO. 24

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH-6A USA S/N 62-4214

SYM	AVG. HD ~ FT	AVG. G.W ~ LB.	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	5000	2570	103.5	AFT .5	465	CLEAN	CLIMB

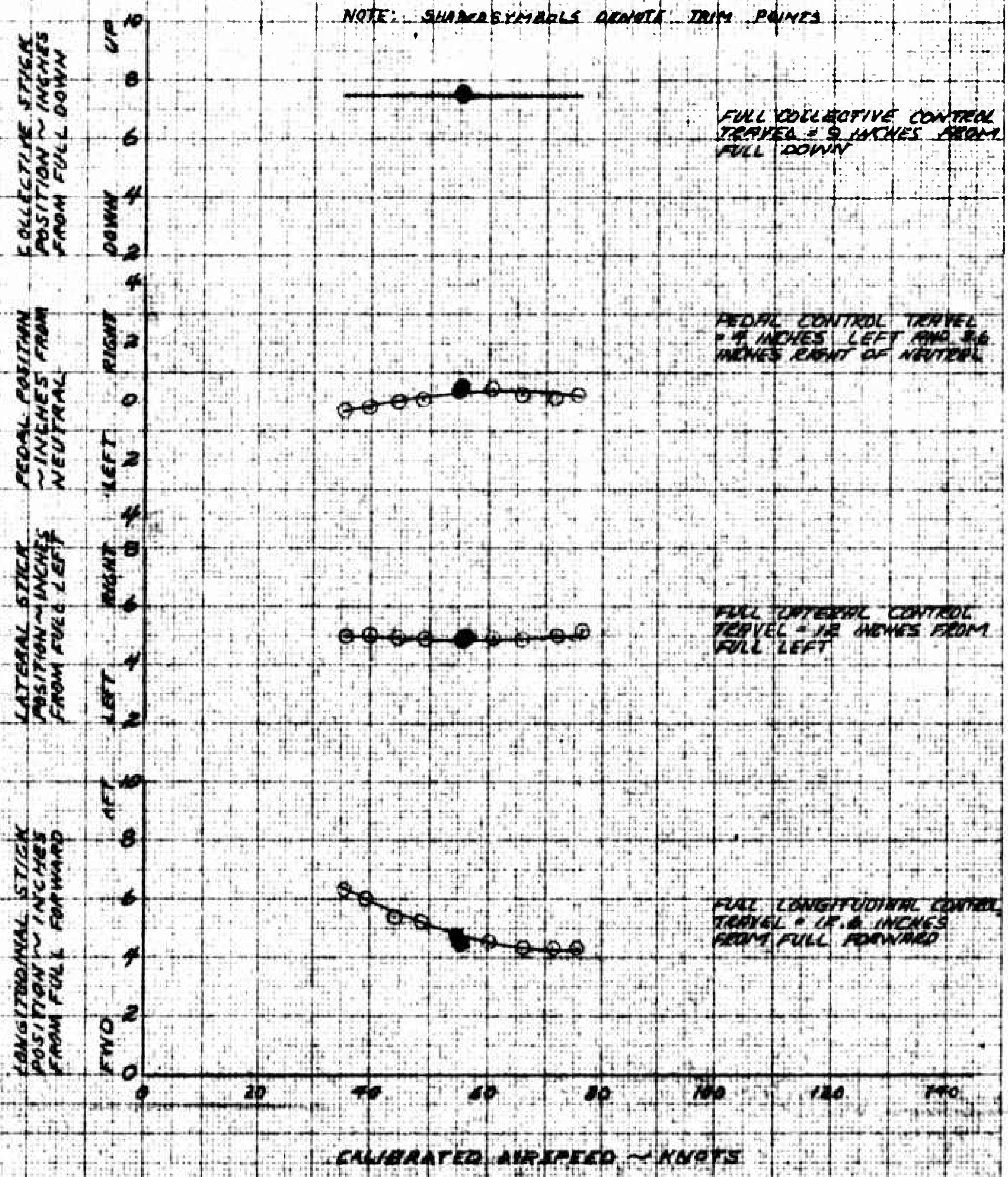

FIGURE NO. 25

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH-6A USA S/N 62-4214

SYM	AVG H_D ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	5000	2600	103.5 AFT	.5 RT	465	CLEAN	AUTOROTATION
△	5000	2600	103.5 AFT	.5 RT	465	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

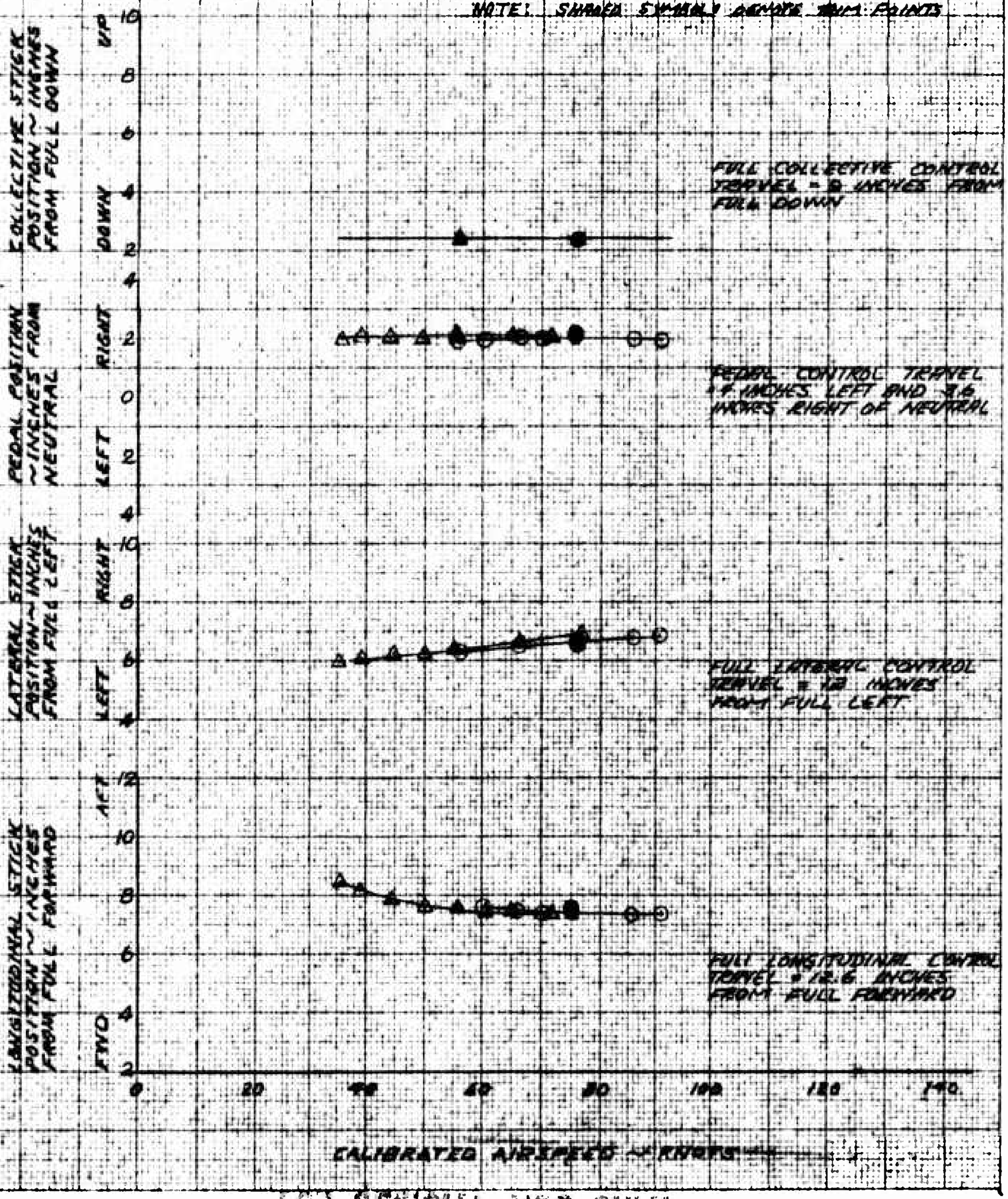

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FIGURE NO. 26

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH-6A USA S/N 62-4214

SYM	AVG. Hp ~ FT.	AVG. G.W. ~ LB.	AVG. C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
△	10000	2110	103.5 AFT	.5RT	465	CLEAN	LEVEL FLT
○	10000	2090	103.5 AFT	.5RT	465	CLEAN	LEVEL FLT
□	10000	2070	103.5 AFT	.6RT	465	CLEAN	LEVEL FLT

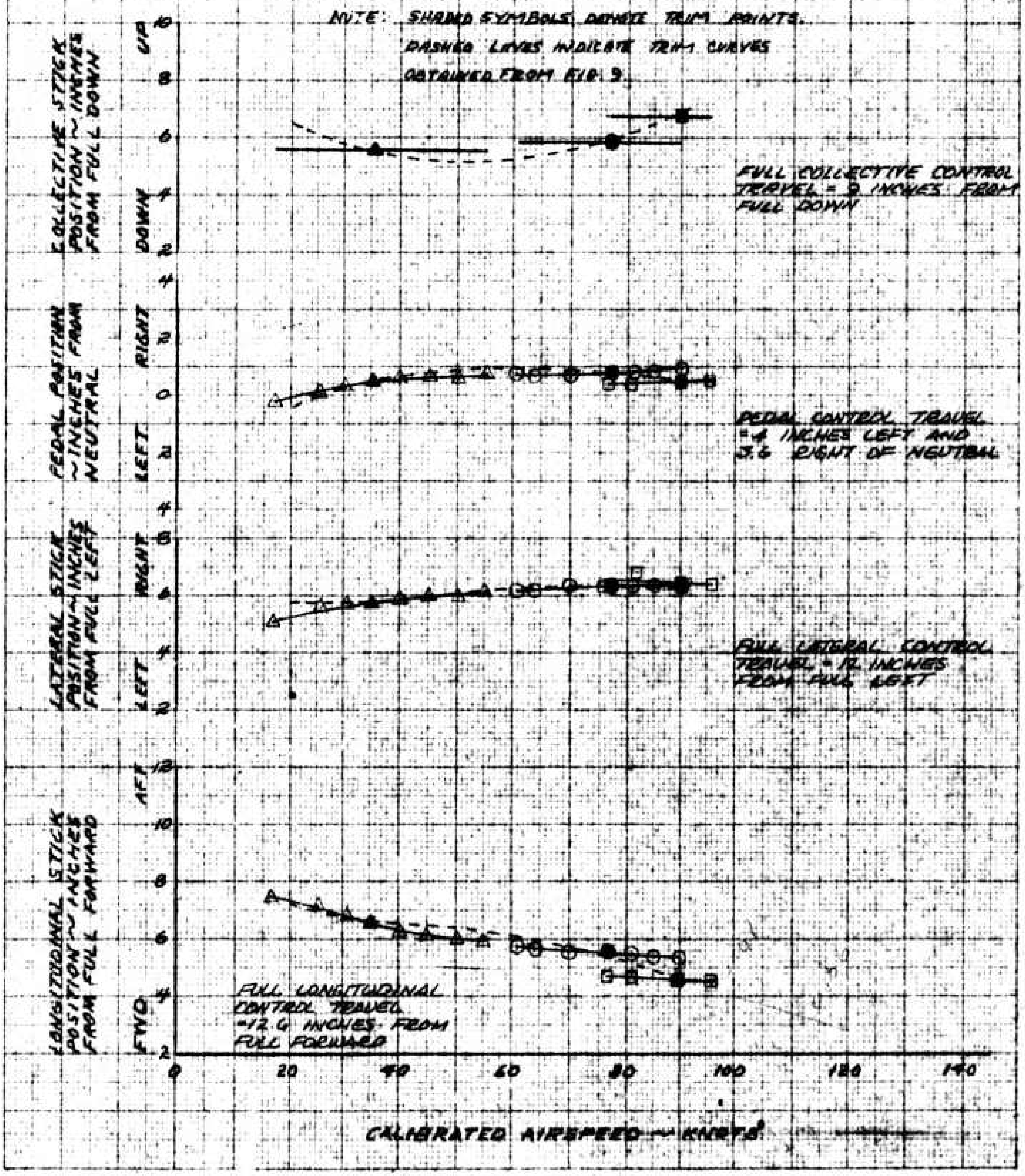

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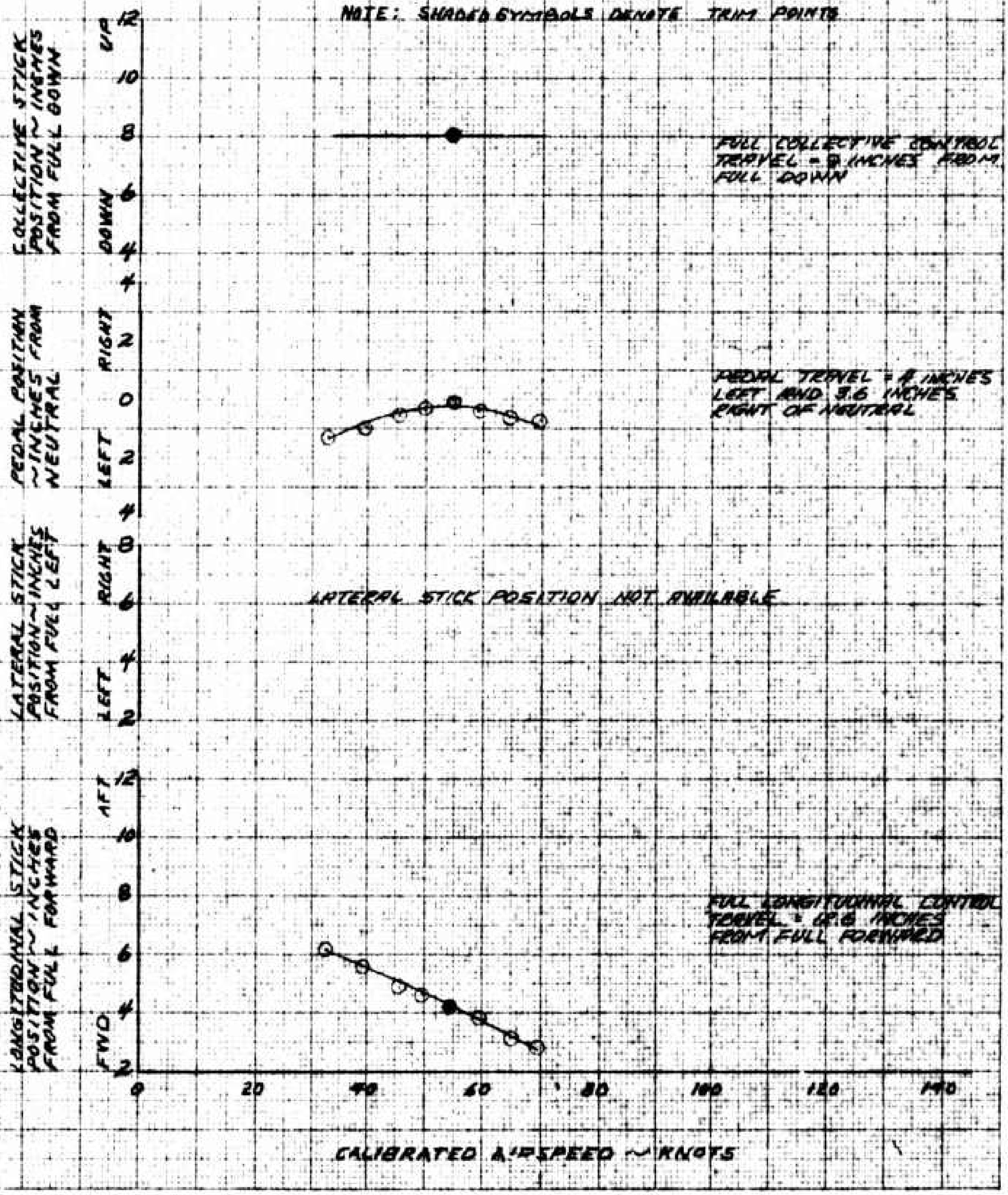
FIGURE NO. 27
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214

SYM	AVG H_D ~ FT	AVG G.W ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	10000	2100	103.5 AFT	.5 RT	465	CLEAN	CLIMB



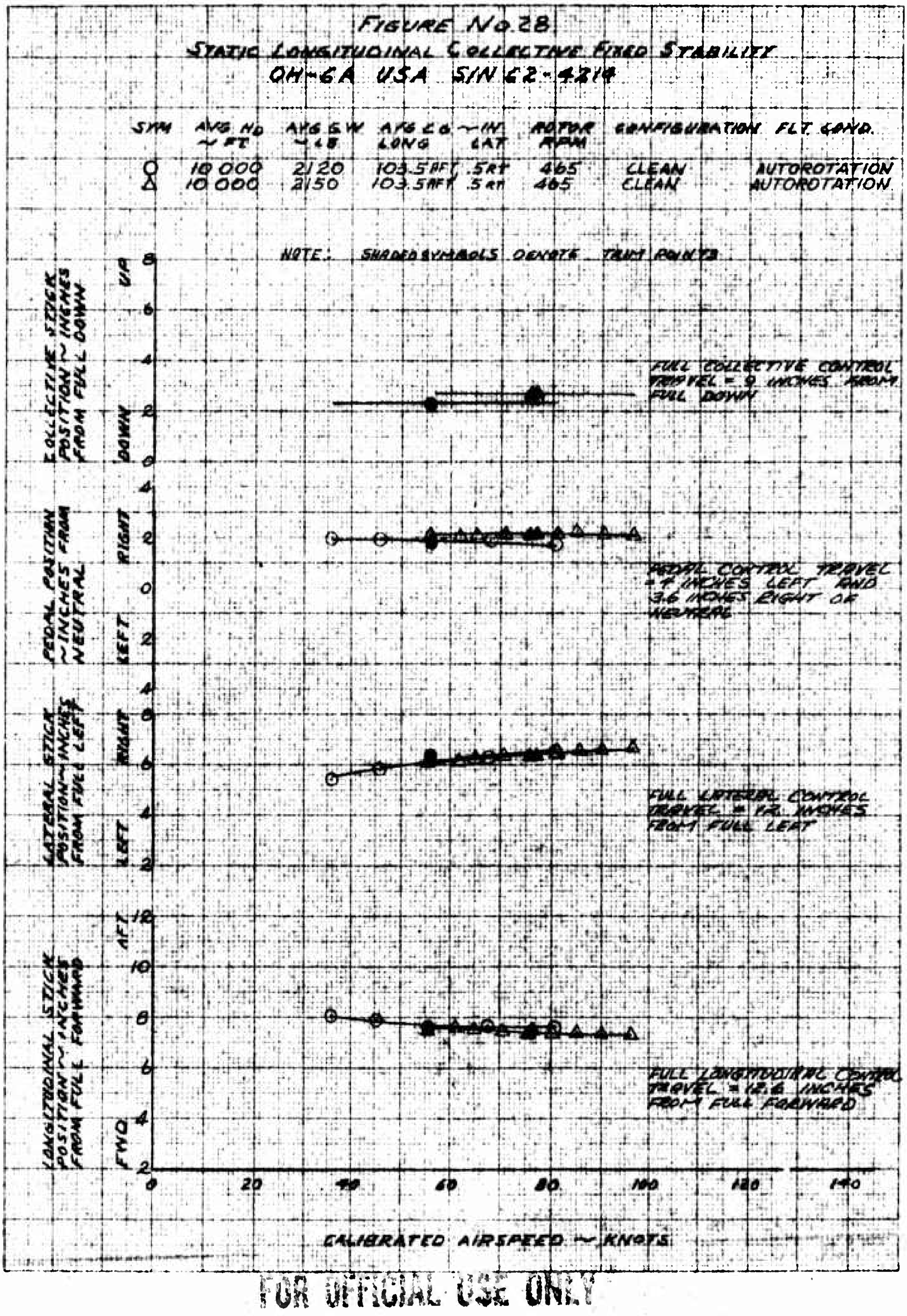


FIGURE No. 28
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214
SYM AVG HD ~ FT AVG GW ~ LB AVG CG ~ IN LONG LAT ROTOR RPM CONFIGURATION FLT COND.
○ 10 000 2120 103.5 AFT .5 RT 465 CLEAN AUTOROTATION
△ 10 000 2150 103.5 AFT .5 RT 465 CLEAN AUTOROTATION
NOTE: SHADED SYMBOLS DENOTE TRIM POINTS
COLLECTIVE STICK POSITION ~ INCHES FROM FULL DOWN
UP
DOWN
FULL COLLECTIVE CONTROL TRAVEL = 9 INCHES FROM FULL DOWN
PEDAL POSITION ~ INCHES FROM NEUTRAL
RIGHT
LEFT
PEDAL CONTROL TRAVEL = 4 INCHES LEFT AND 3.6 INCHES RIGHT OF NEUTRAL
LATERAL STICK POSITION ~ INCHES FROM FULL LEFT
RIGHT
LEFT
FULL LATERAL CONTROL TRAVEL = 12 INCHES FROM FULL LEFT
LONGITUDINAL STICK POSITION ~ INCHES FROM FULL FORWARD
AFT
FWD
FULL LONGITUDINAL CONTROL TRAVEL = 12.6 INCHES FROM FULL FORWARD
0 20 40 60 80 100 120 140
CALIBRATED AIRSPEED ~ KNOTS

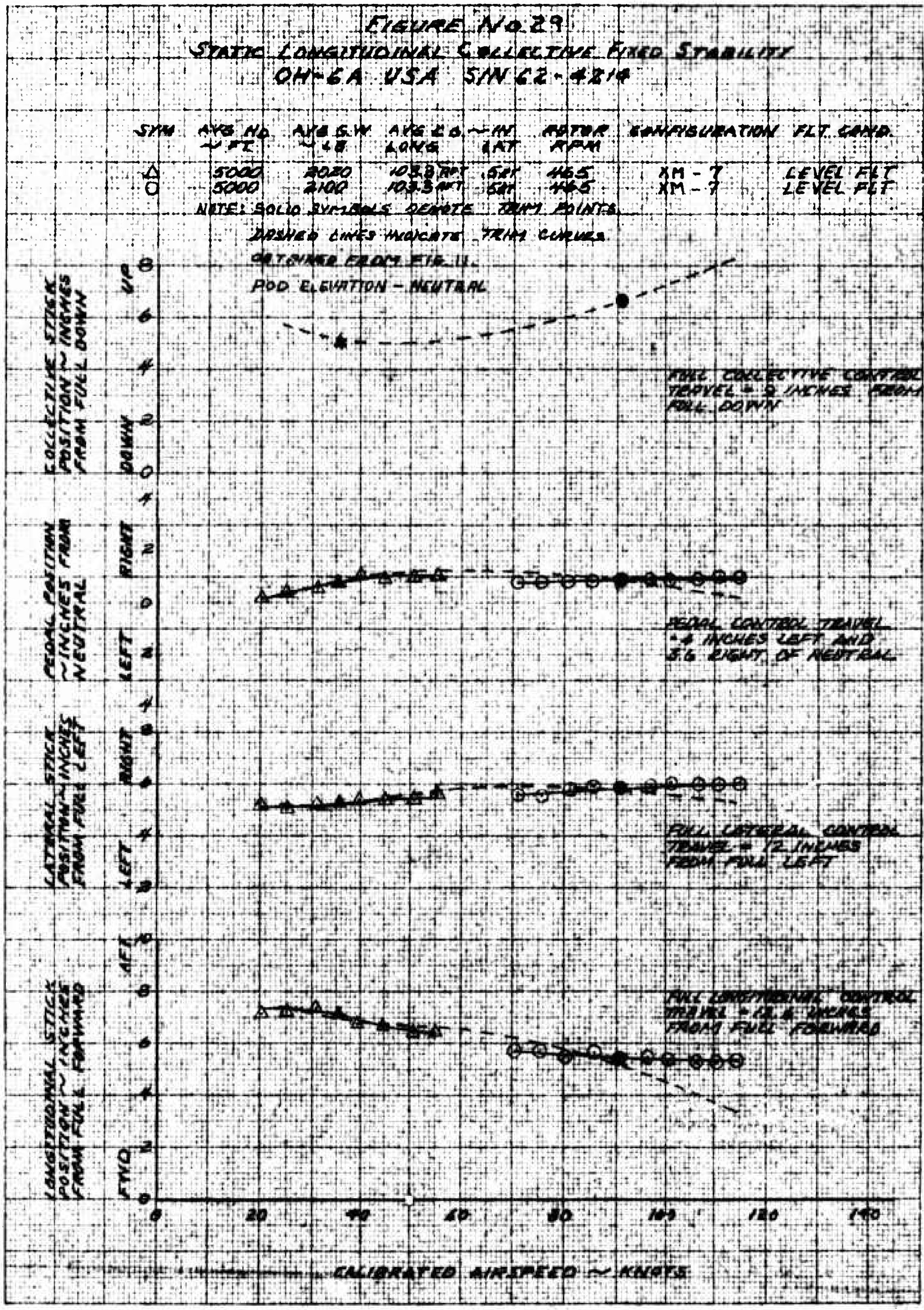


FIGURE No. 29
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214
SYM | AVG Hp ~FT | AVG G.W. ~LB | AVG C.G. ~IN LONG | LAT | ROTOR RPM | CONFIGURATION | FLT COND.
△ 5000 2020 103.8 AFT .5 RT 465 XM-7 LEVEL FLT
○ 5000 2100 103.3 AFT .5 RT 465 XM-7 LEVEL FLT
NOTE: SOLID SYMBOLS DENOTE TRIM POINTS.
DASHED LINES INDICATE TRIM CURVES
OBTAINED FROM FIG. 11.
POD ELEVATION - NEUTRAL
COLLECTIVE STICK POSITION ~ INCHES FROM FULL DOWN
UP
DOWN
FULL COLLECTIVE CONTROL TRAVEL = 9 INCHES FROM FULL DOWN
PEDAL POSITION ~ INCHES FROM NEUTRAL
RIGHT
LEFT
PEDAL CONTROL TRAVEL 4 INCHES LEFT AND 3.6 RIGHT OF NEUTRAL
LATERAL STICK POSITION ~ INCHES FROM FULL LEFT
RIGHT
LEFT
FULL LATERAL CONTROL TRAVEL = 12 INCHES FROM FULL LEFT
LONGITUDINAL STICK POSITION ~ INCHES FROM FULL FORWARD
AFT
FWD
FULL LONGITUDINAL CONTROL TRAVEL = 12.6 INCHES FROM FULL FORWARD
0 20 40 60 80 100 120 140
CALIBRATED AIRSPEED ~ KNOTS

Figure No. 30
Static Longitudinal Collective Fixed Stability
OH-6A USA S/N 62-4214

SYM	AVG HD ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	5000	2150	103.3	AFT .5 RT	465	XM-7	CLIMB

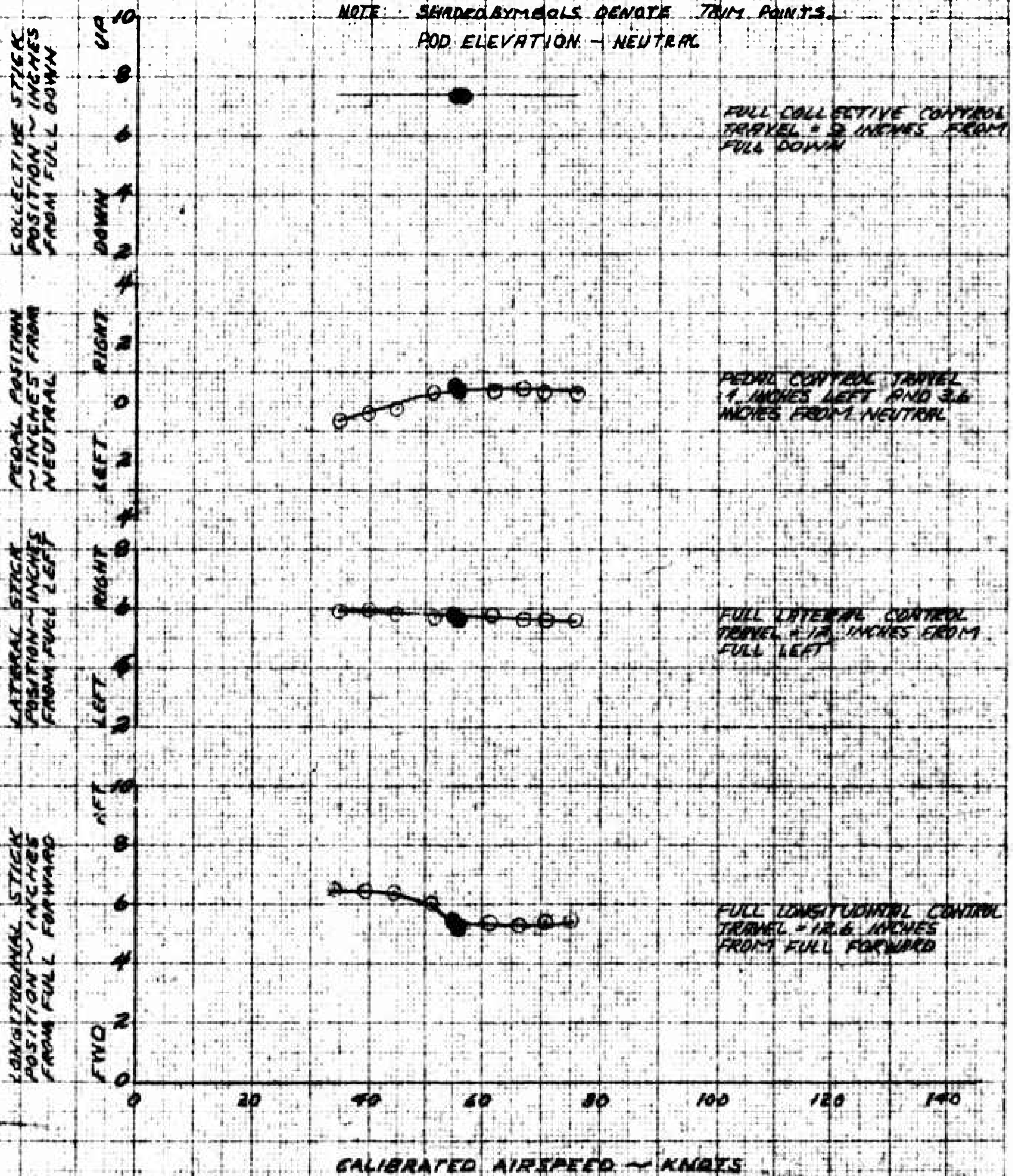


FIGURE NO. 31

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH-6A USA S/N 62-4214

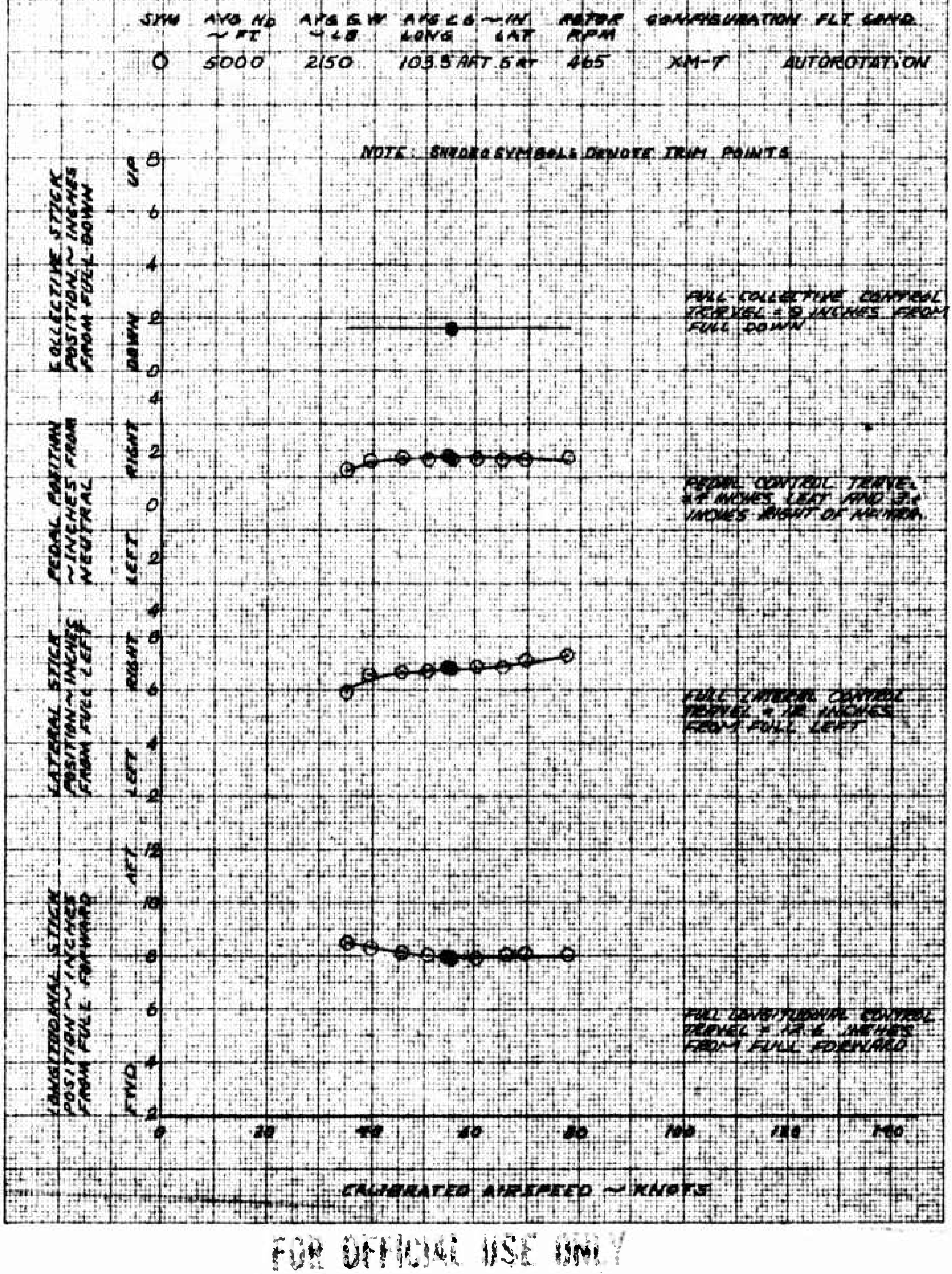


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FIGURE No 32

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH 6A USA S/N 62-4214

SYM	AVG HD ~ FT	AVG GW ~ LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
	5000	2120	101.5 AFT	2.8 LT	465	XM-8	LEVEL FLT
	5000	2080	101.5 AFT	2.8 LT	465	XM-8	LEVEL FLT

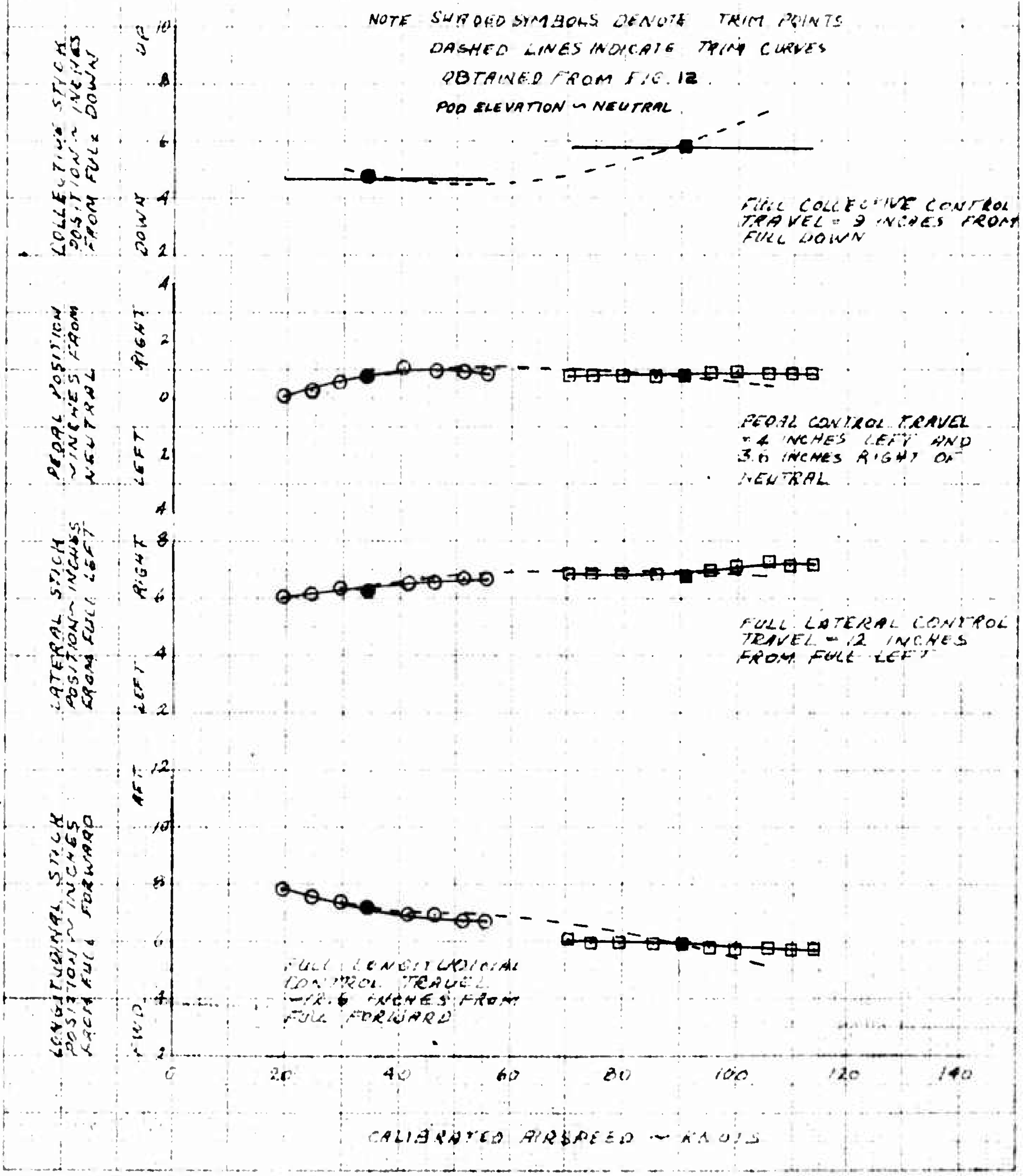

FIGURE No. 33

STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY

OH-6A USA S/N 62-4214

SYM	AVG. HD ~ FT	AVG G.W ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
O	5000	2150	101.5	2.8 LT	465	XM-8	CLIMB

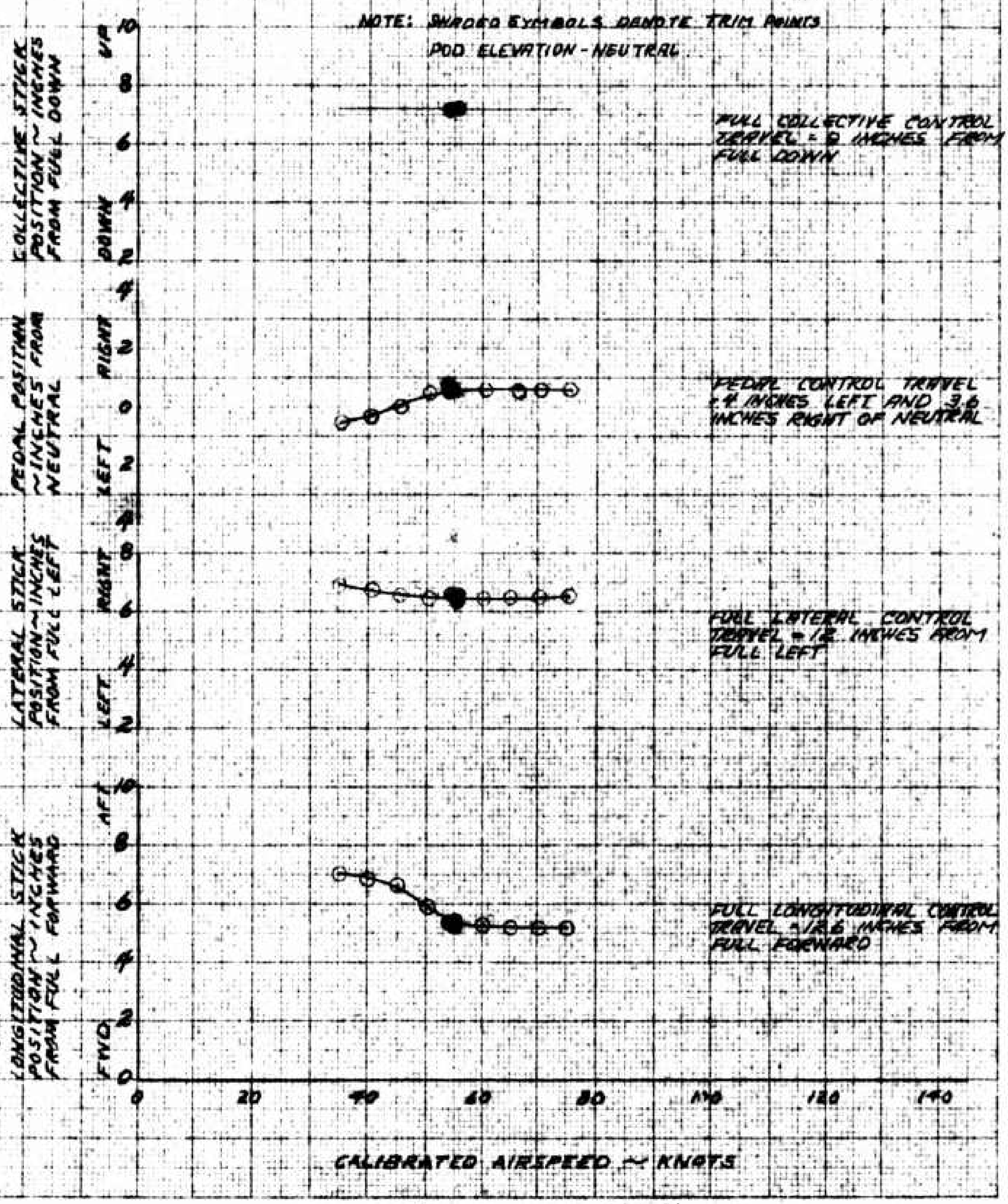

FIGURE No. 34
STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY
OH-6A USA S/N 62-4214

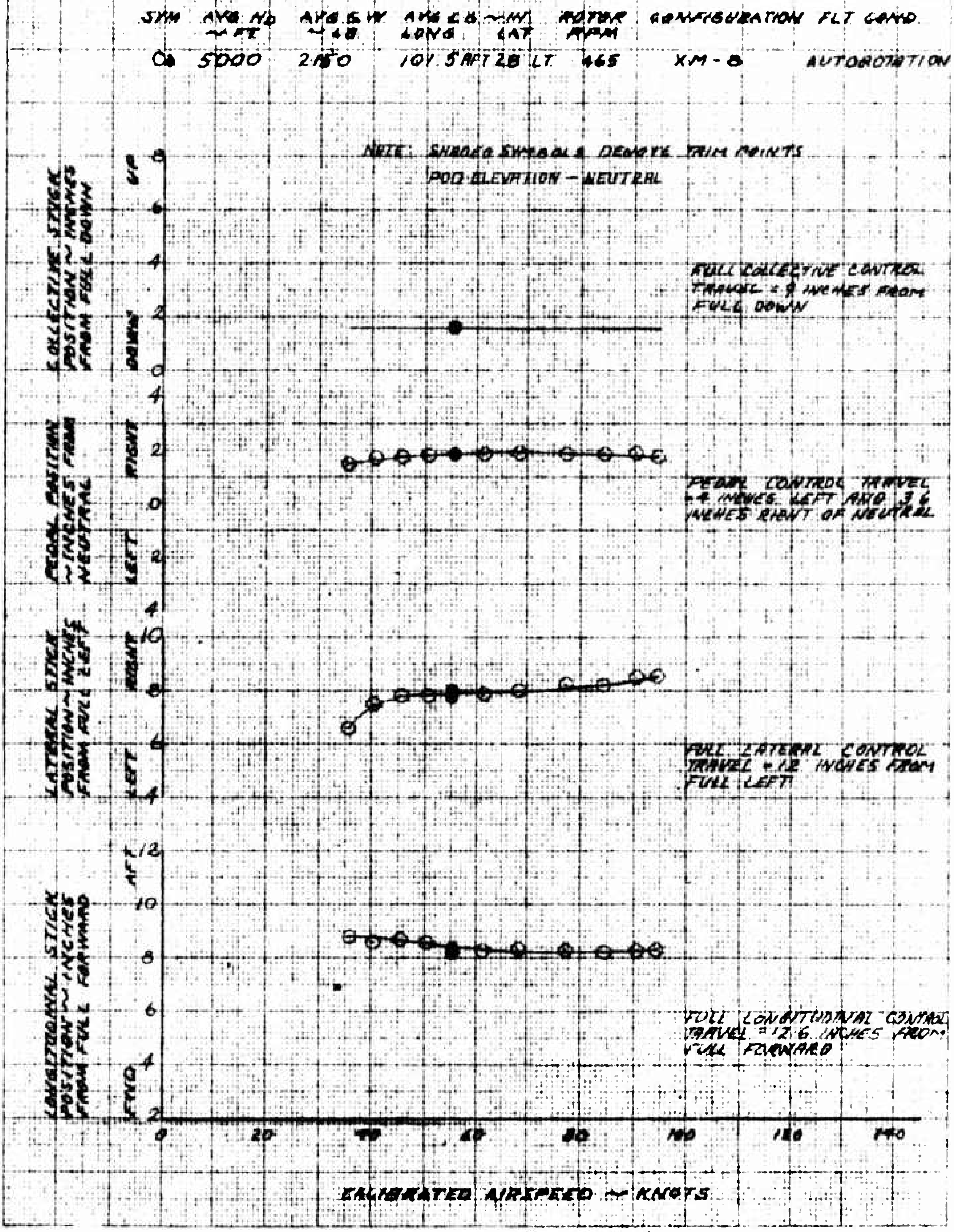

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FIGURE NO. 35

SUMMARY OF LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AVG Hp ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
△	5000	2120	103.5 (AFT)	.5RT	465	CLEAN	LEVEL FLT
○	10000	2115	103.5 (AFT)	.5RT	465	CLEAN	LEVEL FLT
◇	5000	2610	103.5 (AFT)	.5RT	465	CLEAN	LEVEL FLT

NOTE: ALL VALUES DETERMINED AT ZERO SIDESLIP.
DATA OBTAINED FROM FIGURES 37 THROUGH 62

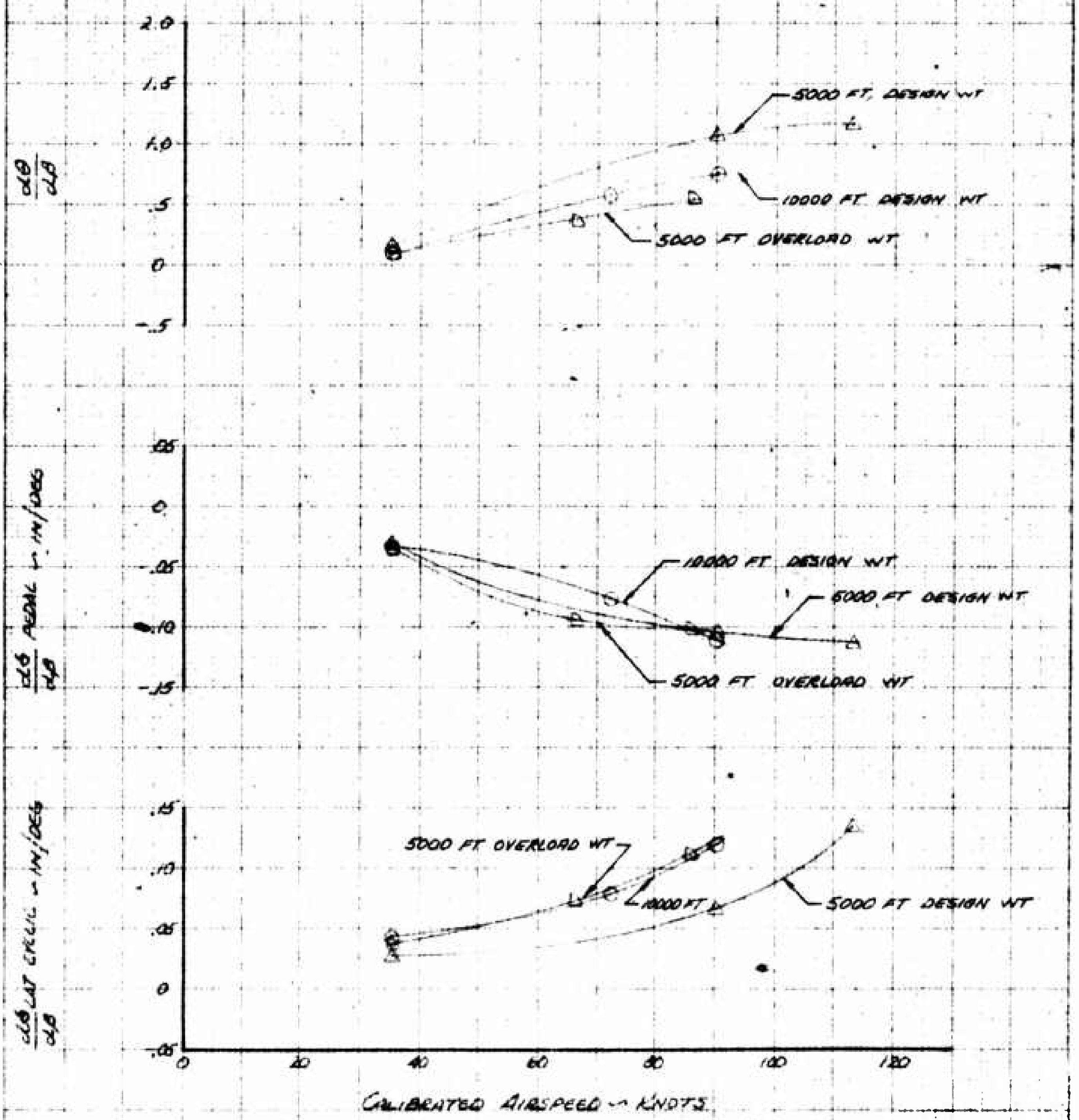

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FIGURE NO 36

SUMMARY OF LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AVG HP FT	AVG GW LB	AVG CG LONG	CG LAT	ROTOR RPM	CONFIGURATION	FLT COND
□	5000	2130	103.5(AFT)	.5RT	465	XM-7	LEVEL FLIGHT
D	5000	2120	102.5(AFT)	2.8LT	465	XM-8	LEVEL FLIGHT

NOTE: DASHED LINE DENOTES CLEAN CONFIGURATION CURVE OBTAINED FROM FIGURE 35

ALL VALUES DETERMINED AT ZERO SIDESLIP.

DATA OBTAINED FROM FIGURES 37 THROUGH 62

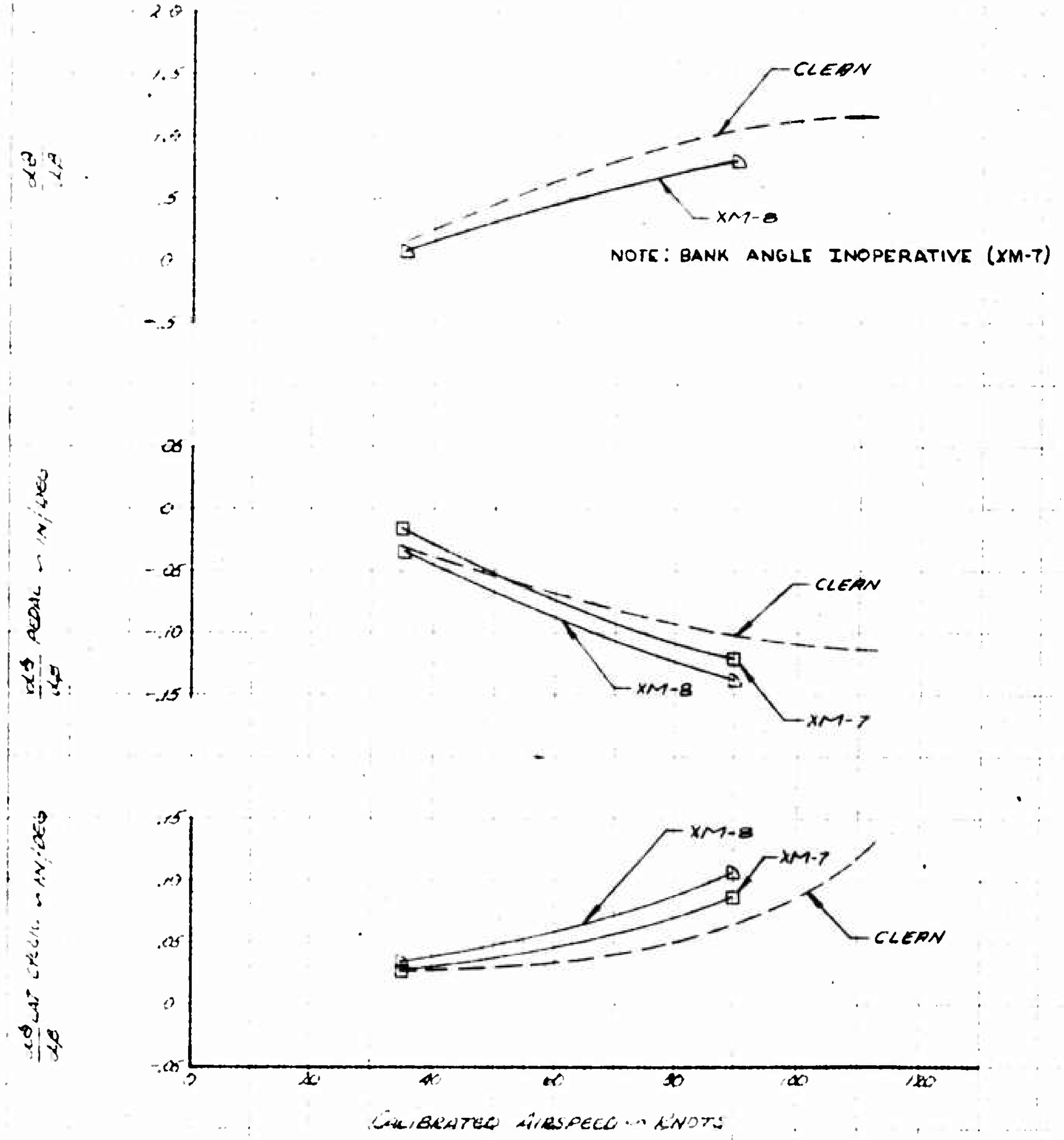

FIGURE NO 37

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-42-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG GW ~LB	AVG C.G ~IN. LONG	LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	35	5000	2140	103.5(AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

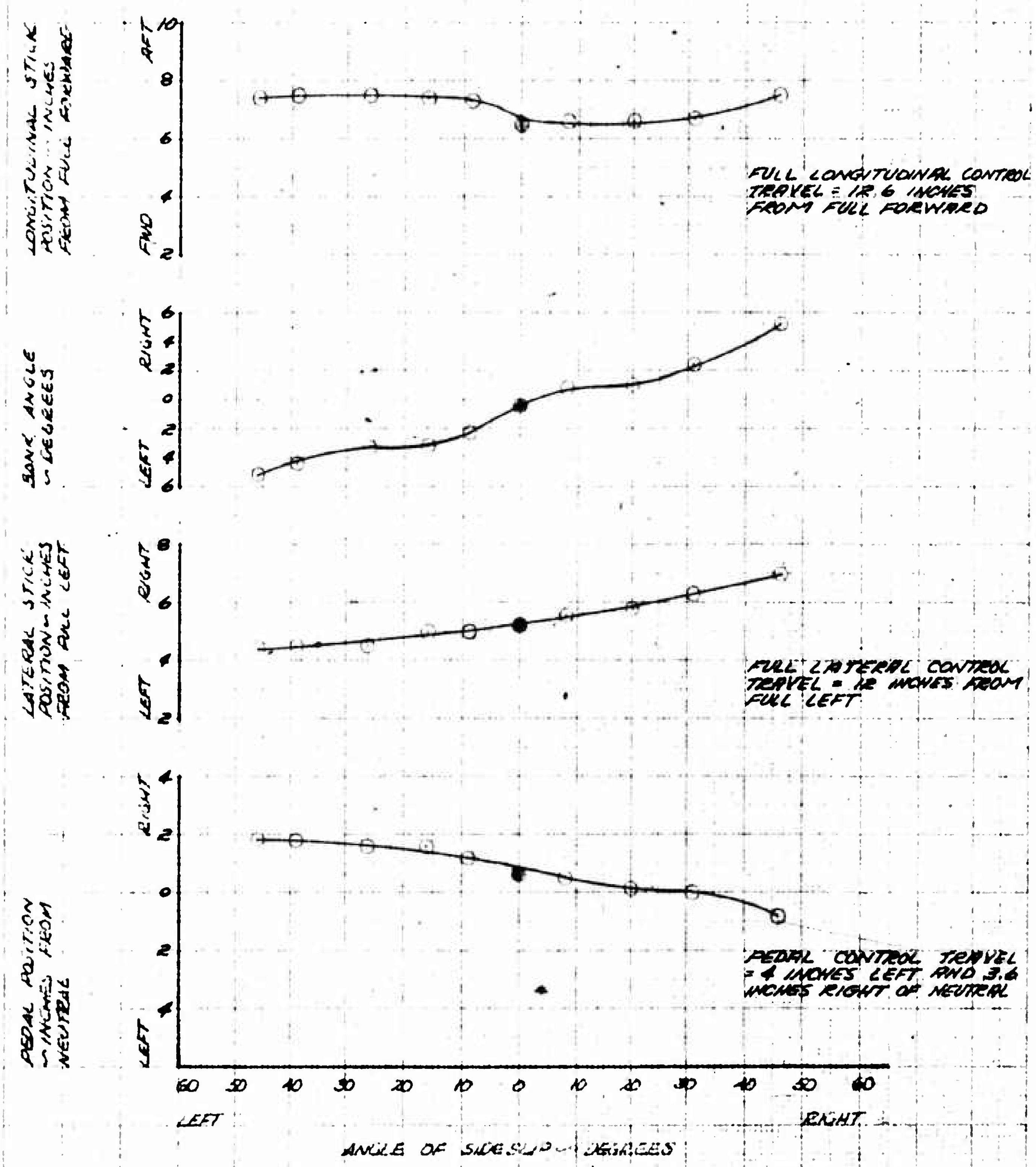

FIGURE NO 38

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG GW ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND
○	90	5000	2100	103.5(AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

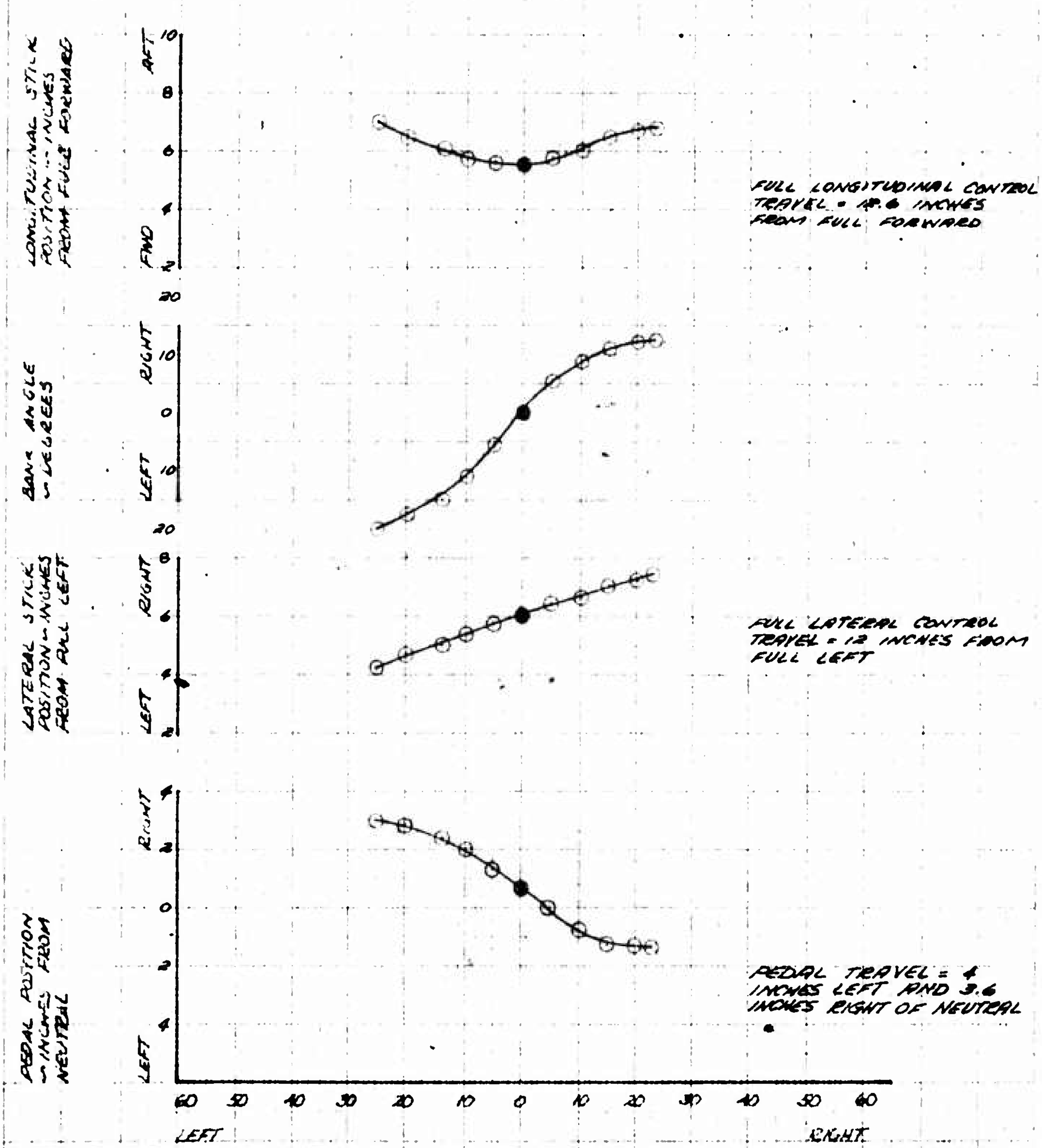

FIGURE NO 39

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_0 ~FT	AVG G.W ~LB	AVG C.G. ~IN. LONG	LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	113	5000	2120	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLIGHT

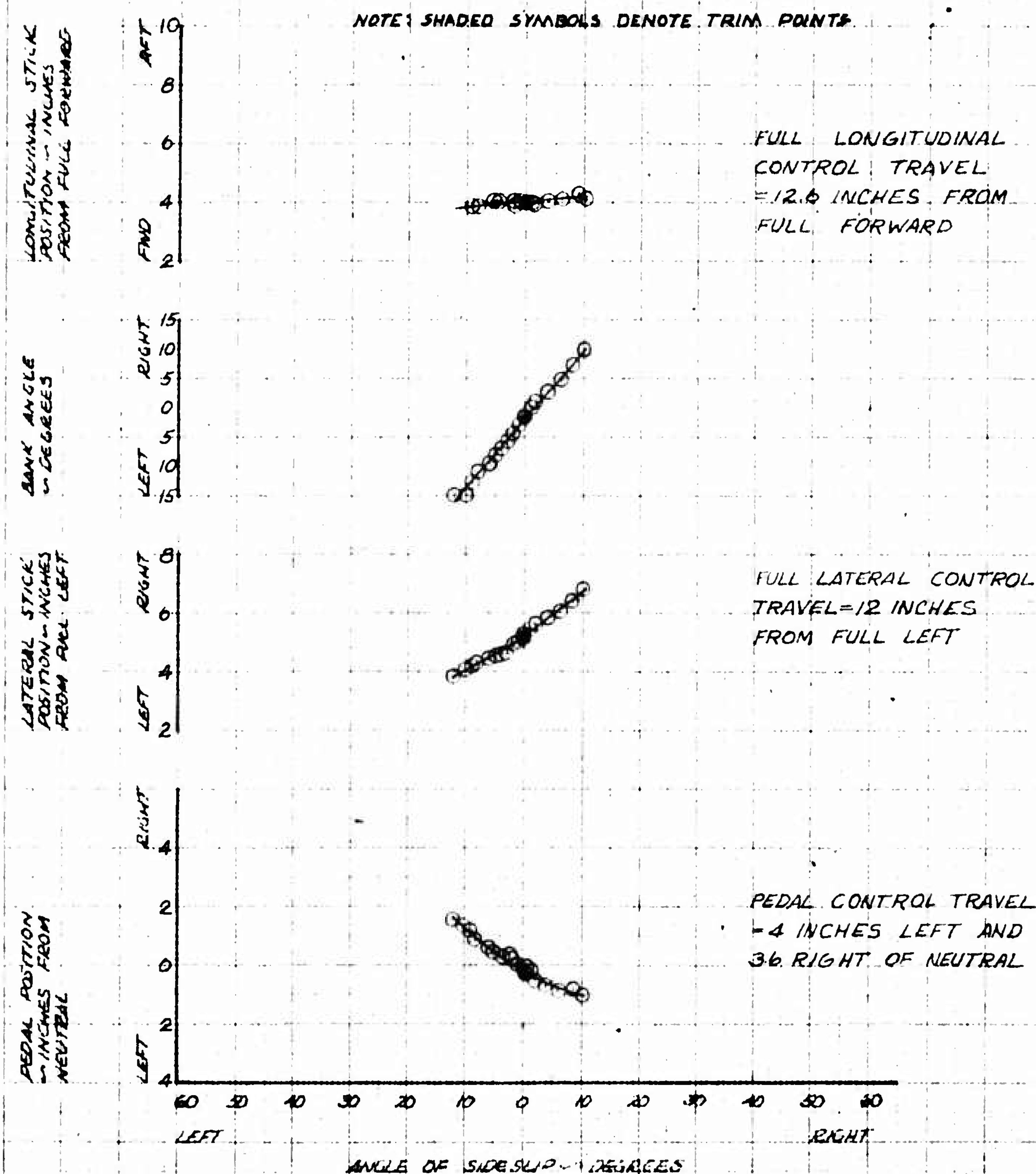

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FIGURE NO 40
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA SN 62-4214

SYM	AIRSPEED KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2180	103.5(AFT)	.5RT	465	CLEAN	CLIMB

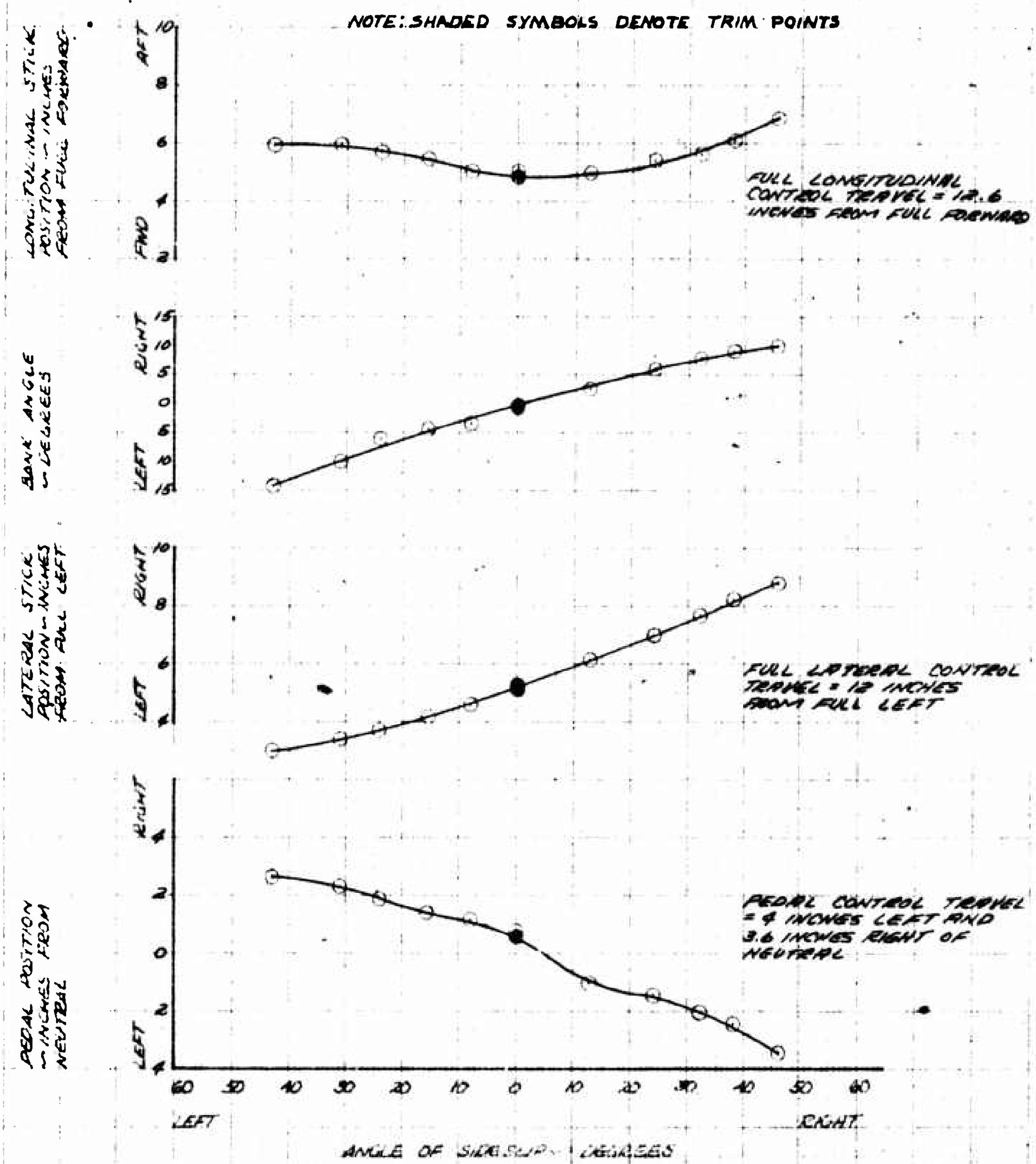

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FIGURE NO 41

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	AVG C.G ~IN. LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	55	5000	2120	103.5 (AFT)	.5 RT	465	CLEAN	AUTOROTATION

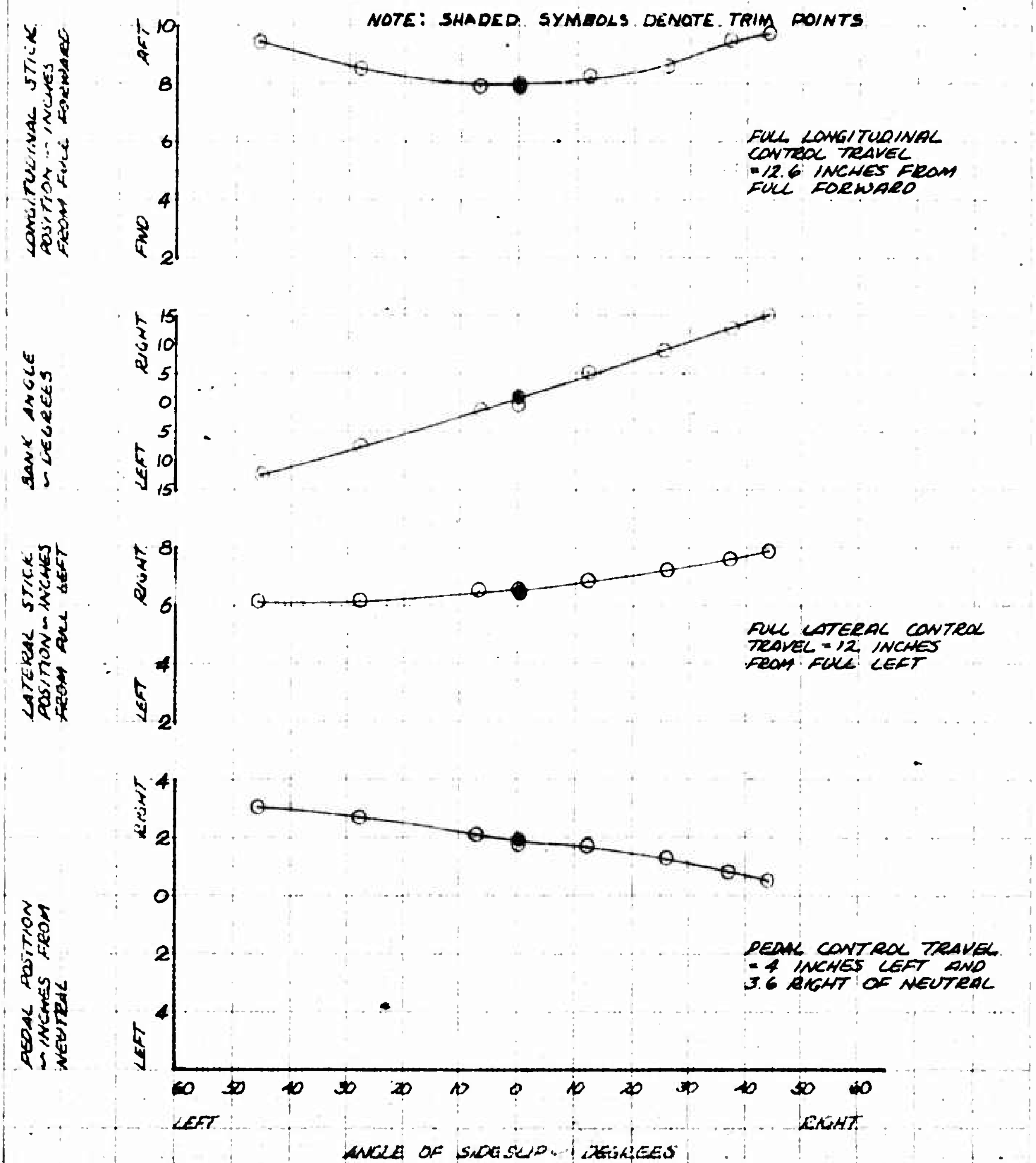

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FIGURE NO 42
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	75.5	5000	2090	103.5 (AFT)	.5 RT	465	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

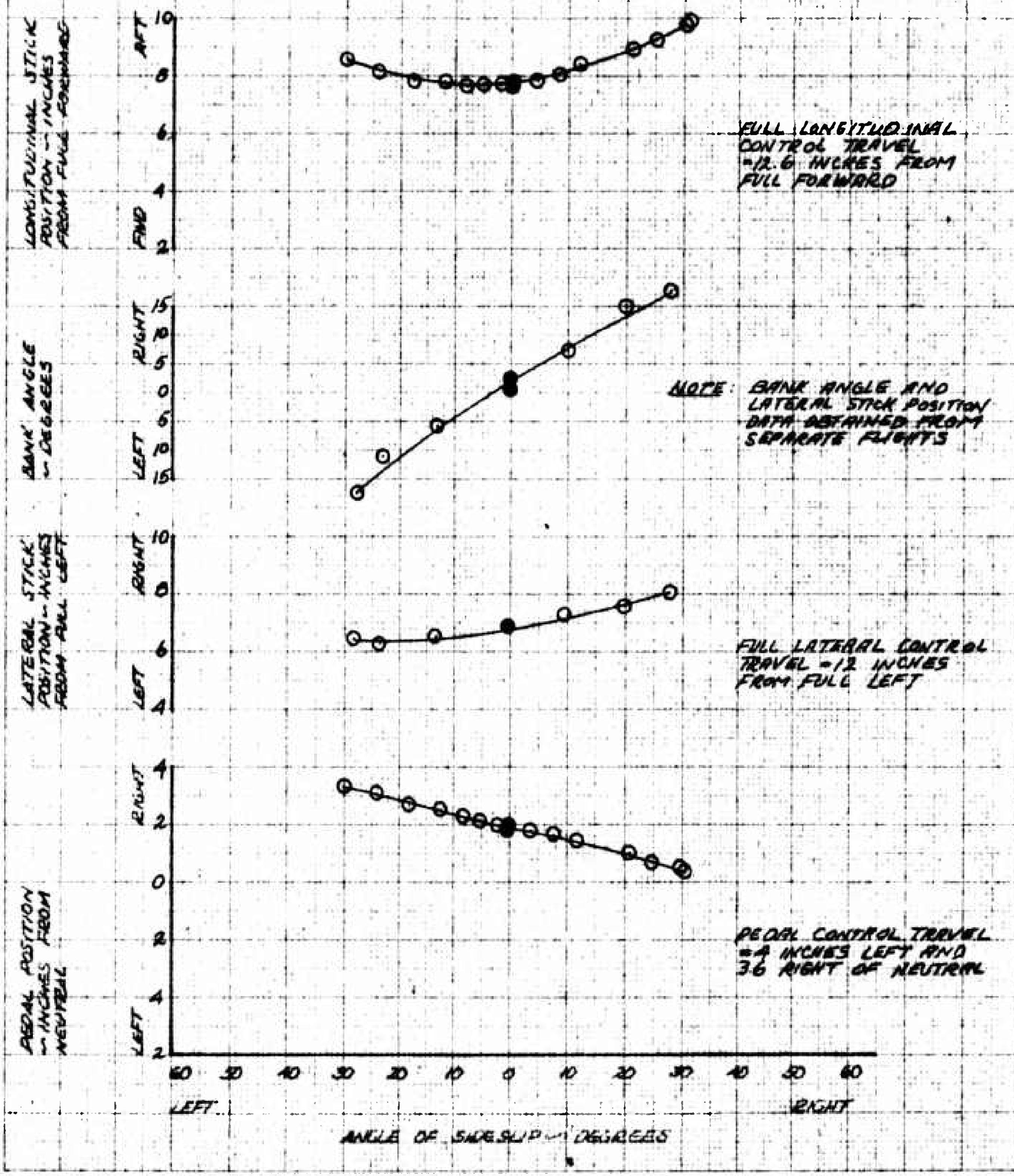

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FIGURE No 43

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG GW ~LB	AVG C.G. ~IN. LONG	AVG C.G. ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	35	5000	2630	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

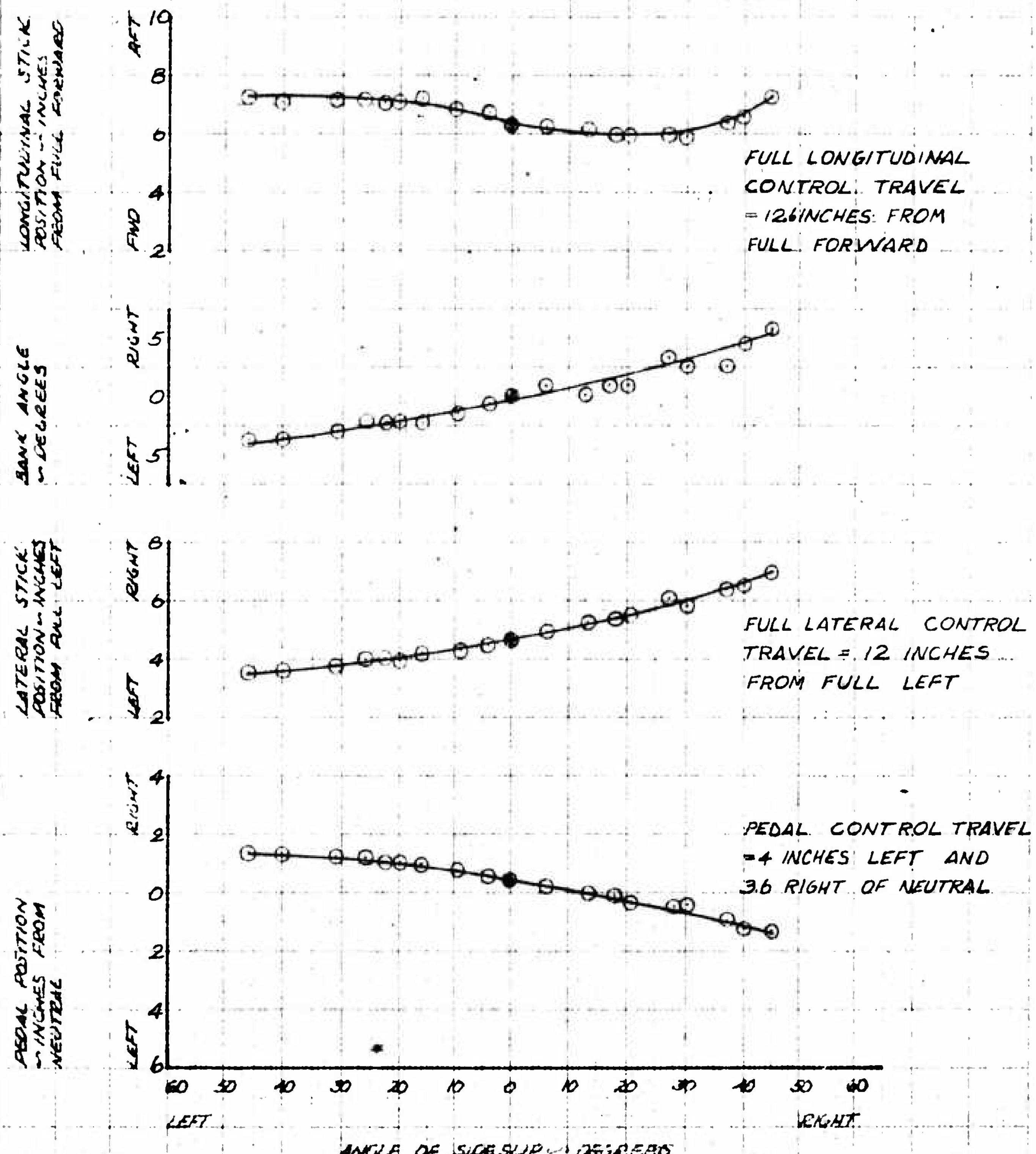

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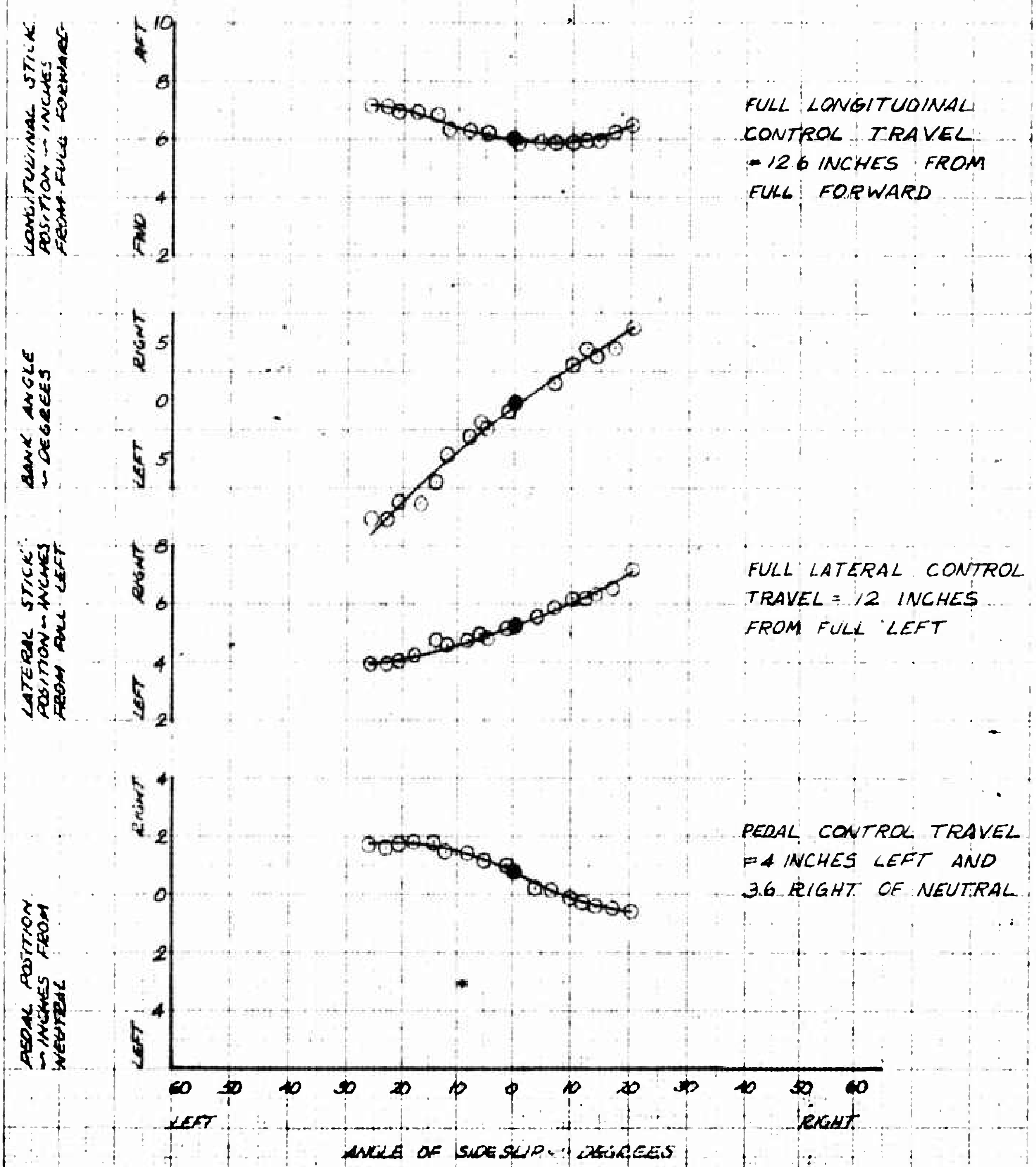
FIGURE NO 44

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_0 ~FT	AVG GW ~LB	AVG CG ~IN. LONG	AVG CG ~IN. LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	66.5	5000	2610	103.5(AFT)	.5 RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

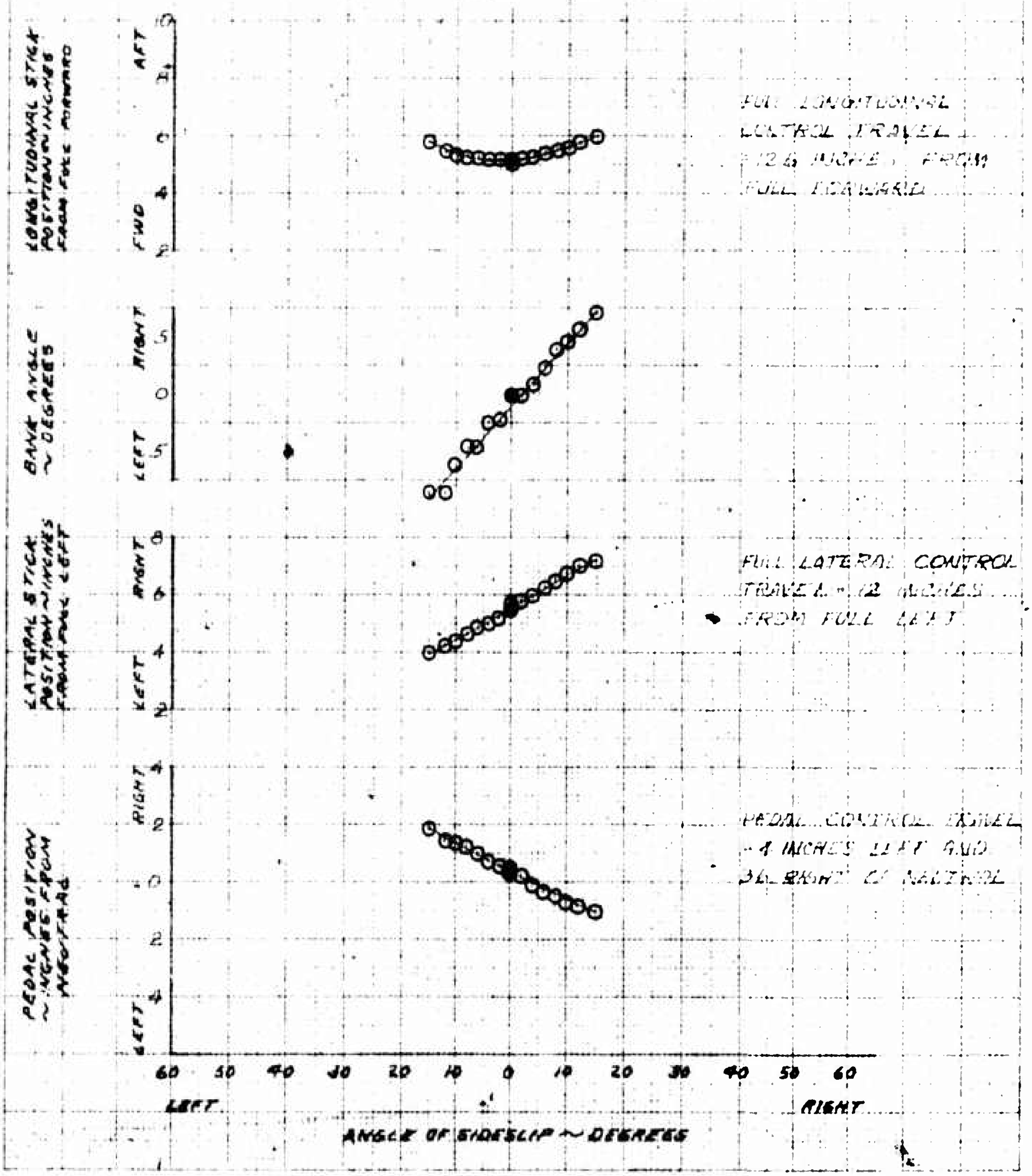


FOR OFFICIAL USE ONLY

FIGURE No. 45
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	86	5000	2580	103.5(AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS



FOR OFFICIAL USE ONLY

FIGURE NO 46

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_0 ~FT	AVG GW ~LB	AVG CG ~IN. LONG	AVG CG ~IN. LAT	ROTOR RPM	CONFIGURATION	FLT COND.
O	55	5000	2700	103.5 (AFT)	.5 RT	465	CLEAN	CLIMB

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

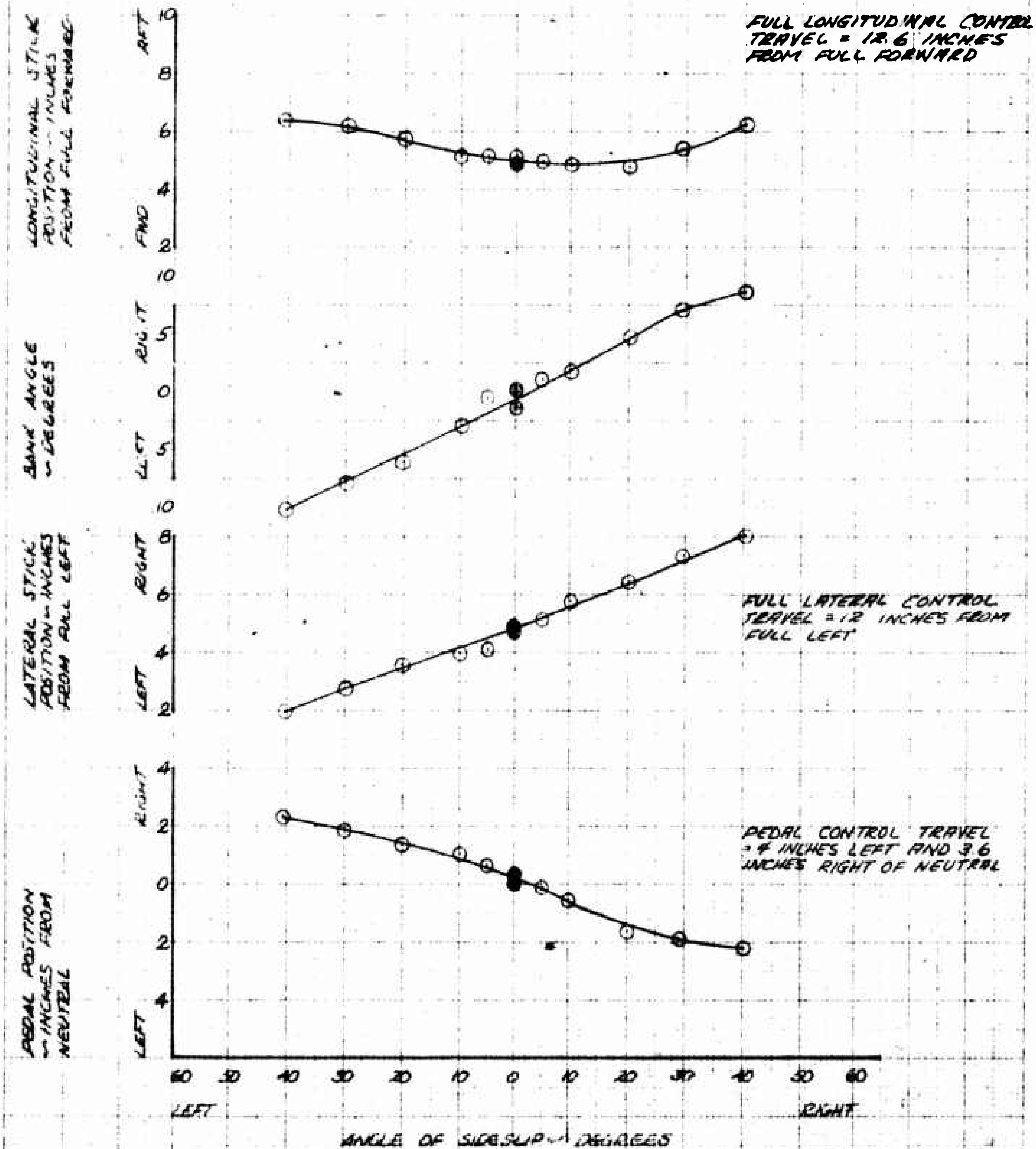


FIGURE NO 47

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_D ~FT	AVG GW ~LB	AVG CG ~IN. LONG	AVG CG ~IN. LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	55	5000	2560	103.5 (AFT)	.5 RT	465	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

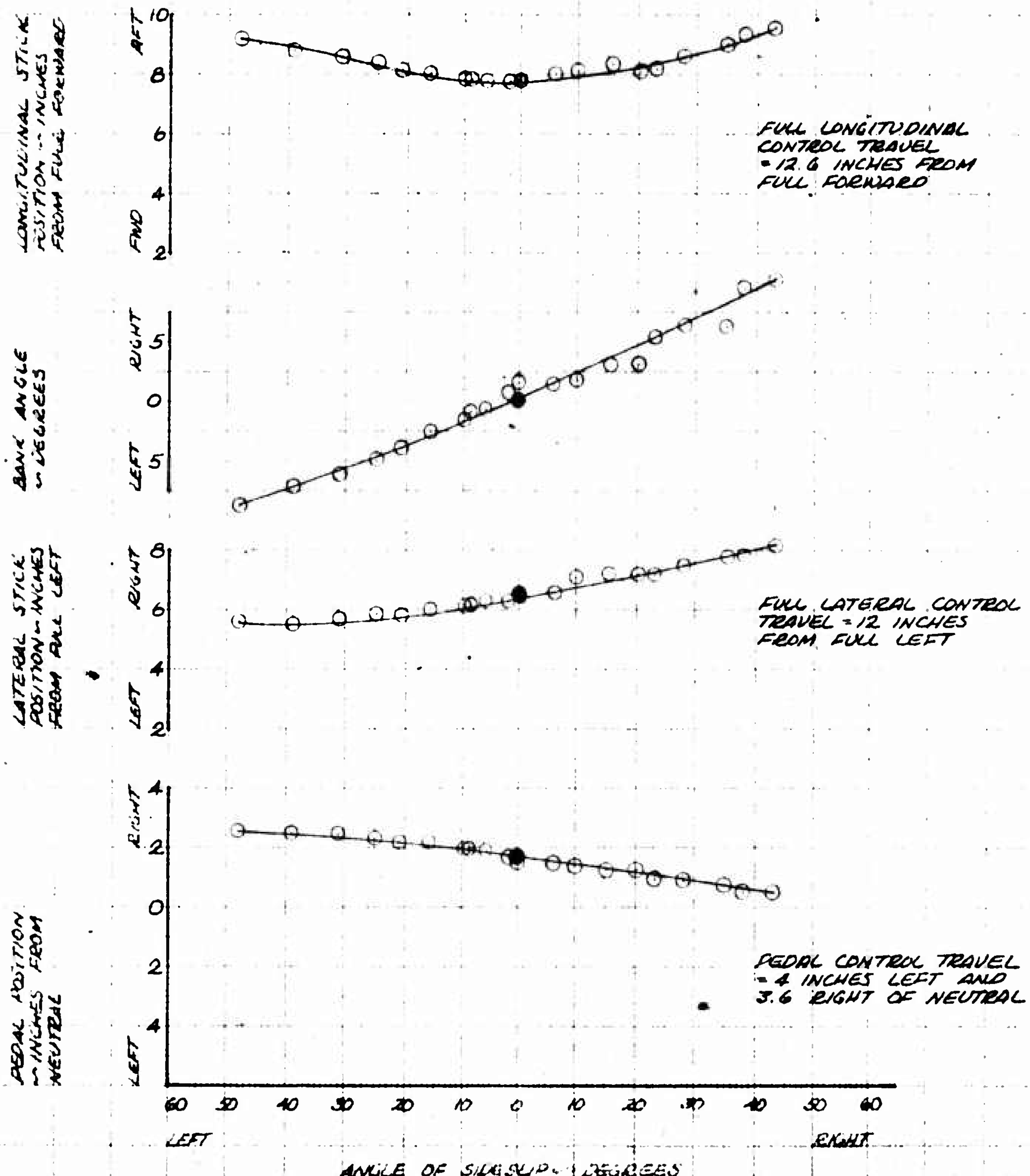


FIGURE No 48
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G.~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
O	75	5000	2670	103.5 (AFT)	.5 RT	465+	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

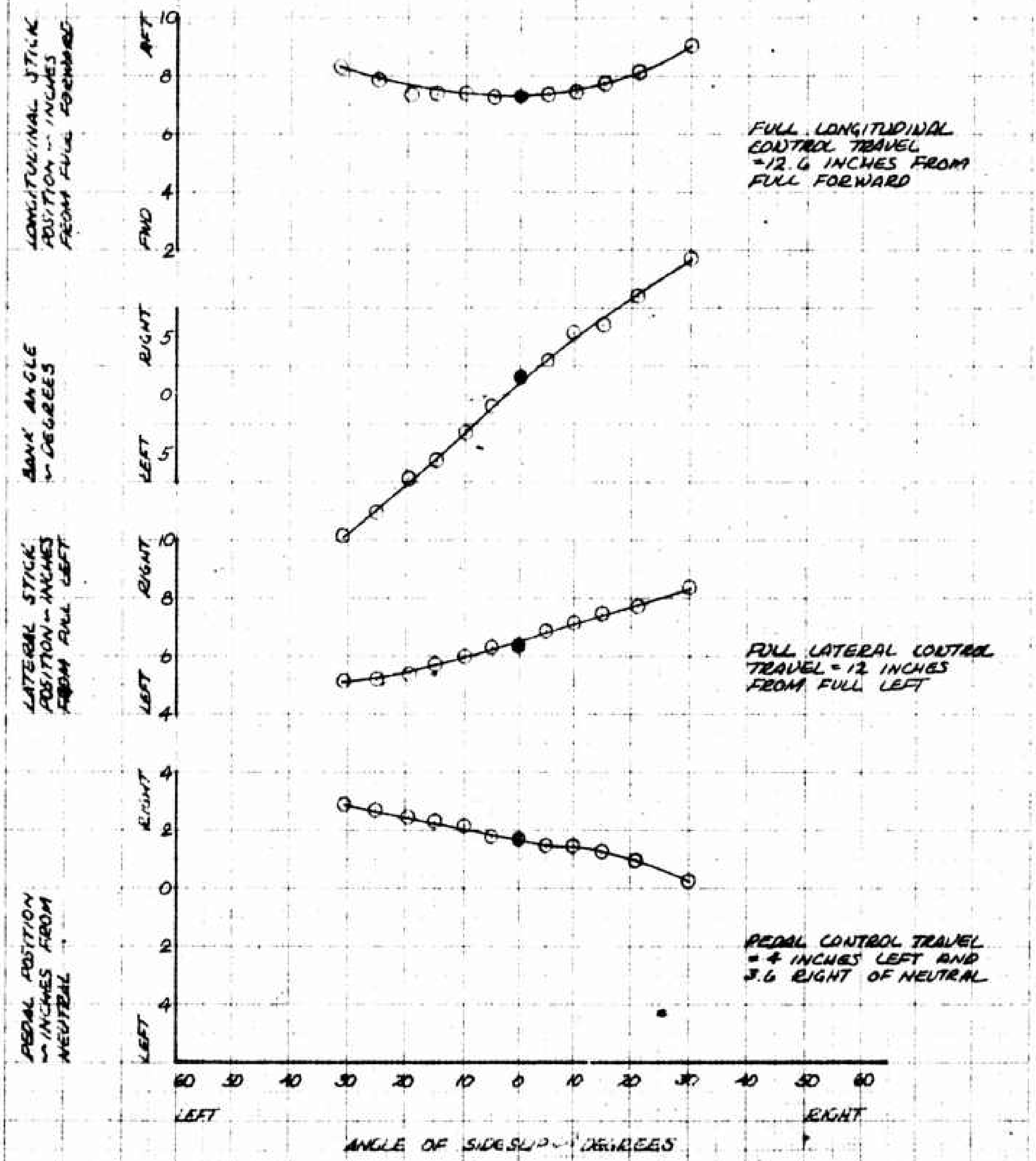


FIGURE NO 49
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_0 ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	10000	2120	103.5(AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

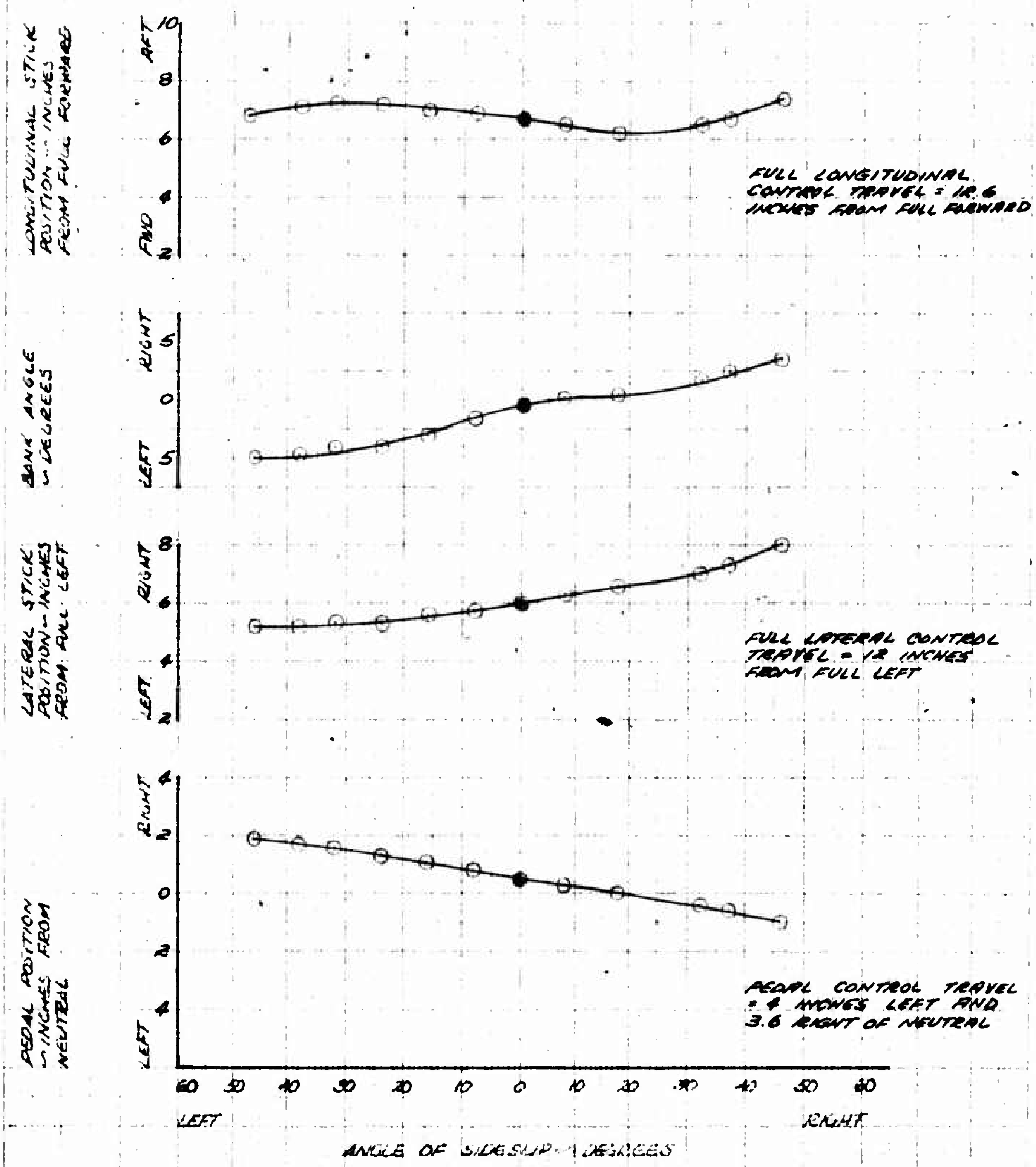


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FIGURE NO 50

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG.	AVG C.G ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
○	72	10000	2090	103.5 (AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

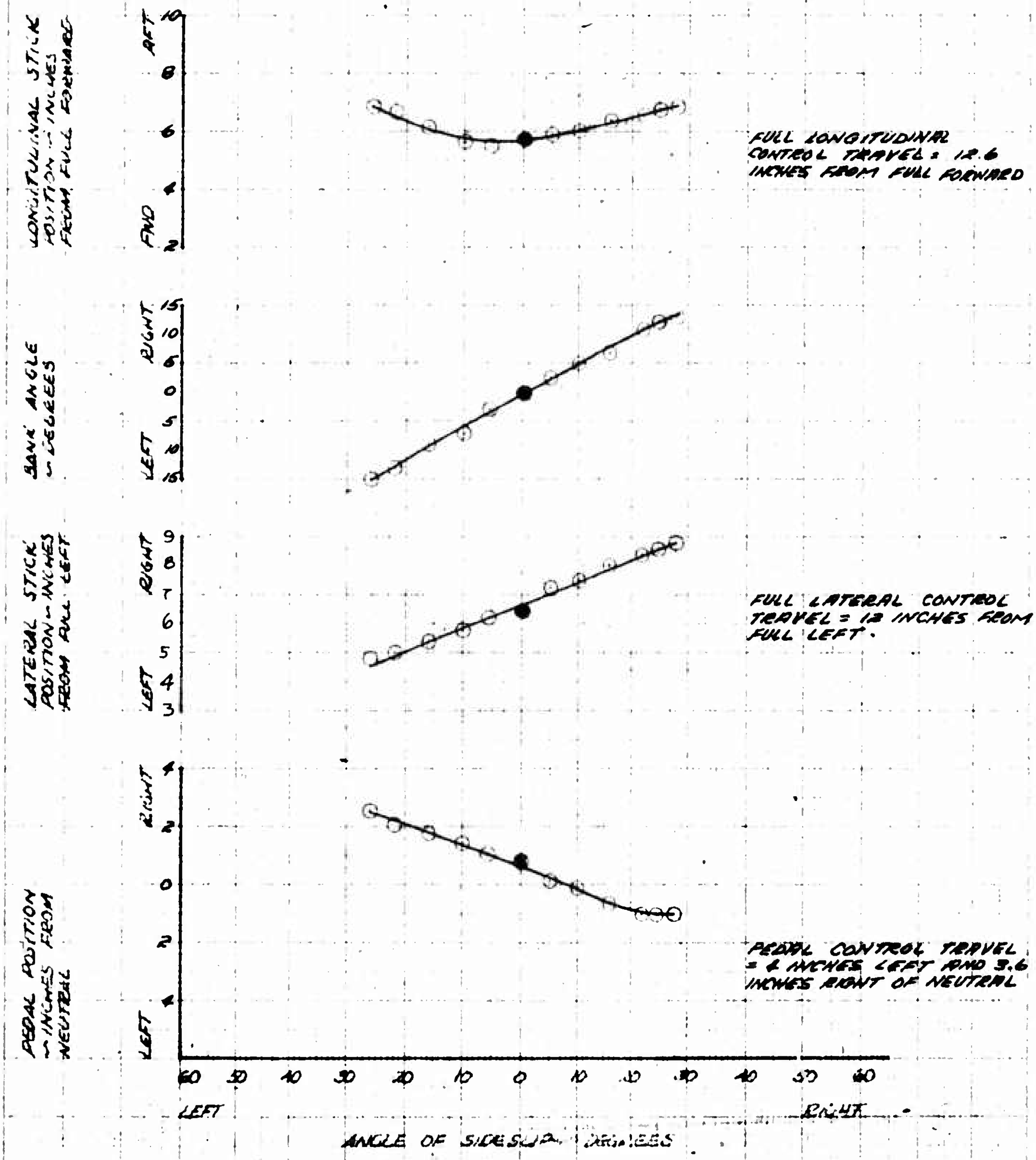

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FIGURE NO 51

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_P ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
O	90	10000	2120	103.5(AFT)	.5RT	465	CLEAN	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

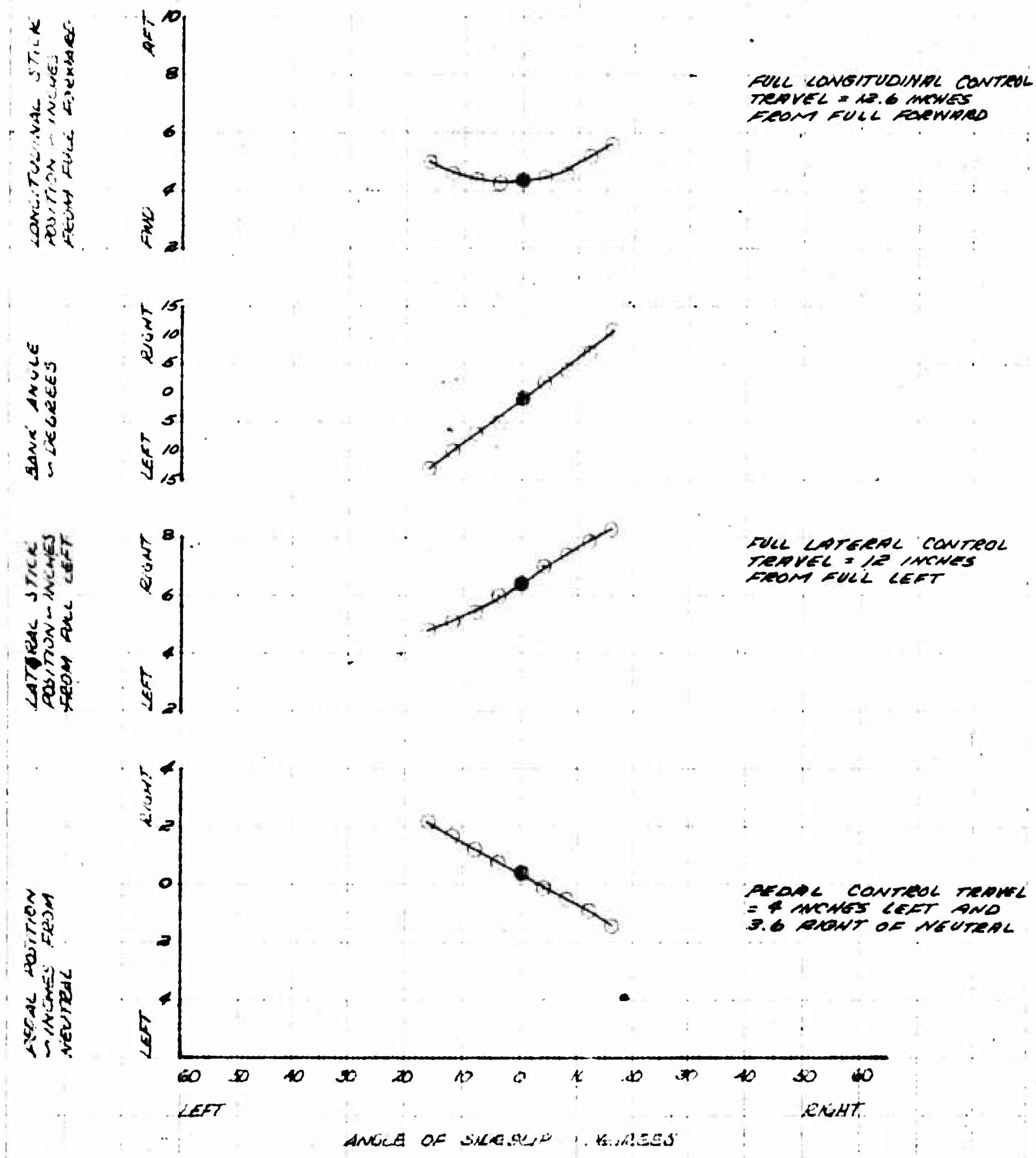

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FIGURE NO 52

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	54	10000	2160	104 AFT	.5RT	465	CLEAN	CLIMB

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

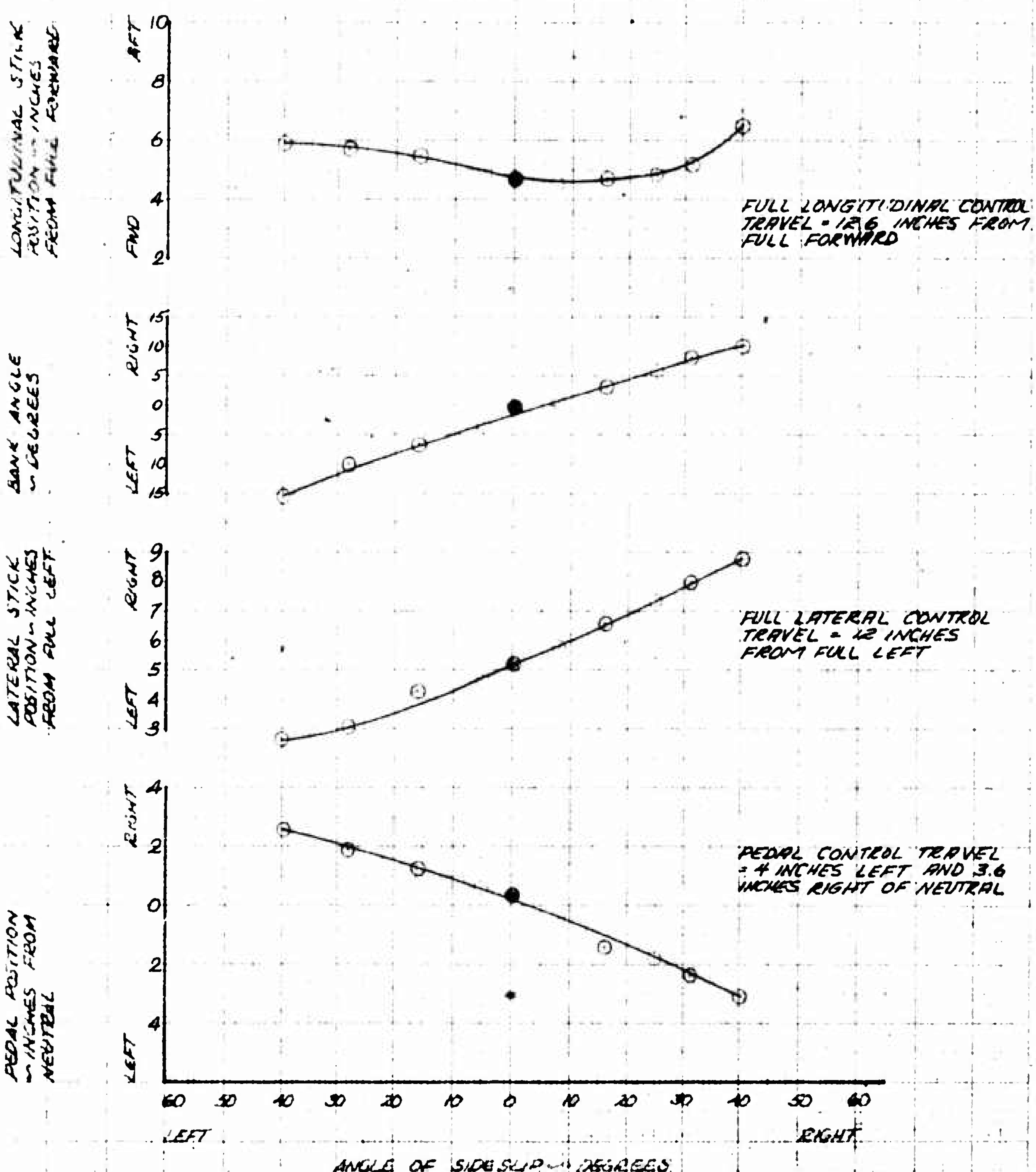

FIGURE NO 53

STATIC LATERAL - DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	55	10000	2100	103.5(AFT)	.5RT	465	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

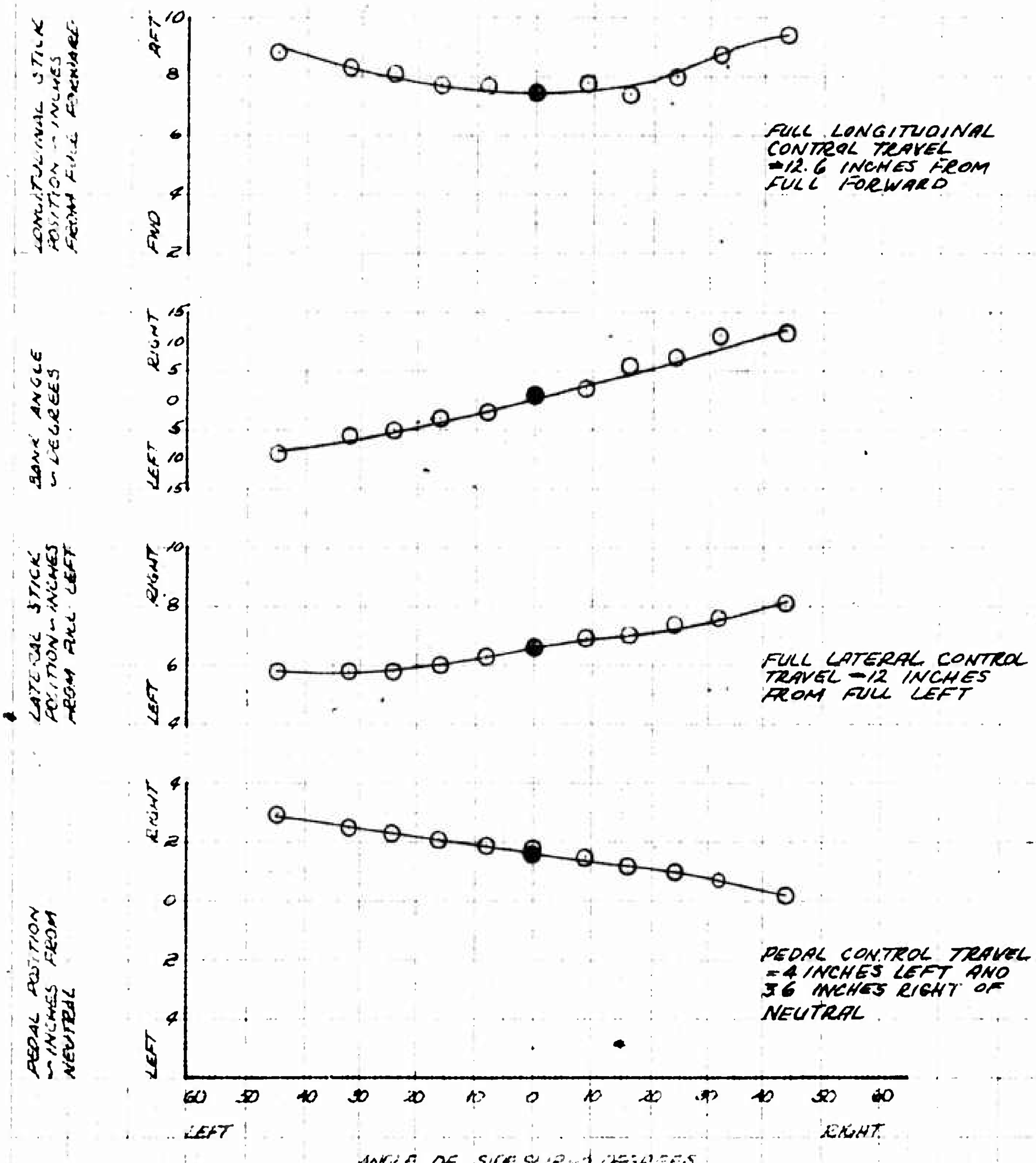

FIGURE NO 54
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	AVG C.G ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
○	75	10000	2110	103.5(AFT)	.5RT	465	CLEAN	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

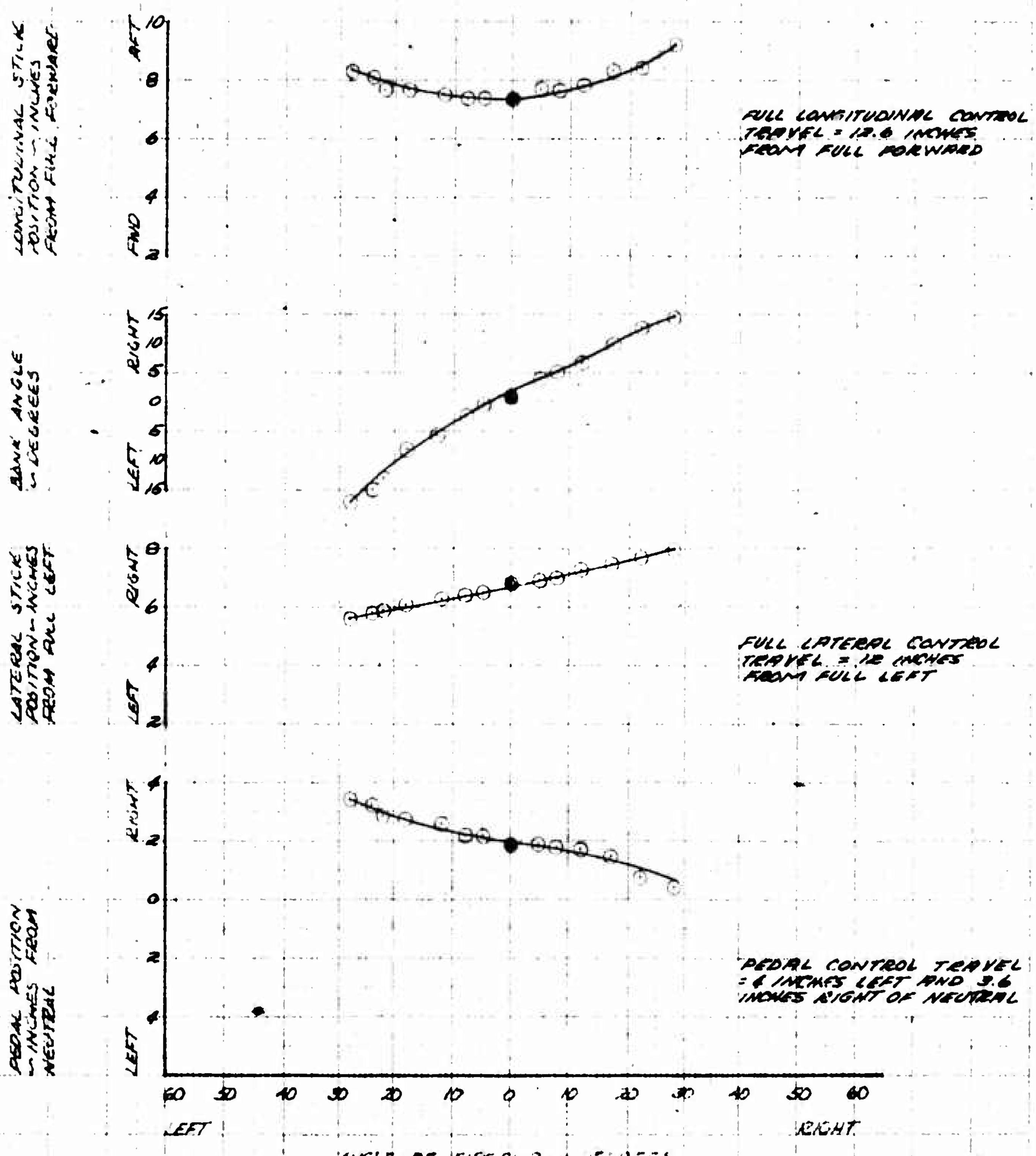

FIGURE NO 55
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	AVG C.G ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	5000	2110	103.5(AFT)	.5 RT	465	XM-7	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS.

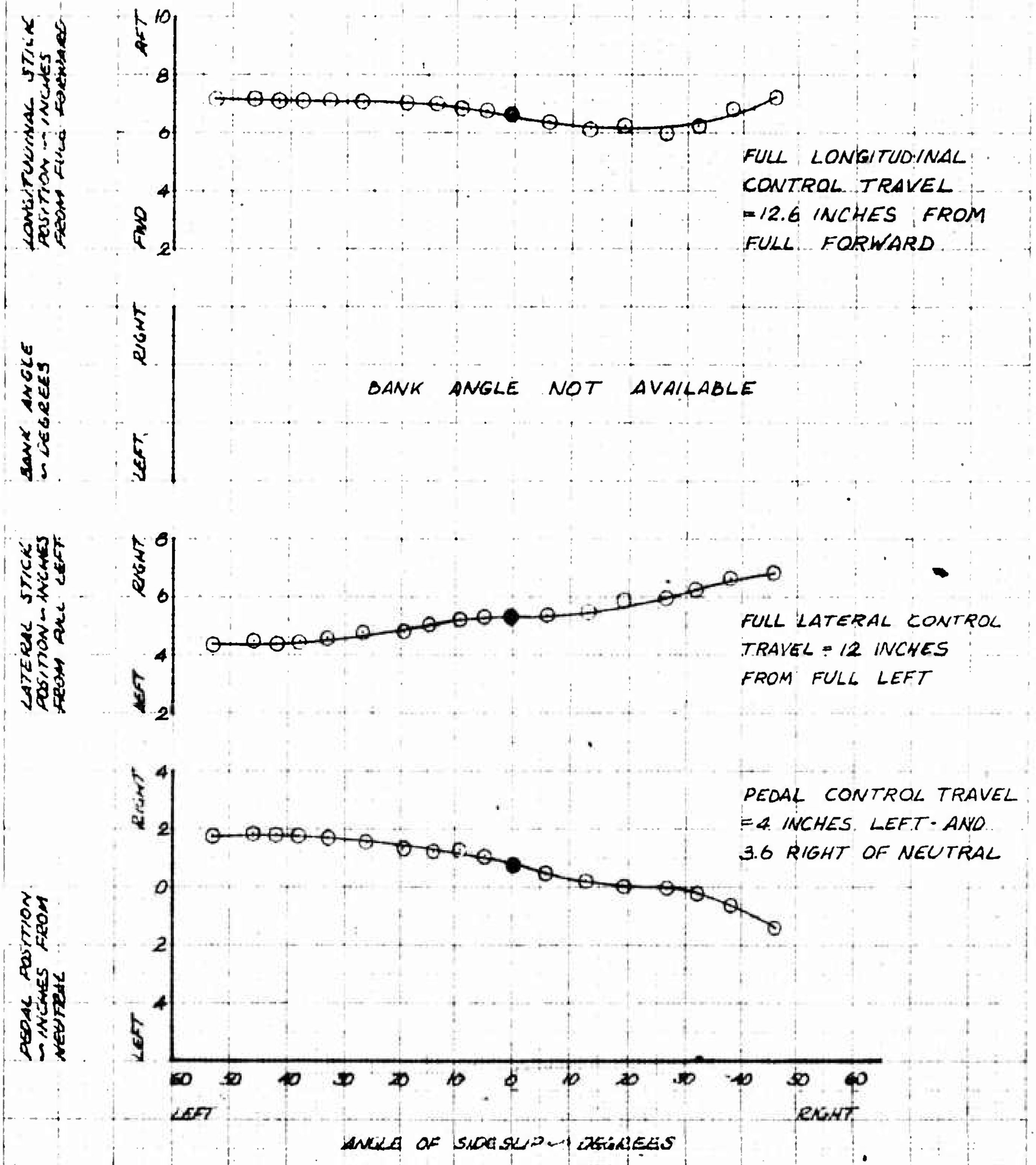

FIGURE No. 56
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hd ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	90	5000	2140	103.5(AFT)	.5 RT	465	XM-7	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

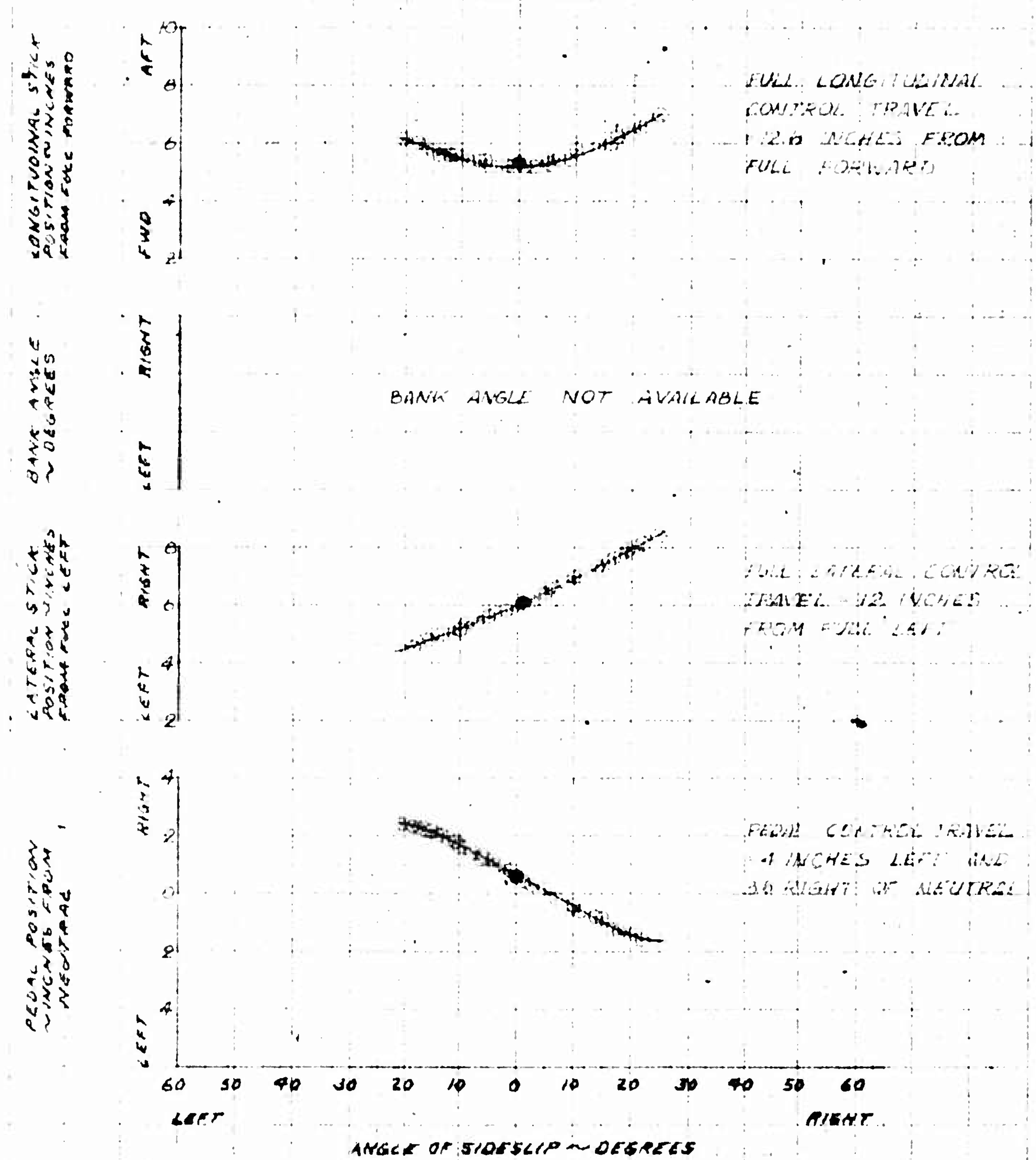

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FIGURE NO 57
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_D ~FT	AVG G.W. ~LB	AVG C.G. ~IN. LONG	AVG C.G. ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT. COND.
O	55	5000	2070	103.5(AFT)	.5RT	465	XM-7	CLIMB

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

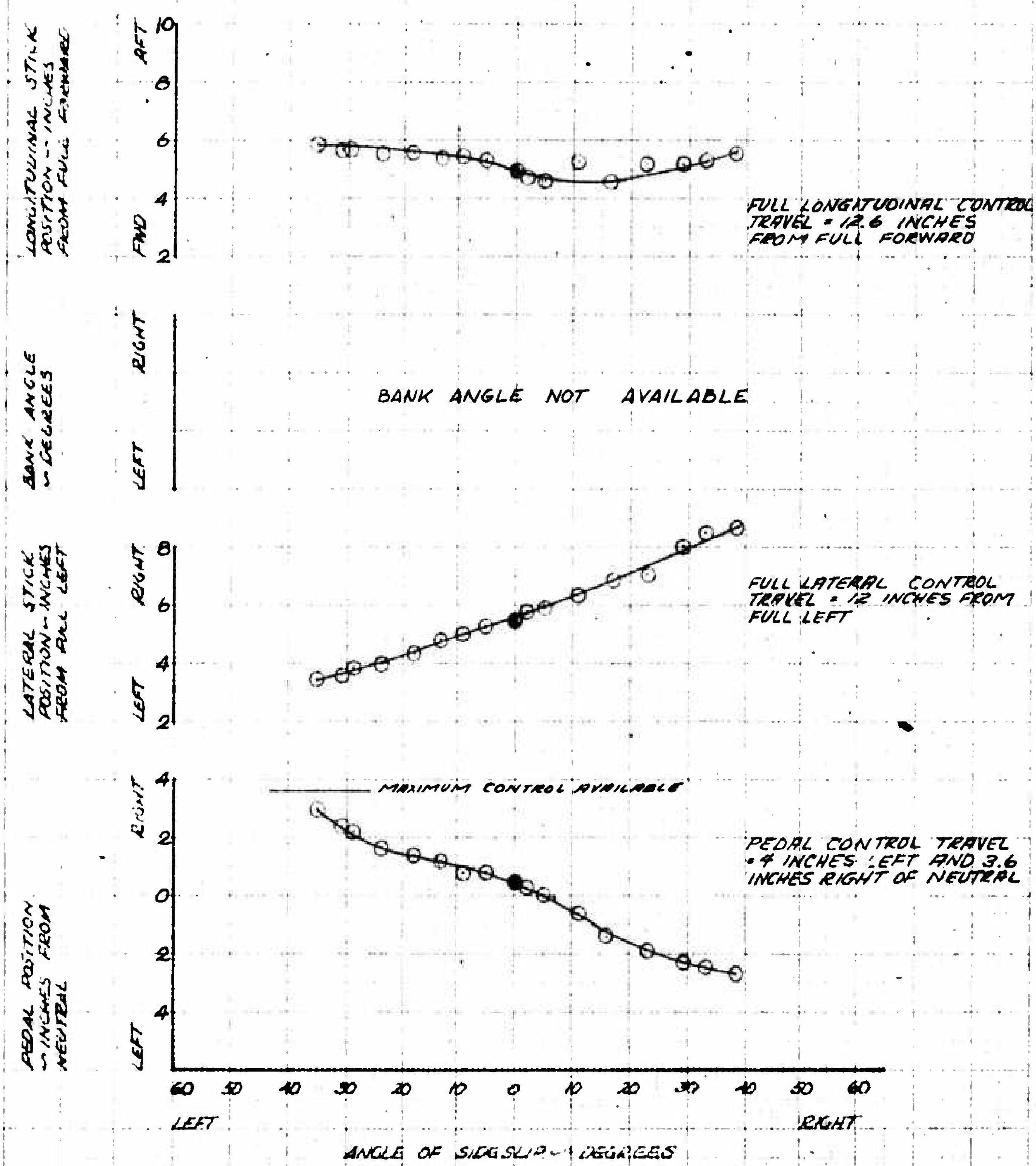

FIGURE NO 58

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_0 ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	AVG C.G ~IN. LAT.	ROTOR RPM	CONFIGURATION	FLT COND.
O	55	5000	2100	103.5 (AFT)	.5 RT	465	XM-7	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

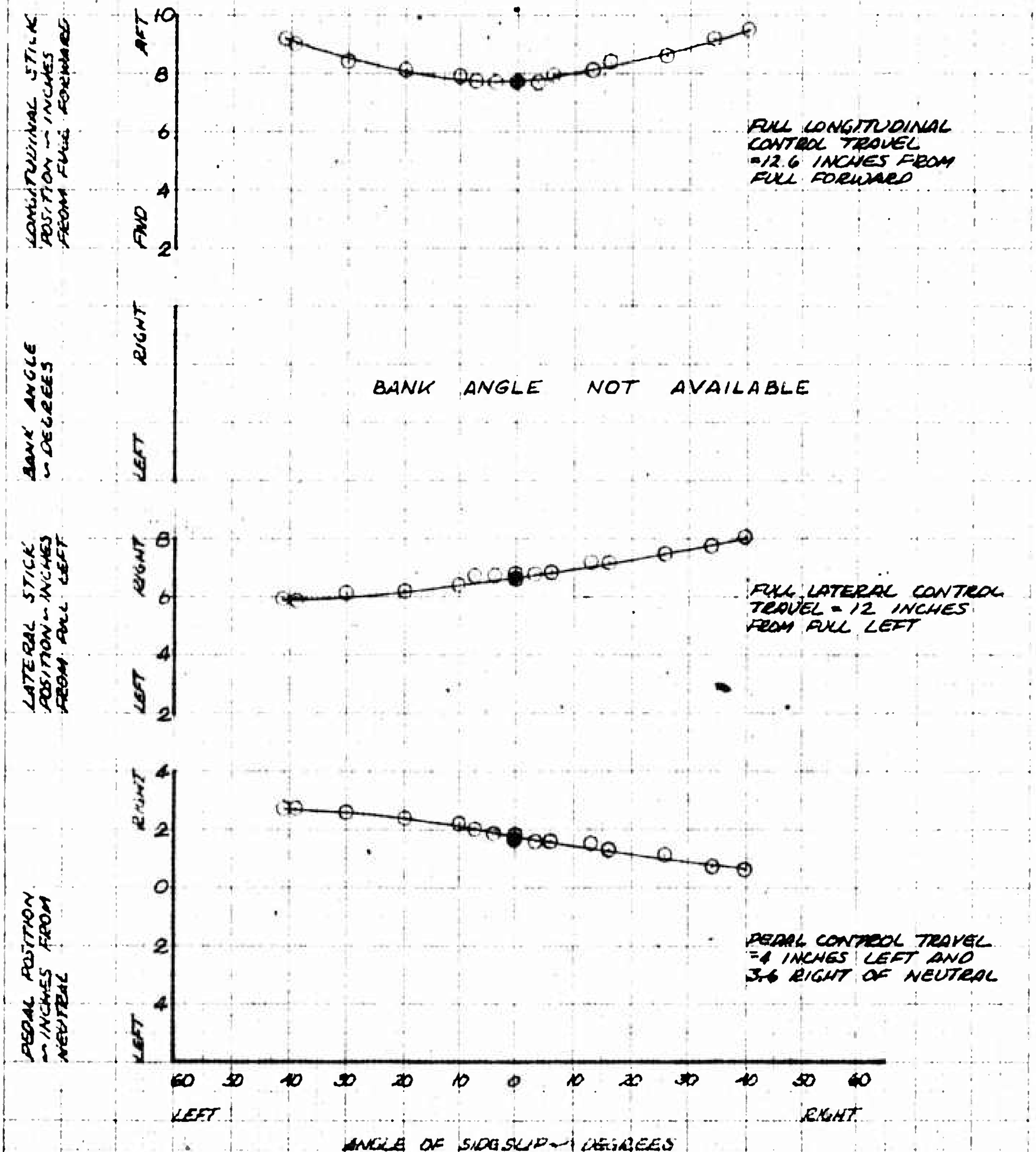

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FIGURE NO 59

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_o ~FT	AVG GW ~LB	AVG C.G. ~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	35	5000	2100	101.5 (AFT)	2.80 LT	465	XM-8	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

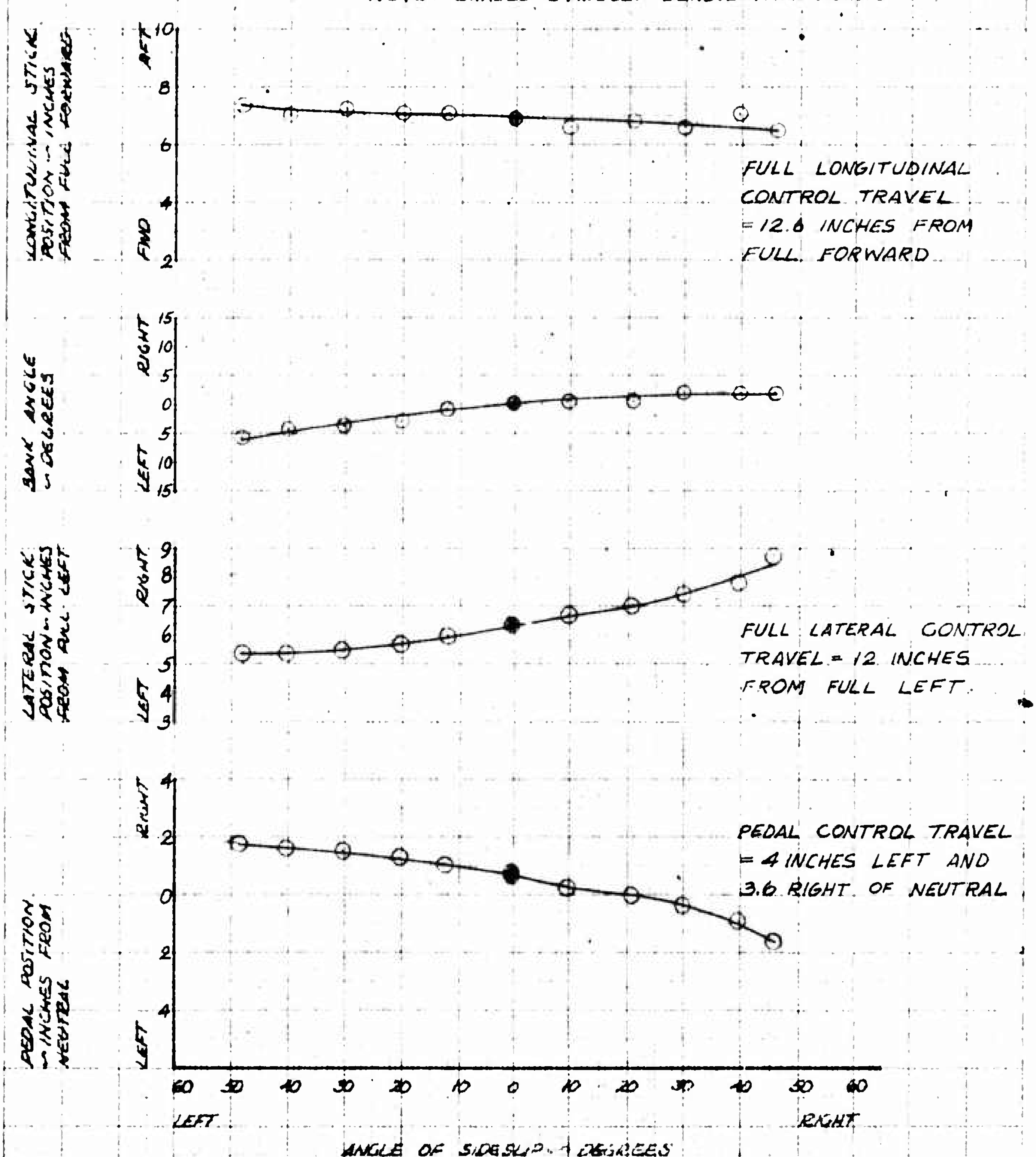


FIGURE NO 60

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	90	5000	2130	101.5(AFT)	2.8 RT	465	XM-8	LEVEL FLIGHT

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

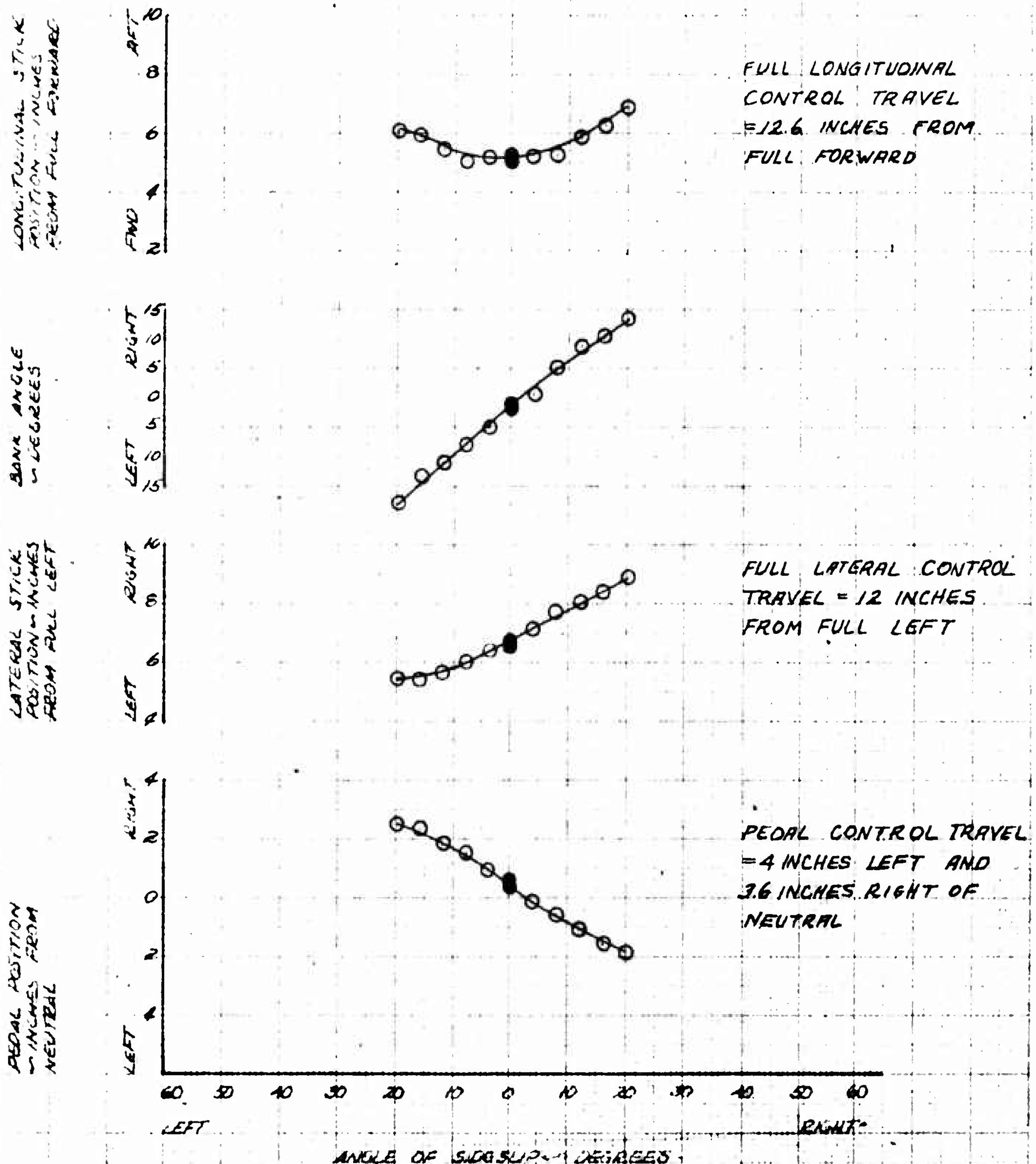


FIGURE NO. 61
STATIC LATERAL-DIRECTIONAL STABILITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG C.G. ~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	55	5000	2150	101.3(AFT)	2.80 LT	465	XM-8	CLIMB

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

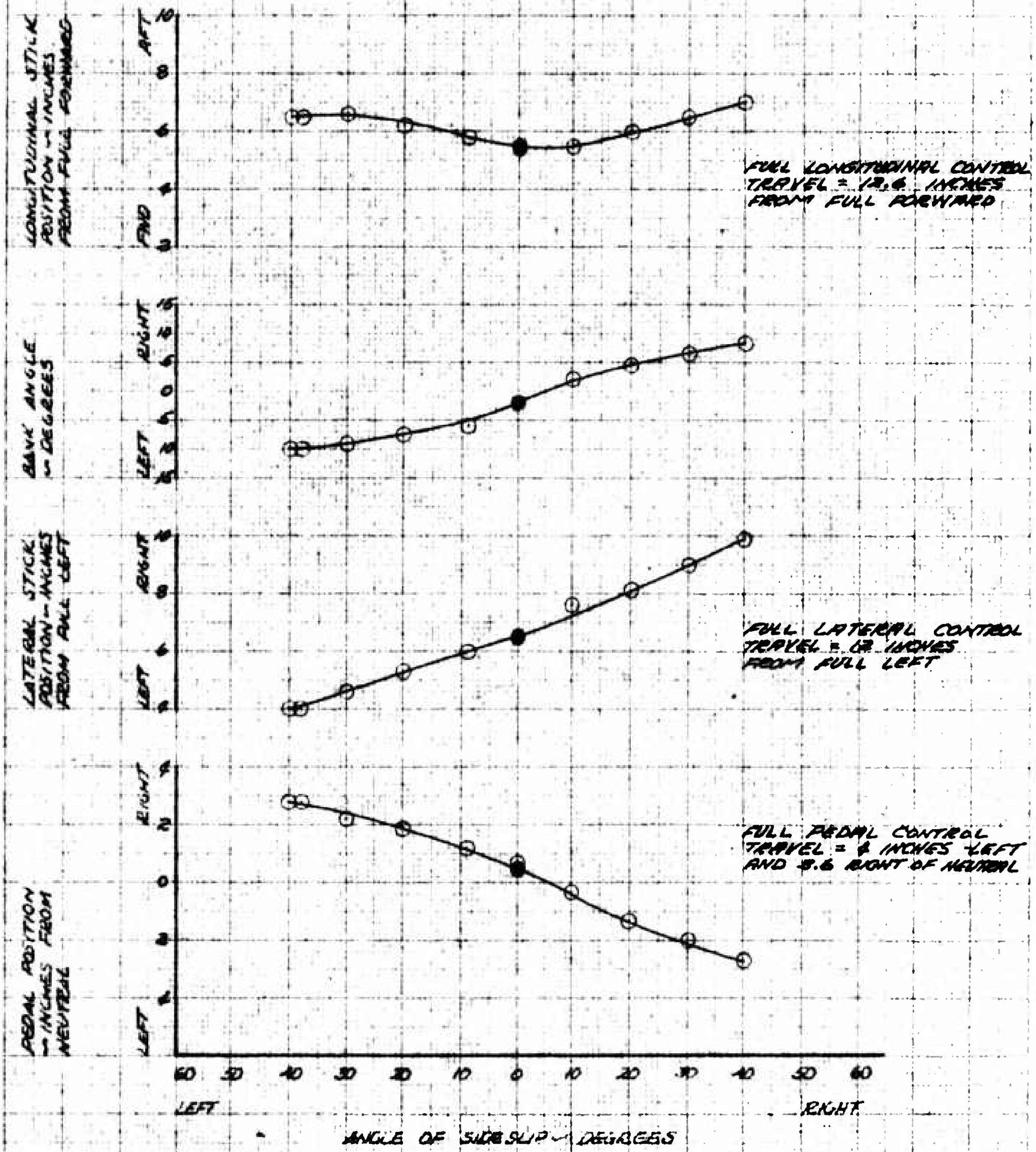


FIGURE NO. 62

STATIC LATERAL-DIRECTIONAL STABILITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_P ~FT	AVG GW ~LB	AVG C.G ~IN. LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
O	55	5000	2080	101.5 (AFT)	2.8RT.	465	XM-8	AUTOROTATION

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS

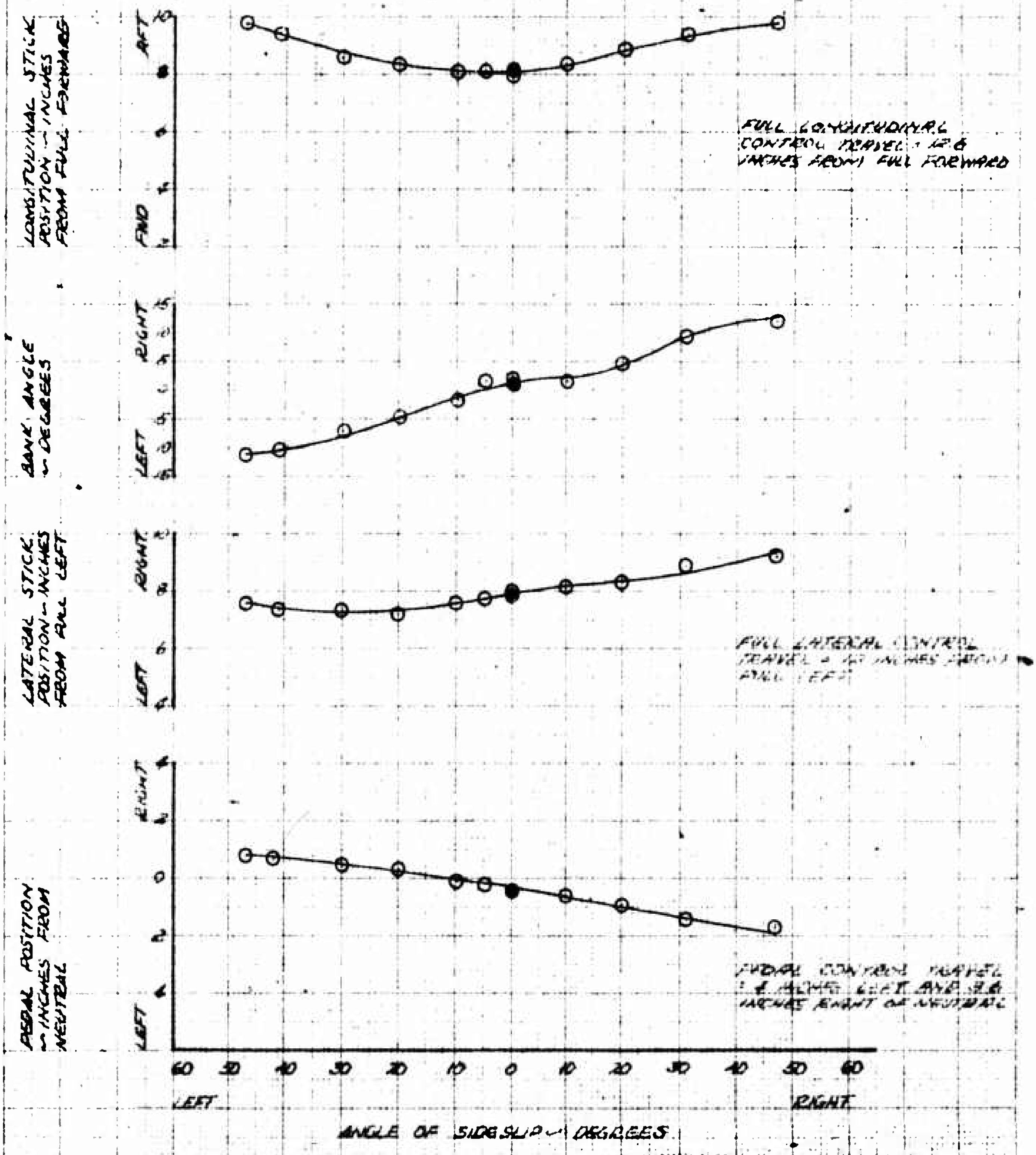
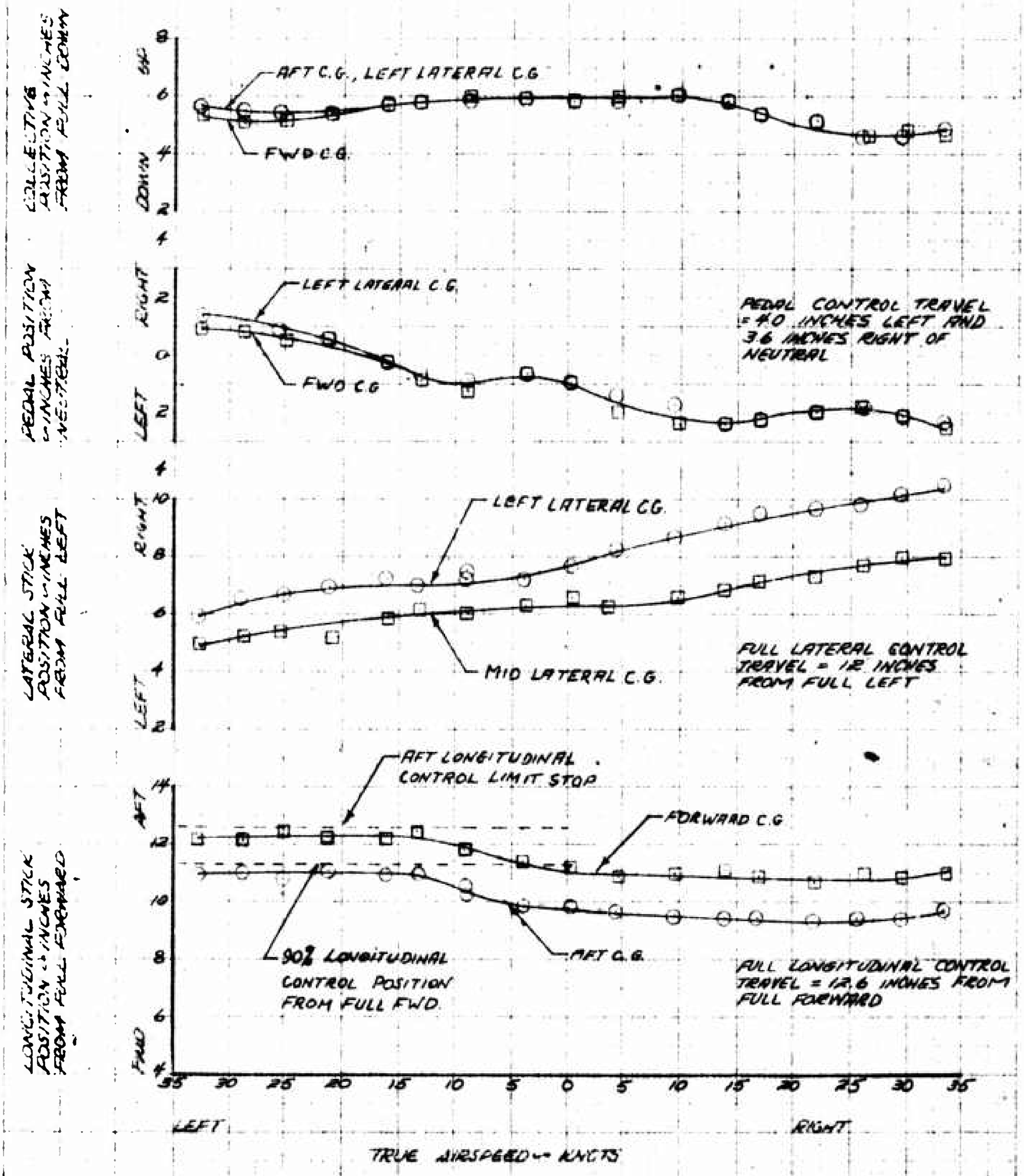


FIGURE NO. 63

CONTROL POSITIONS IN SIDEWARD FLIGHT

OH- A USA S/N

SYM	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	800	2150	102.5(AFT)	2.89 RT	465	CLEAN	LEVEL FLT (IGE)
□	800	2150	97.(FWD)	.5 RT	465	CLEAN	LEVEL FLT (IGE)



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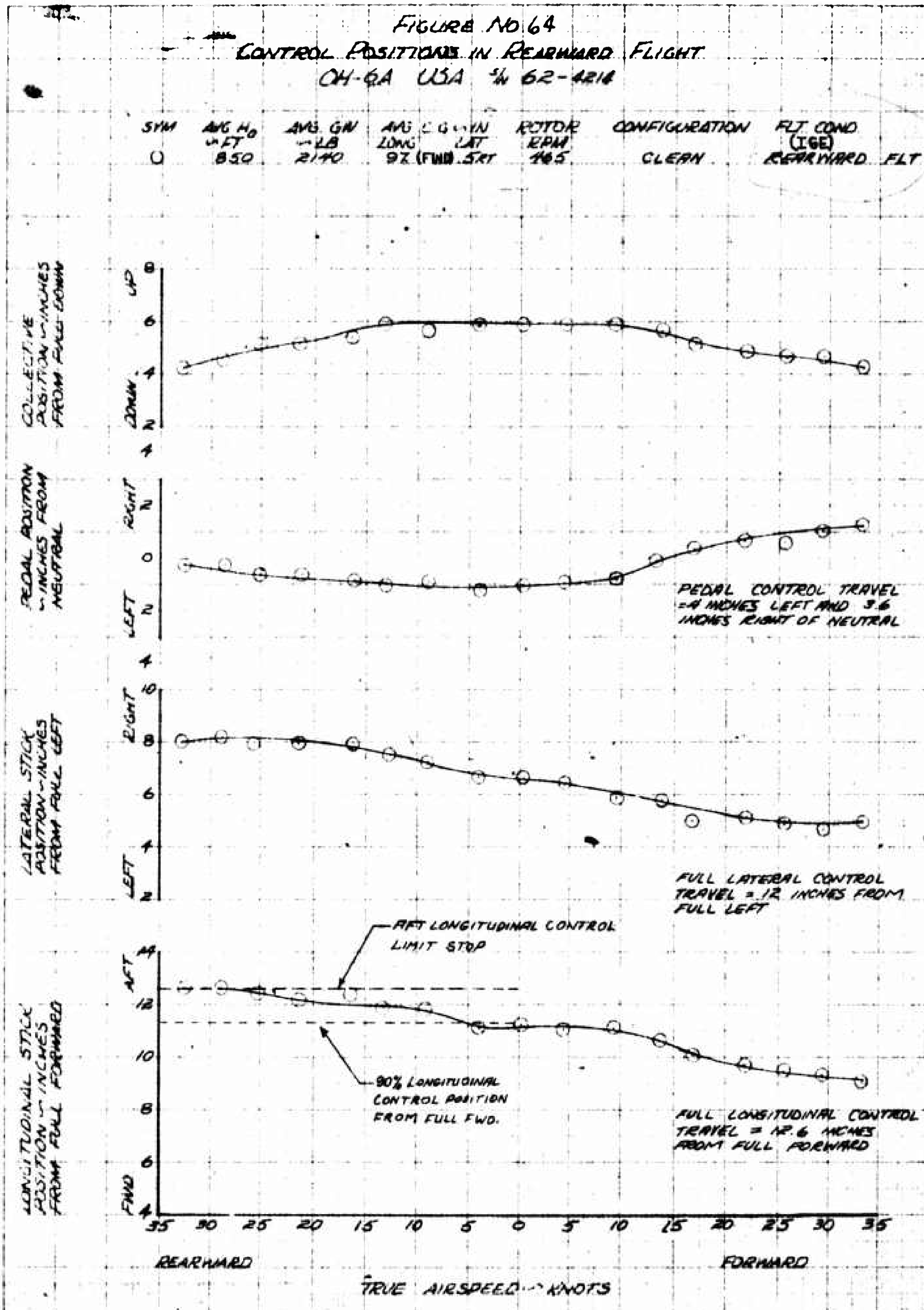

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FORWARD LONGITUDINAL PULSE

CONFIGURATION: CLEAN [illegible] FLIGHT CONDITION: HOVER [illegible]

[illegible] 12 [illegible] INCHES TRIM CAS: ZERO

[illegible] DENSITY ALTITUDE: 1200 FEET

[illegible] 103.5 INCHES (AFT) ROTOR SPEED: 465 RPM

PITCH ——— ROLL - - - - YAW ---------

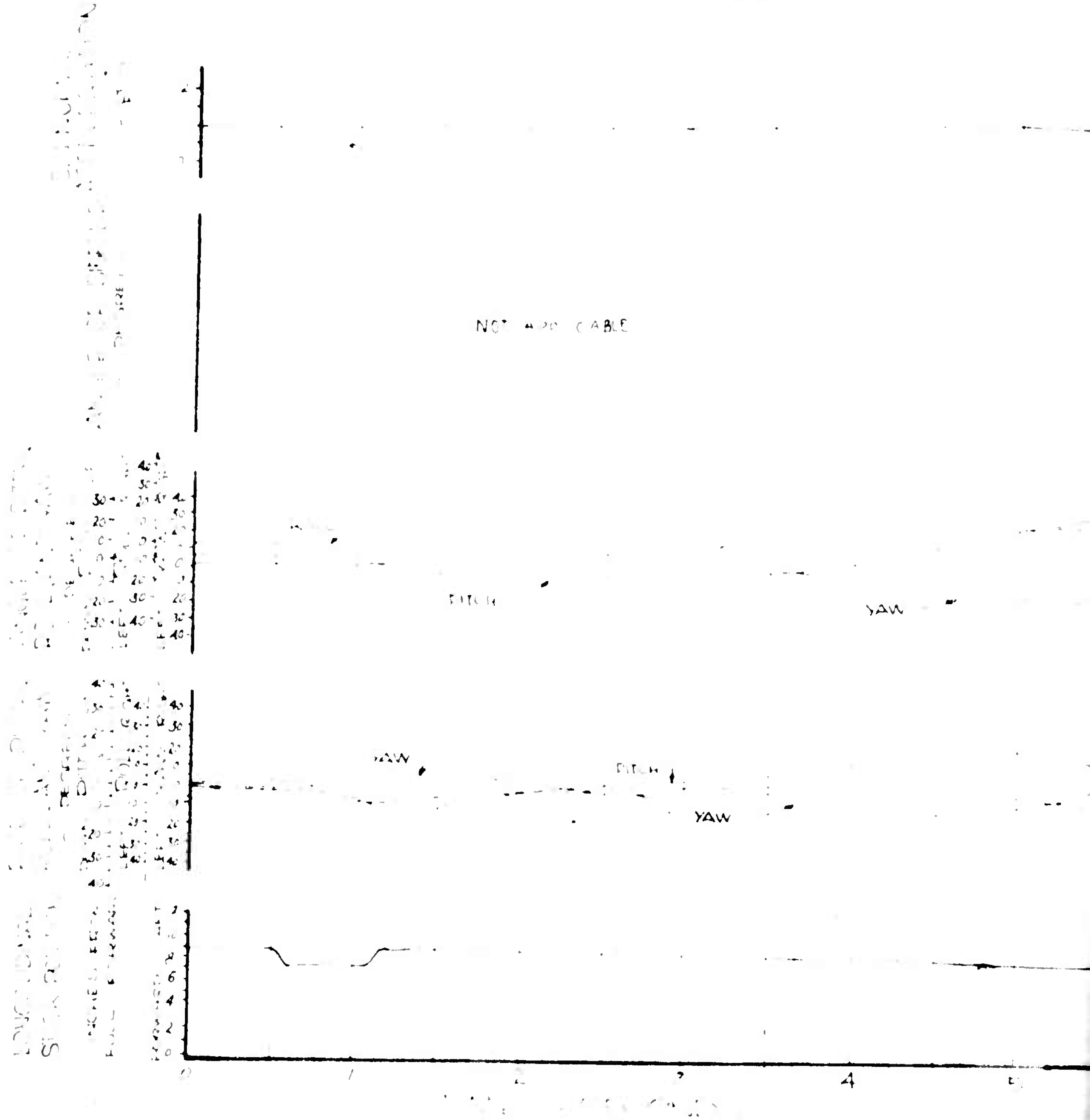


FIGURE NO. 66

AFT LONGITUDINAL PULSE

OH-6A [illegible] S/N 62-4214

CONFIGURATION: CLEAN — FLIGHT CONDITION: LEVEL FLIGHT

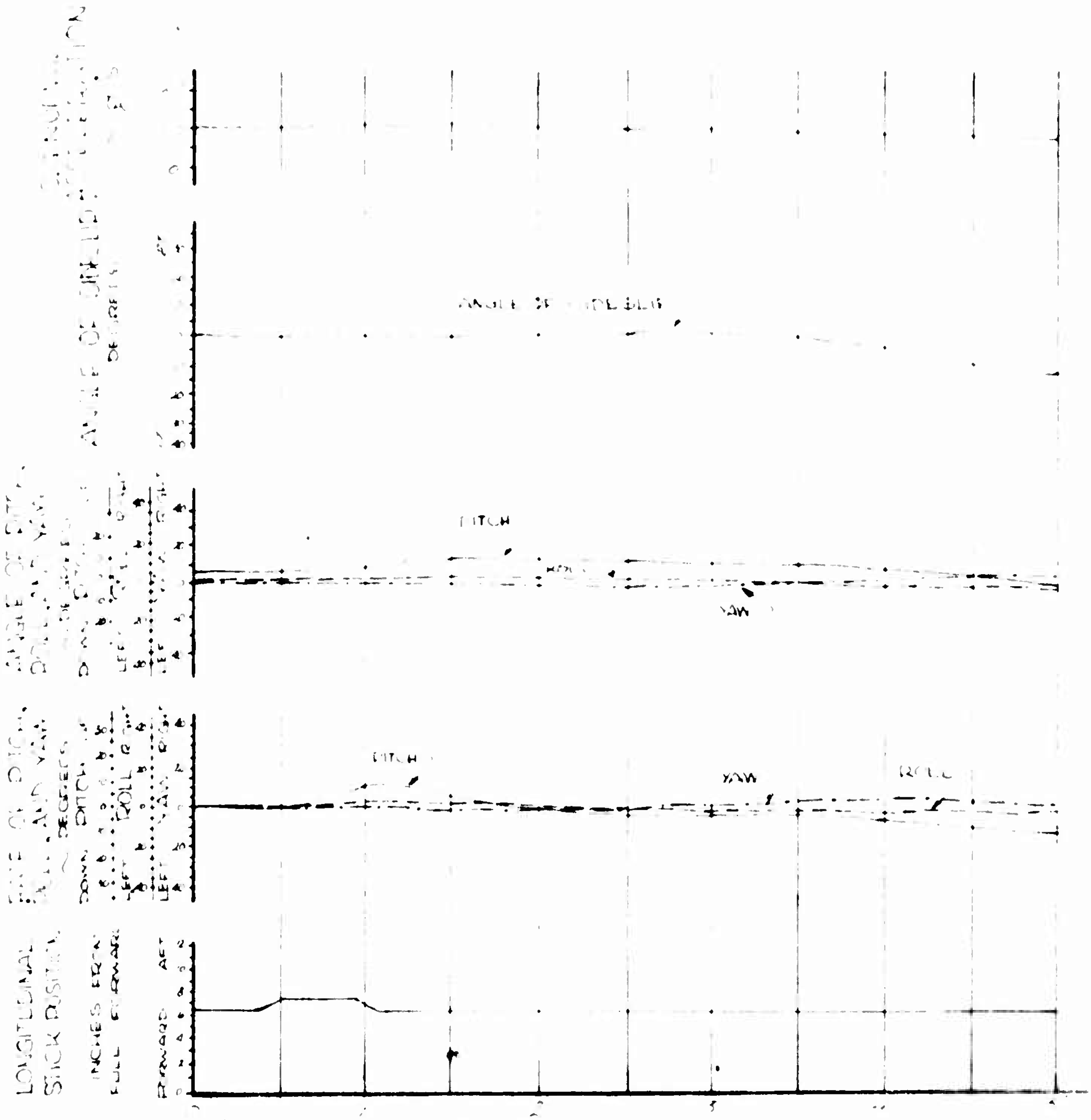
FULL LONGITUDINAL TRAVEL: 12.6 INCHES — TRIM CAS: 35 KNOTS

AVERAGE GROSS WEIGHT: 2160 LBS — DENSITY ALTITUDE: 5000 FEET

LONG. C.G. LOCATION: 103.5 INCHES (AFT) — ROTOR SPEED: [illegible] RPM

LATERAL C.G. LOCATION: [illegible]

PITCH ———— ROLL - - - - YAW — - — -



TIME ~ SECONDS

FIGURE NO. 47

FORWARD LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN — FLIGHT CONDITION: LEVEL FLIGHT

FULL LONGITUDINAL TRAVEL: 12.6 INCHES — TRIM CAS: 35 KNOTS

AVERAGE GROSS WEIGHT: 2160 LBS — DENSITY ALTITUDE: 5000 FEET

LONG. C.G. LOCATION: 104 INCHES (AFT) — ROTOR SPEED: [illegible] R.P.M.

LATERAL C.G. LOCATION: [illegible] IN. (LEFT)

PITCH ———— ROLL — — — — YAW — · — · —

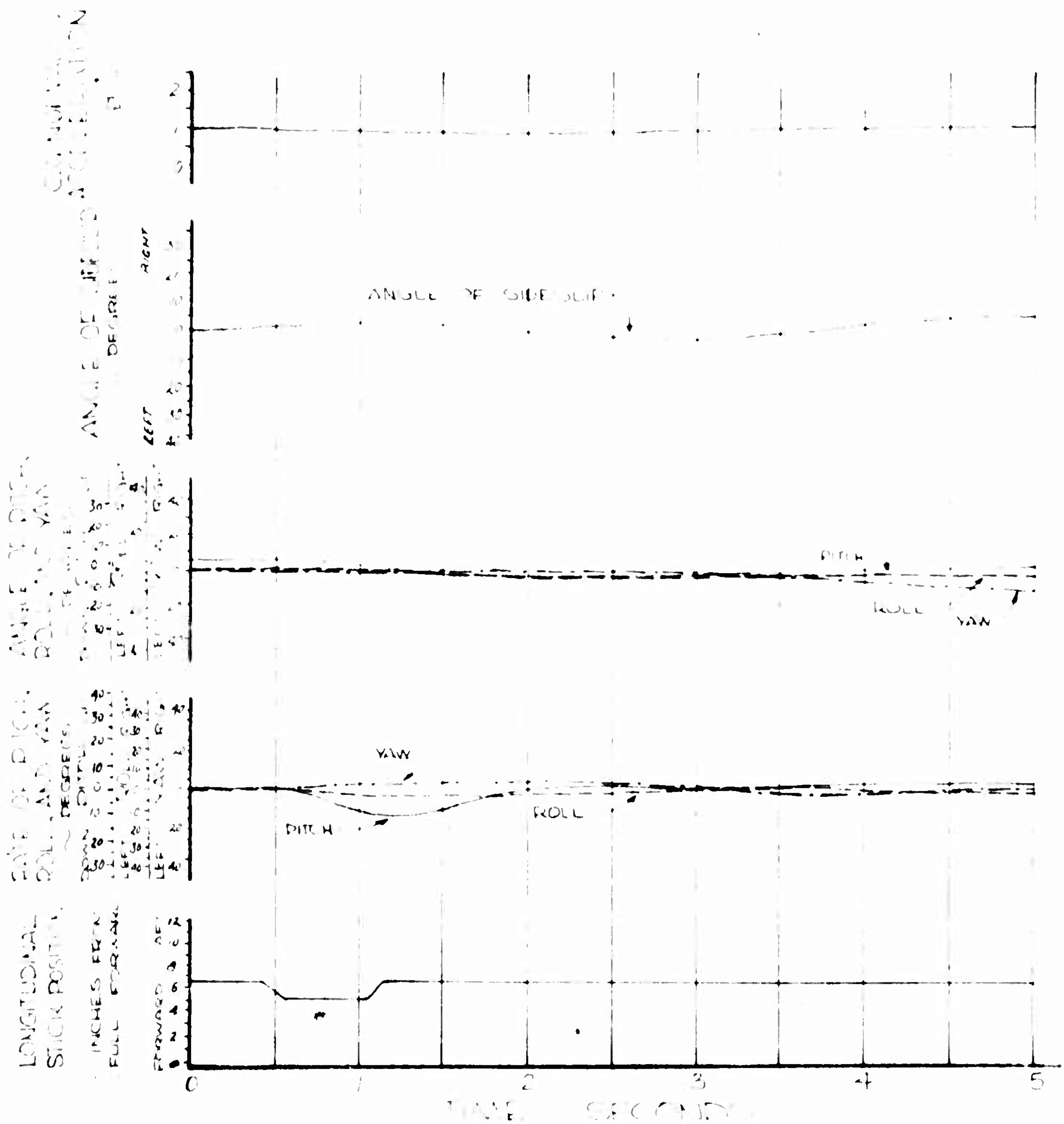


FIGURE NO. 68

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2140 LBS
LONG C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: 5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 90 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

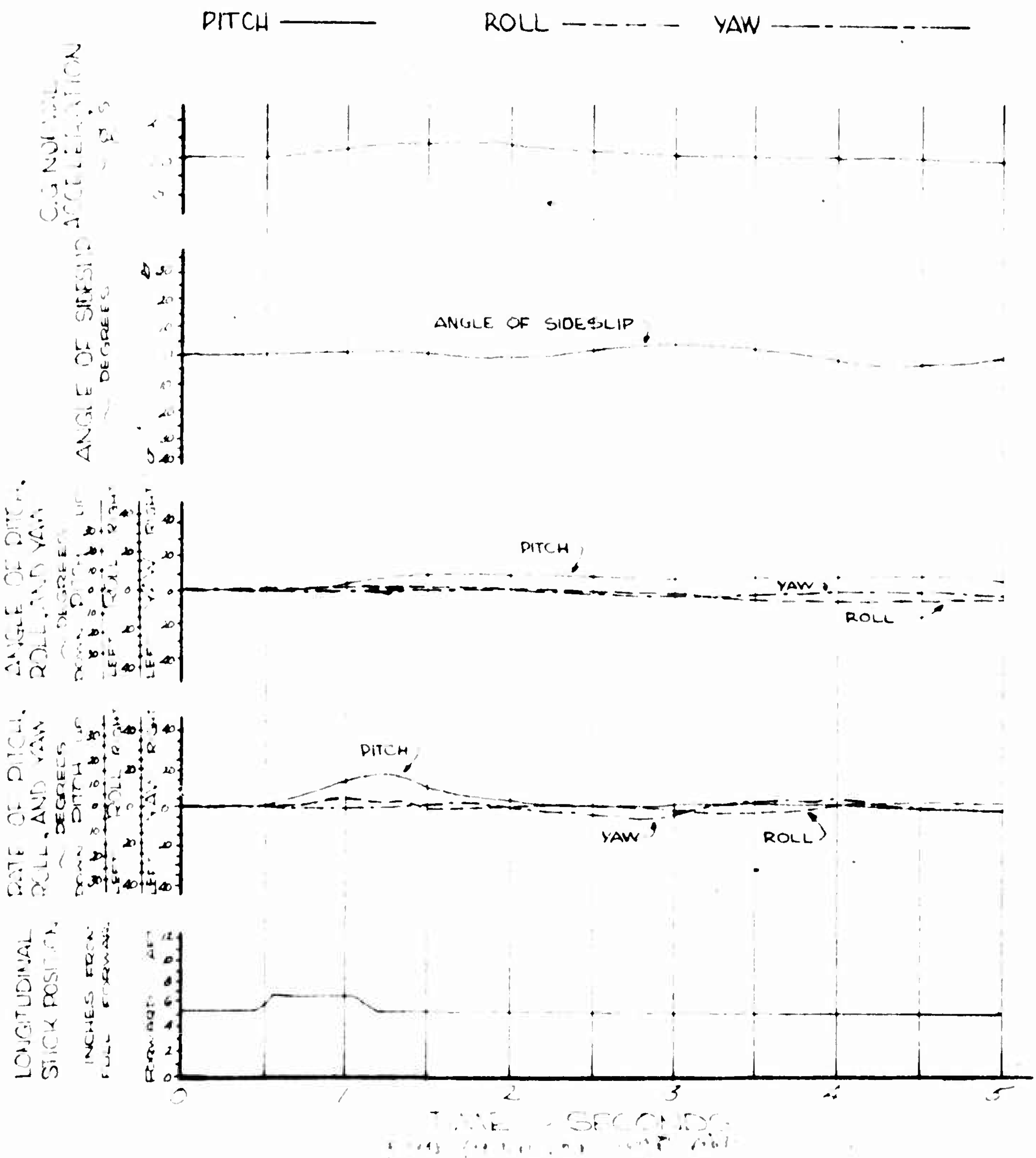


FIGURE NO. 69

FORWARD LONGITUDINAL PULSE

OH 6A, U.S.A. S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 90 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH ———— ROLL - - - - YAW - - - - - -

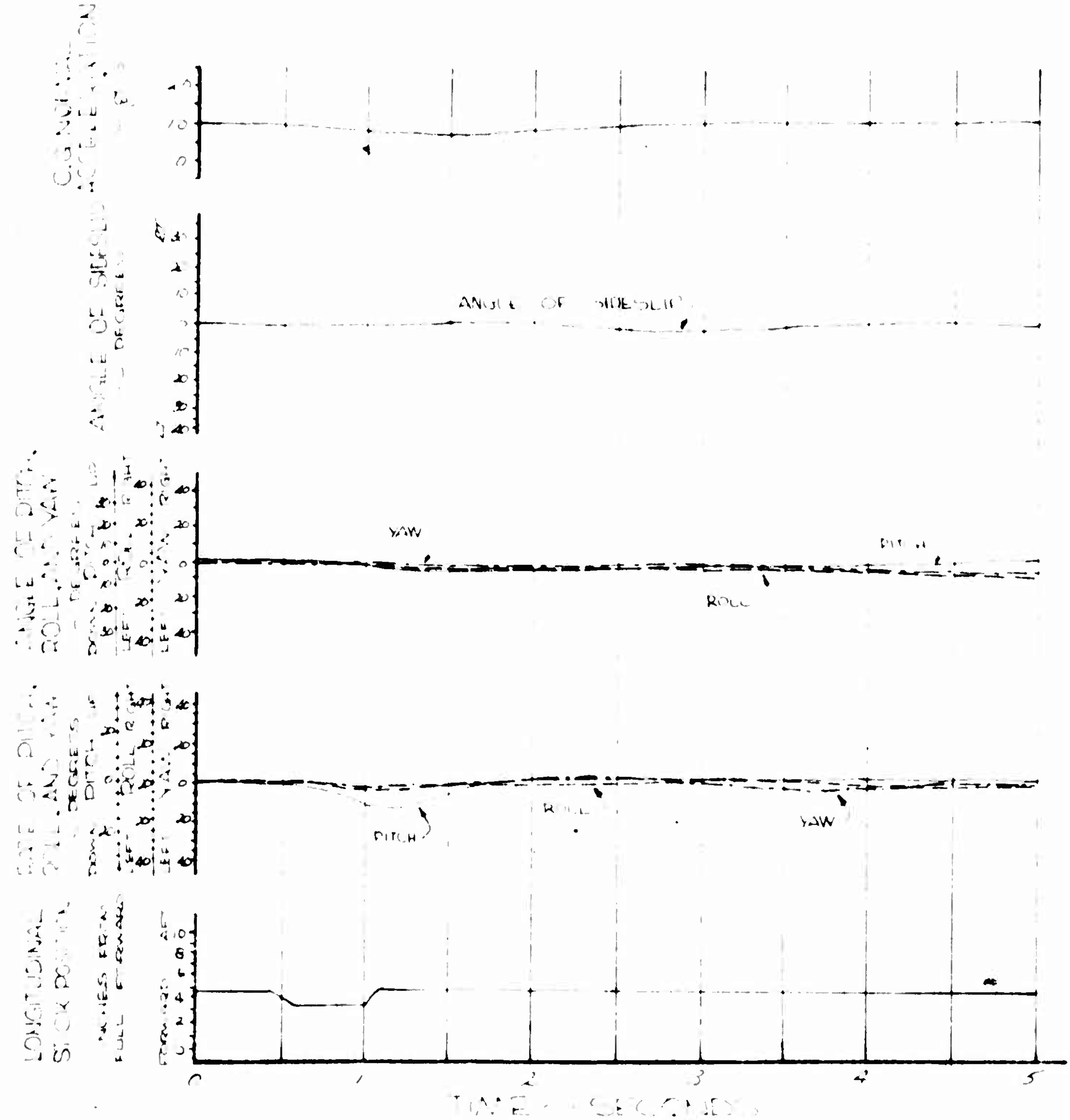


FIGURE NO. 70

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN

FULL LONGITUDINAL TRAVEL : 12.5 INCHES

AVERAGE GROSS WEIGHT : 2100 LBS

LONG. C.G. LOCATION : 103.5 INCHES (AFT)

LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION : LEVEL FLIGHT

TRIM CAS : 102 KNOTS

DENSITY ALTITUDE : 5000 FEET

ROTOR SPEED : 465 RPM

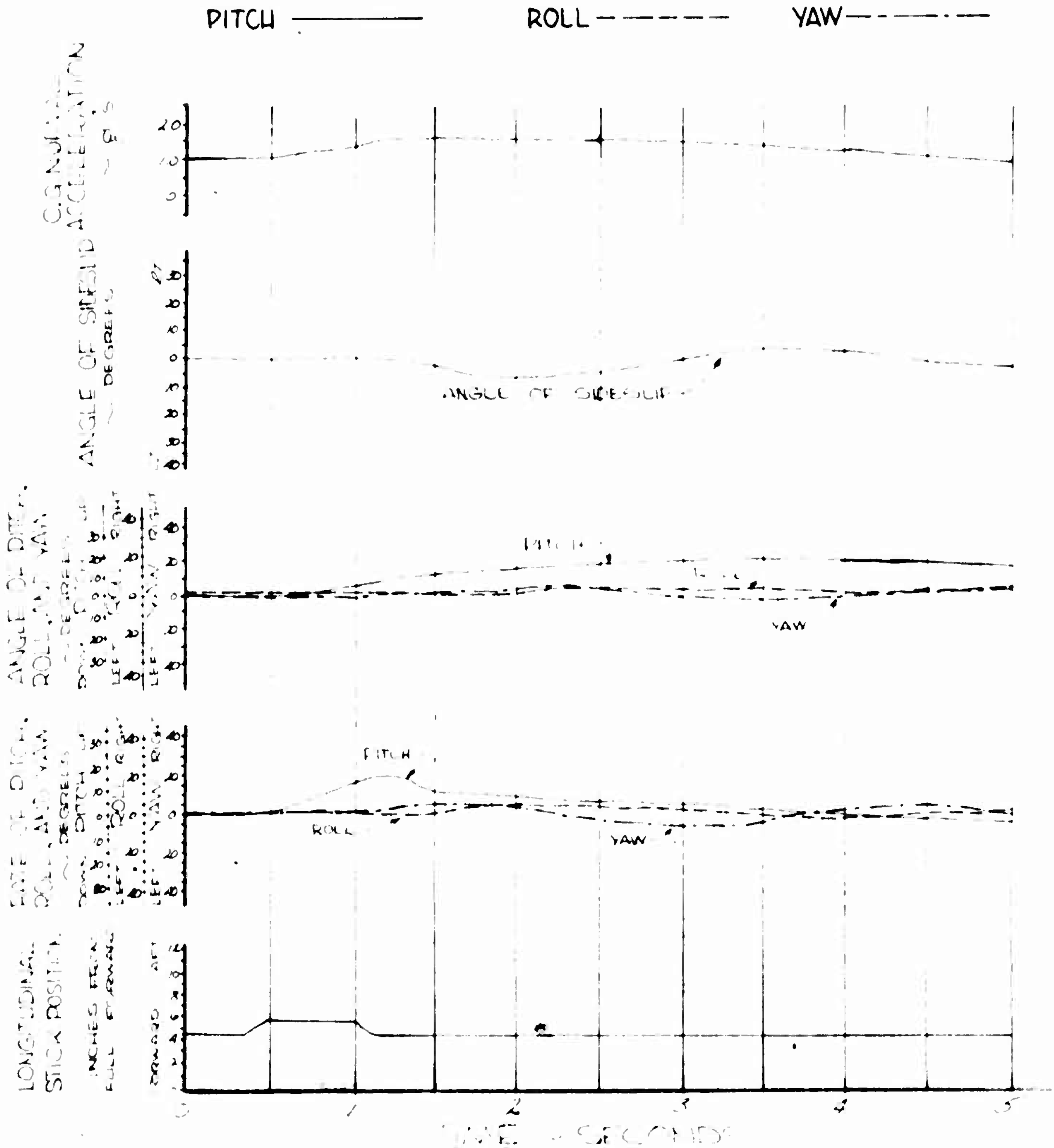


FIGURE NO. 71

FORWARD LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN	FLIGHT CONDITION: CLIMB
FULL LONGITUDINAL TRAVEL: 12.5 INCHES	TRIM CAS: 55 KNOT
AVERAGE GROSS WEIGHT: 2160 LBS	DENSITY ALTITUDE: 5000 FEET
LONG. C.G. LOCATION: 103.5 INCHES (AFT)	ROTOR SPEED: 465 RPM
LATERAL C.G. LOCATION: [illegible]	

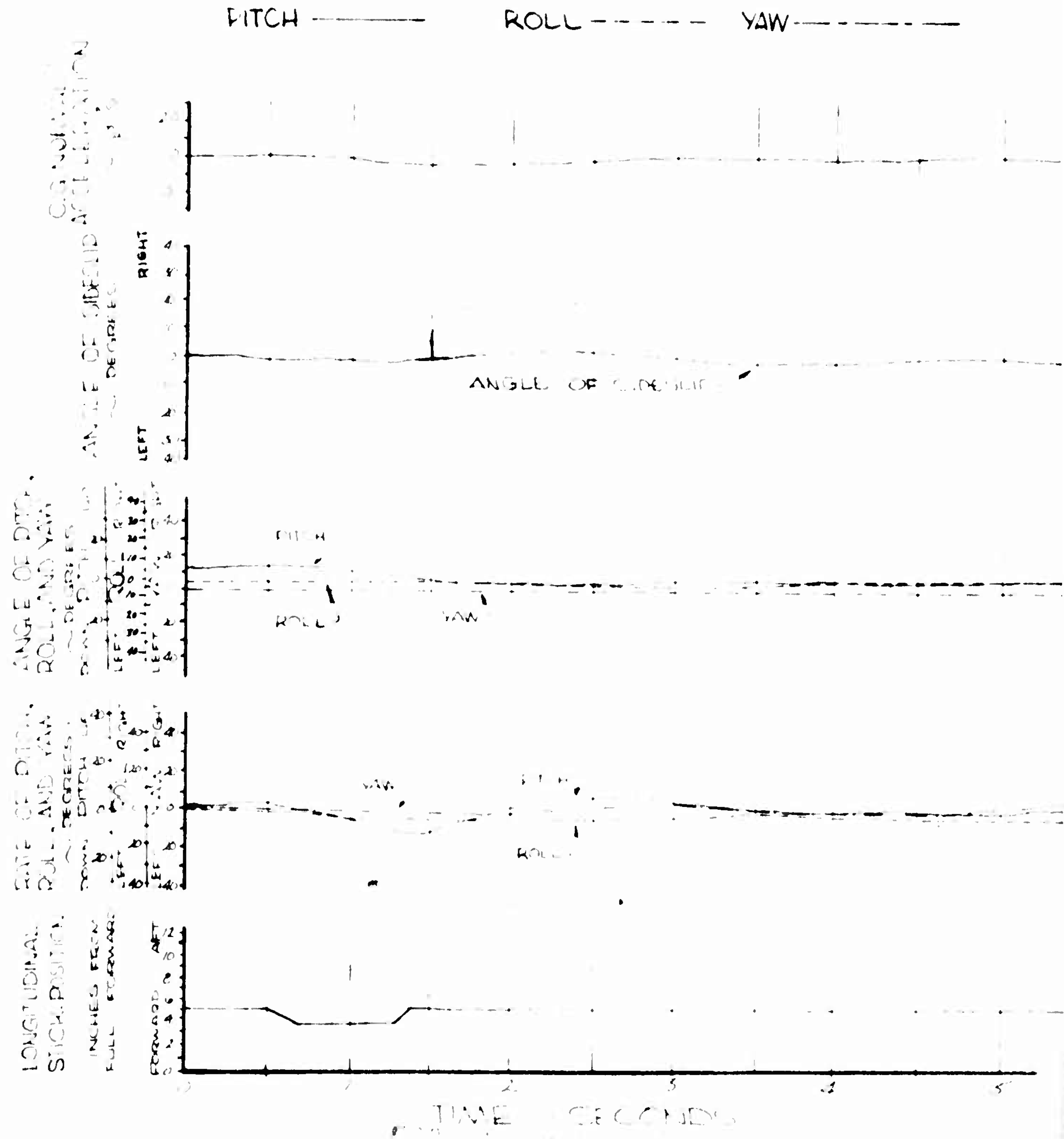


FIGURE NO. 72

AFT LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62 4214

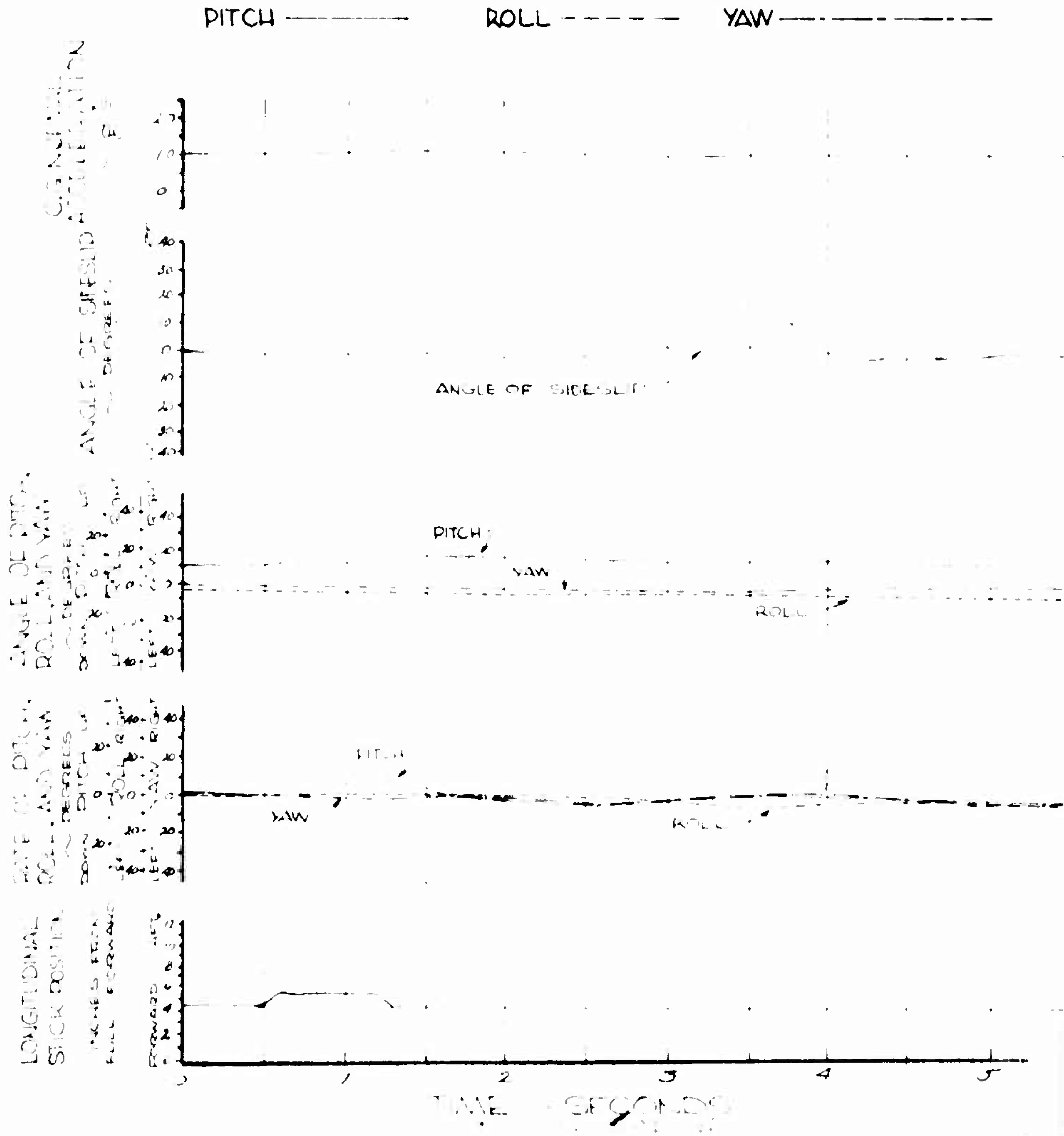
CONFIGURATION: CLEAN — FLIGHT CONDITION: CLIMB

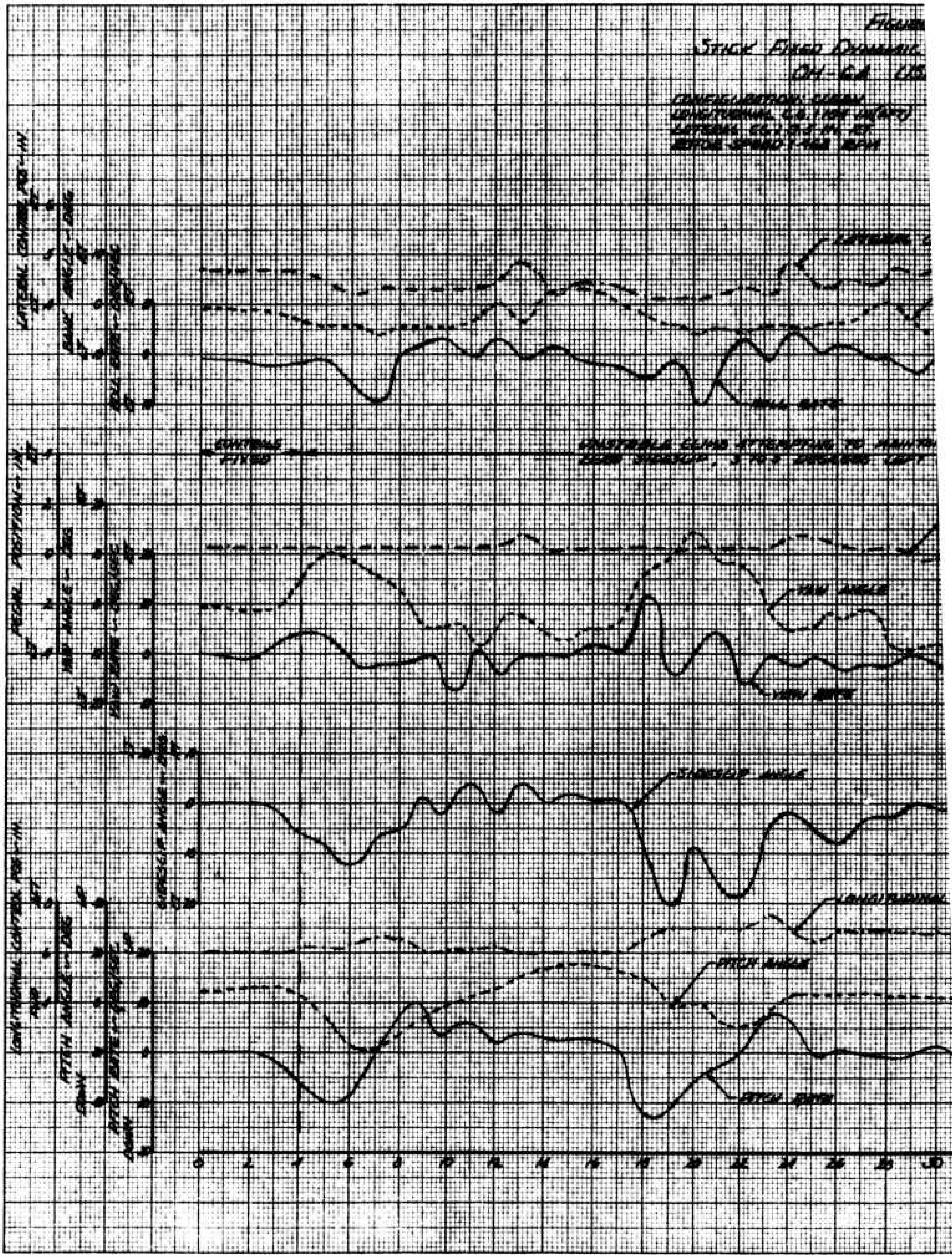
FULL LONGITUDINAL TRAVEL: 12.6 INCHES — TRIM CAS: 55 KNOTS

AVERAGE GROSS WEIGHT: 2160 LBS — DENSITY ALTITUDE: 5000 FEET

LONG. C.G. LOCATION: 103.5 INCHES (AFT) — ROTOR SPEED: 465 RPM

LATERAL C.G. LOCATION: .5 IN (RT)




STICK FIXED DYNAMIC
OH-6A
ROLL RATE
YAW ANGLE
YAW RATE
SIDESLIP ANGLE
PITCH ANGLE
PITCH RATE

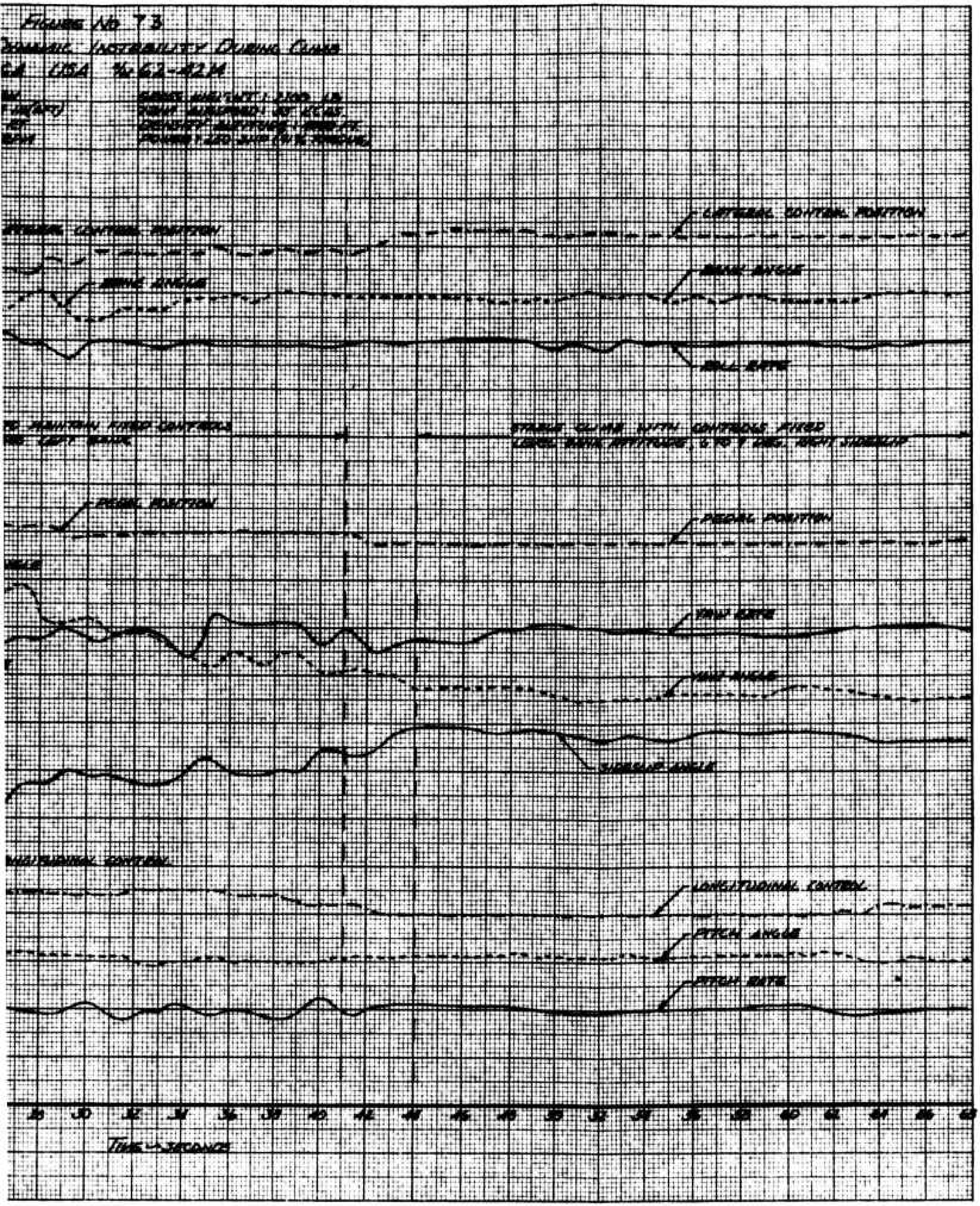


FIGURE No 73
LATERAL CONTROL POSITION
BANK ANGLE
ROLL RATE
PEDAL POSITION
YAW RATE
YAW ANGLE
SIDESLIP ANGLE
LONGITUDINAL CONTROL
PITCH ANGLE
PITCH RATE
30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68
TIME ~ SECONDS

FIGURE NO. 74

AFT LONGITUDINAL PULSE

CH 6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL ... TRAVEL: ... INCHES
AVERAGE GROSS WEIGHT: 2080 LBS
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: AUTOROTATION
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

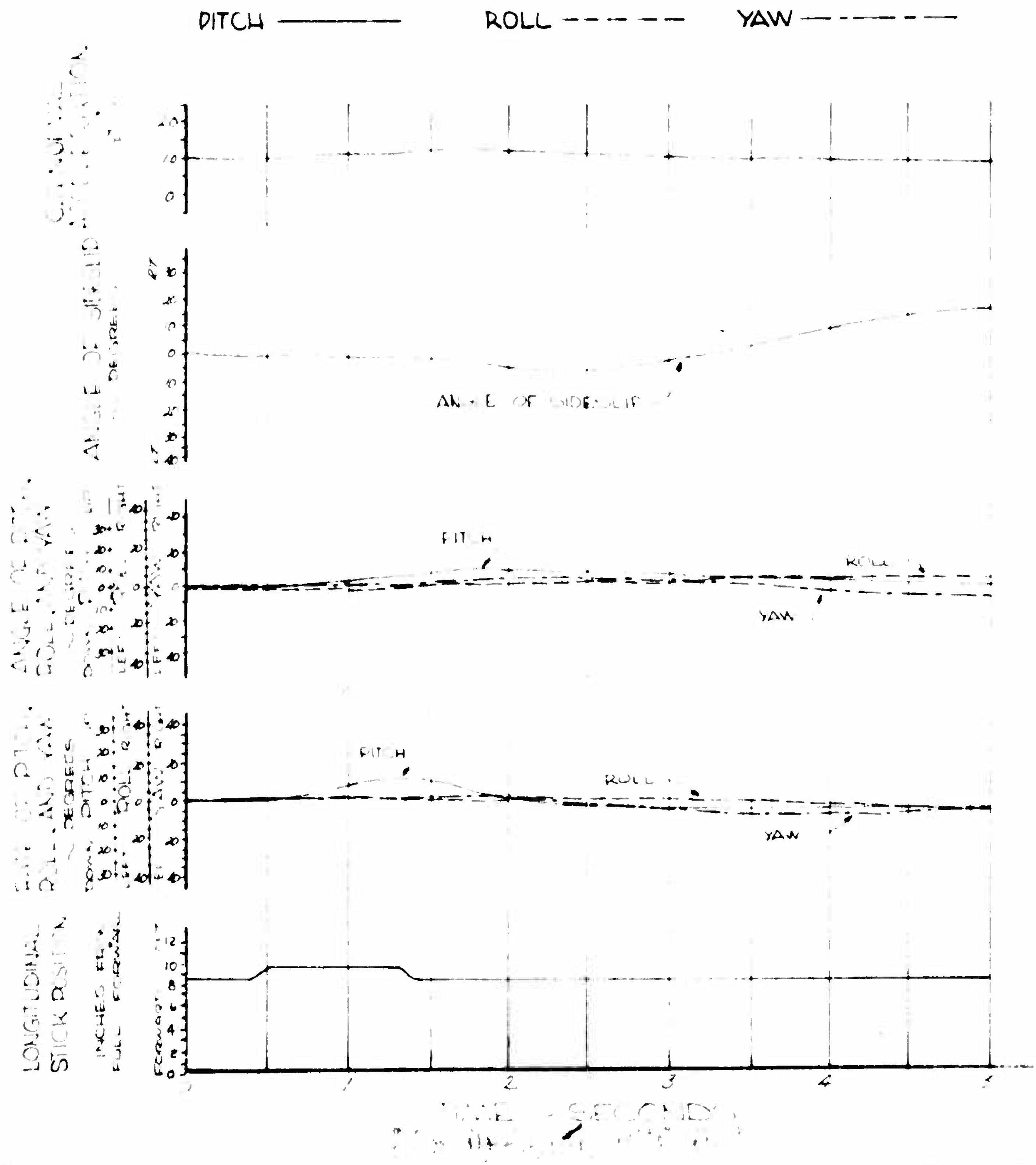


FIGURE NO.

AFT LONGITUDINAL PULSE

CONFIGURATION: CLEAN — FLIGHT CONDITION: LEVEL FLIGHT

: 12 INCHES — TRIM CAS: 102.5 KNOTS

: 2110 LBS. — DENSITY : 5000 FEET

LOCATION: 97 INCHES (FWD) — SPEED: 465 RPM

LATERAL C.G. LOCATION: .5 INCH

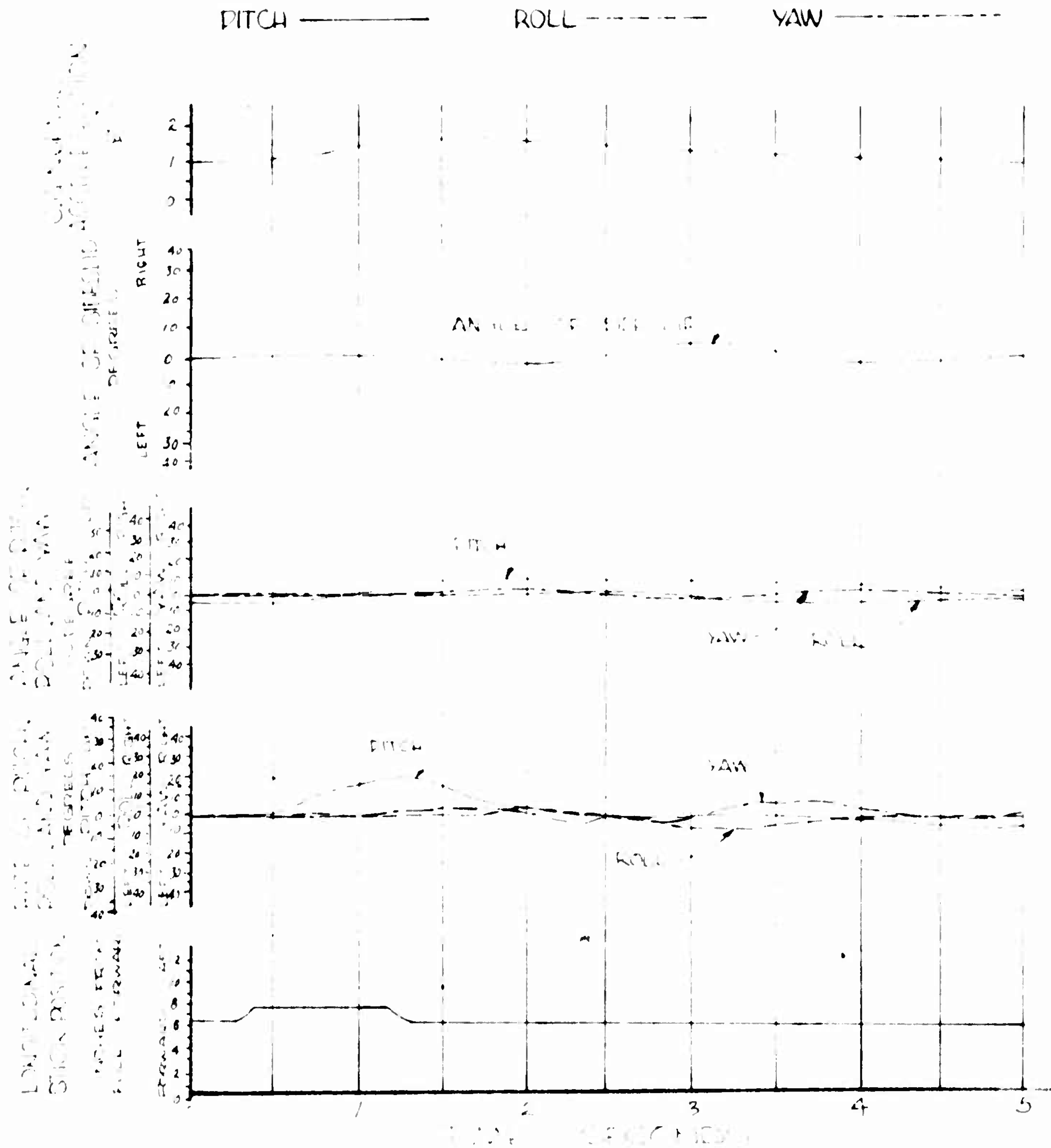


FIGURE NO. 76

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN | FLIGHT CONDITION : CLIMB
FULL LONGITUDINAL TRAVEL :12.6 INCHES | TRIM CAS :55 KNOTS
AVERAGE GROSS WEIGHT : 2130 LBS. | DENSITY ALTITUDE :4750 FEET
LONG. C.G. LOCATION : 97 INCHES (FWD) | ROTOR SPEED : 465 RPM
LATERAL C.G. LOCATION : .5 IN.(RT.)

PITCH ———— ROLL - - - - YAW —·—·—

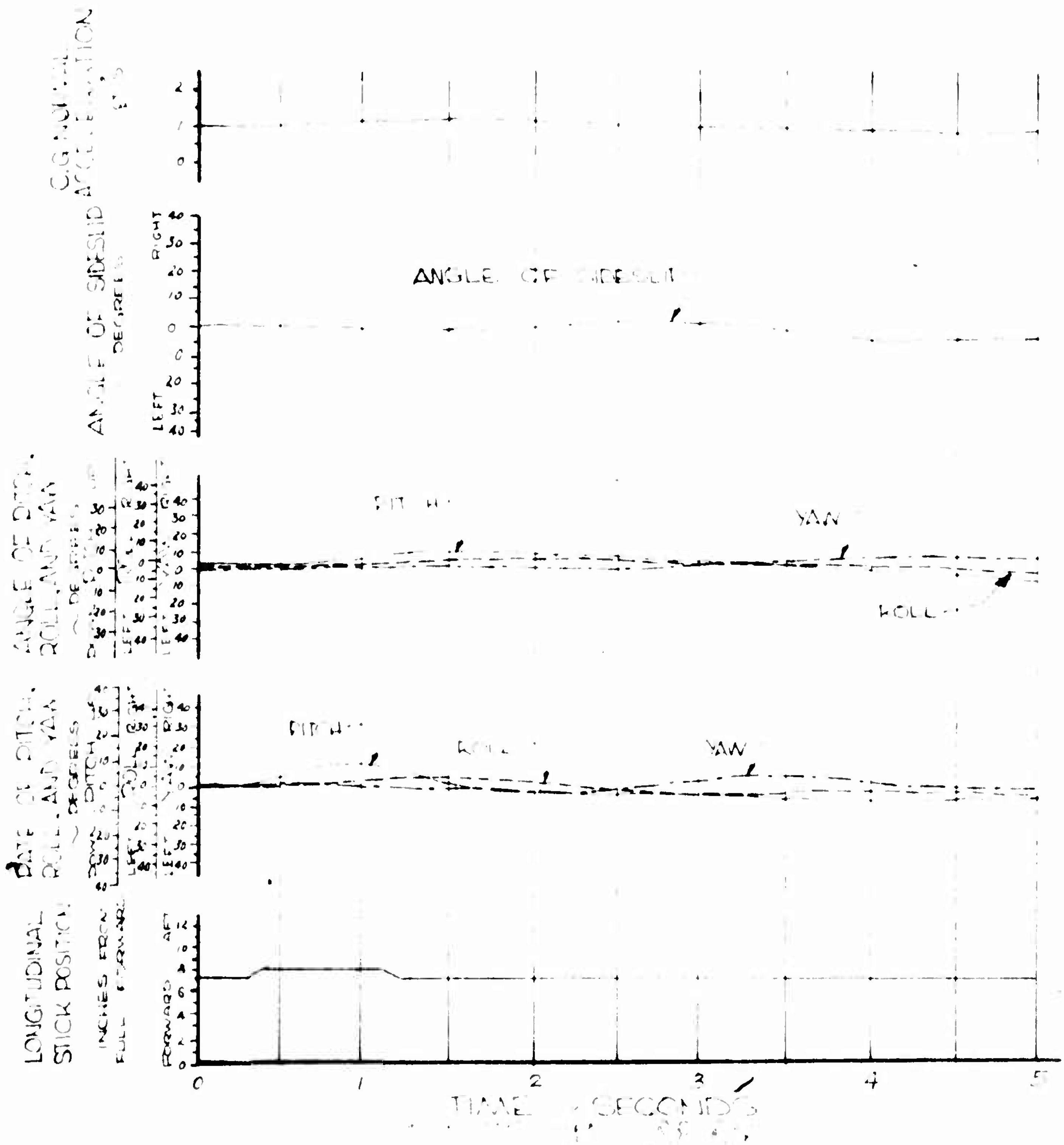


FIGURE NO. 77

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL LONGITUDINAL TRAVEL : 12.6 INCHES
AVERAGE GROSS WEIGHT : 1970 LBS.
LONG C.G. LOCATION : 97 INCHES (FWD)
LATERAL C.G LOCATION : .5 IN. RT

FLIGHT CONDITION : AUTOROTATION
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

PITCH ———— ROLL - - - - - - - YAW — - — - —

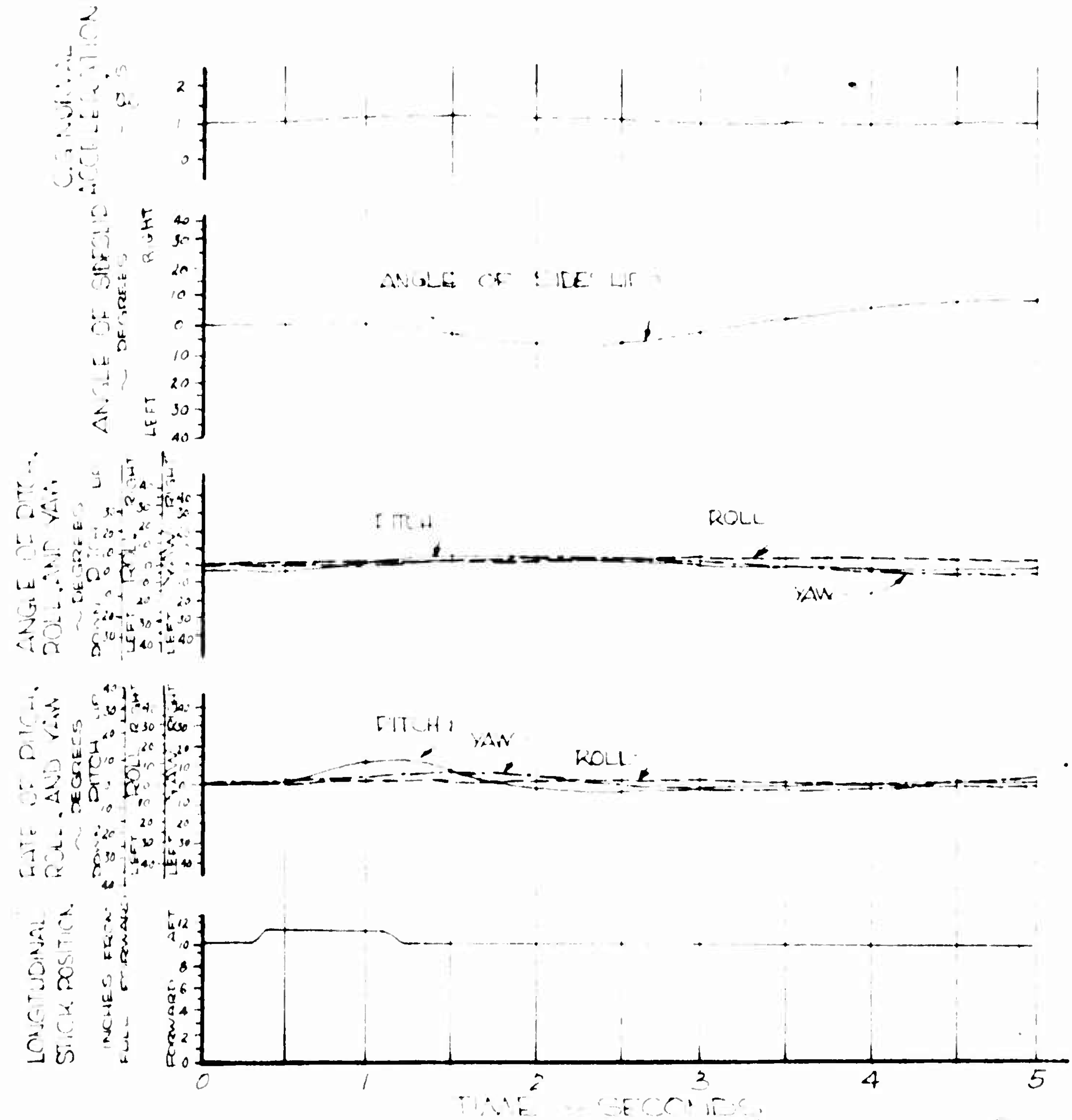


FIGURE NO. 78

AFT LONGITUDINAL PULSE

CH-[illegible] A, U.S.A., S/N 62-42

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2690 LBS.
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .4 IN. (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 70 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH ———— ROLL - - - - - - YAW — - — - —

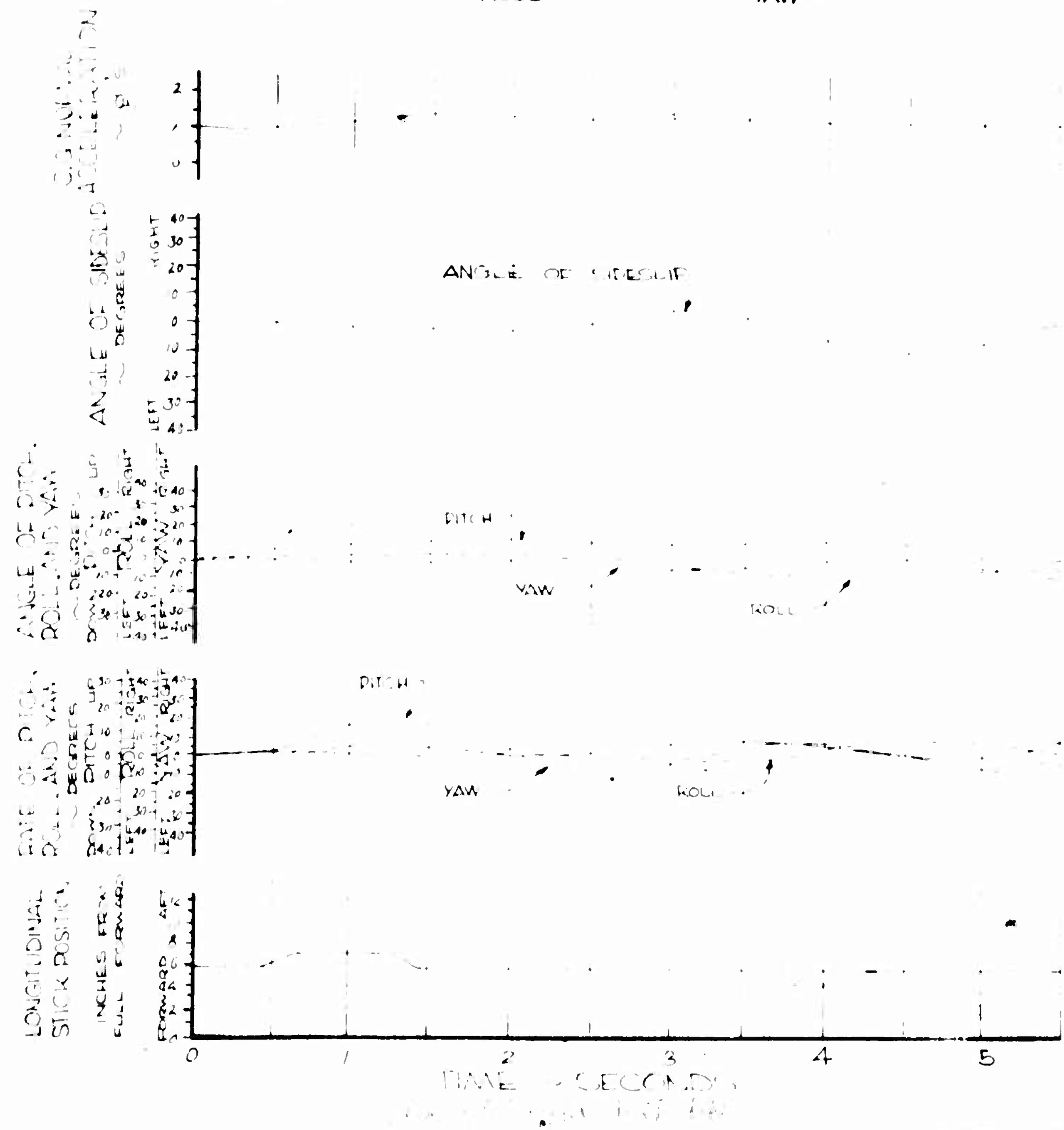


FIGURE NO. 79

FORWARD LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN — FLIGHT CONDITION : CLIMB

FULL LONGITUDINAL TRAVEL : 12.6 INCHES — TRIM CAS : 55 KNOTS

AVERAGE GROSS WEIGHT : 2700 LBS. — DENSITY ALTITUDE : 5000 FEET

LONG. C.G. LOCATION : 103.5 INCHES (AFT) — ROTOR SPEED : 465 RPM

LATERAL C.G. LOCATION : .4 INCHES (RT.)

PITCH ———— ROLL - - - - - - YAW — - — - —

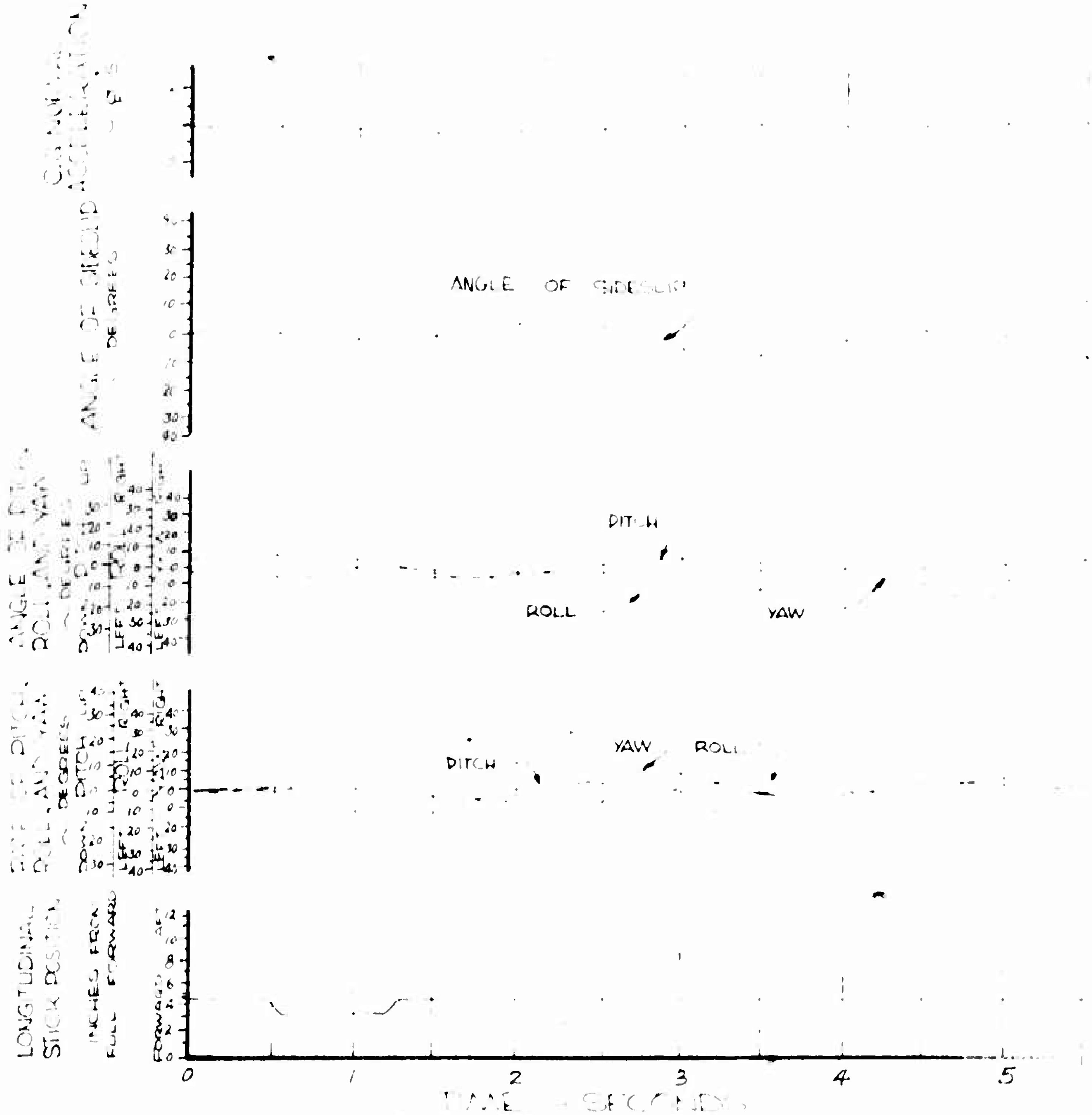


FIGURE NO. 8[illegible]

FORWARD LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4211

CONFIGURATION: CLEAN

[illegible] : [illegible] INCHES

AVERAGE GROSS WEIGHT : 2[illegible] LBS

LONG. C.G. LOCATION : 103.5 IN. [illegible] (AFT).

LATERAL C.G. LOCATION: [illegible] IN. RT.

FLIGHT CONDITION: LEVEL FLIGHT

TRIM CAS: 35 KNOTS

DENSITY ALTITUDE : 10000 FEET

ROTOR SPEED : [illegible] RPM

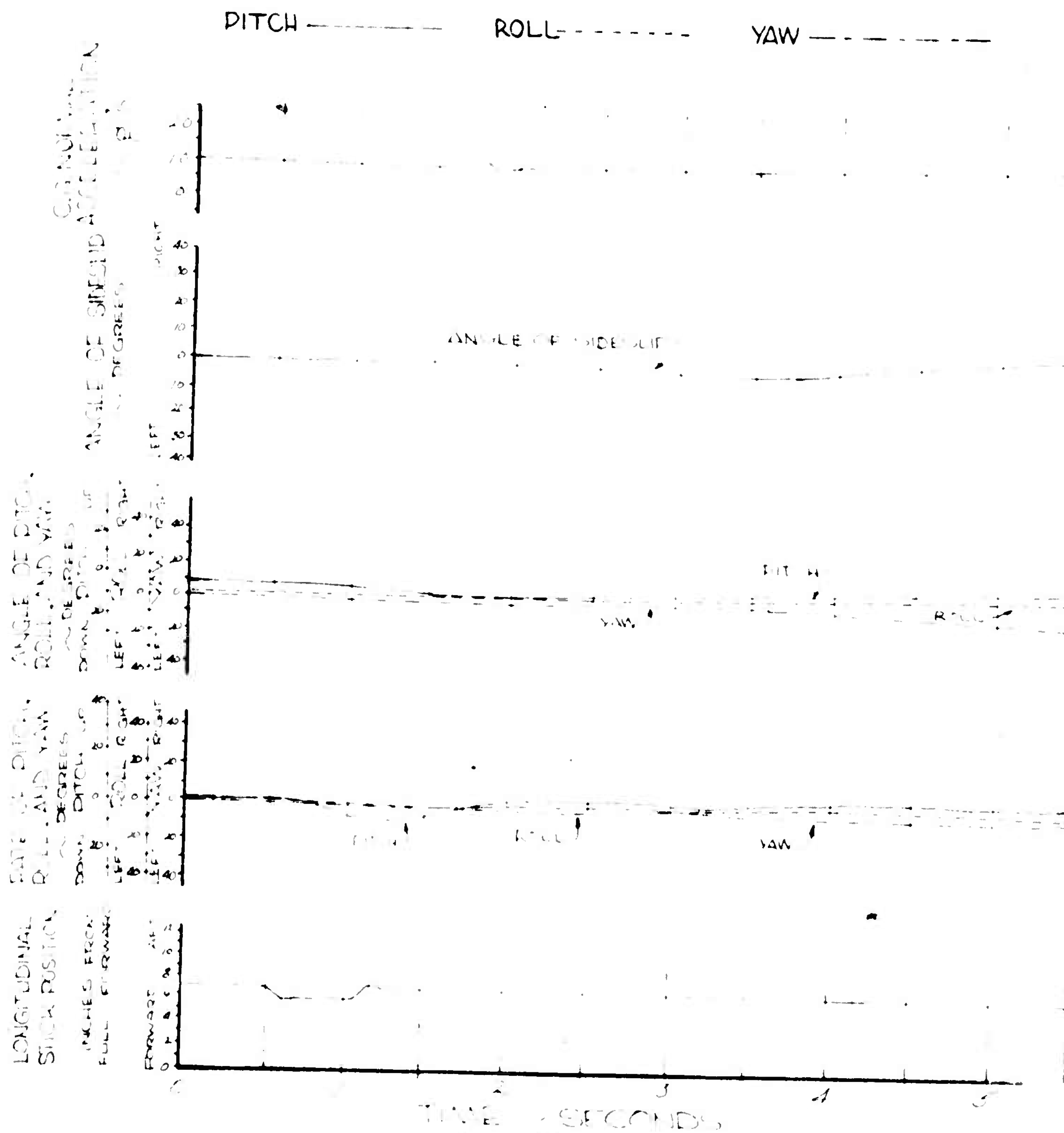


FIGURE NO. 81

AFT LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2080 LBS.
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 89 KNOTS
DENSITY ALTITUDE: 10000 FEET
ROTOR SPEED: 465 RPM

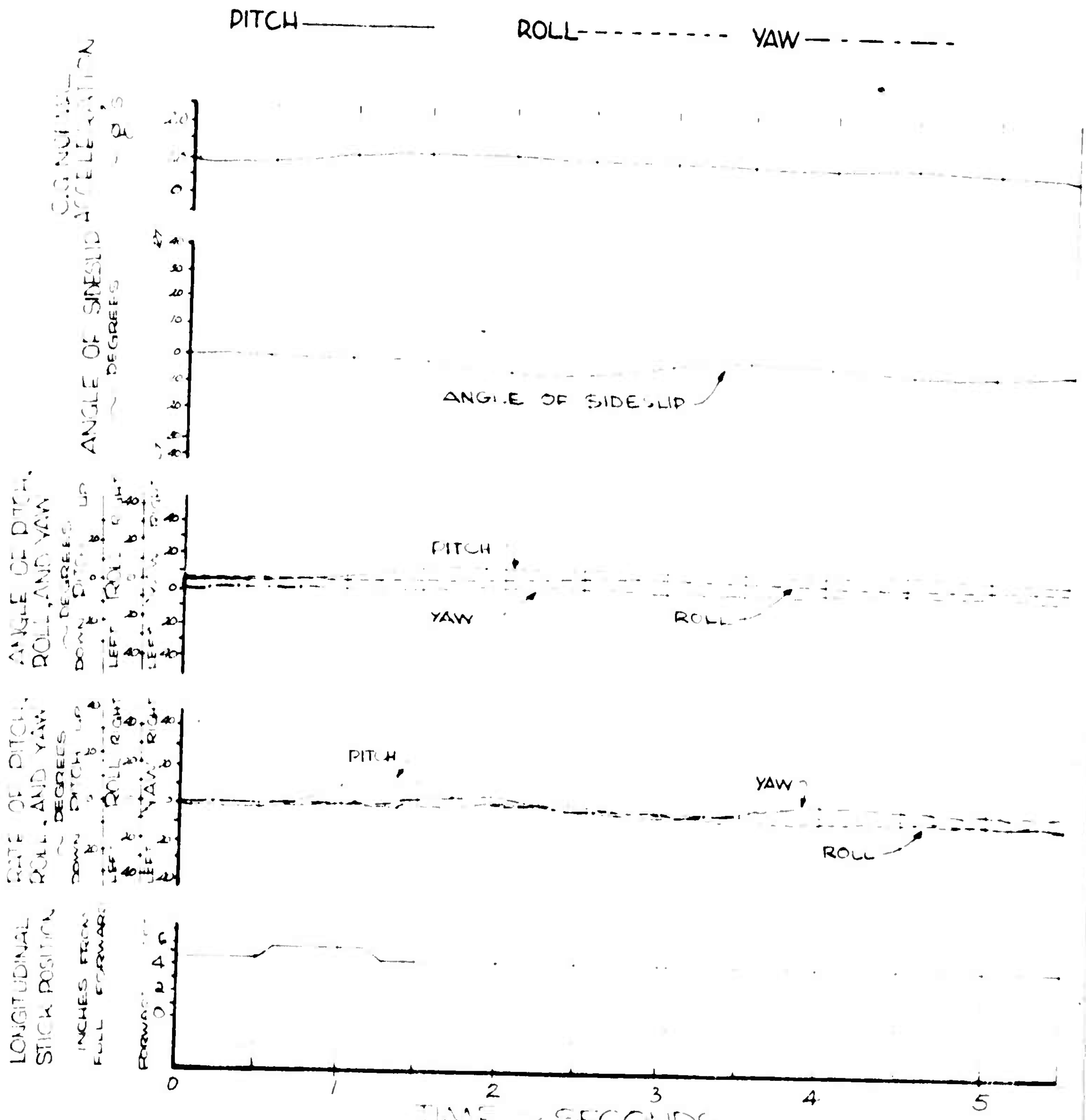
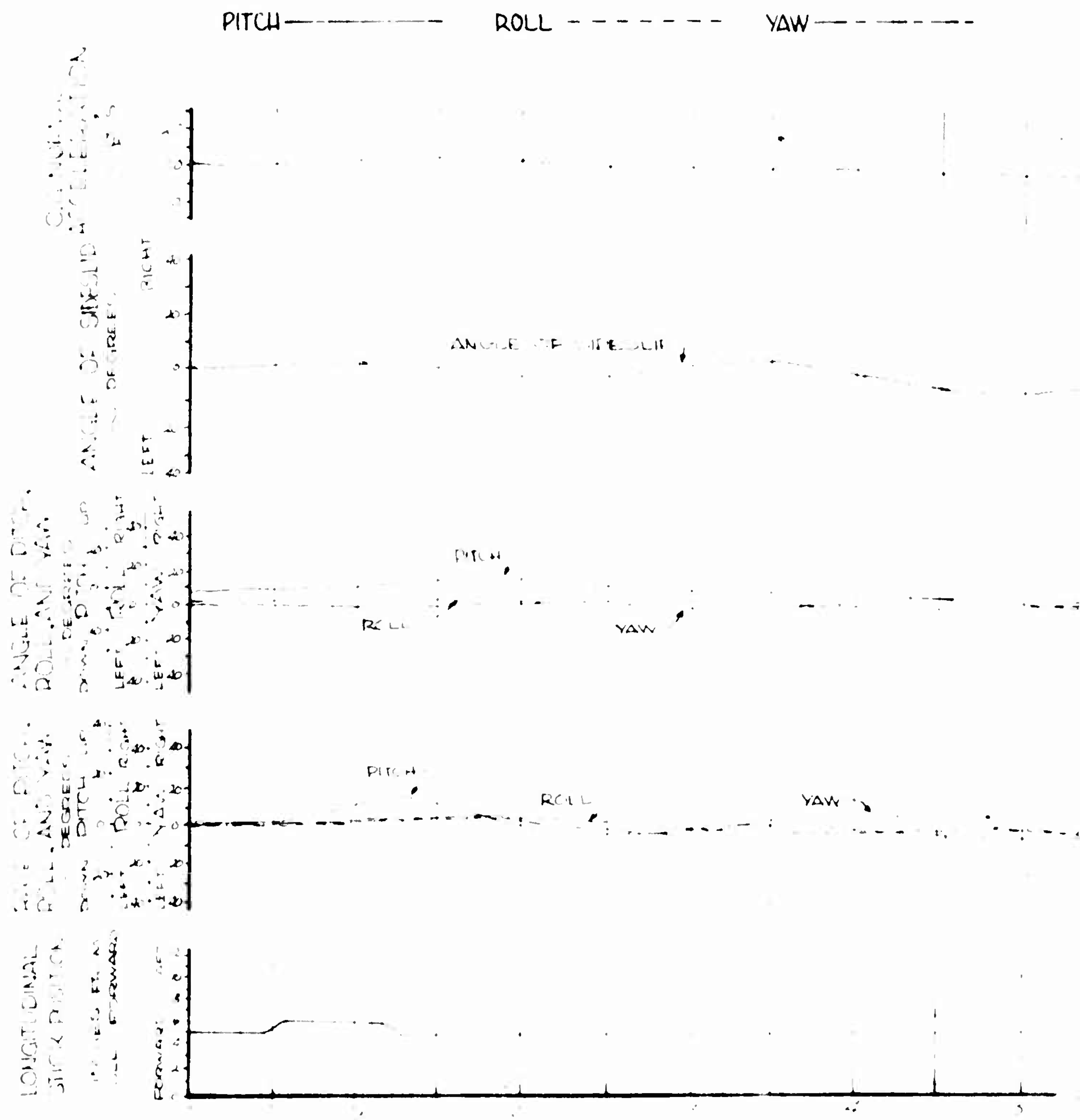


FIGURE NO. 82

AFT LONGITUDINAL PULSE

OH-6A U.S.A. S/N 62-4214

CONFIGURATION: CLEAN
FLIGHT CONDITION: CLIMB
TRIM CAS: 53 KNOTS
AVERAGE GROSS WEIGHT: 2160 LBS
DENSITY ALTITUDE 10000 FEET
LONG. C.G. LOCATION: 105.5 INCHES (AFT)
ROTOR SPEED: 466 RPM
LATERAL C.G. LOCATION: .5 IN. L



TIME ~ SECONDS

FIGURE NO. 83

FORWARD LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN | FLIGHT CONDITION: AUTOROTATION
FULL LONGITUDINAL TRAVEL: 12.6 INCHES | TRIM CAS: 55 KNOTS
AVERAGE GROSS WEIGHT: 2160 LBS | DENSITY ALTITUDE 10000 FEET
LONG. C.G. LOCATION: 103.5 INCHES (AFT) | ROTOR SPEED: 465 RPM
LATERAL C.G. LOCATION: .5 IN (RT)

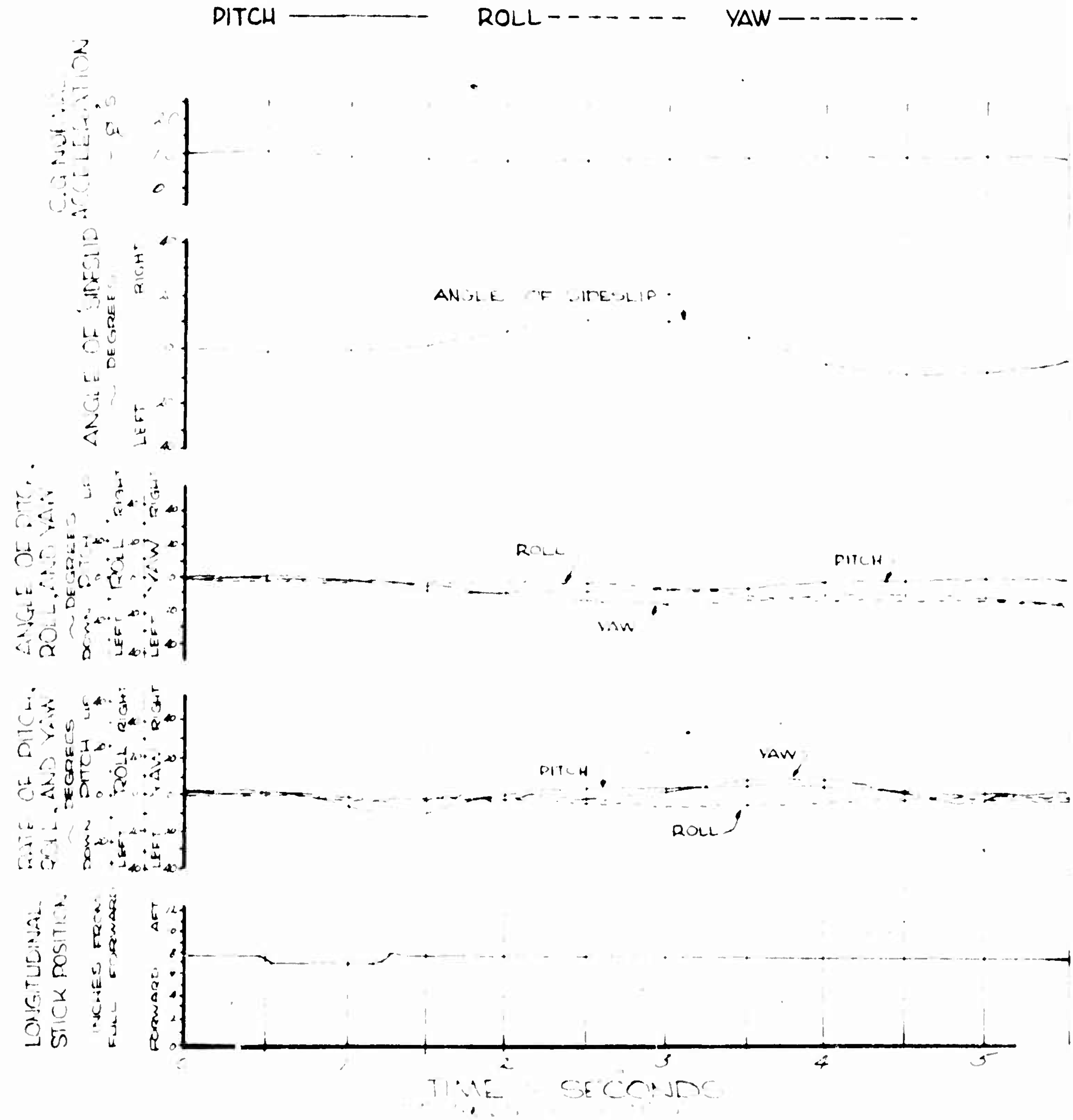


FIGURE NO. 84

FORWARD LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 — FLIGHT CONDITION: HOVER (IGE)
FULL LONGITUDINAL TRAVEL: 12.6 INCHES — TRIM CAS: ZERO
AVERAGE GROSS WEIGHT: 2100 LBS — DENSITY ALTITUDE: 1000 FEET
LONG. C.G. LOCATION: 103.3 INCHES (AFT) — ROTOR SPEED: 465 RPM
LATERAL C.G. LOCATION: .5 IN. (RT)

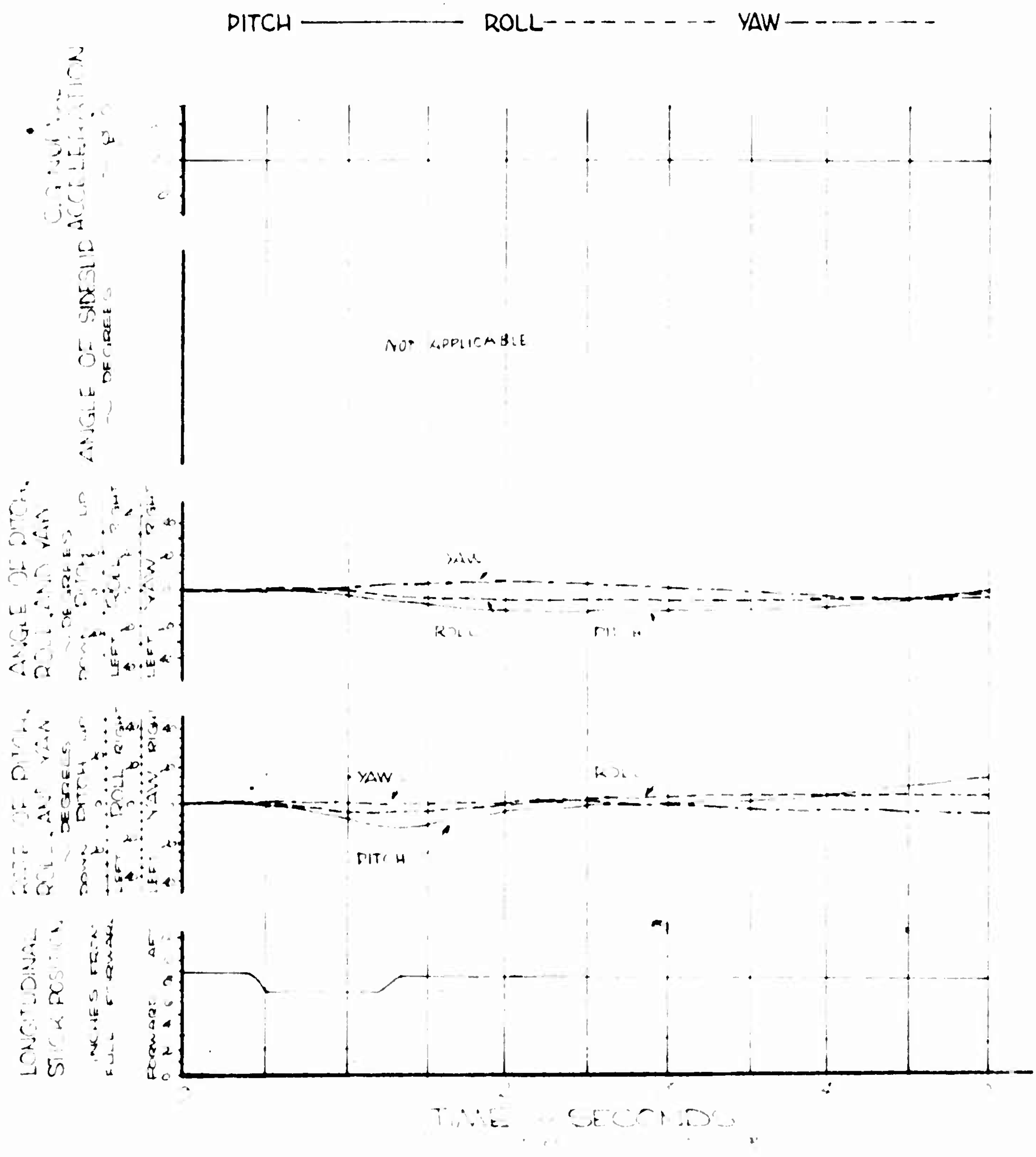


FIGURE NO. 85

FORWARD LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG C.G. LOCATION: 103.3 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

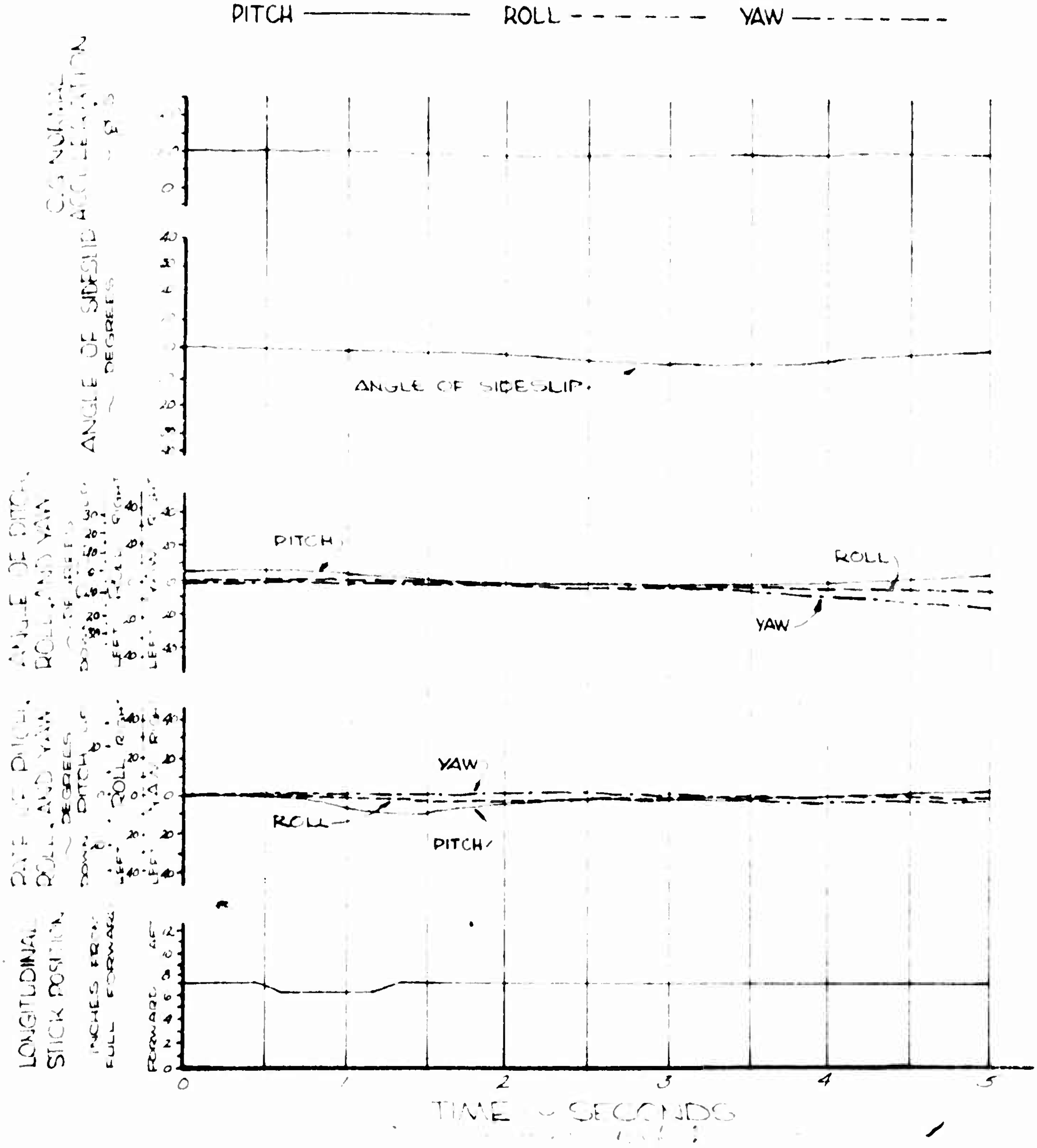


FIGURE NO. 86

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION: AM-8
FULL [illegible]: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2150 LBS.
LONG. C.G. LOCATION: 101.5 INCHES
LATERAL C.G. LOCATION: 2.85 IN. (LT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH ——— ROLL - - - - - YAW -·-·-·-

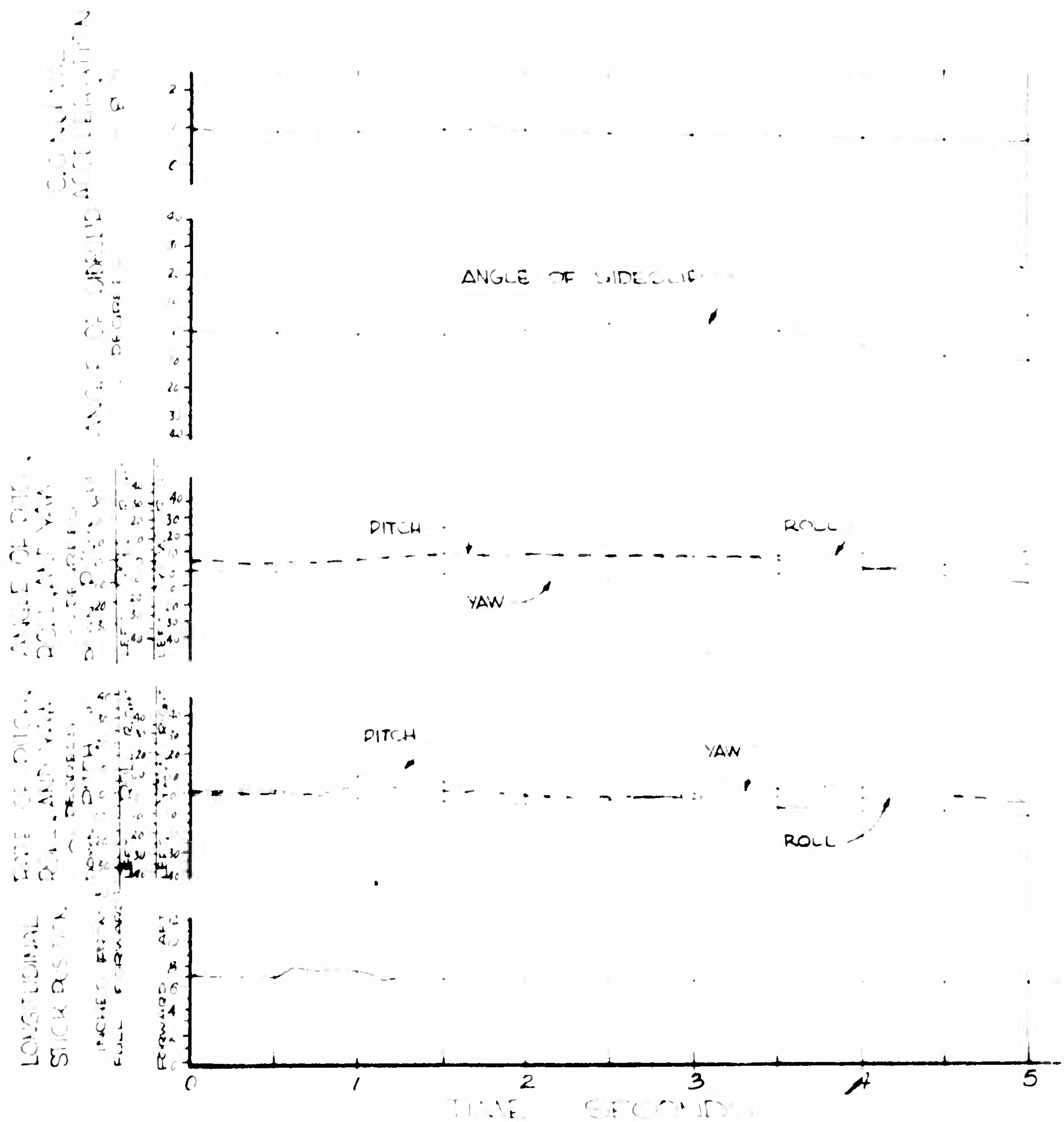


FIGURE NO. 81

AFT LONGITUDINAL PULSE

CH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 | FLIGHT CONDITION: LEVEL FLIGHT
FULL LONGITUDINAL TRAVEL: 12.6 INCHES | TRIM CAS: 102 KNOTS
AVERAGE GROSS WEIGHT: 2100 LBS | DENSITY ALTITUDE: 5000 FEET
LONG. C.G. LOCATION: 103.3 INCHES (AFT) | ROTOR SPEED: 465 RPM
LATERAL C.G. LOCATION: 1.5 IN. (R)

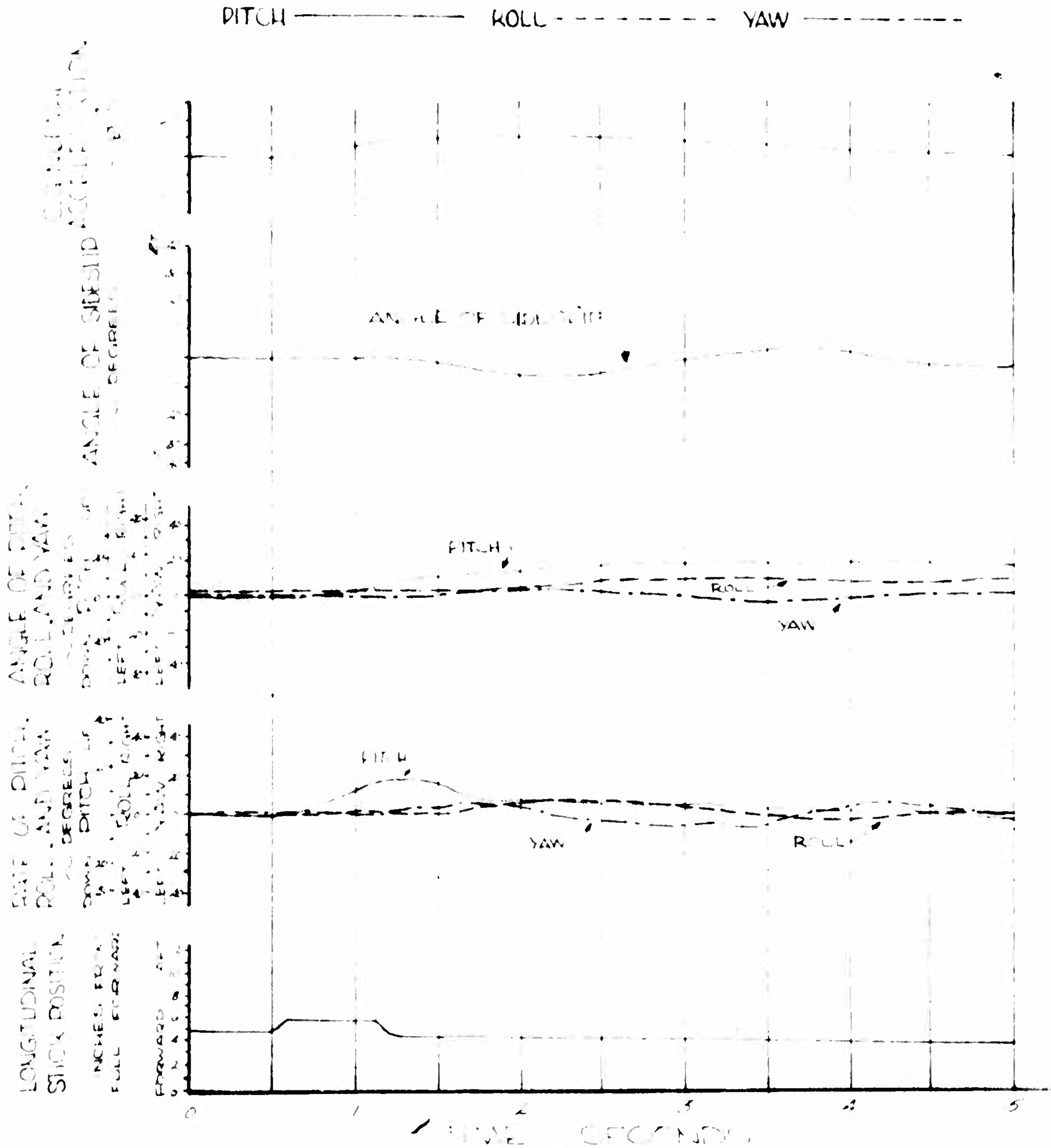


FIGURE NO. 88

AFT LONGITUDINAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : XM-8 FLIGHT CONDITION : AUTOROTATION
FULL LONGITUDINAL TRAVEL : 12.6 INCHES TRIM CAS : 55 KNOTS
AVERAGE GROSS WEIGHT : 2130 LBS. DENSITY ALTITUDE : 5000 FEET
LONG C.G. LOCATION : 101.5 INCHES (AFT) ROTOR SPEED : 465 RPM
LATERAL C.G. LOCATION : 2.85 INCHES (L)

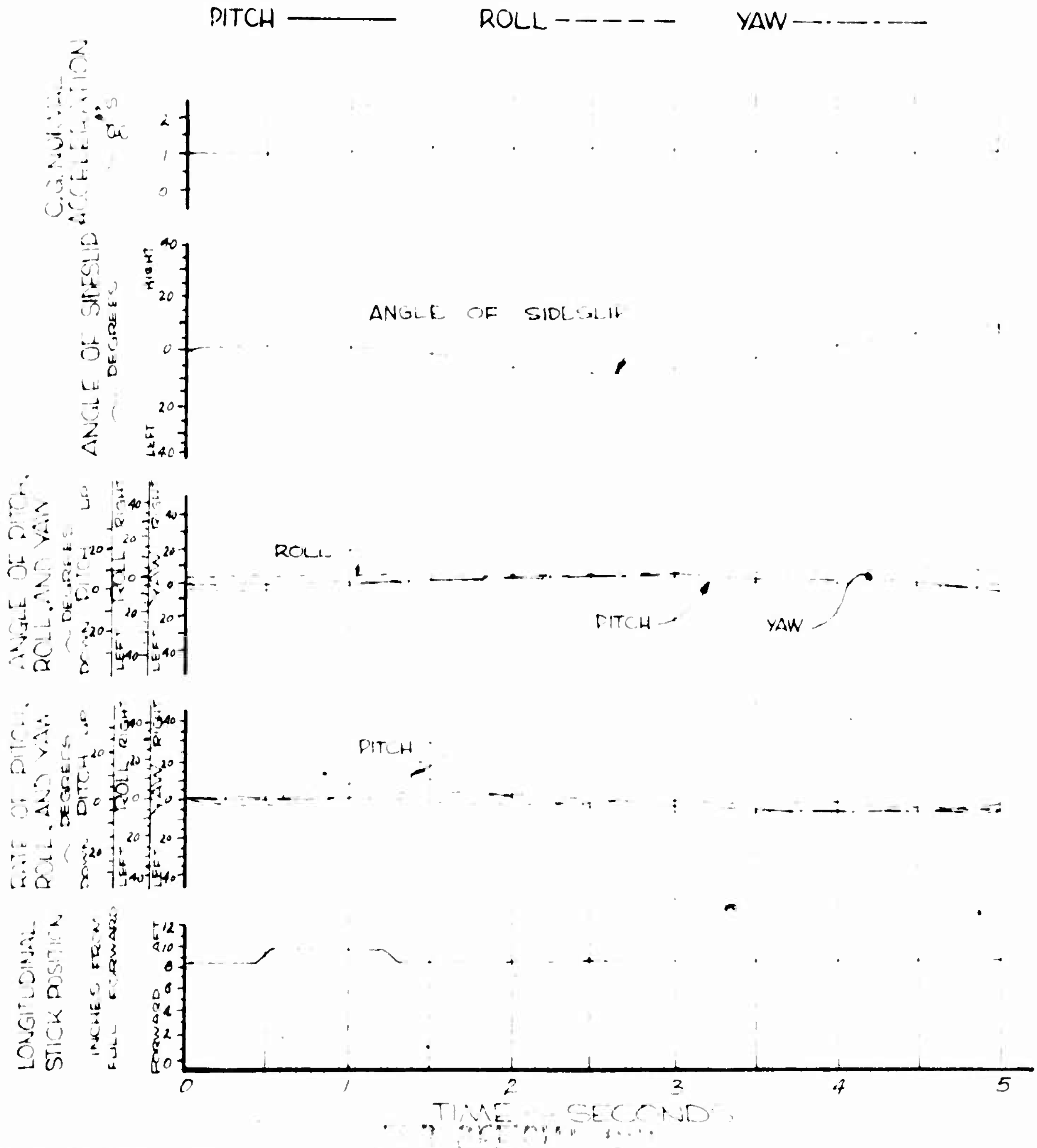


FIGURE NO. 87

RIGHT LATERAL PULSE

OH-6 A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: HOVER (IGE)
TRIM CAS: ZERO
DENSITY ALTITUDE: 1200 FEET
ROTOR SPEED: 465 RPM

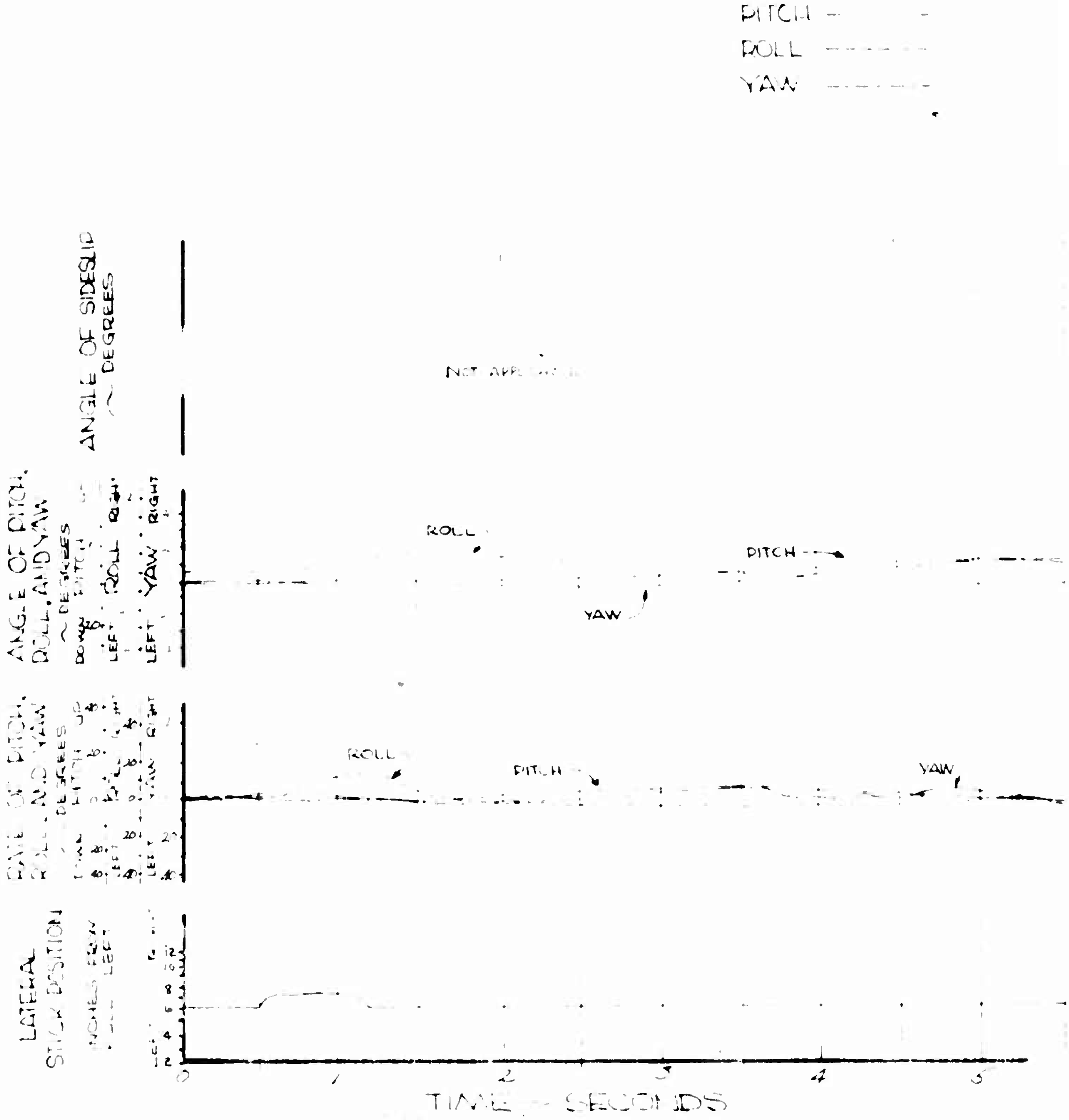


FIGURE NO. 90

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL LATERAL TRAVEL : 12.0 INCHES
AVERAGE GROSS WEIGHT : 2160 LBS
LONG. C.G. LOCATION : 103.5 INCHES AFT
LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 35 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

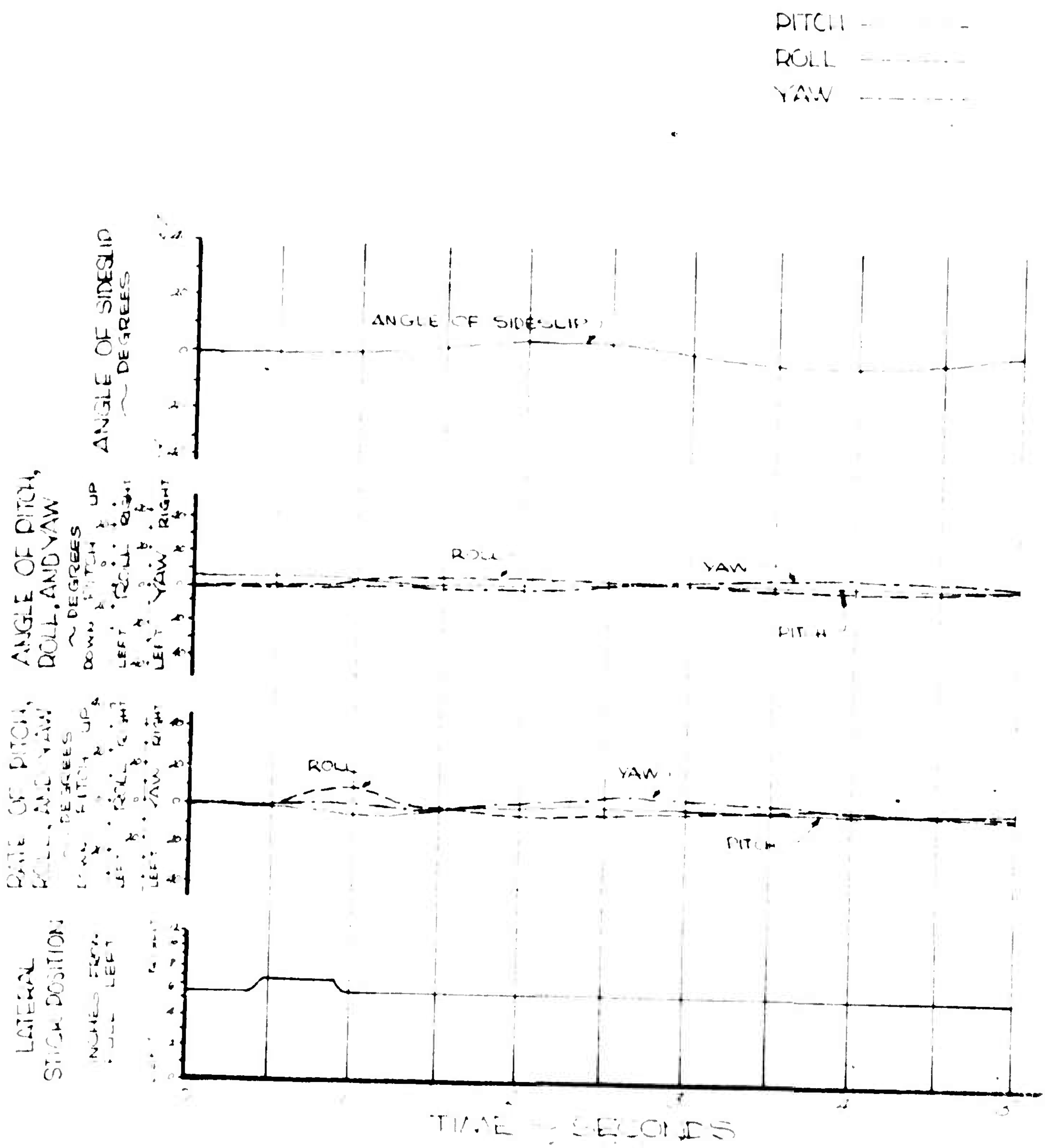


FIGURE NO. 91

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2140 LBS
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 90 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

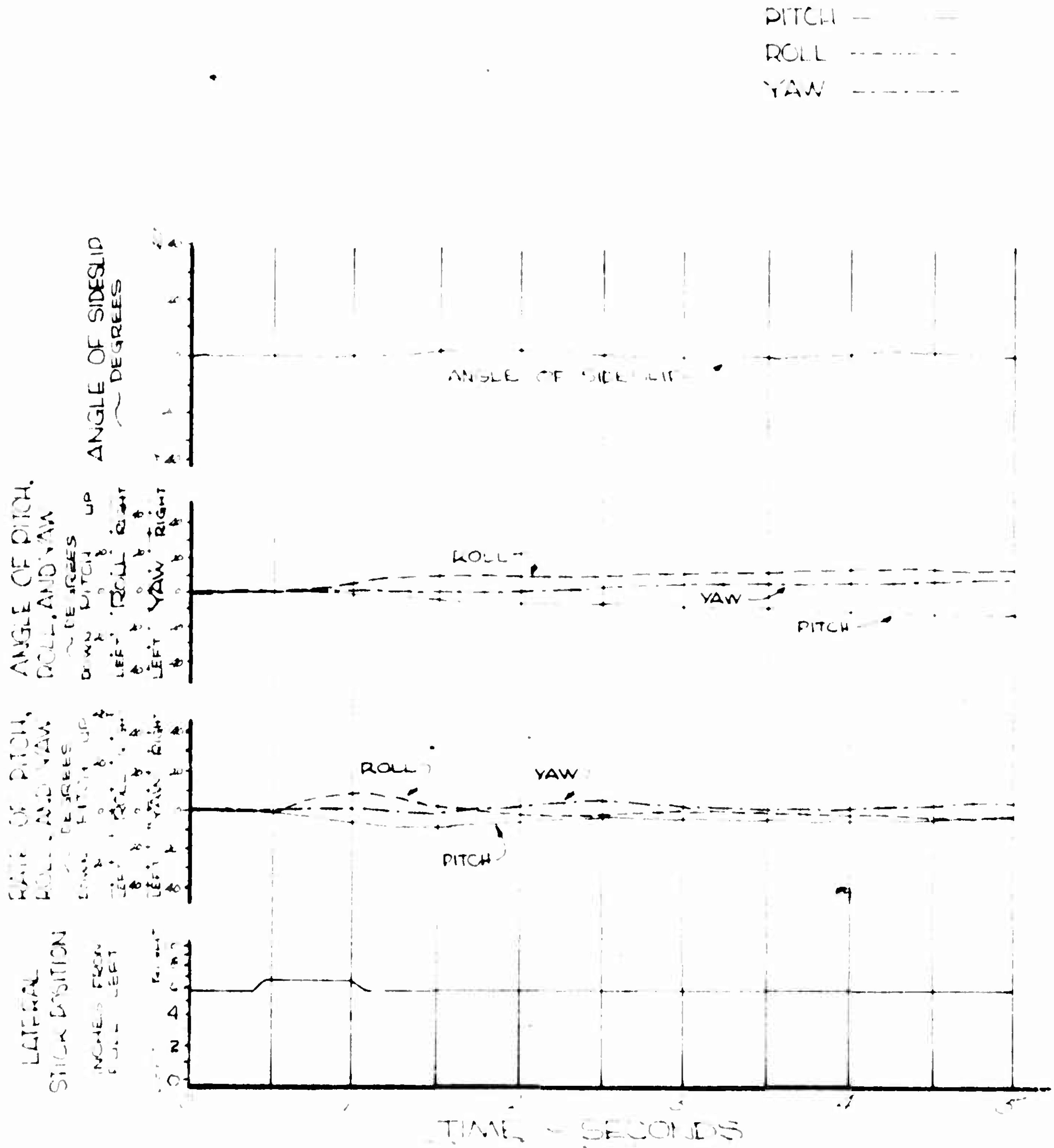


FIGURE NO. 92

LEFT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES AFT
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 102 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

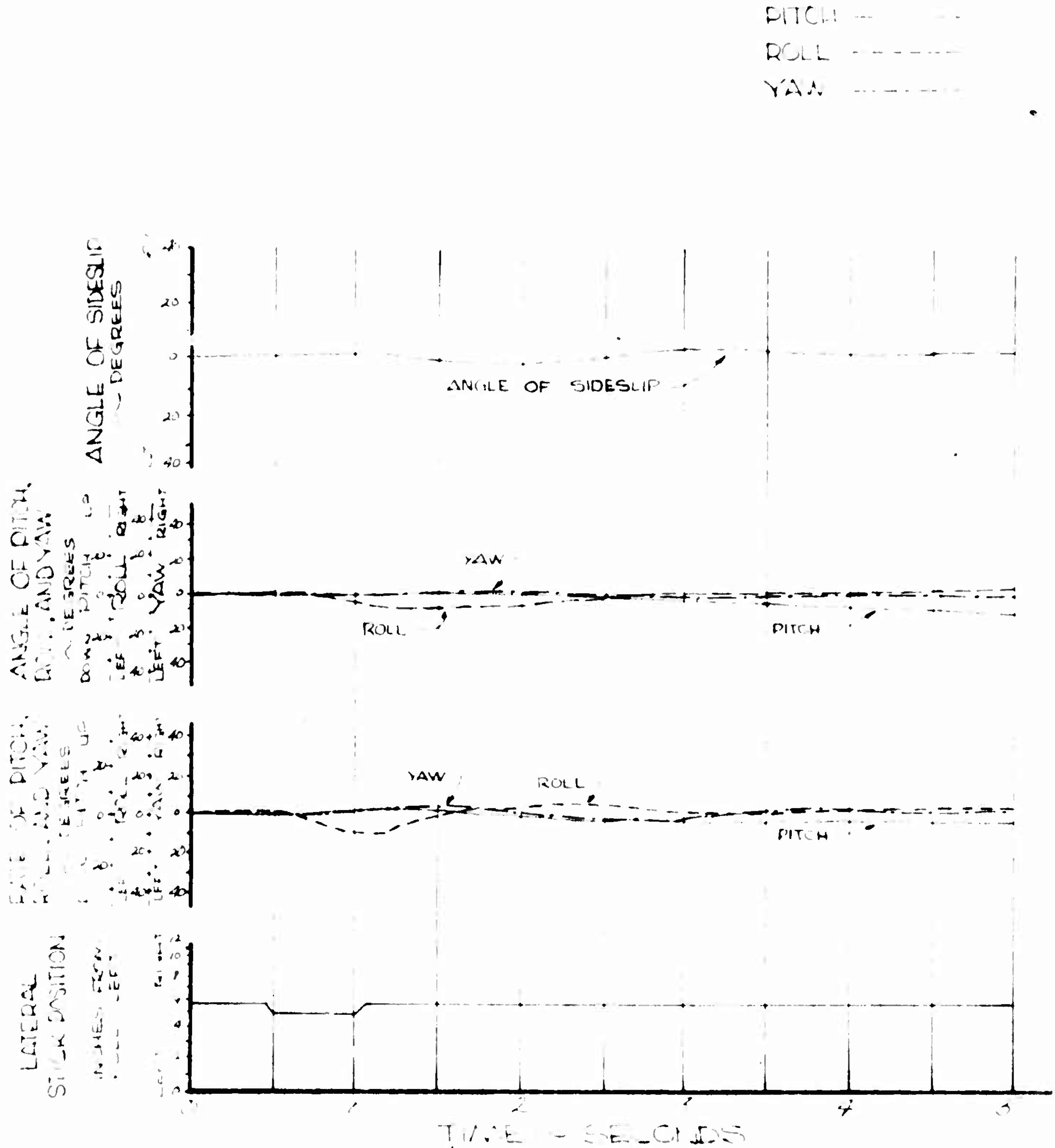


FIGURE NO. 93

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS.
LONG. C.G. LOCATION: 10_ INCHES AFT
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 102 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

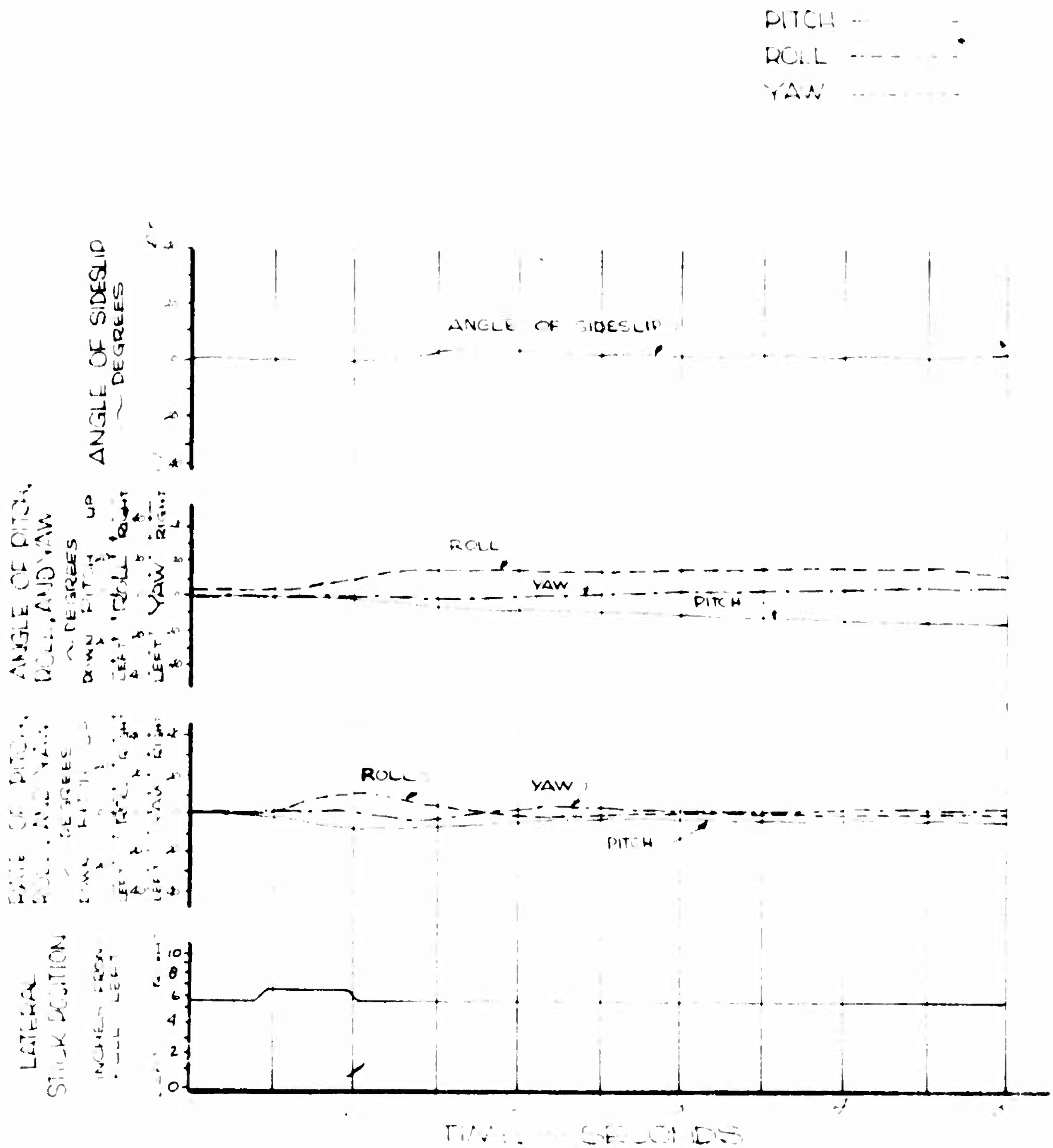


FIGURE NO. 94

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2180 LBS
LONG. C.G. LOCATION: 103.5 INCHES AFT
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: CLIMB
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

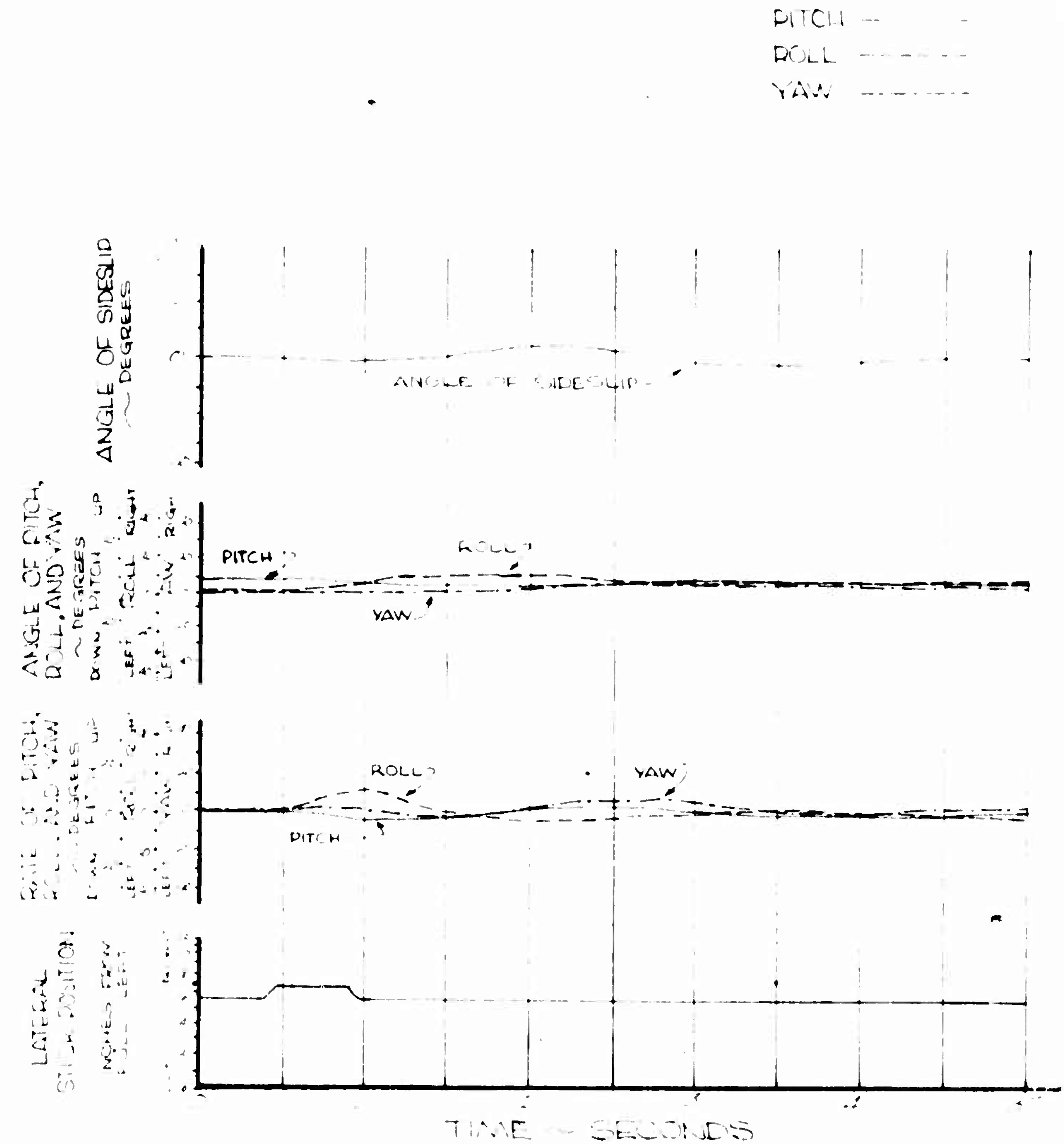


FIGURE NO. 95

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN

FULL LATERAL TRAVEL : 12.0 INCHES

AVERAGE GROSS WEIGHT : 2080 LBS

LONG. C.G. LOCATION : 103.5 INCHES (AFT)

LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION: AUTOROTATION

TRIM CAS : 55 KNOTS

DENSITY ALTITUDE : 5000 FEET

ROTOR SPEED : 465 RPM

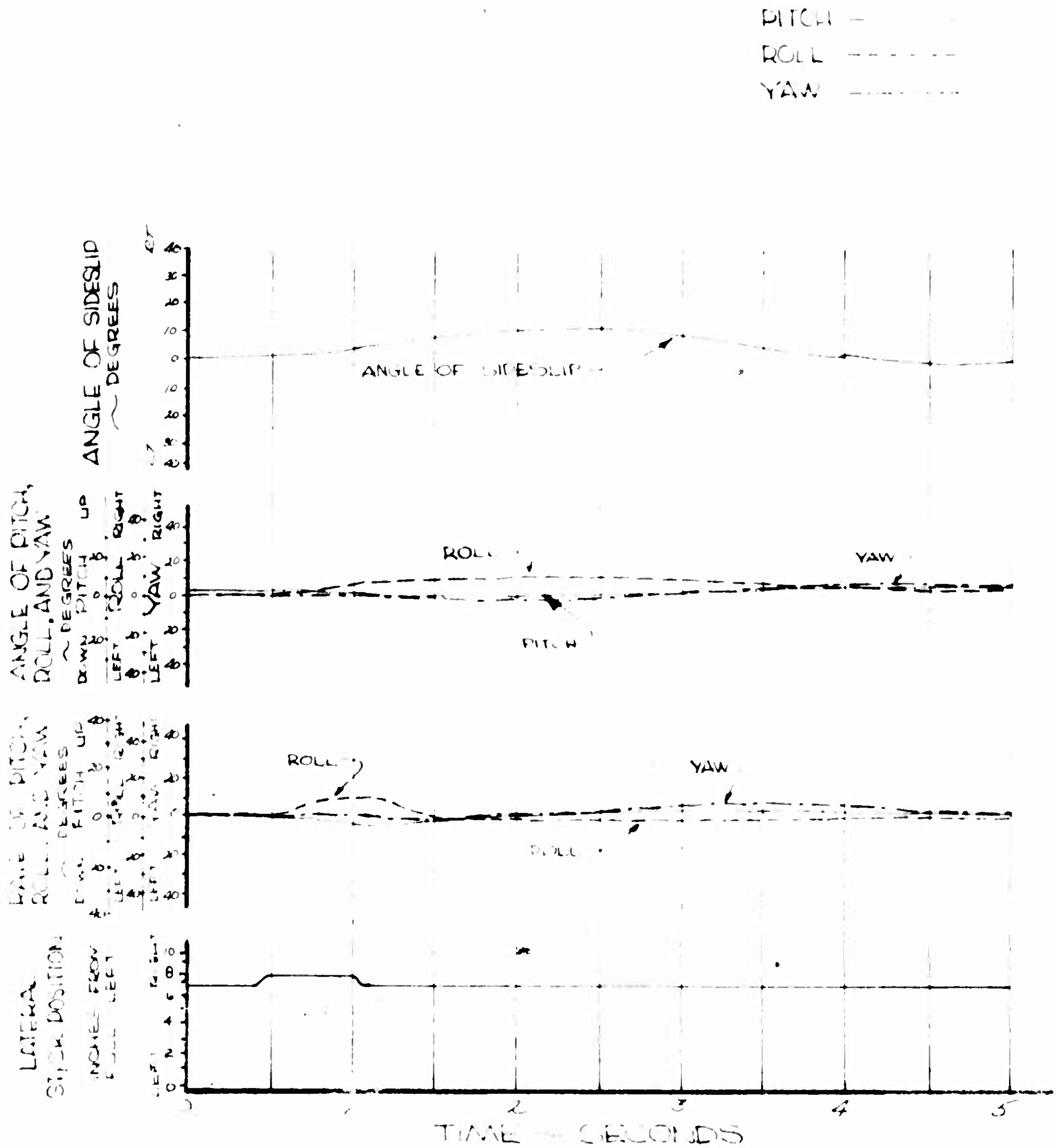


FIGURE NO. 97

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN

FULL LATERAL TRAVEL : 12 INCHES

AVERAGE GROSS WEIGHT : 2600 LBS.

LONG. C.G. LOCATION : 103.5 INCHES(AFT)

LATERAL C.G. LOCATION : .4 IN. RT.

FLIGHT CONDITION : LEVEL FLIGHT

TRIM CAS : 70 KNOTS

DENSITY ALTITUDE : 5000 FEET

ROTOR SPEED : [illegible] RPM

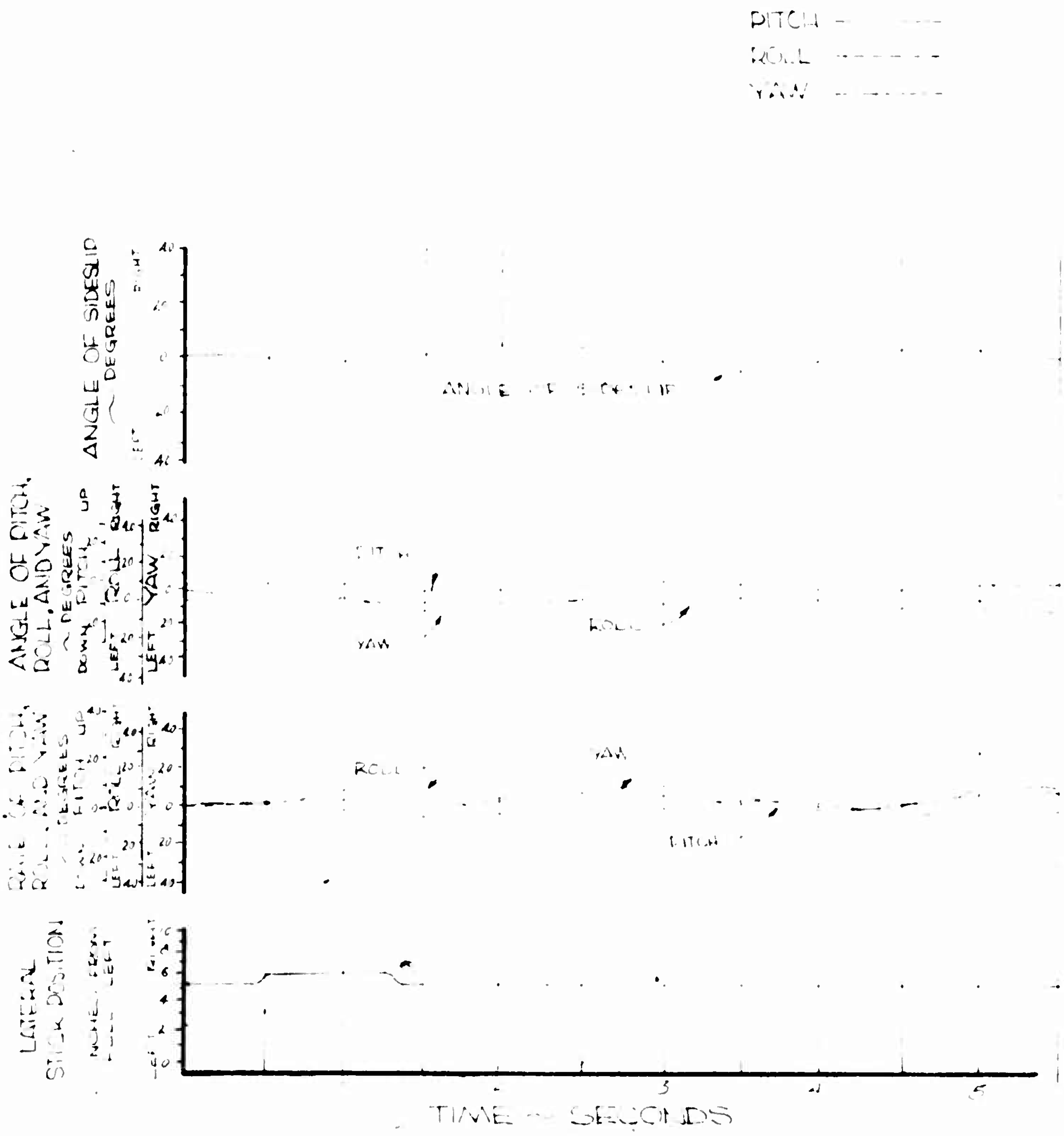


FIGURE NO. 96

LEFT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN

FULL LATERAL TRAVEL: 12 INCHES

AVERAGE GROSS WEIGHT: 2070 LBS.

LONG. C.G LOCATION: 97 INCHES FWD

LATERAL C.G LOCATION: [illegible]

FLIGHT CONDITION: LEVEL FLIGHT

TRIM CAS: 102 KNOTS

DENSITY ALTITUDE: 5000 FEET

ROTOR SPEED: 465 RPM

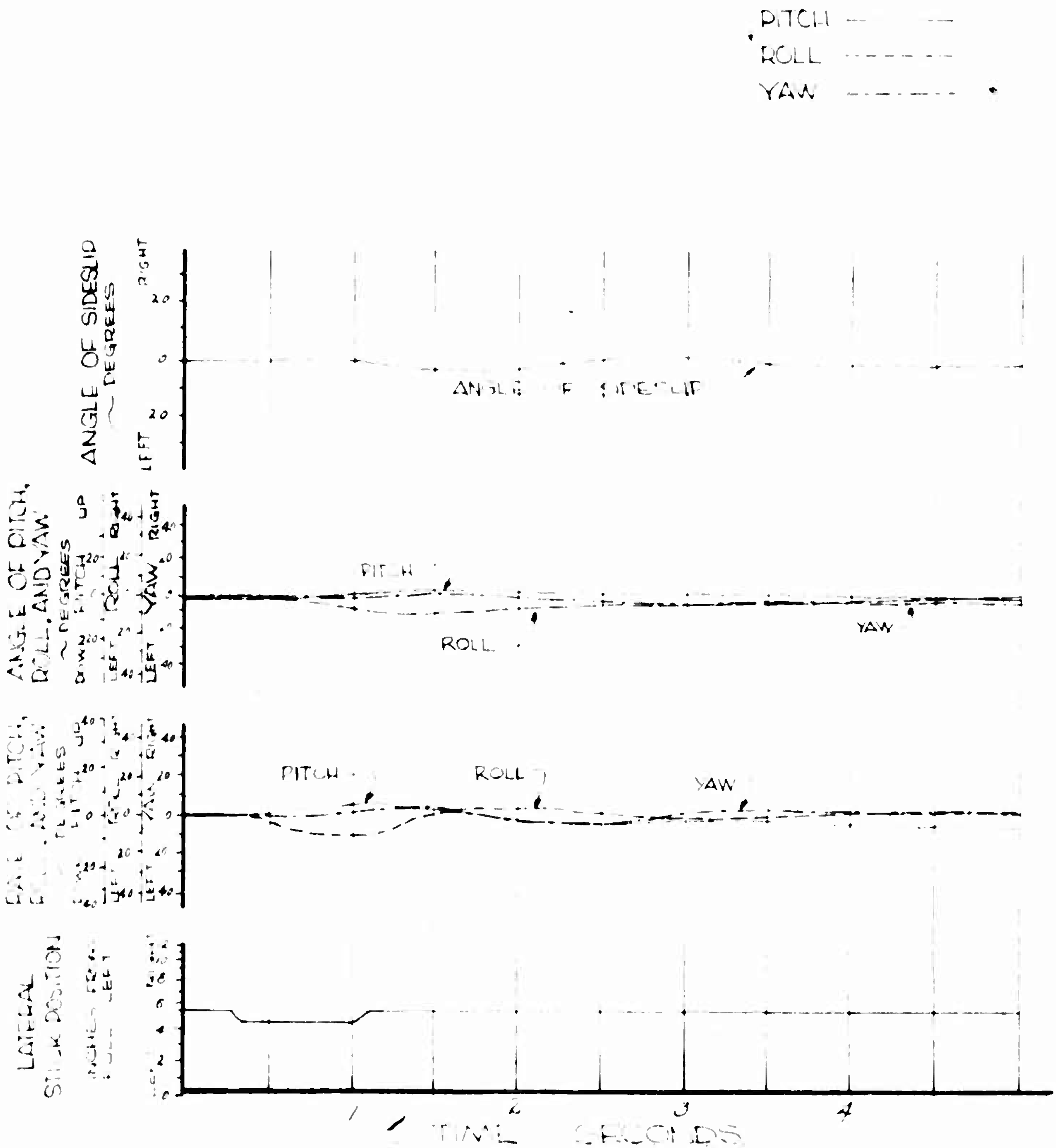


FIGURE NO. 98
RIGHT LATERAL PULSE
OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12 INCHES
AVERAGE GROSS WEIGHT: 2610 LBS
LONG. C.G. LOCATION: 108.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 86 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

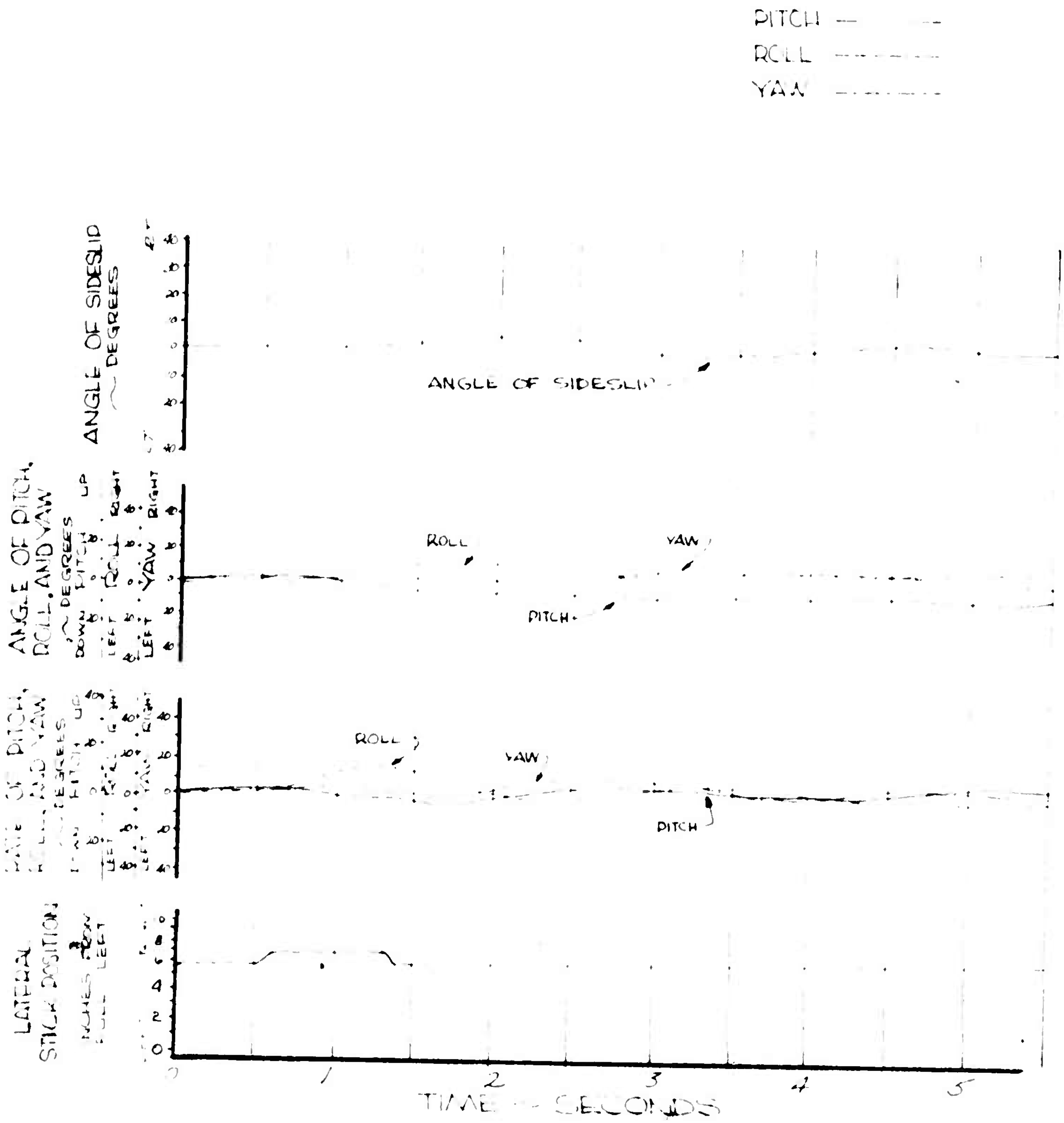


FIGURE NO. 99

LEFT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2700 LBS
LONG C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G LOCATION: .5 IN (RT)

FLIGHT CONDITION: CLIMB
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5200 FEET
ROTOR SPEED: 465 RPM

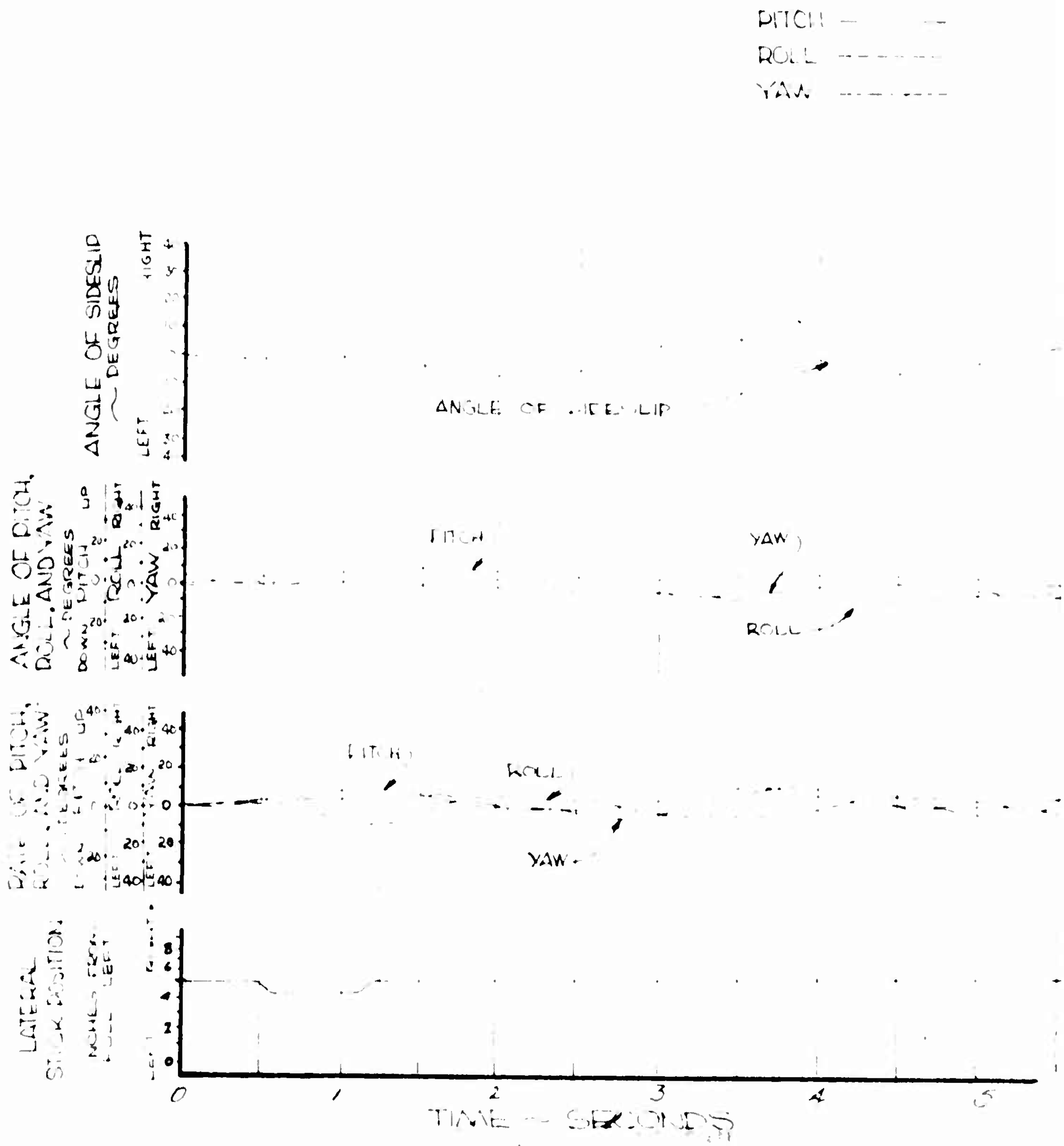


FIGURE NO. 100

RIGHT LATERAL PULSE

OH-CA, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LATERAL TRAVEL: [illegible] INCHES
AVERAGE GROSS WEIGHT: [illegible] LBS
LONG. C.G. LOCATION: 103.5 INCHES [illegible]
LATERAL C.G. LOCATION: [illegible]

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 80 KNOTS
DENSITY ALTITUDE: [illegible] FEET
ROTOR SPEED: 465 RPM

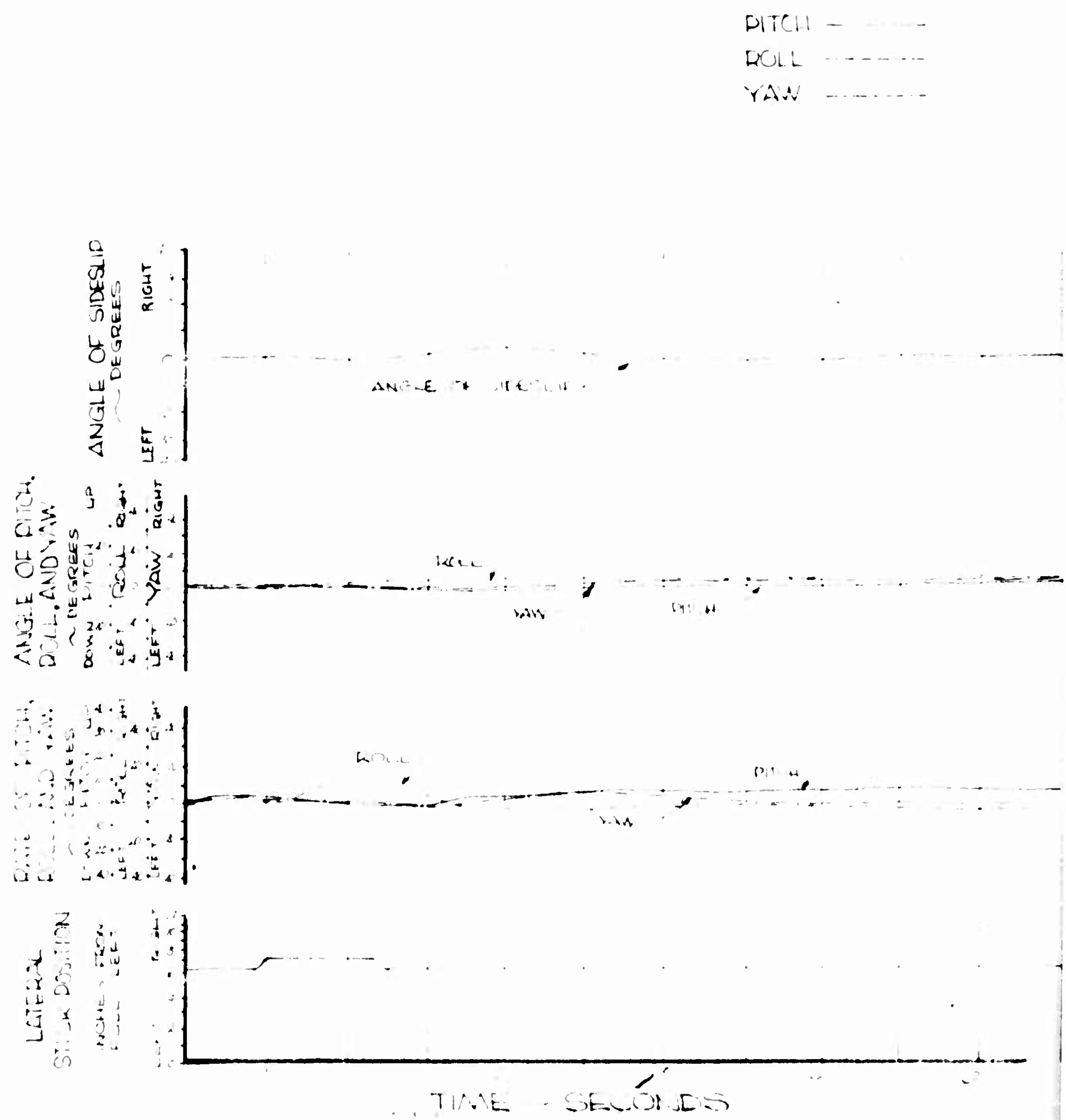


FIGURE NO. 101

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN

FULL LATERAL TRAVEL : 12.0 INCHES

AVERAGE GROSS WEIGHT : 2160 LBS

LONG. C.G. LOCATION : 103.5 INCHES (AFT)

LATERAL C.G. LOCATION : .5 IN (R)

FLIGHT CONDITION : AUTOROTATION

TRIM CAS : 55 KNOTS

DENSITY ALTITUDE : 10000 FEET

ROTOR SPEED : 465 RPM

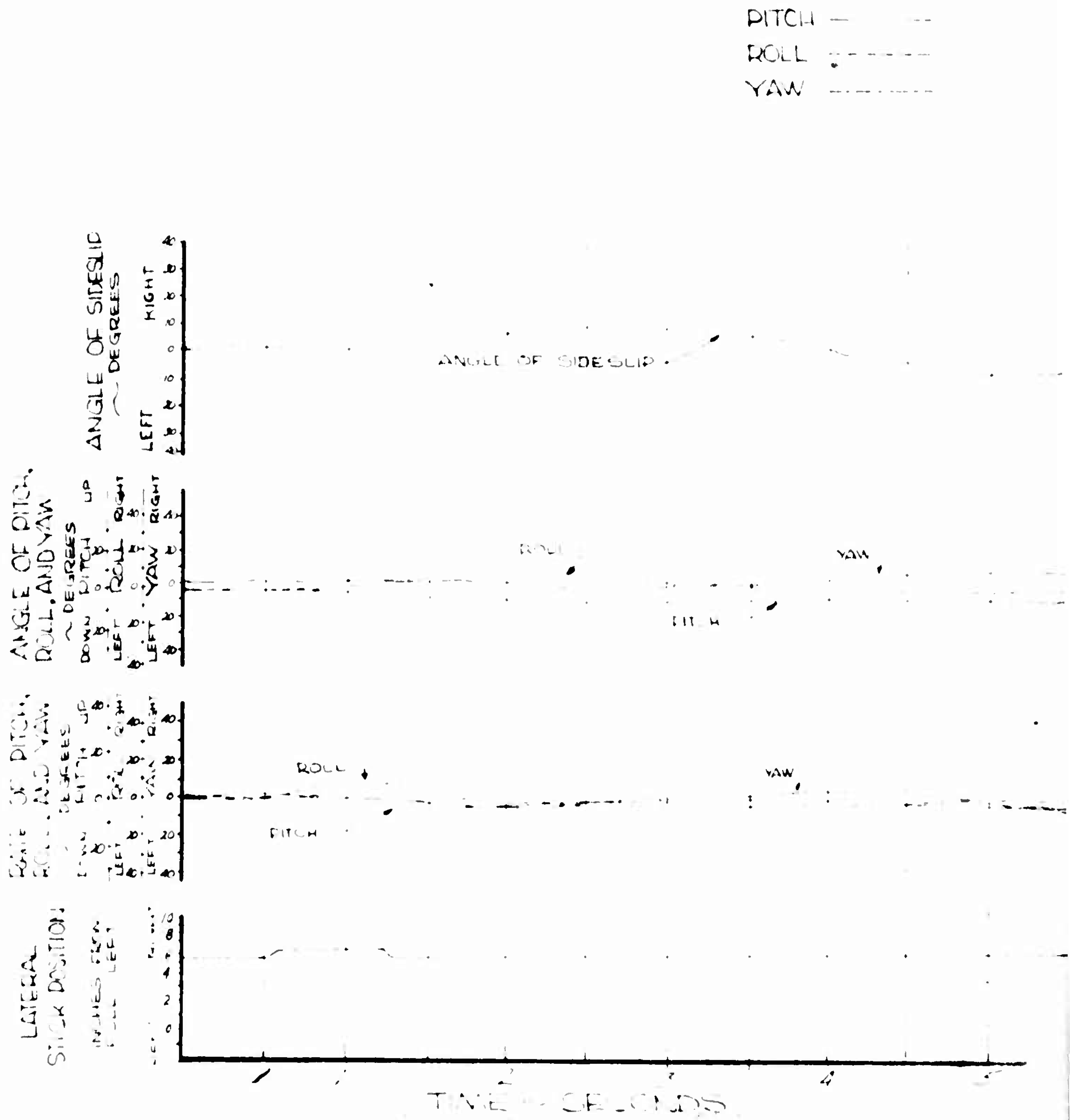


FIGURE NO. 102

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LATERAL TRAVEL: [illegible] INCHES
AVERAGE GROSS WEIGHT: [illegible] LBS
LONG. C.G. LOCATION: 103.3 INCHES (AFT)
LATERAL C.G. LOCATION: [illegible]

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

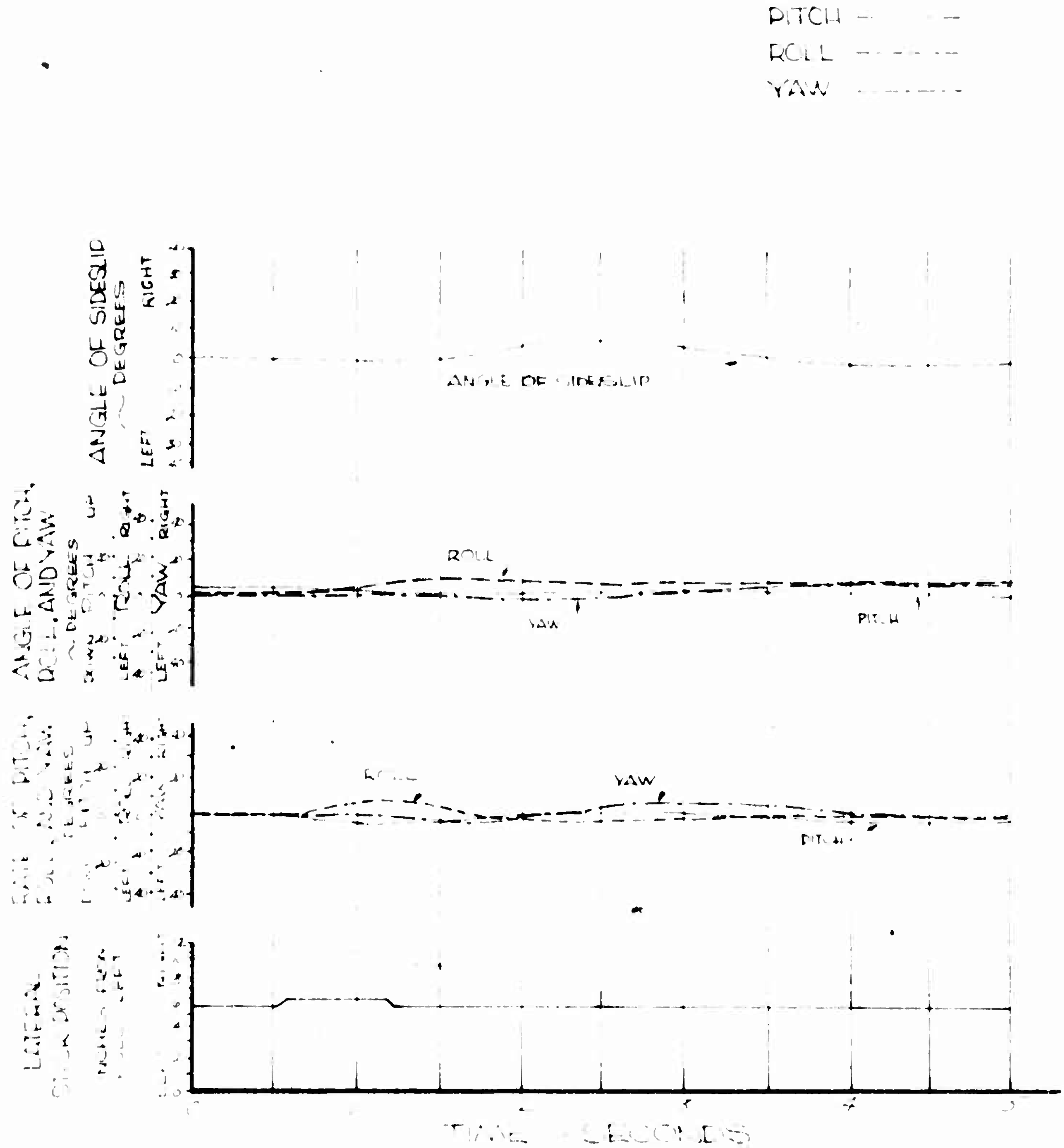


FIGURE NO. 103

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : XM-7
FULL LATERAL TRAVEL : 12.[illegible] INCHES
AVERAGE GROSS WEIGHT : 2100 LB
LONG. C.G. LOCATION : 103.3 IN [illegible]
LATERAL C.G LOCATION : .[illegible] IN [illegible]

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 90 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

PITCH
ROLL
YAW

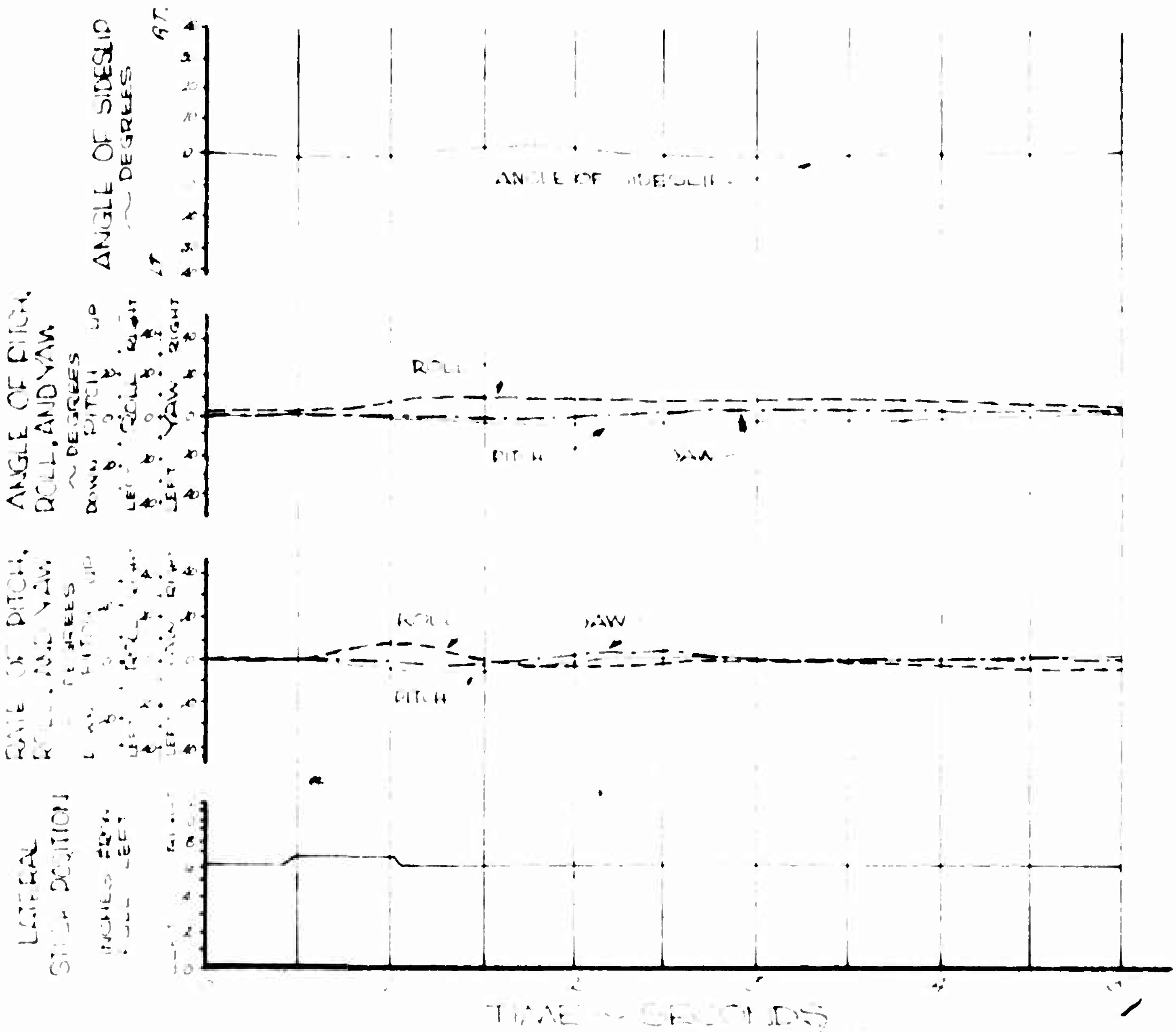


FIGURE NO. 104

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : XM-8
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT : 2120 LBS
LONG C.G. LOCATION: 101.5 INCHES (AFT)
LATERAL C.G. LOCATION : 2.85 IN (RT)

FLIGHT CONDITION : CLIMB
TRIM CAS : 55 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

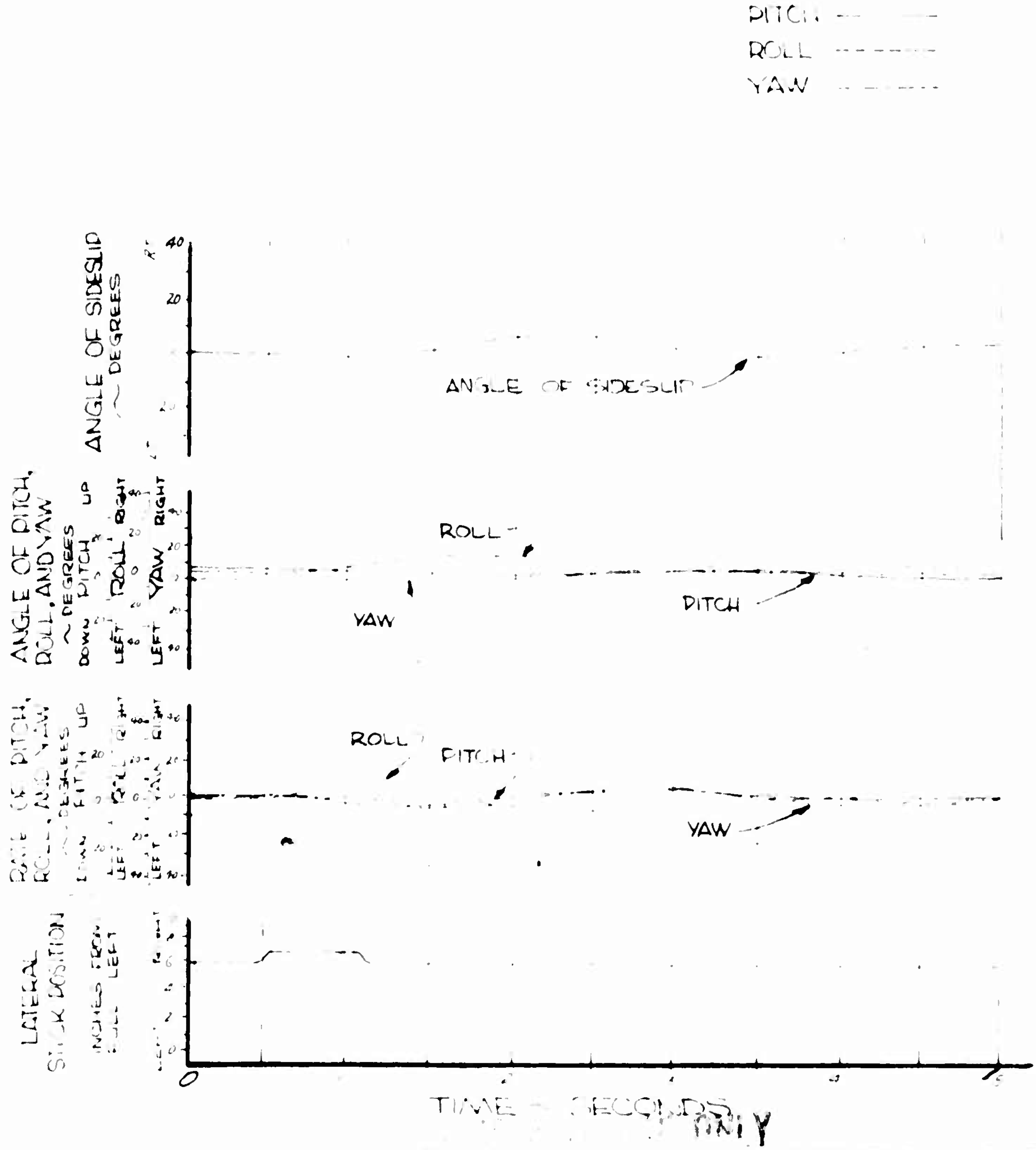


FIGURE NO. 105

RIGHT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LATERAL TRAVEL: 12.0 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.3 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (LT)

FLIGHT CONDITION: AUTOROTATION
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

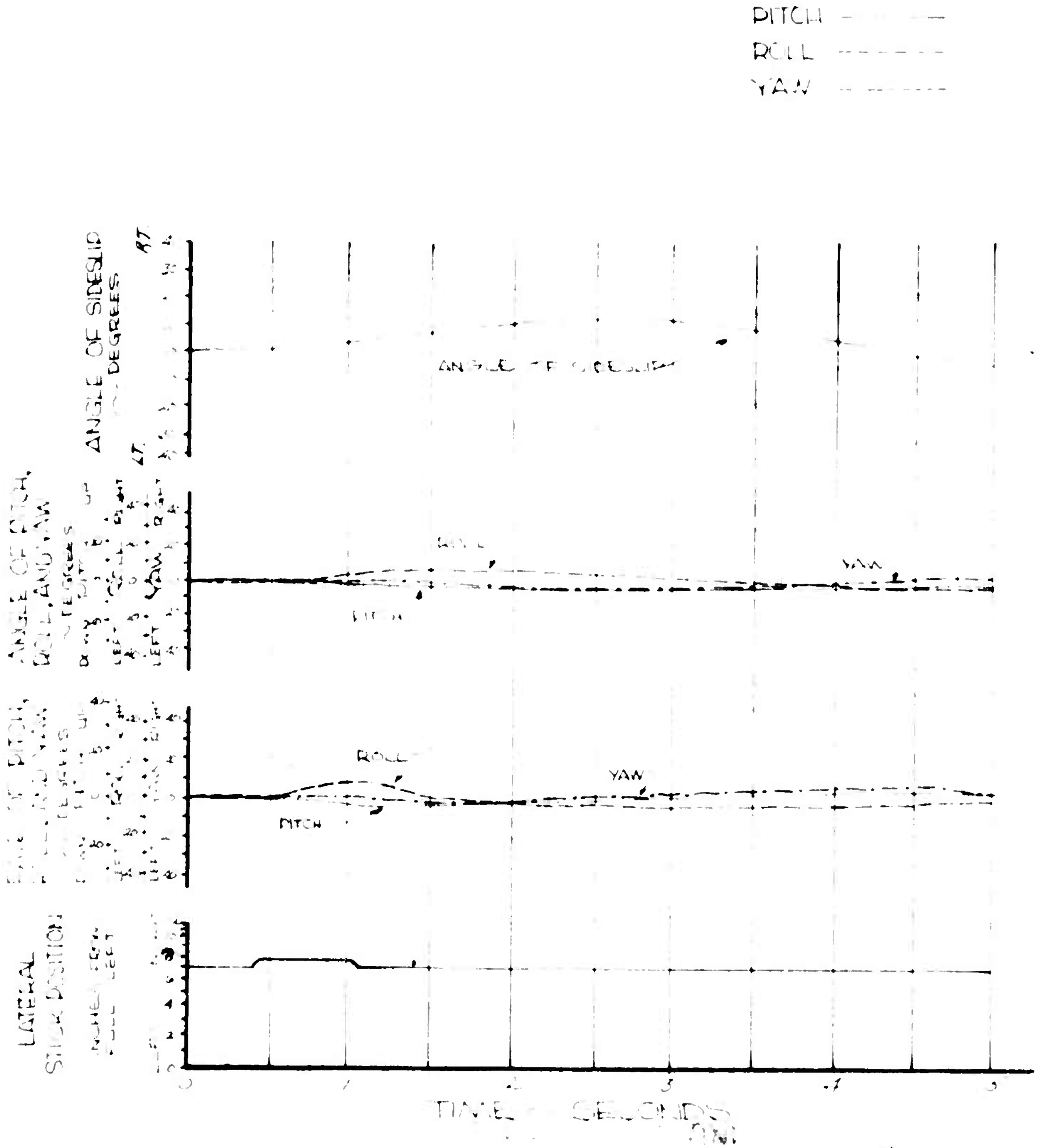


FIGURE NO. 106

LEFT LATERAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : XM-8
FULL LATERAL TRAVEL : 12.0 INCHES
AVERAGE GROSS WEIGHT : 2080 LBS
LONG. C.G. LOCATION : 101.5 INCHES (AFT)
LATERAL C.G. LOCATION : 2.85 IN. (RT)

FLIGHT CONDITION : AUTOROTATION
TRIM CAS : 55 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

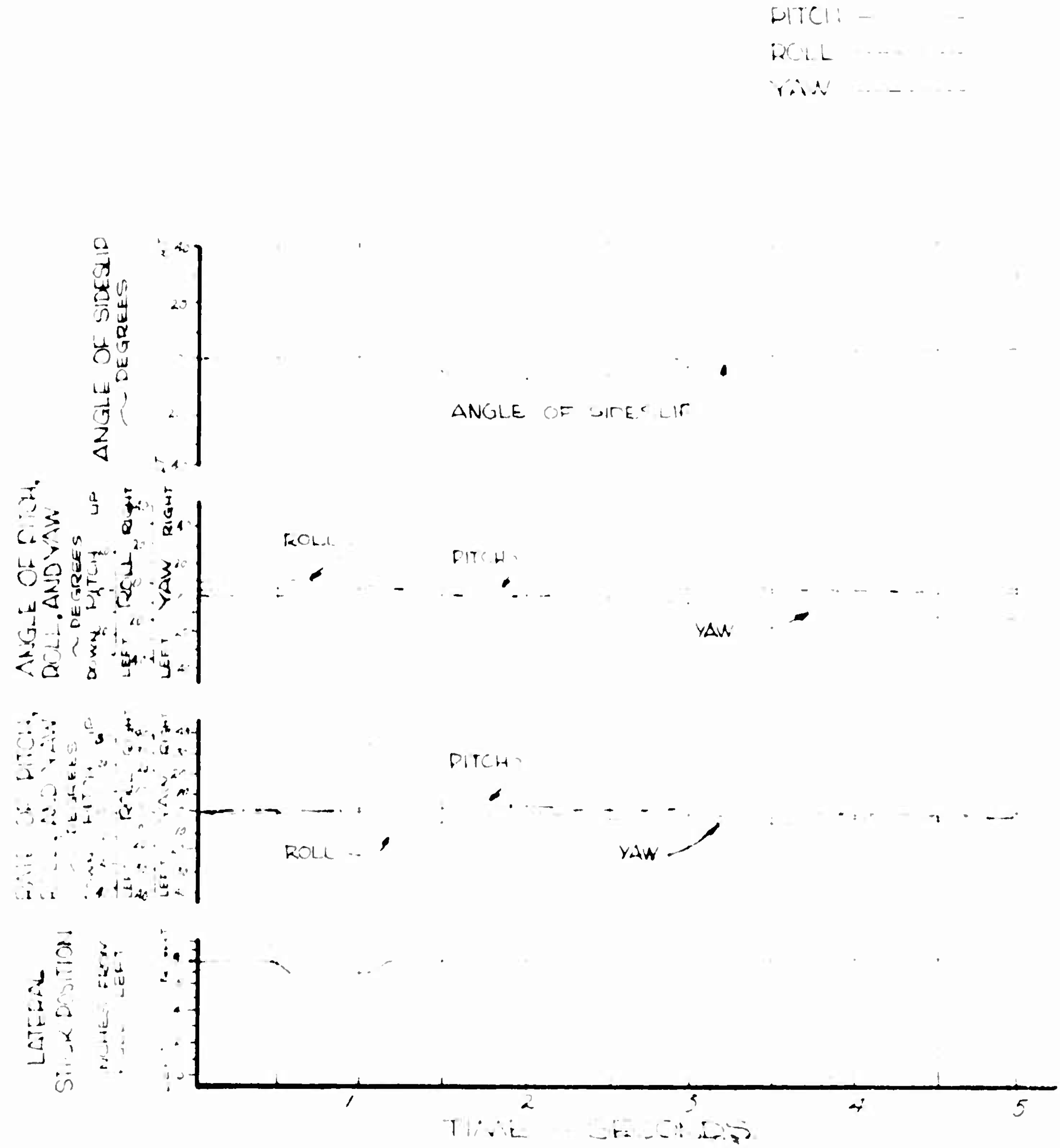


FIGURE NO. 107

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.6 INCHES
AVERAGE GROSS WEIGHT : 2130 LBS.
LONG. C.G. LOCATION : 103.5 INCHES AFT
LATERAL C.G. LOCATION : .5 IN. [illegible]

FLIGHT CONDITION : HOVER (IGE)
TRIM CAS : ZERO
DENSITY ALTITUDE : 1000 FEET
ROTOR SPEED : 465 RPM

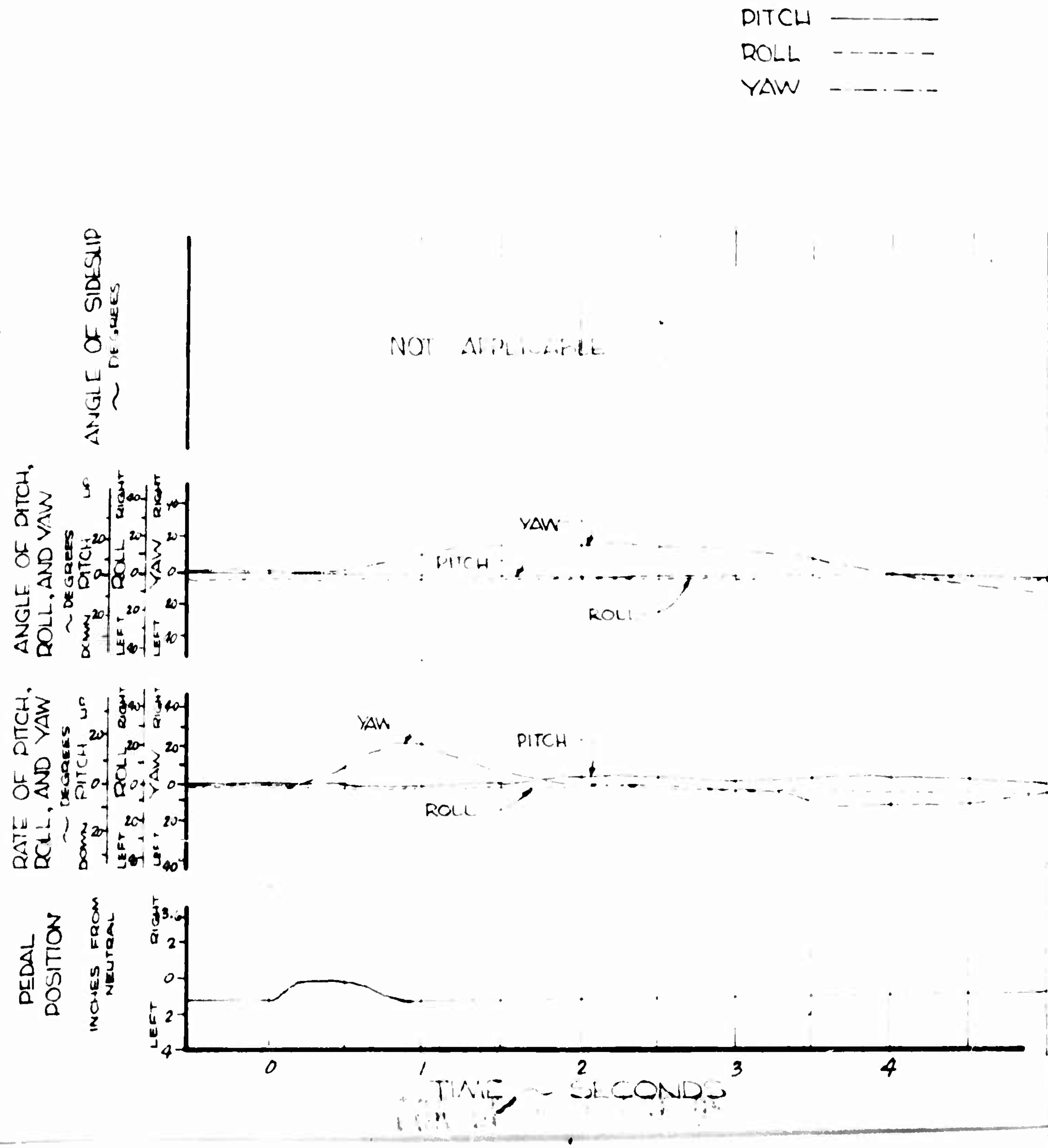


FIGURE NO. 108

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2160 LBS
LONG. C.G. LOCATION: 103.5 INCHES AFT
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH ————
ROLL - - - - - -
YAW —·—·—

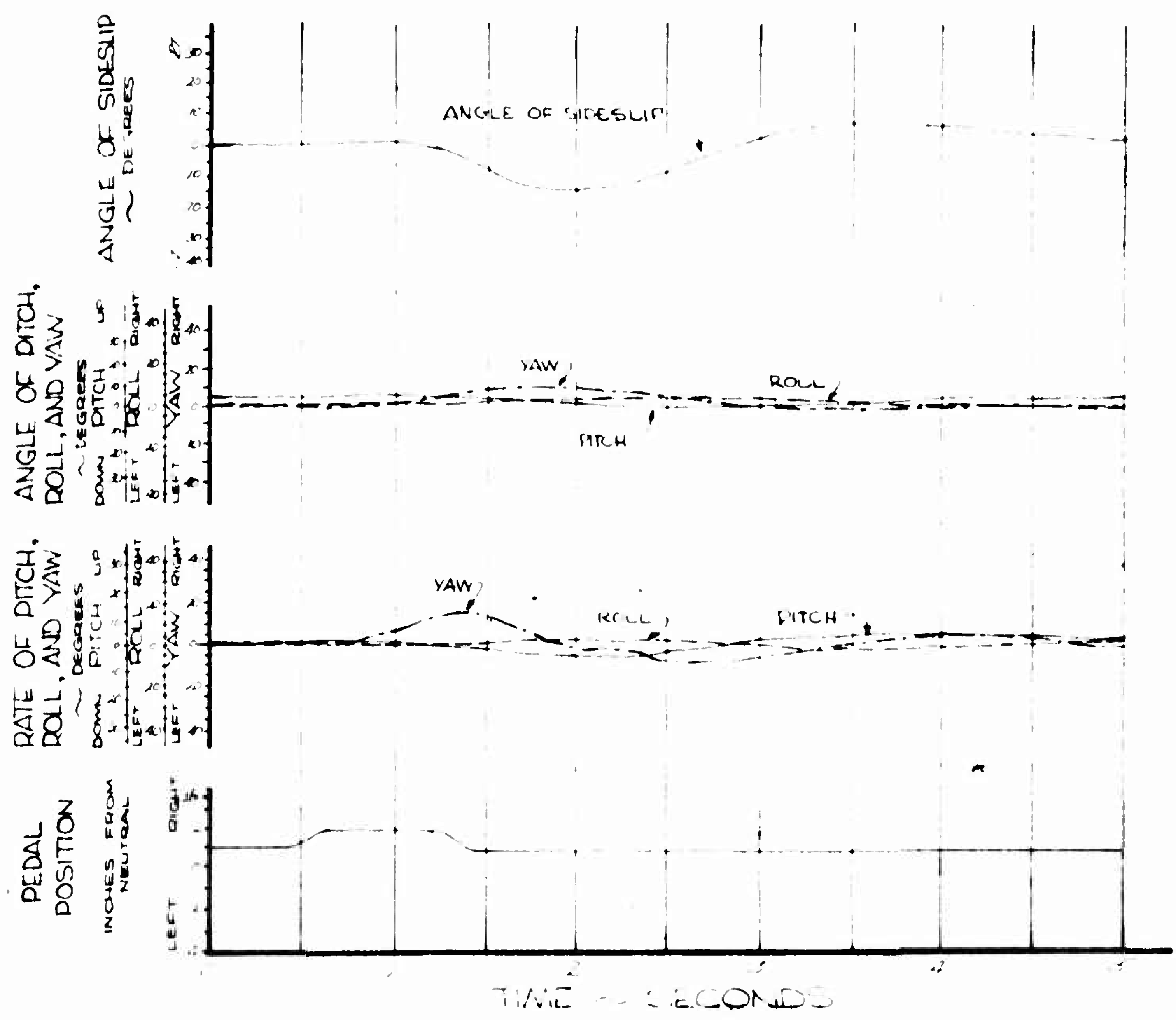


FIGURE NO. 109

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT : 2140 LBS
LONG. C.G. LOCATION : 103.5 INCHES (AFT)
LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 90 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED: 465 RPM

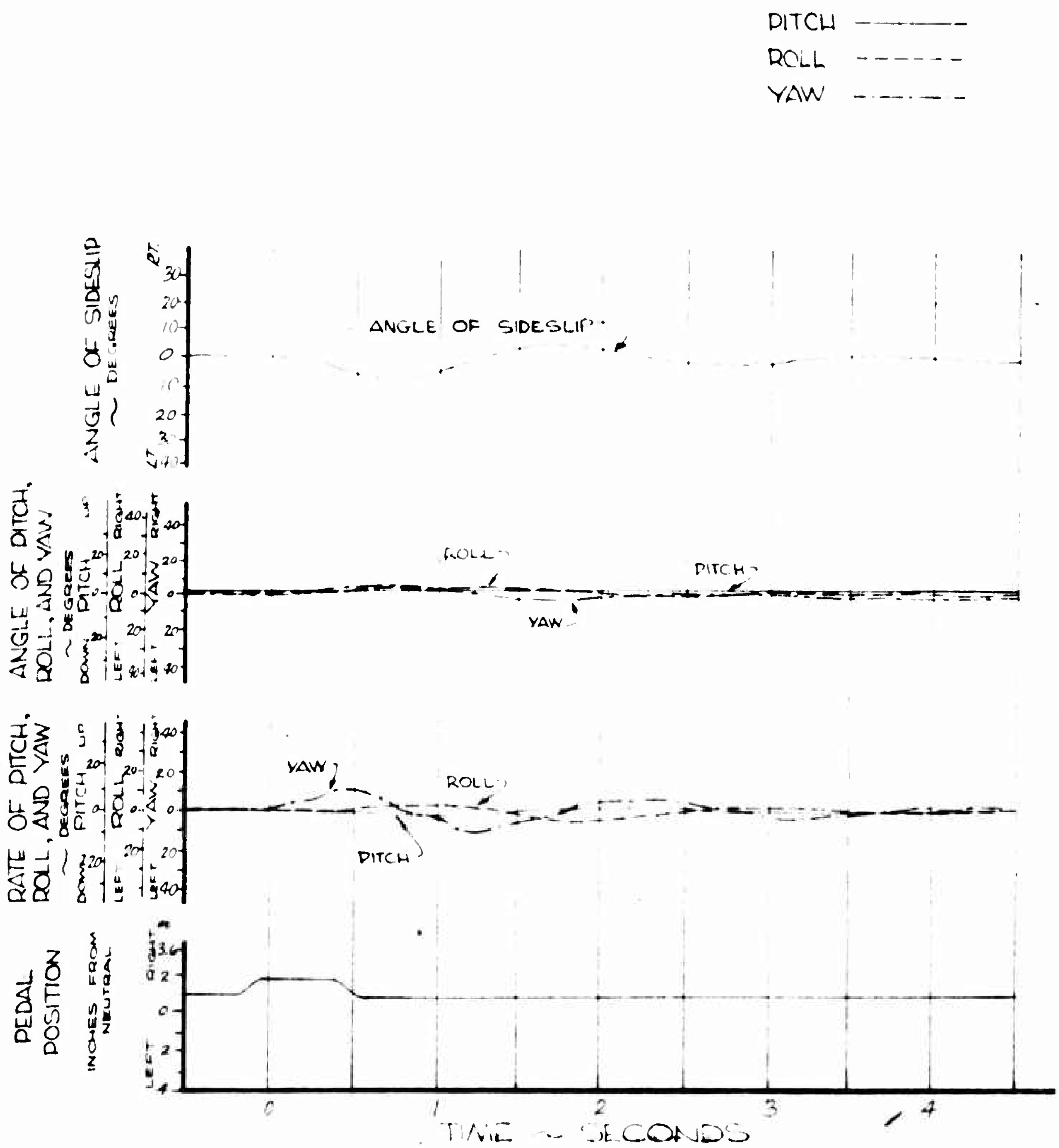


FIGURE NO. 110

LEFT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.6 INCHES
AVERAGE GROSS WEIGHT : 2100 LBS
LONG. C.G. LOCATION : 103.5 INCHES
LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 102 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

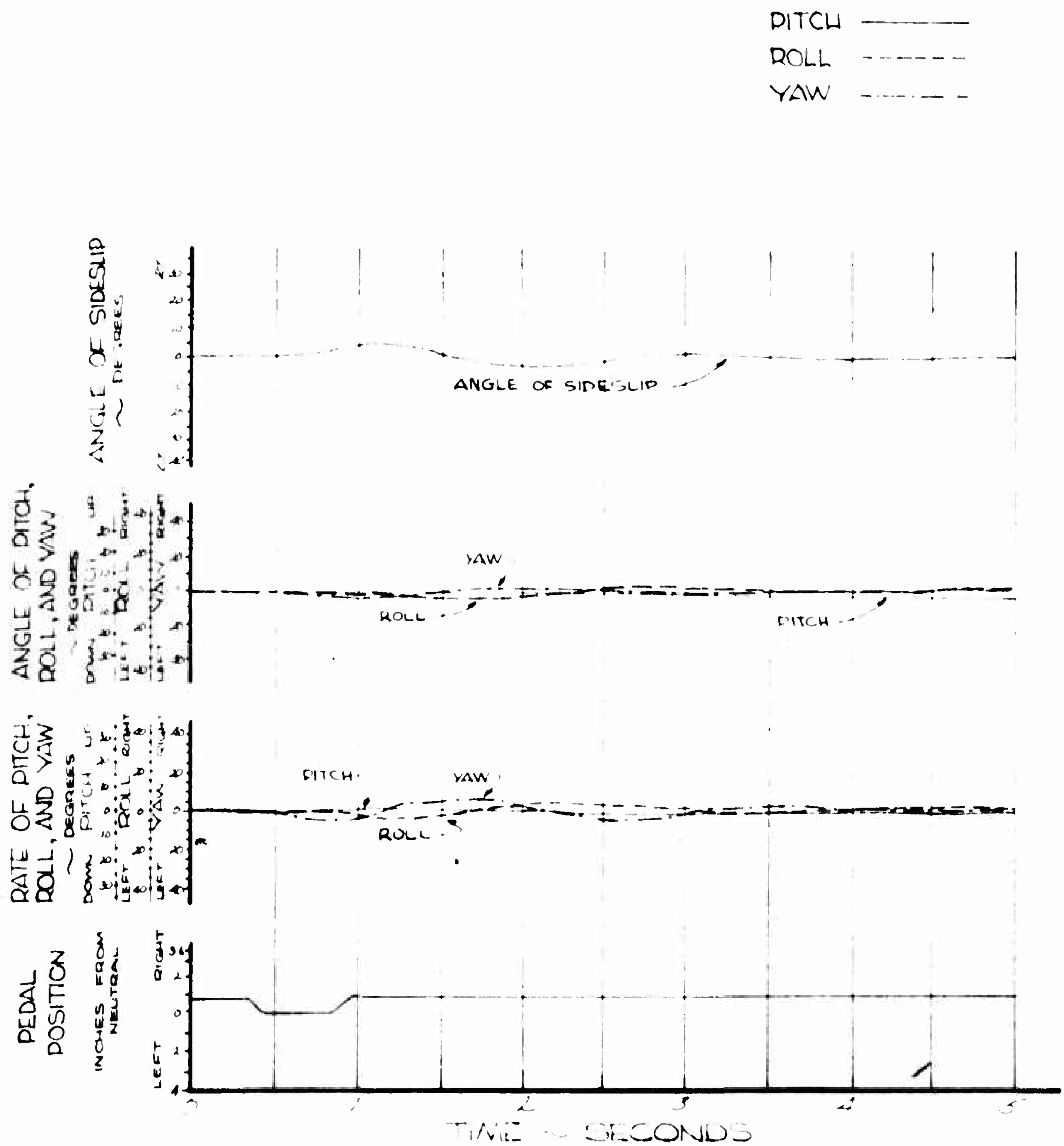


FIGURE NO. 111

LEFT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2160 LBS
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. RT.

FLIGHT CONDITION: CLIMB
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

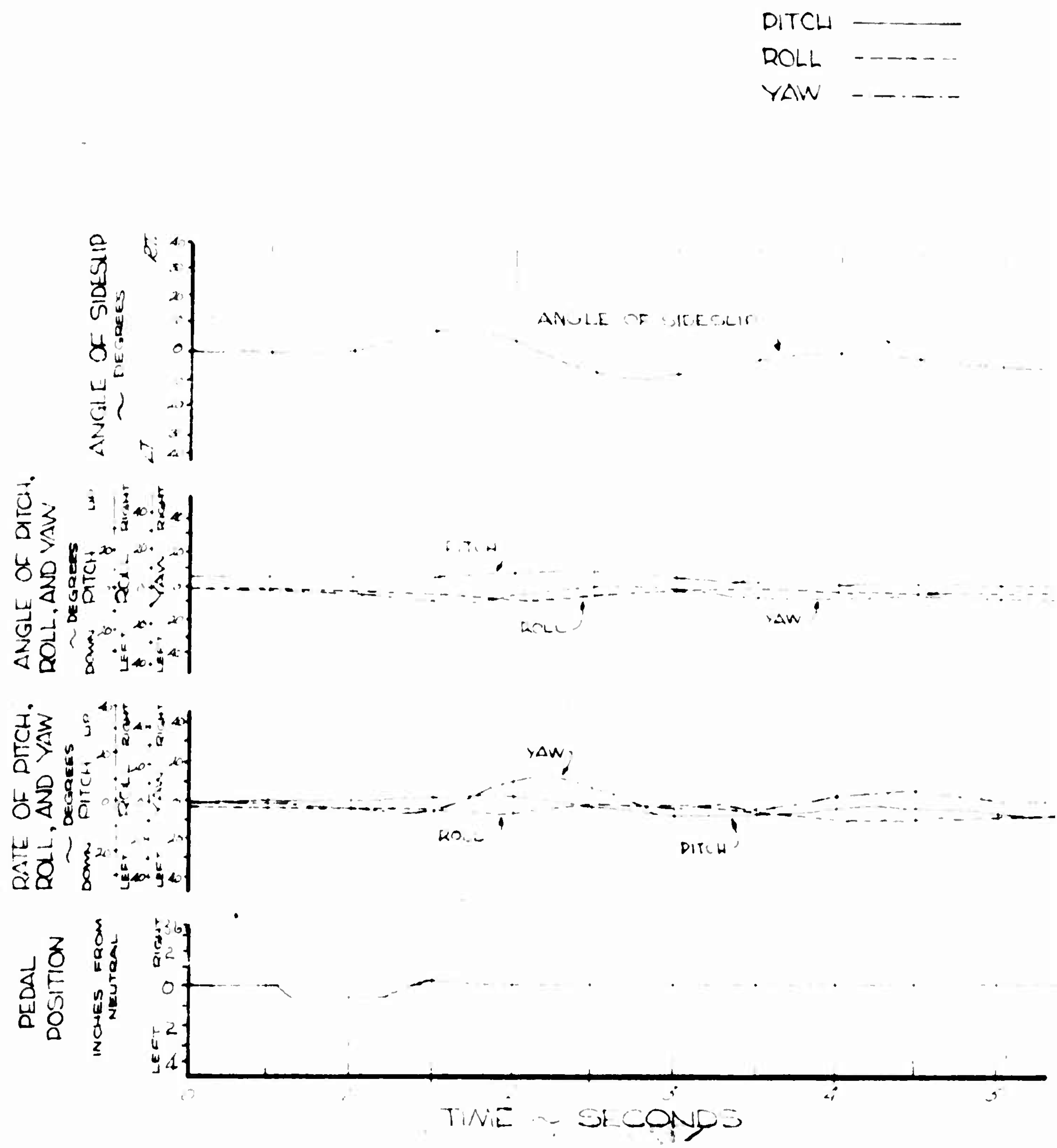


FIGURE NO. 112

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. RT.

FLIGHT CONDITION: AUTOROTATION
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

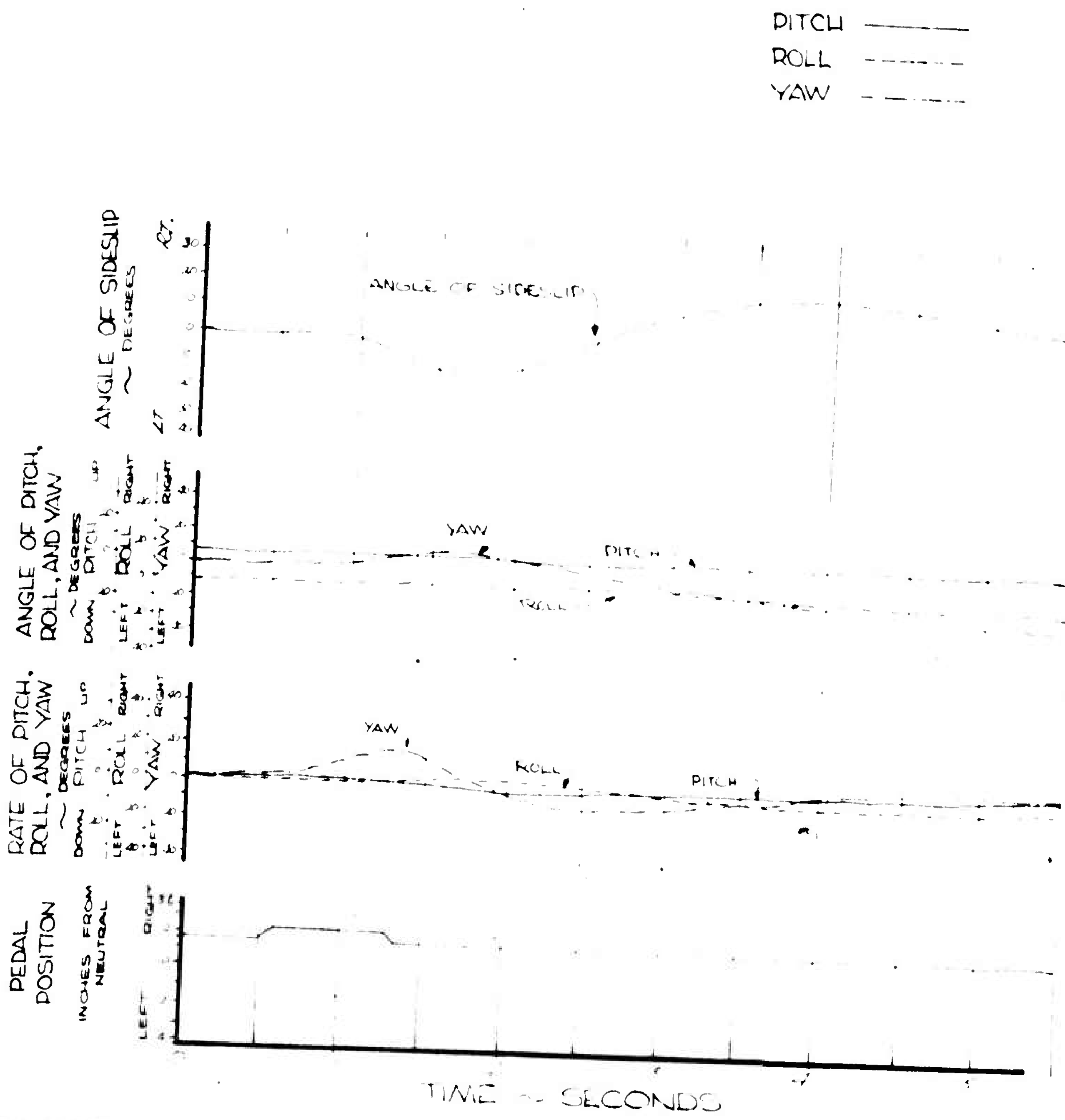


FIGURE NO. 113

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.6 INCHES
AVERAGE GROSS WEIGHT : 2150 LBS.
LONG. C.G. LOCATION : 97 INCHES (FWD)
LATERAL C.G. LOCATION : .5 IN. ([illegible])

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 35 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 46[illegible] RPM

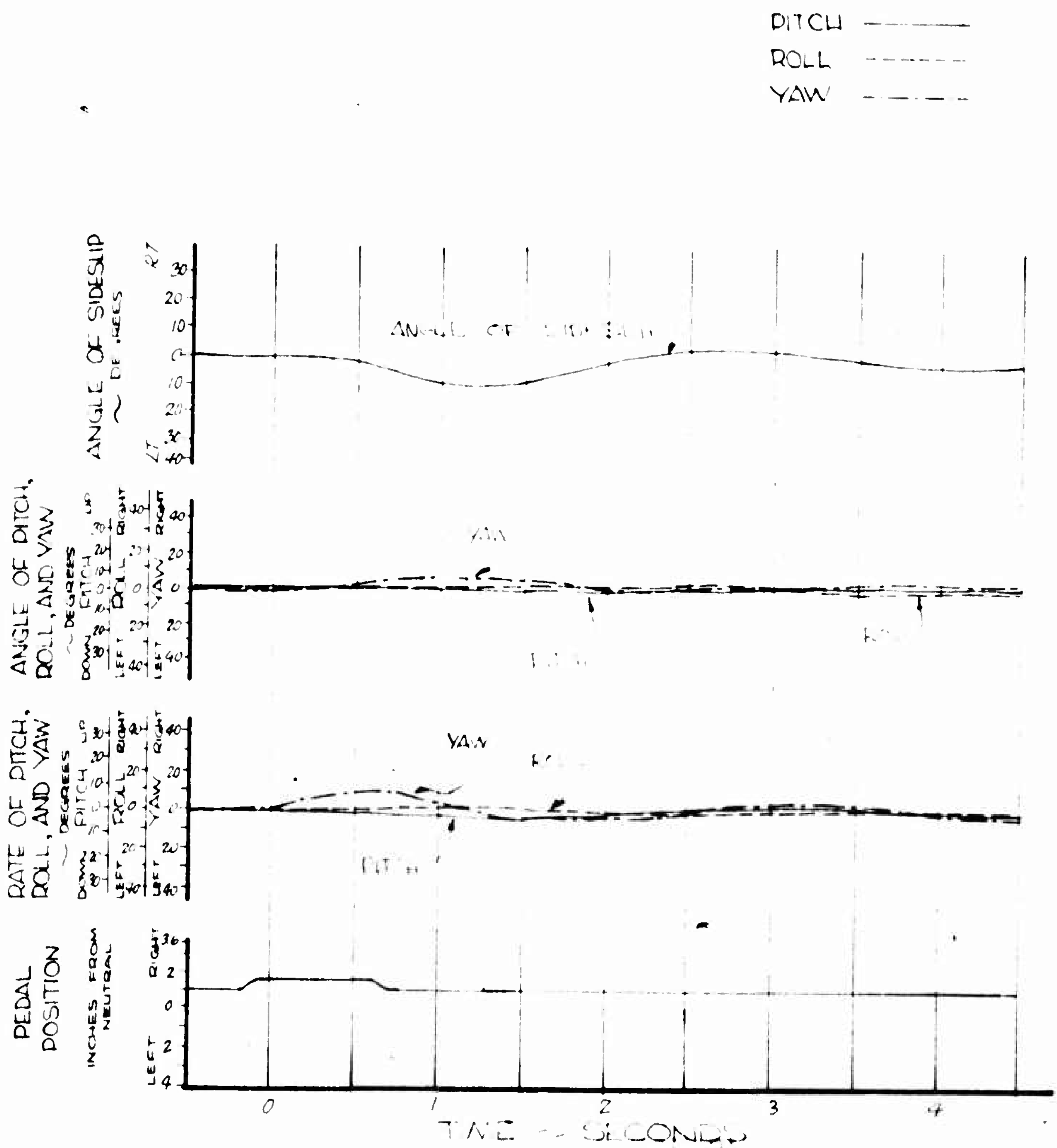


FIGURE NO. 114

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.6 INCHES
AVERAGE GROSS WEIGHT : 2130 LBS.
LONG. C.G. LOCATION : 97 INCHES
LATERAL C.G. LOCATION : .5 INCHES (RT)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 102.5 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

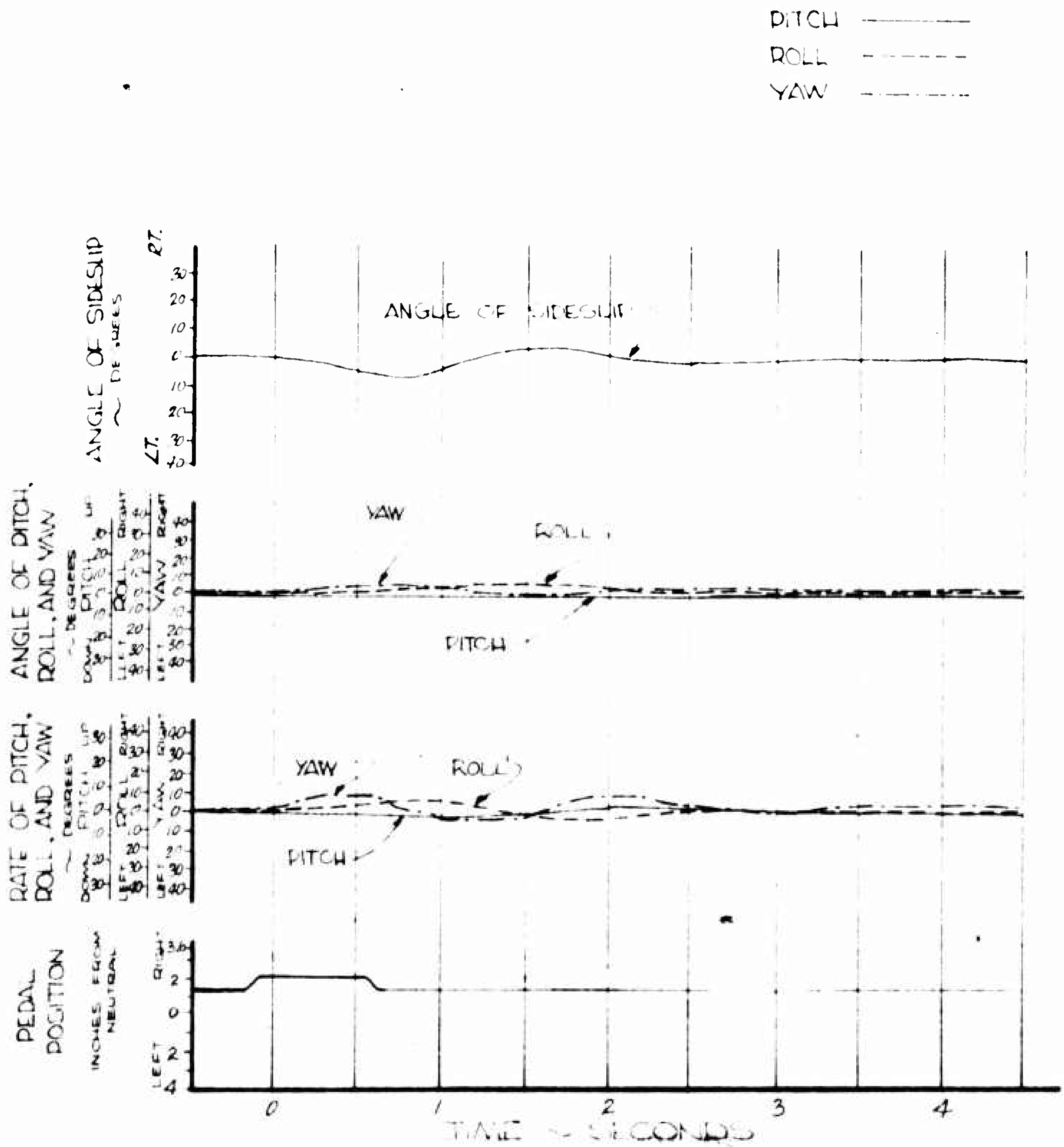


FIGURE NO. 115

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2710 LBS.
LONG. C.G. LOCATION: 103.5 INCHES AFT
LATERAL C.G. LOCATION: .4 IN. (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

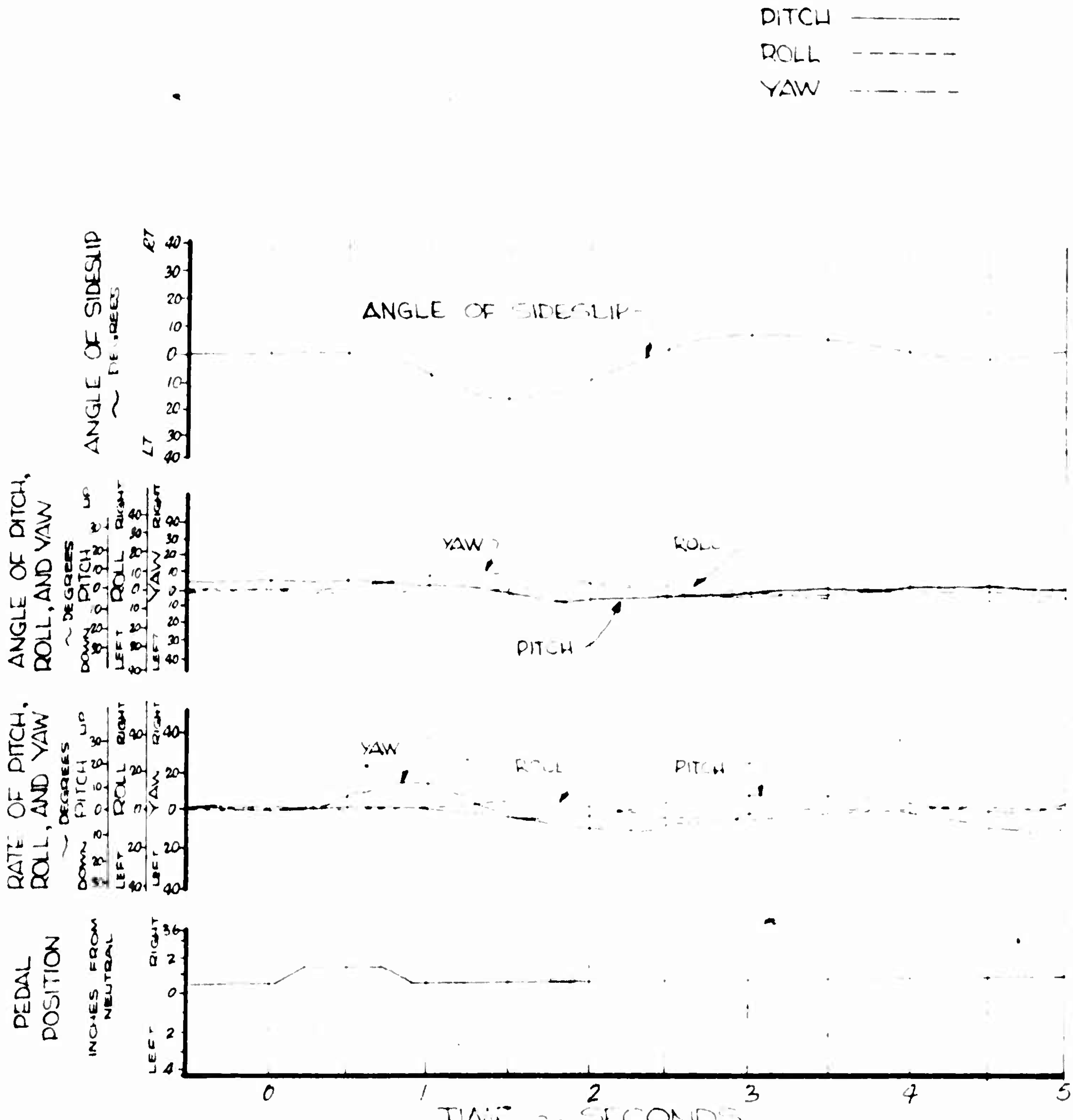


FIGURE NO. 116

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.0 INCHES
AVERAGE GROSS WEIGHT : 2100 LBS
LONG. C.G. LOCATION : 103.5 INCHES
LATERAL C.G. LOCATION : .5 IN (RT)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 86 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

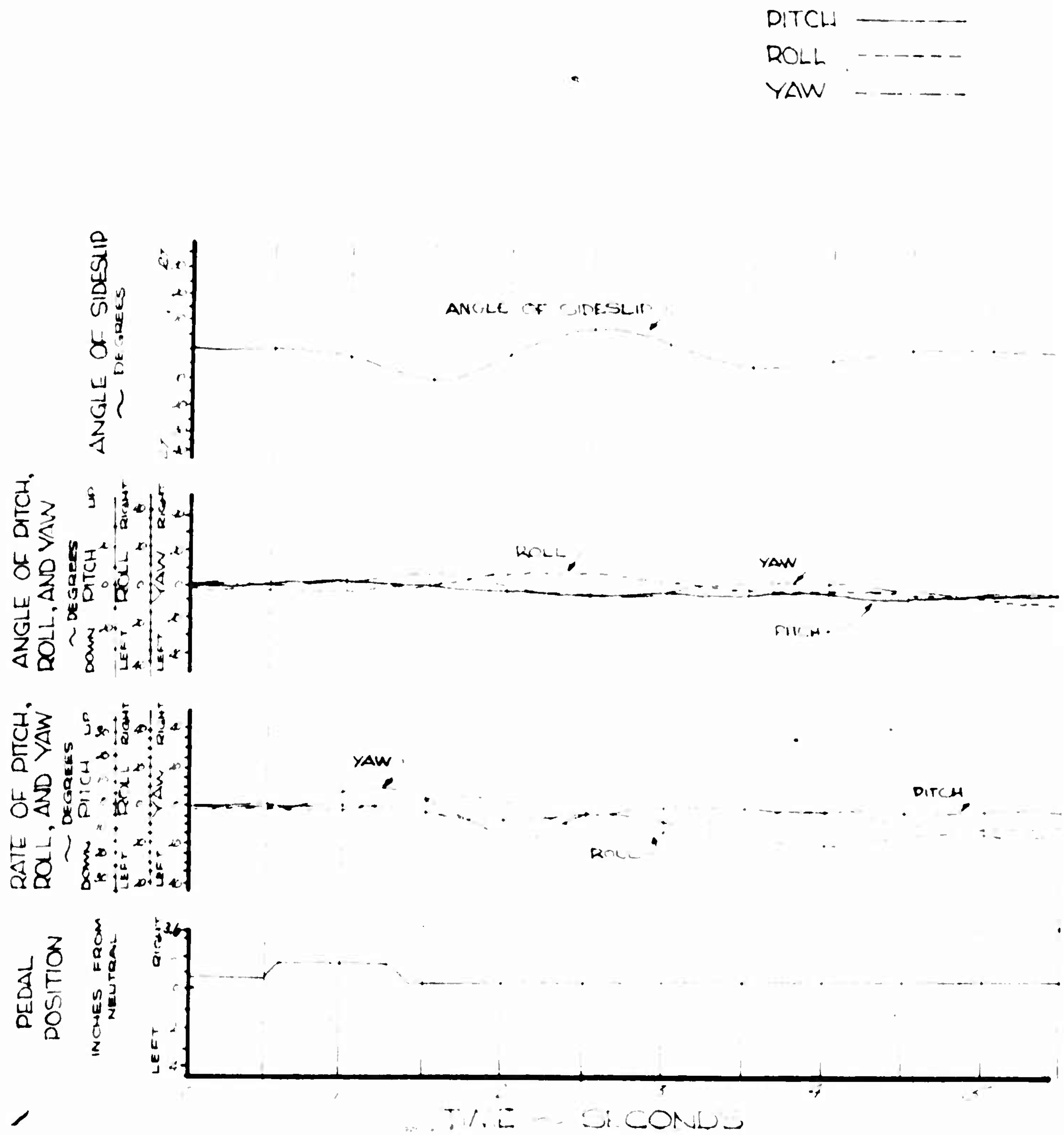


FIGURE NO. 117

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2700 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .4 IN. RT.

FLIGHT CONDITION: CLIMB
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

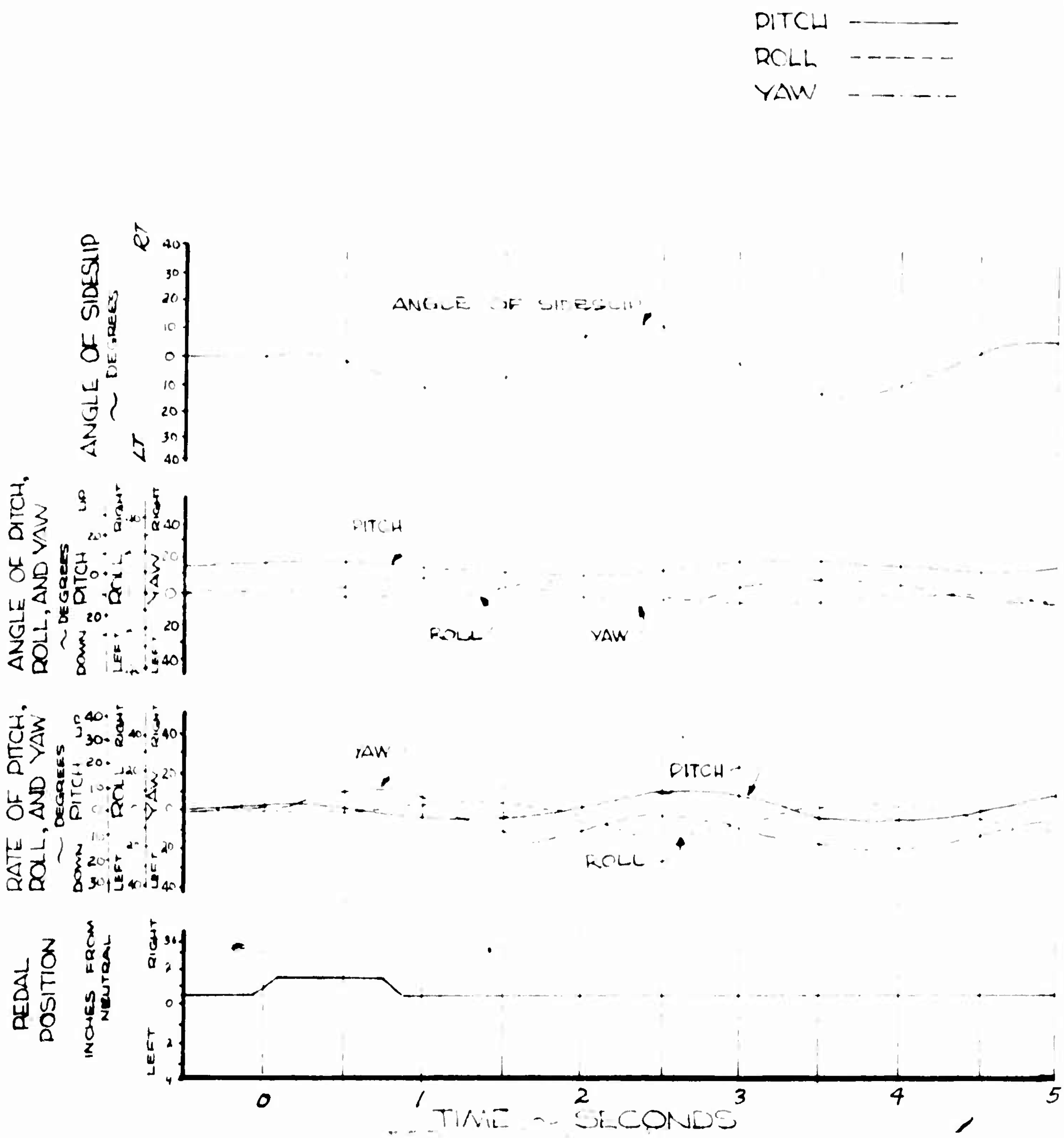


FIGURE NO. 118

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
FULL PEDAL TRAVEL : 7.6 INCHES
AVERAGE GROSS WEIGHT : 2680 LBS.
LONG. C.G. LOCATION : 103.5 INCHES (AFT)
LATERAL C.G. LOCATION : .4 IN. (RT)

FLIGHT CONDITION : AUTOROTATION
TRIM CAS : 55 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 4__ RPM

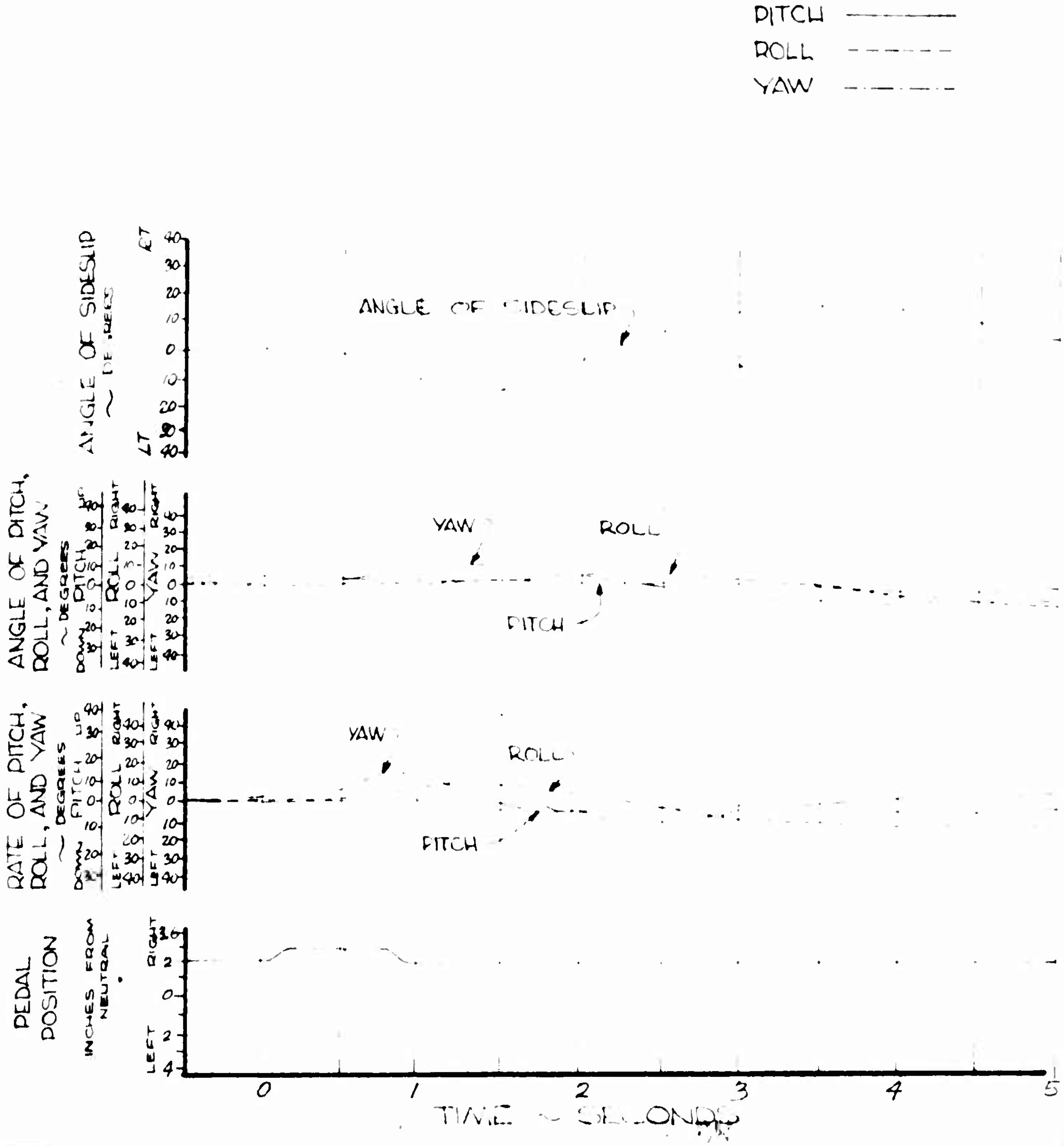


FIGURE NO. 119

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 16 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 89 KNOTS
DENSITY ALTITUDE: 10000 FEET
ROTOR SPEED: 465 RPM

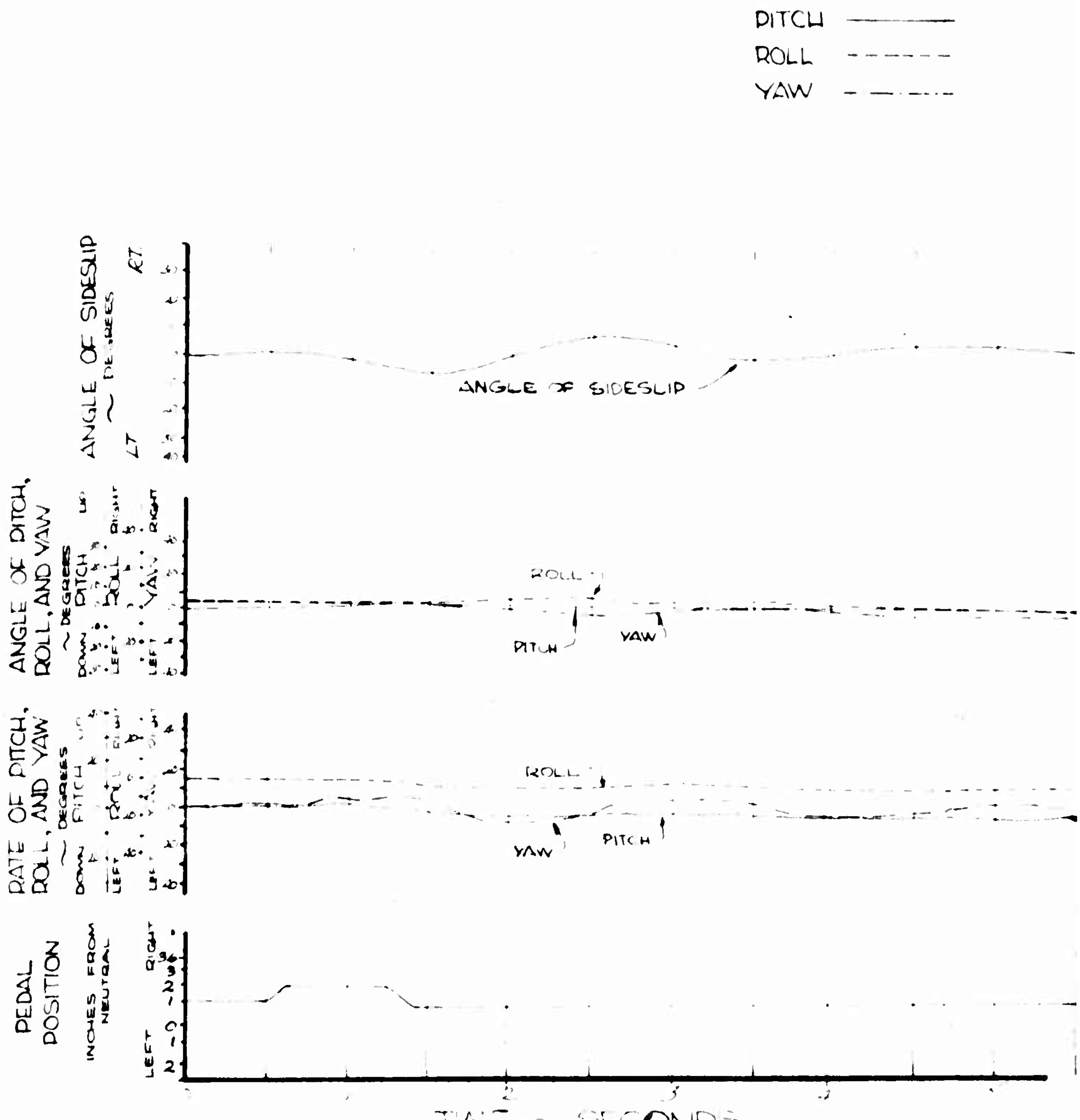


FIGURE NO. 120

LEFT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: [illegible] 3.5 INCHES
LATERAL C.G. LOCATION: [illegible] IN (RT)

FLIGHT CONDITION: CLIMB
TRIM CAS: 54 KNOTS
DENSITY ALTITUDE: 10000 FEET
ROTOR SPEED: 4[illegible] RPM

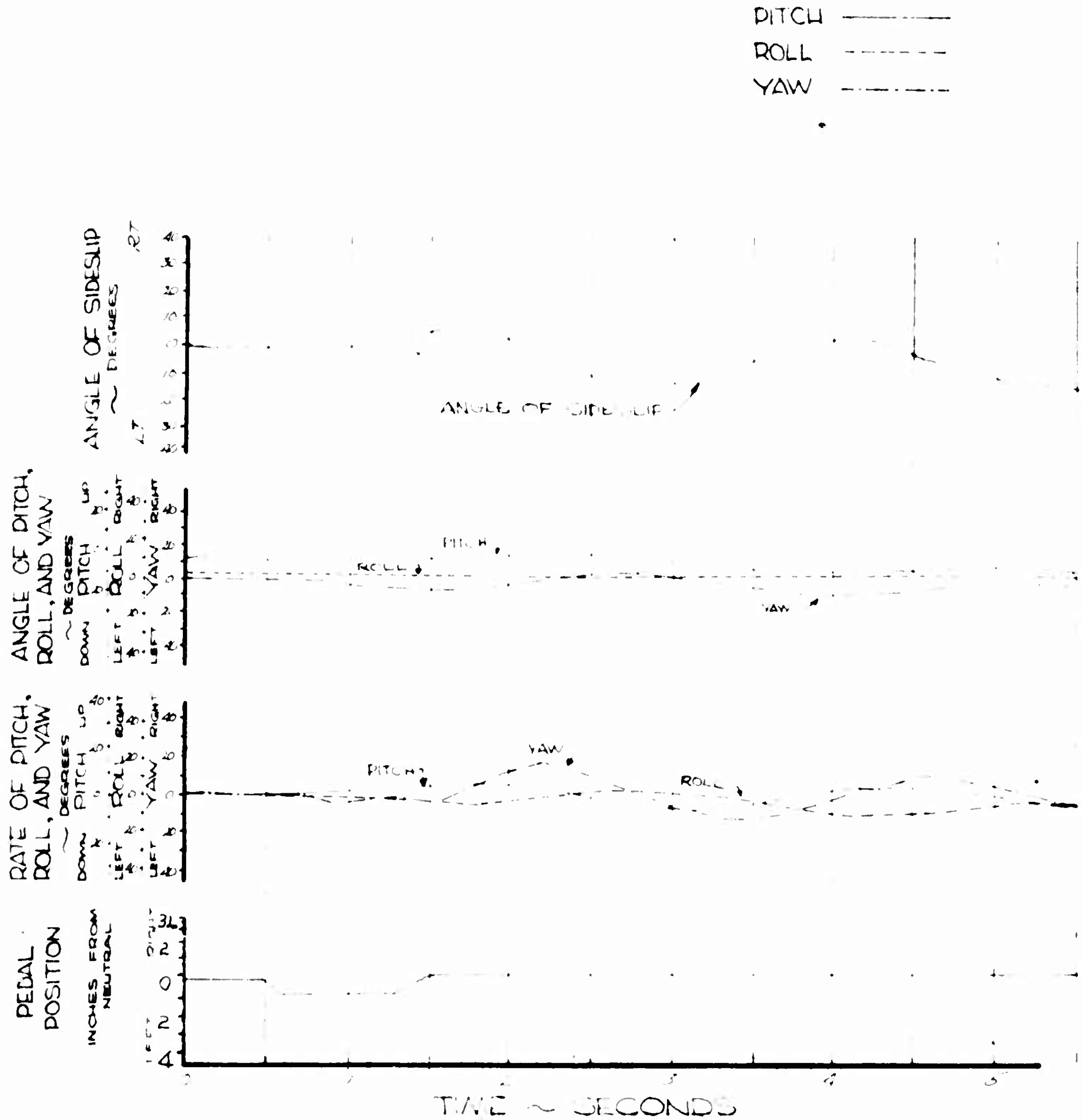


FIGURE NO. 121

LEFT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 8.0 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.5 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: AUTOROTATION
TRIM CAS: 54 KNOTS
DENSITY ALTITUDE: 10000 FEET
ROTOR SPEED: 465 RPM

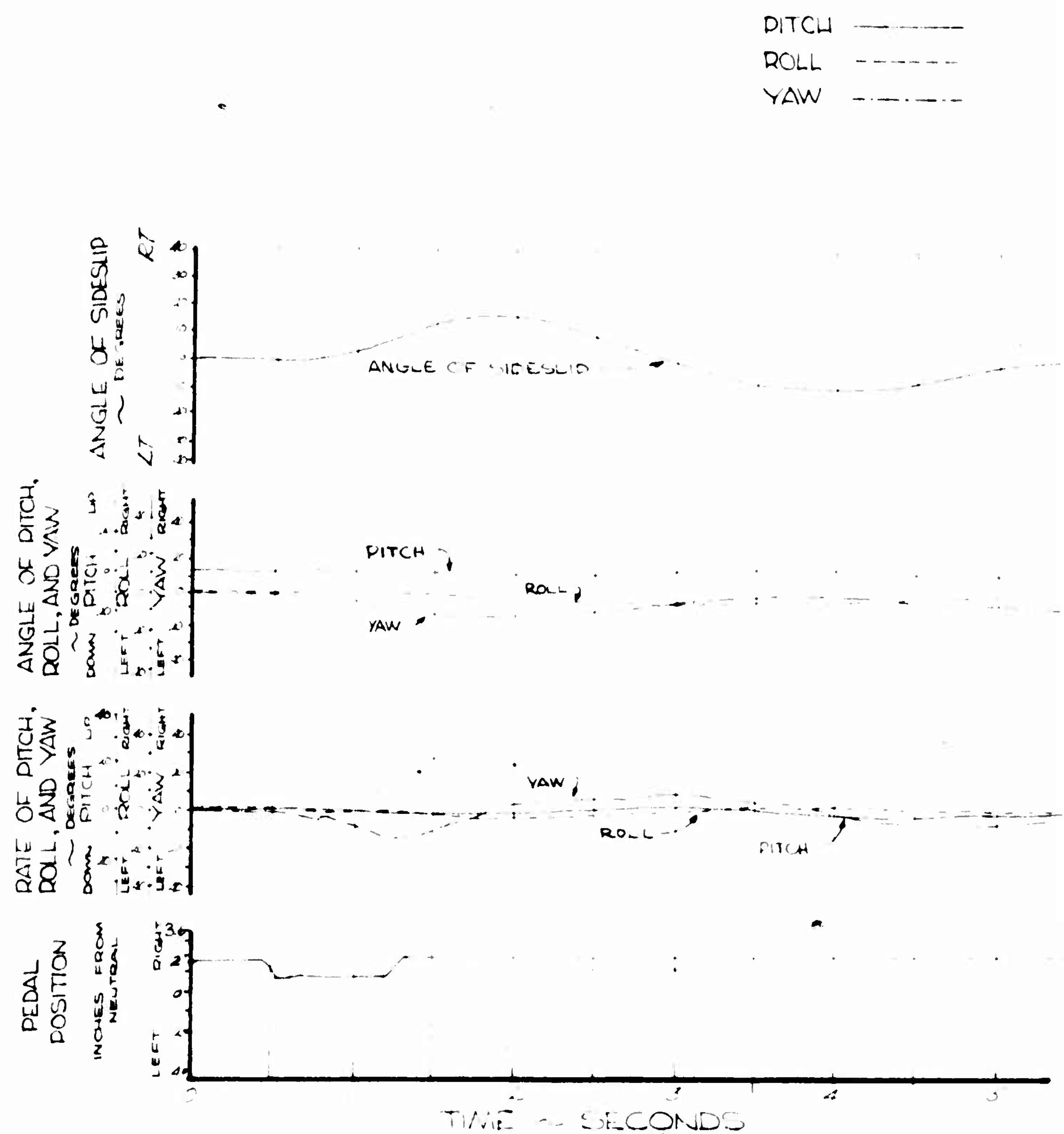


FIGURE NO. 122

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM7   FLIGHT CONDITION: HOVER

FULL PEDAL TRAVEL: 8 INCHES   TRIM CAS: ZERO

AVERAGE GROSS WEIGHT: 2100 LBS   DENSITY ALTITUDE: 1000 FEET

LONG. C.G. LOCATION: 103.5 INCHES (AFT)   ROTOR SPEED: 485 RPM

LATERAL C.G. LOCATION: .5 IN. (RT)

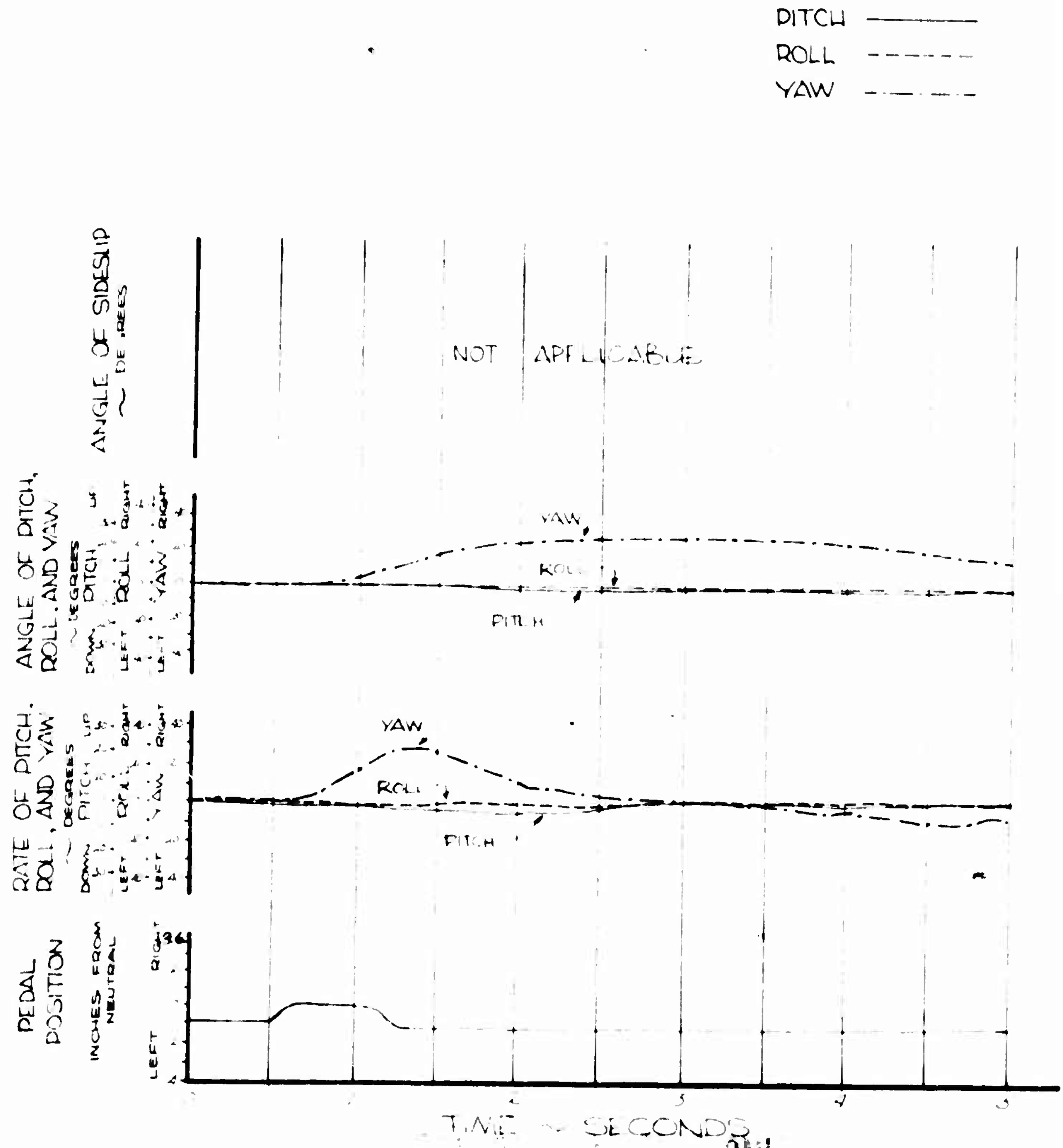


FIGURE NO. 123

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL PEDAL TRAVEL: 8.0 INCHES
AVERAGE GROSS WEIGHT: 2100 LBS
LONG. C.G. LOCATION: 103.3 INCHES (AFT)
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

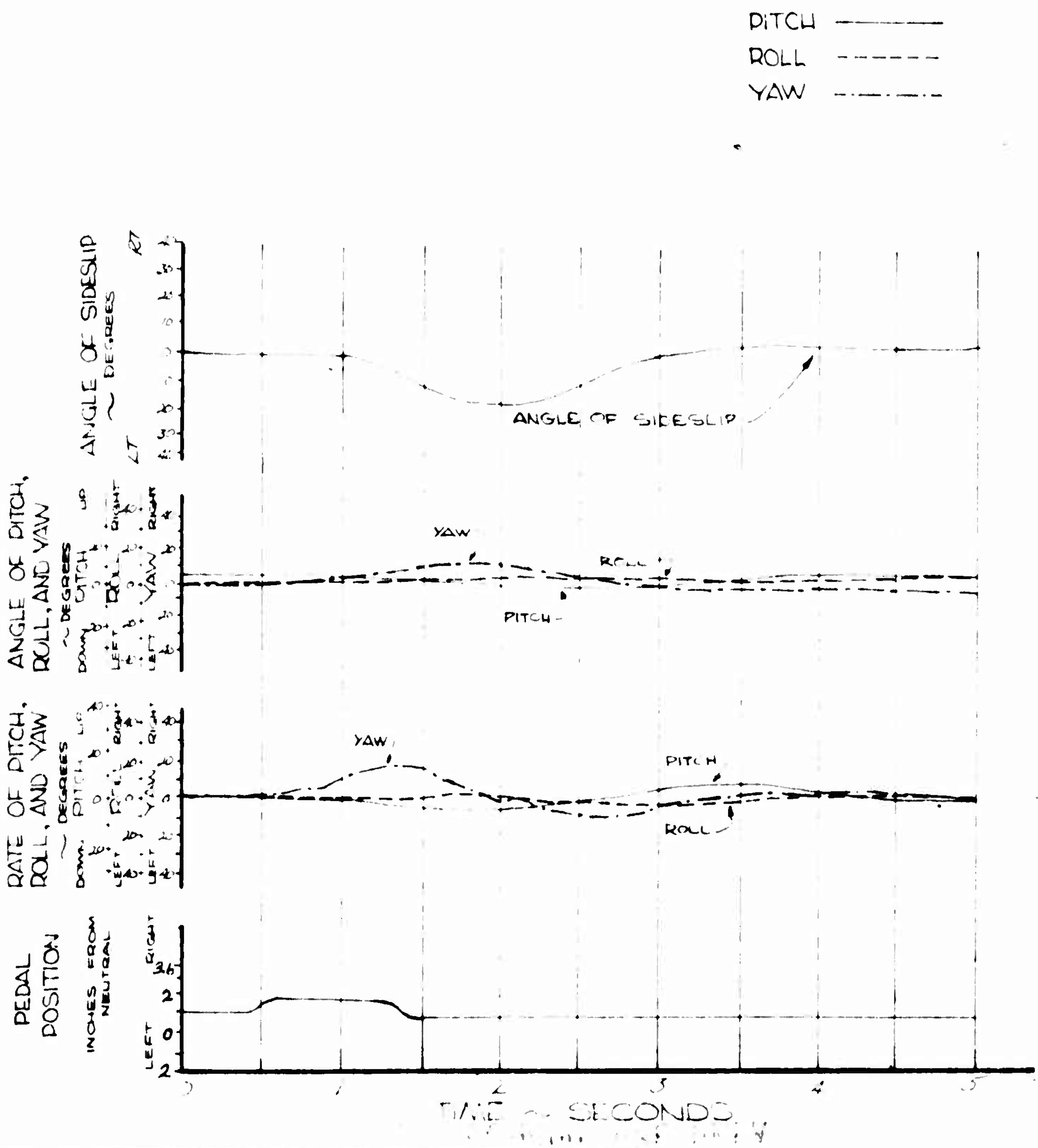


FIGURE NO. 124

RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8

FULL PEDAL TRAVEL: 4.6 INCHES

AVERAGE GROSS WEIGHT: 2130 LBS

LONG. C.G. LOCATION: 101.5 INCHES

LATERAL C.G. LOCATION: 2.85 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT

TRIM CAS: 90 KNOTS

DENSITY ALTITUDE: 5000 FEET

ROTOR SPEED: 465 RPM

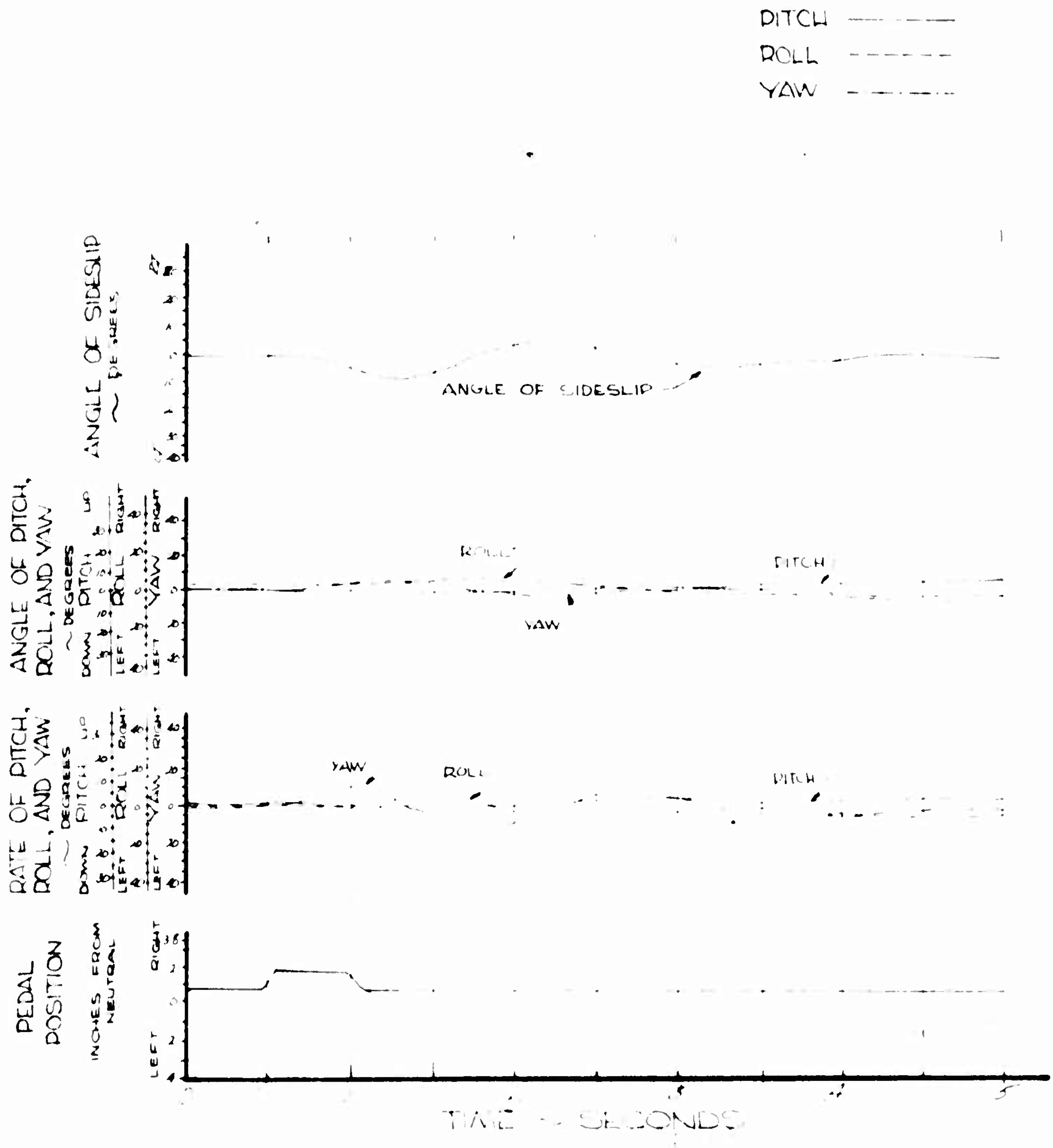


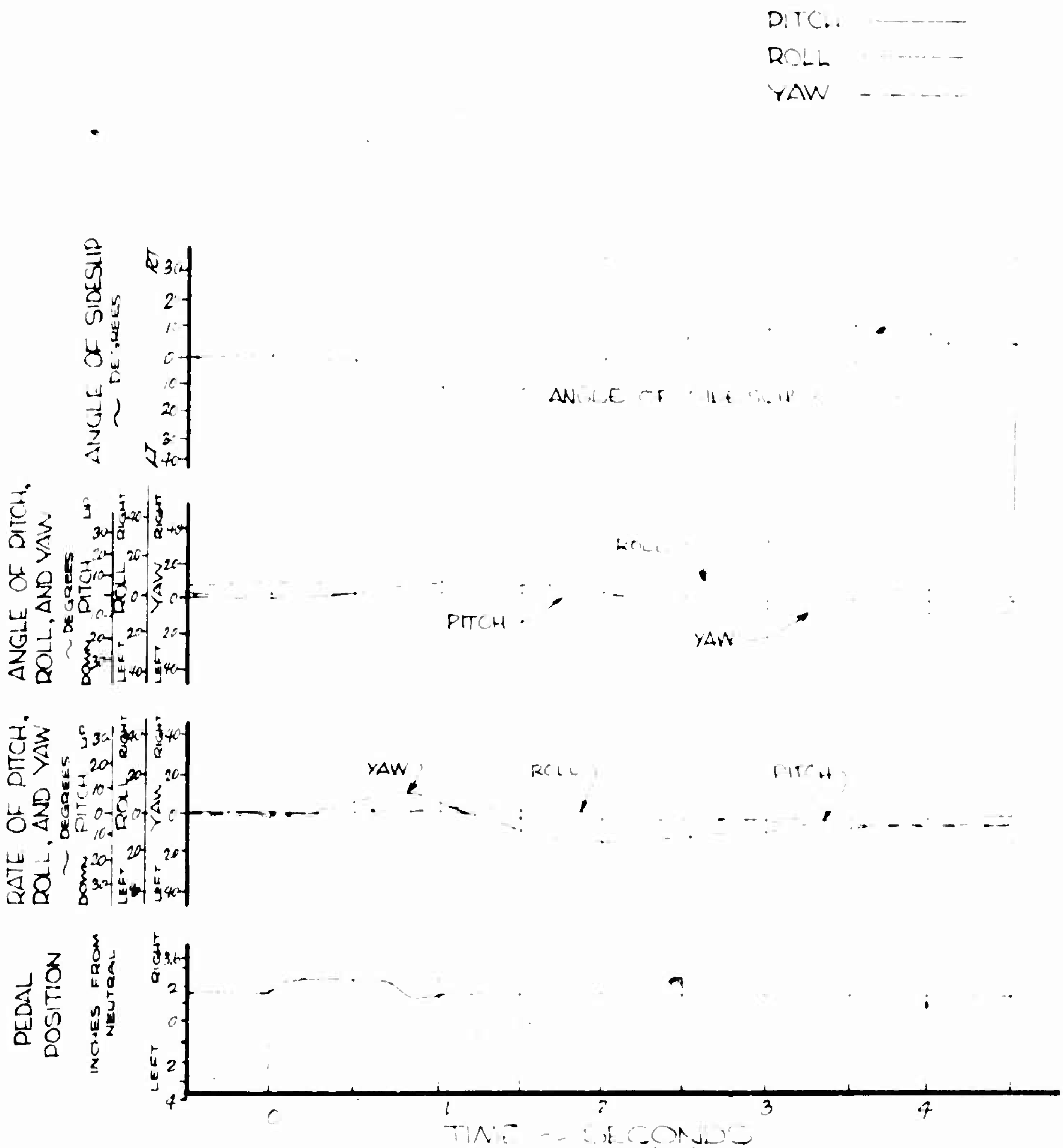
FIGURE NO. 125

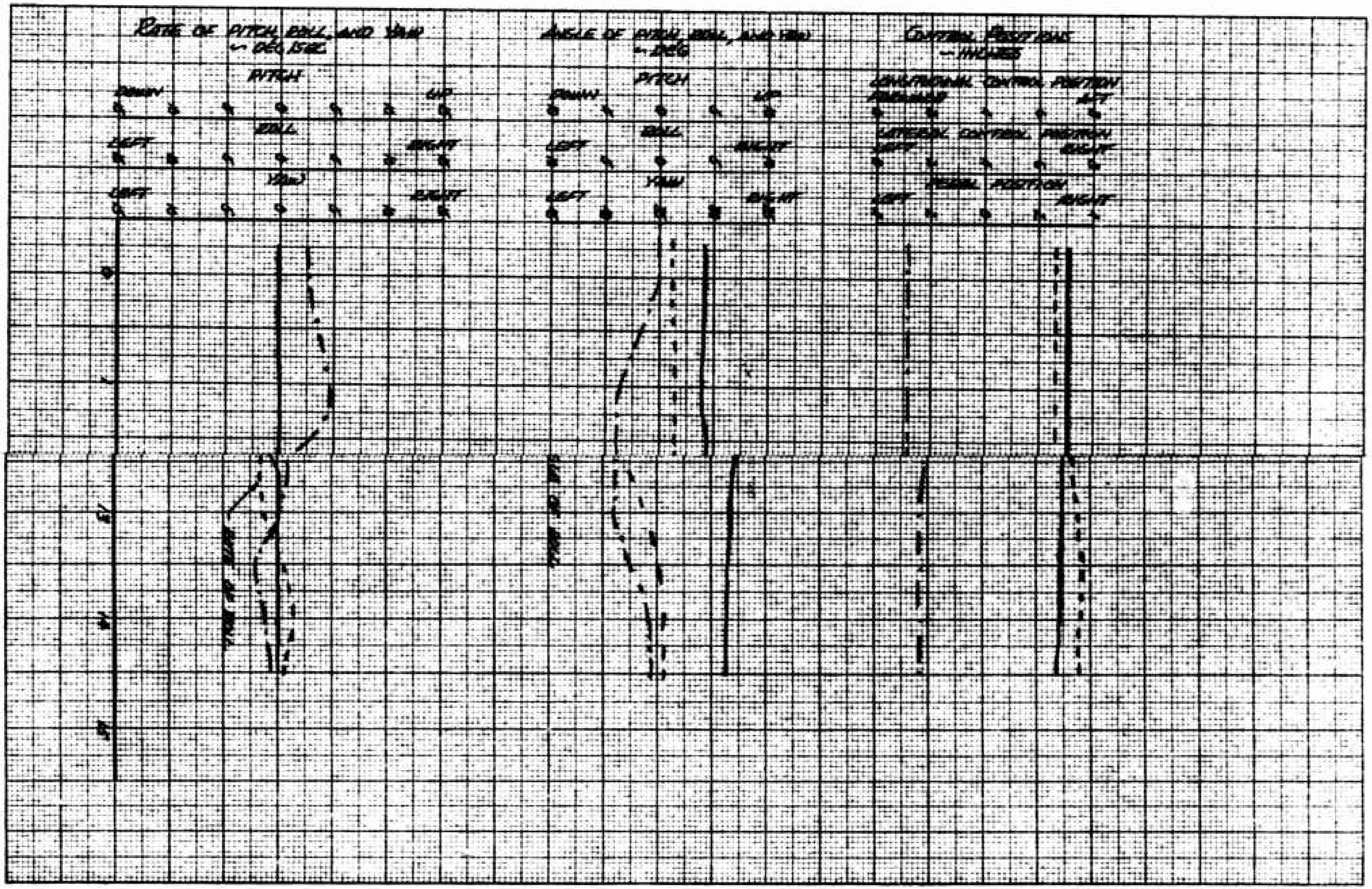
RIGHT DIRECTIONAL PULSE

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION:
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT:
LONG. C.G. LOCATION: 101.5 INCHES
LATERAL C.G. LOCATION: 2.85 IN.

FLIGHT CONDITION: AUTOROTATION
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: RPM




RATE OF PITCH, ROLL, AND YAW ~ DEG/SEC
PITCH
DOWN
UP
ROLL
LEFT
RIGHT
YAW
LEFT
RIGHT
ANGLE OF PITCH, ROLL, AND YAW ~ DEG
PITCH
DOWN
UP
ROLL
LEFT
RIGHT
YAW
LEFT
RIGHT
CONTROL POSITIONS ~ INCHES
LONGITUDINAL CONTROL POSITION
FORWARD
AFT
LATERAL CONTROL POSITION
LEFT
RIGHT
PEDAL POSITION
LEFT
RIGHT
RATE OF ROLL

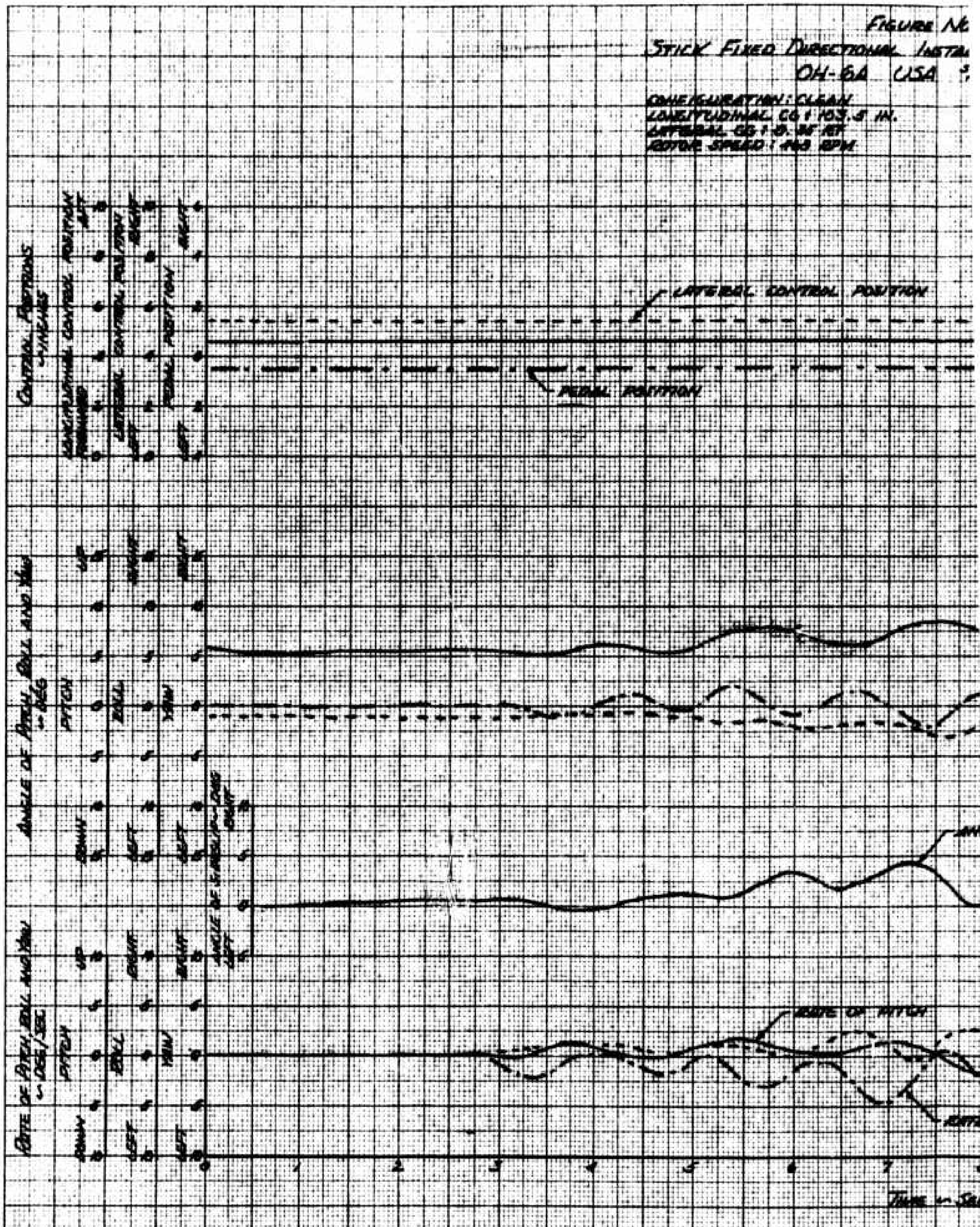


FIGURE N
STICK FIXED DIRECTIONAL INSTA
OH-6A USA
CONFIGURATION: CLEAN
LONGITUDINAL CG 103.5 IN.
CONTROL POSITIONS ~INCHES
LATERAL CONTROL POSITION
PEDAL POSITION
ANGLE OF PITCH, ROLL AND YAW ~ DEG
PITCH
ROLL
YAW
RATE OF PITCH, ROLL AND YAW ~ DEG/SEC
RATE OF PITCH
0
1
2
3
4
5
6
7
8
TIME ~ SEC

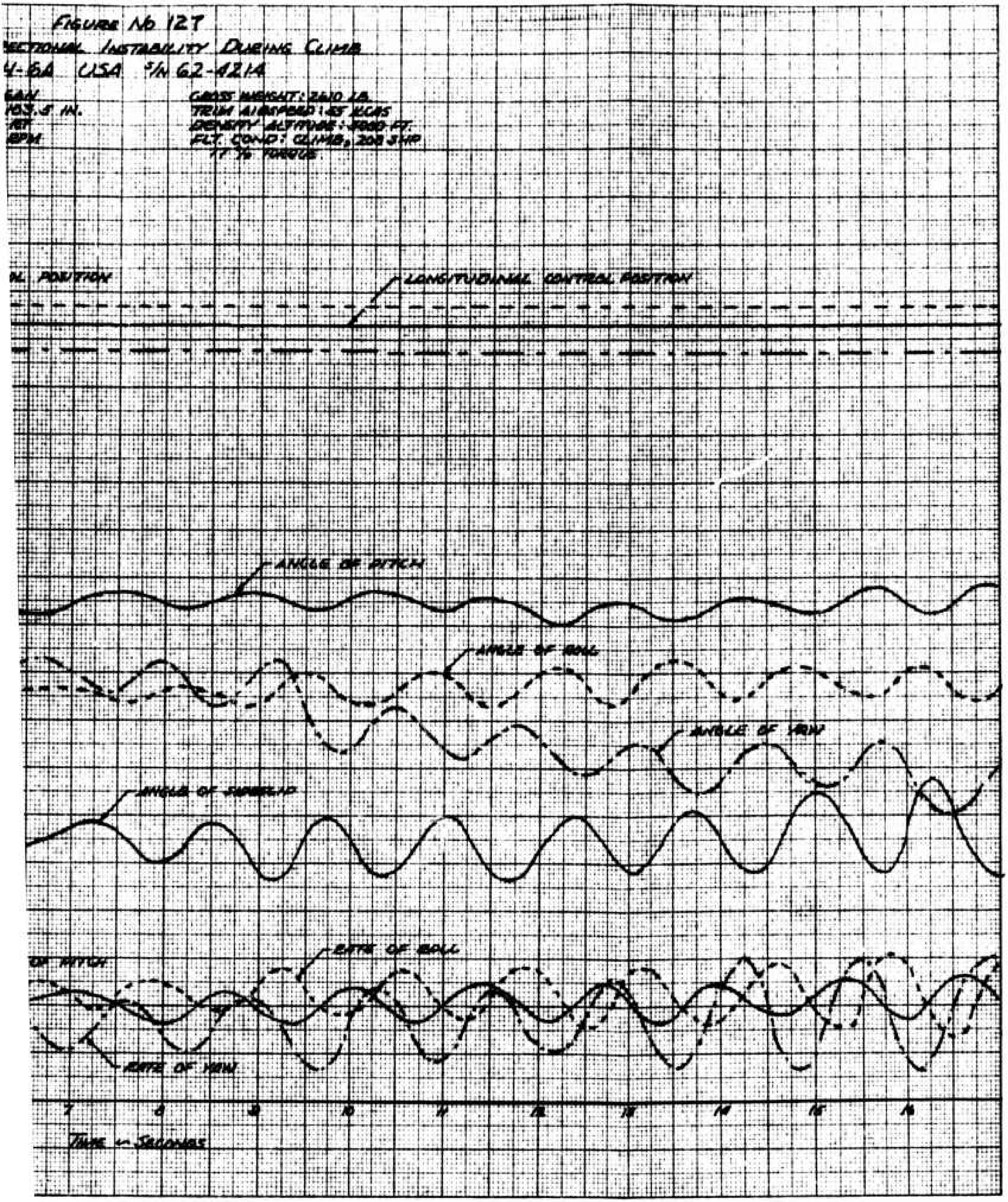


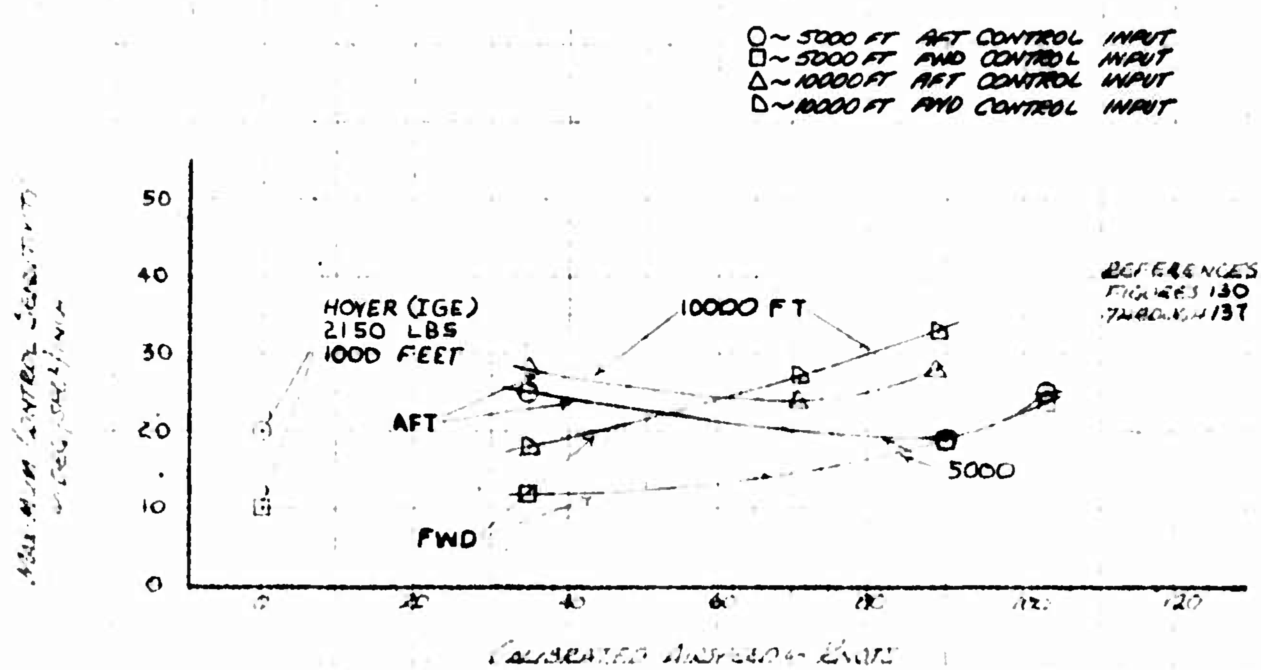
FIGURE No 127
ECTIONAL INSTABILITY DURING CLIMB
4-6A USA S/N 62-4214
GROSS WEIGHT: 2610 LB.
TRIM AIRSPEED: 45 KCAS
FLT. COND: CLIMB, 208 SHP
77 % TORQUE
103.5 IN.
LONGITUDINAL CONTROL POSITION
ANGLE OF PITCH
ANGLE OF ROLL
ANGLE OF YAW
ANGLE OF SIDESLIP
RATE OF ROLL
RATE OF YAW
7
8
9
10
11
12
13
14
15
16
TIME ~ SECONDS

FIGURE NO 128

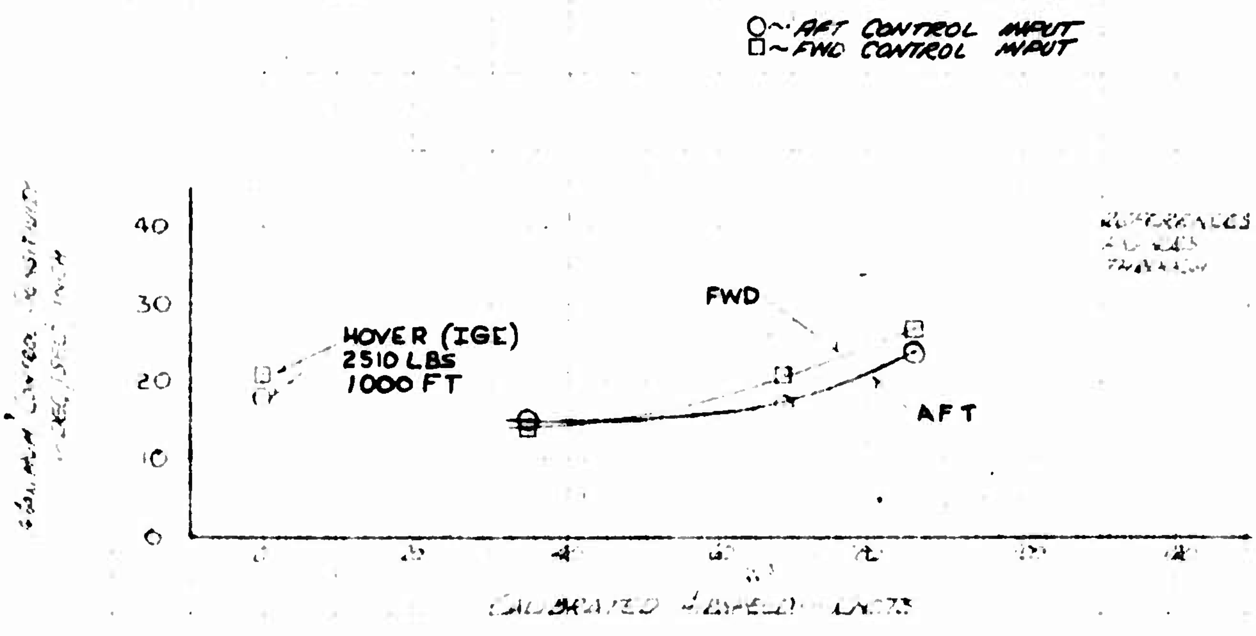
SUMMARY OF LONGITUDINAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

AVG HD FT	AVG GW LB	AVG CG IN LONG	AVG CG IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT
10000	2120	103.5	.5RT	465	CLEAN	LEVEL FLT



AVG HD FT	AVG GW LB	AVG CG IN LONG	AVG CG IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2620	103.5	.5RT	465	CLEAN	LEVEL FLT



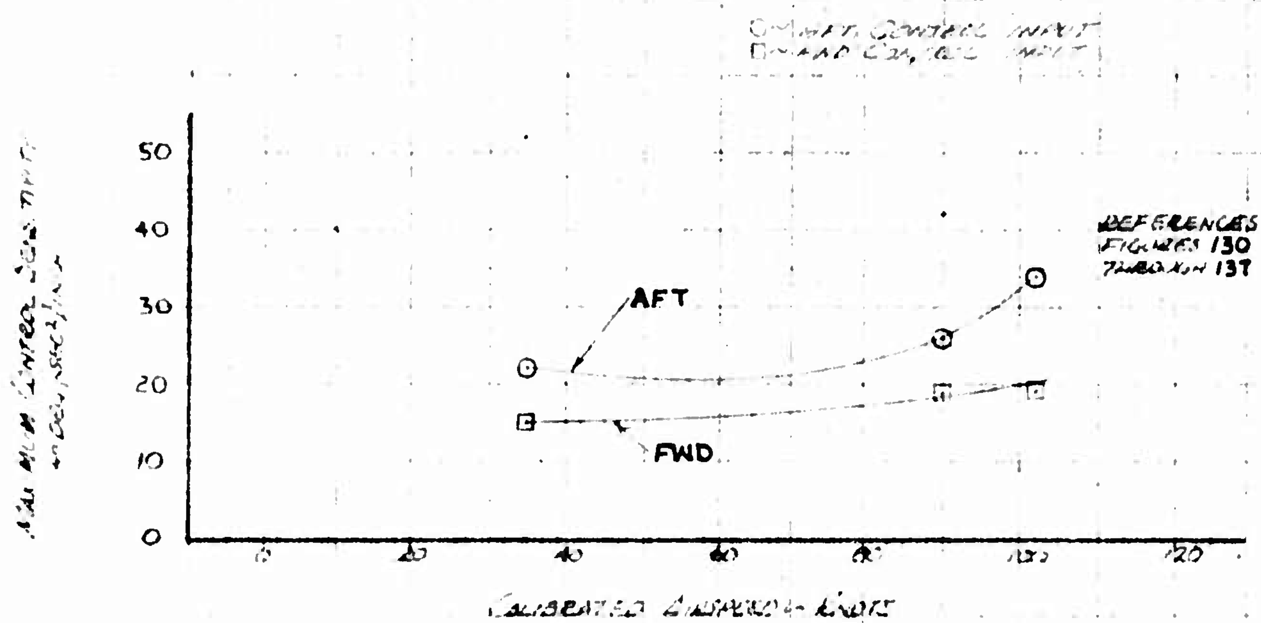
FOR OFFICIAL USE ONLY

FIGURE NO 129

SUMMARY OF LONGITUDINAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

AVG H_p FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
5000	2160	101.5	2.89 LT	465	XM-8	LEVEL FLT



AVG H_p FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
5000	2120	103.5	.5 RT	465	XM-7	LEVEL FLT

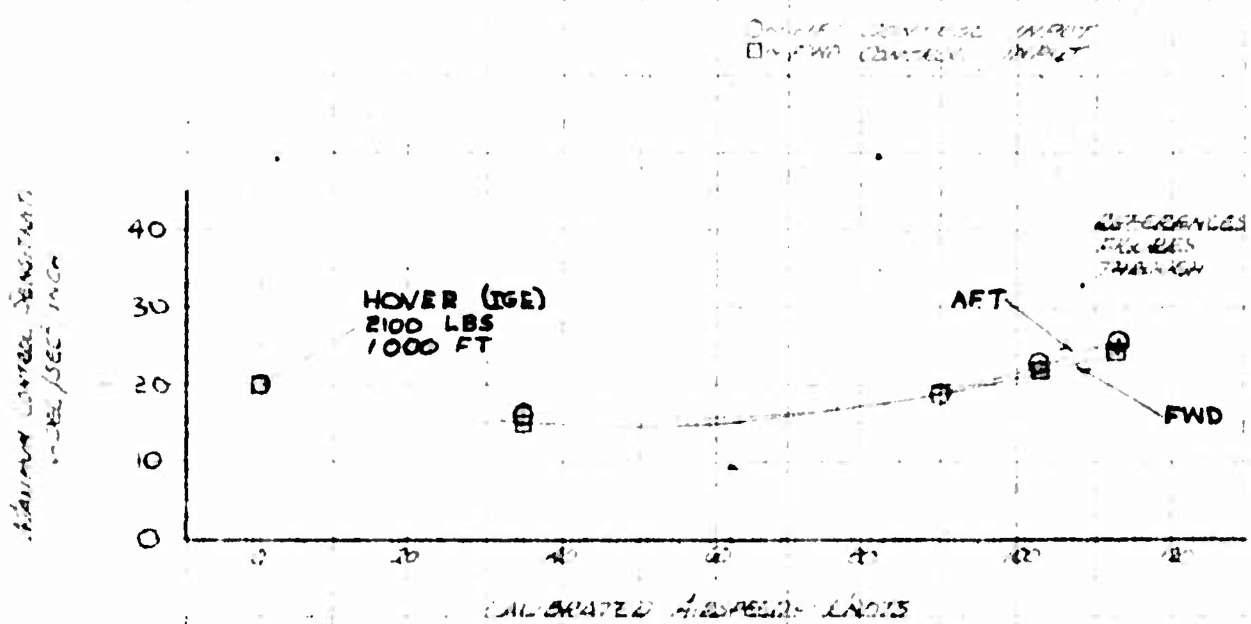
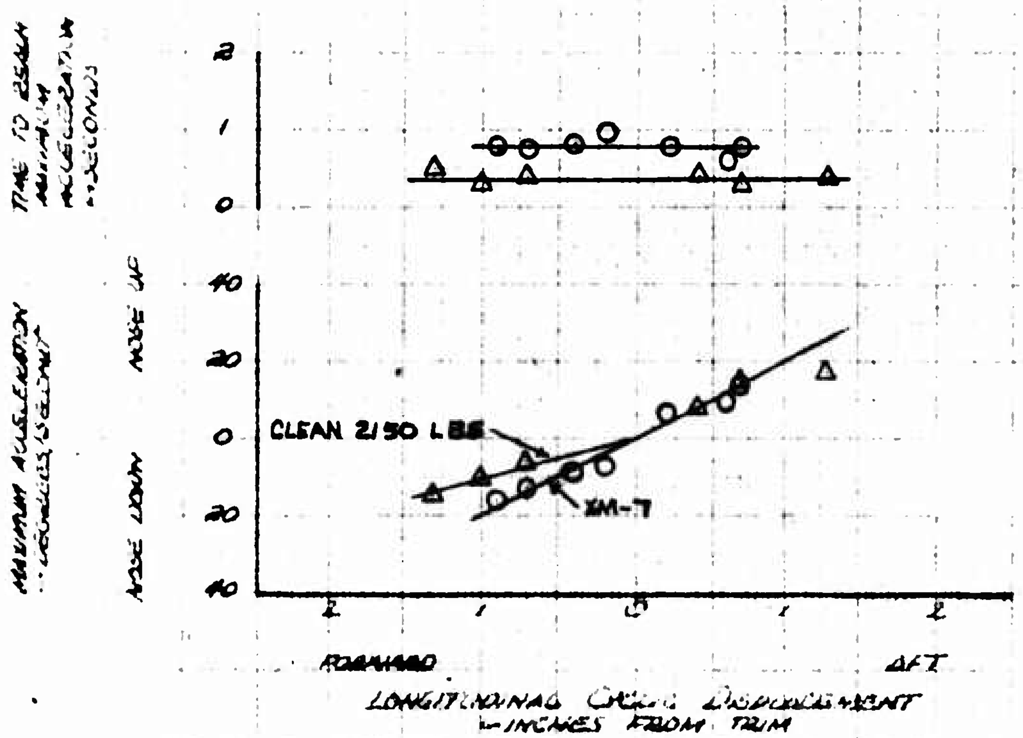


FIGURE NO. 130

LONGITUDINAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KTS	AVG Hp ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	ZERO	1000	2100	103.5	.5 RT	465	XM-7	HOVER
□	ZERO	1000	2510	103.5	.4 RT	466	CLEAN	HOVER
△	ZERO	1000	2150	103.5	.5 RT	465	CLEAN	HOVER



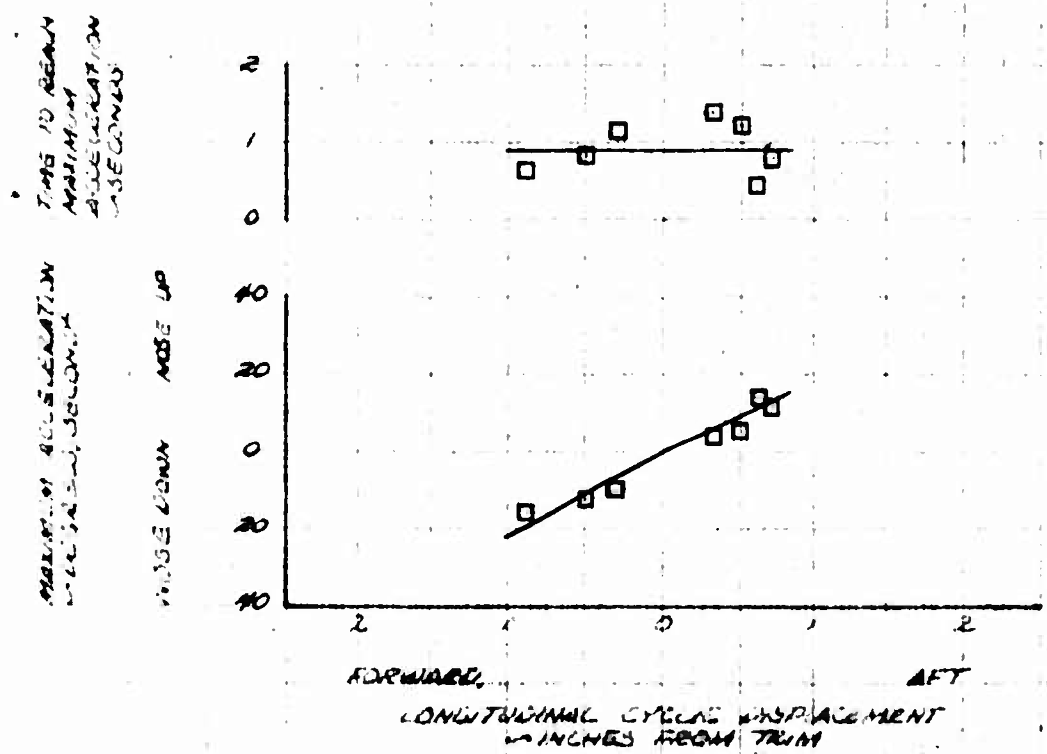
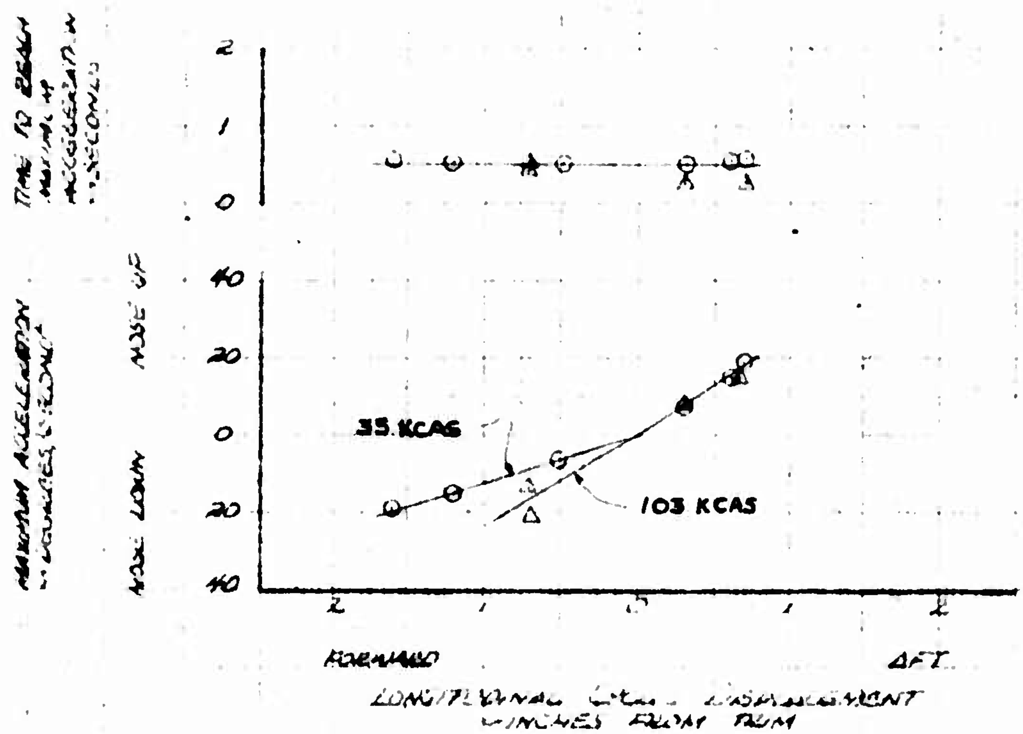


FIGURE NO 131
LONGITUDINAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG Hp FT	AVG GW LB	AVG CG LONG	CG LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.5R	465	CLEAN	LEVEL FLT
□	90	5000	2090	103.5	.5R	465	CLEAN	LEVEL FLT
△	103	5000	2100	103.5	.5R	466	CLEAN	LEVEL FLT



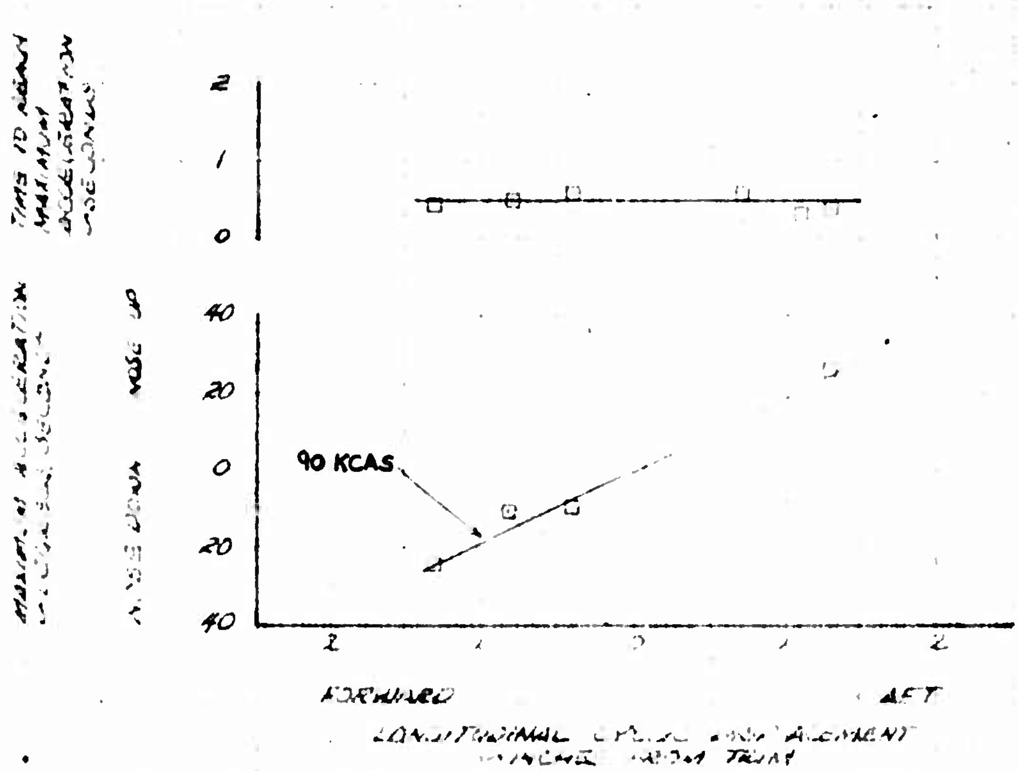


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FIGURE NO 132
LONGITUDINAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2100	103.5	.5Lt	46.5	CLEAN	NOTED
□	55	10000	2100	103.5	.5Lt	46.5	CLEAN	NOTED

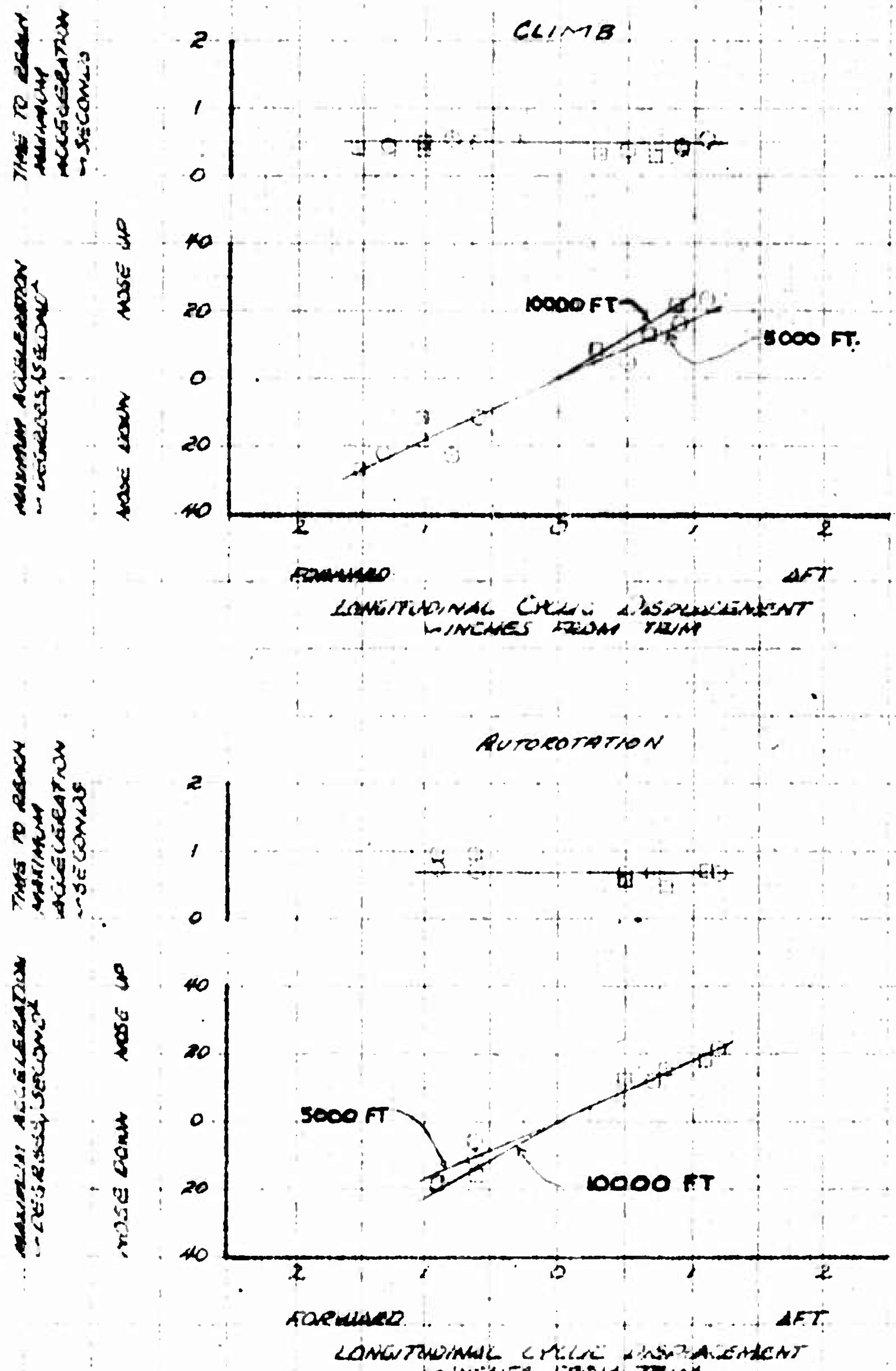

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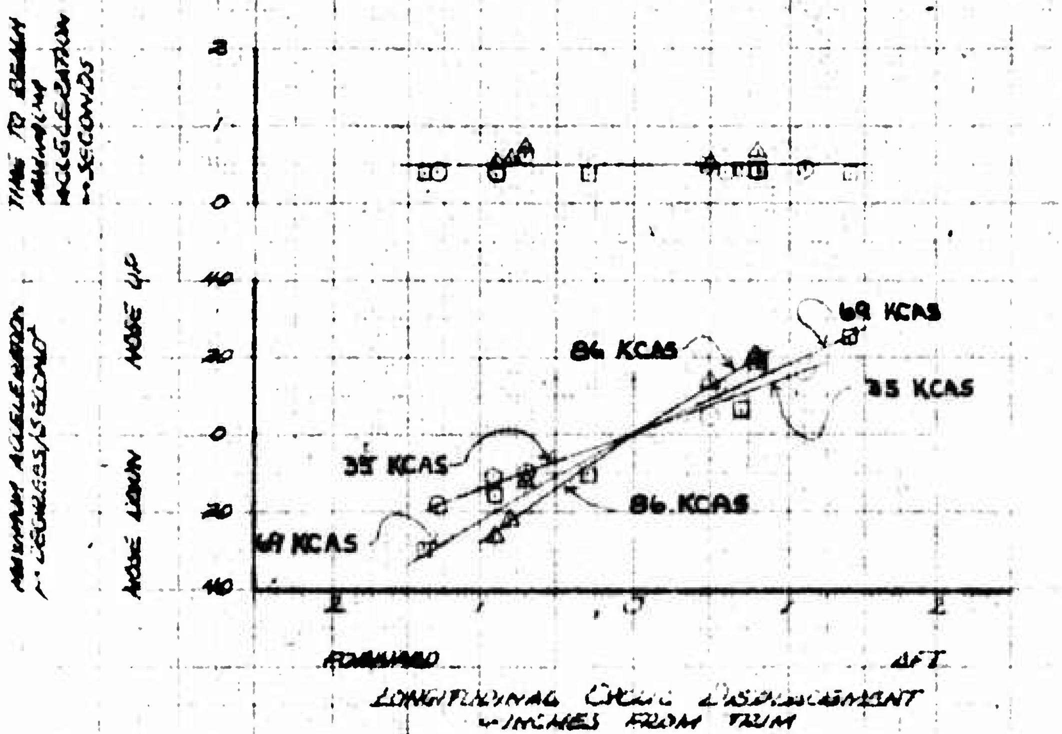
FIGURE NO 133

LONGITUDINAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN (LONG)	(LAT)	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	.5R	465	CLEAN	LEVEL FLT
□	69	5000	2620	103.5	.5R	465	CLEAN	LEVEL FLT
△	86	5000	2550	103.5	.5R	465	CLEAN	LEVEL FLT
⬭	55	5000	2700	103.5	.5R	465	CLEAN	CLIMB
D	55	5000	2480	103.5	.5R	465	CLEAN	AUTOROTATION



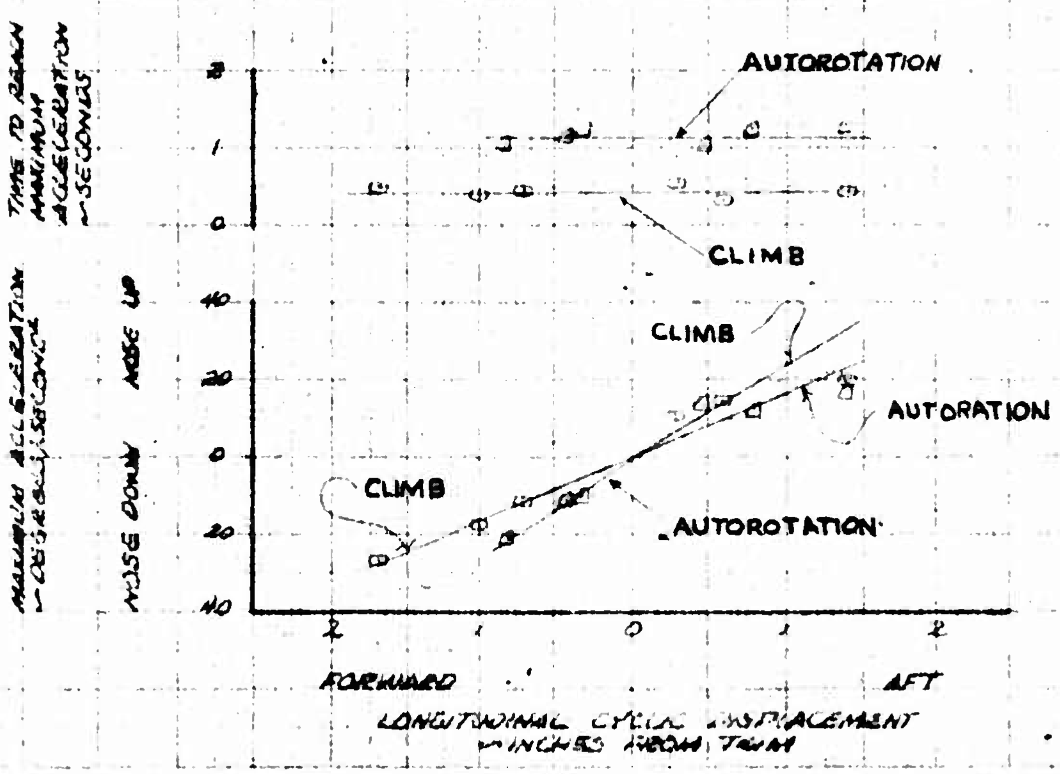
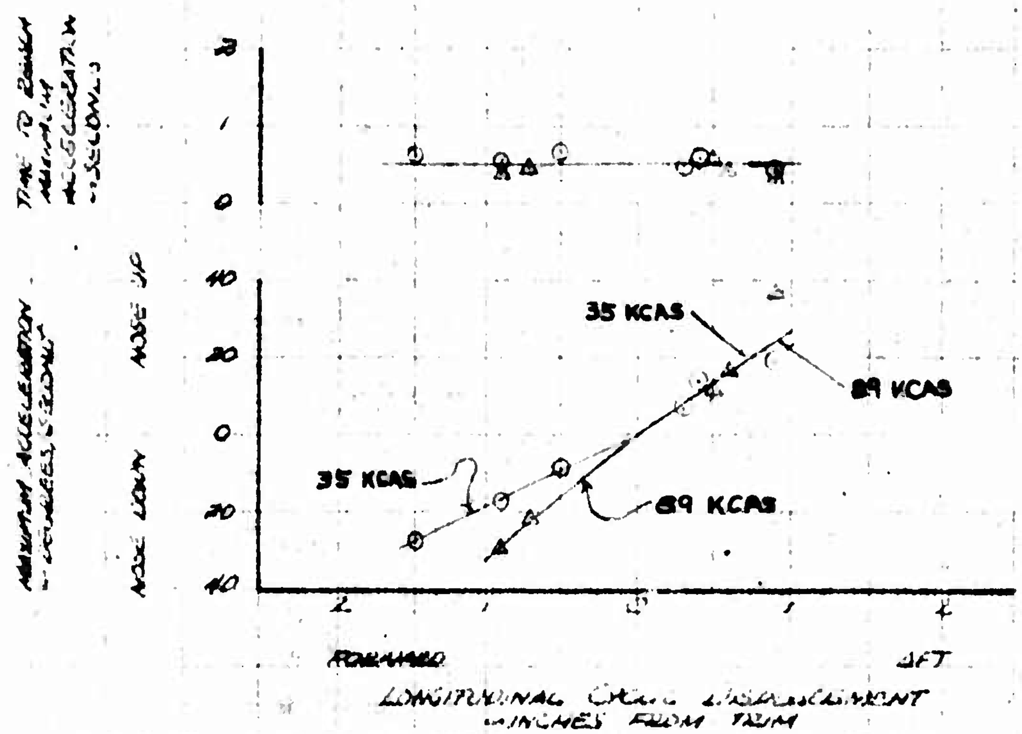


FIGURE NO 134
LONGITUDINAL CONTROL SENSITIVITY
CH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG HP ~FT	AVG GW ~LB	AVG CG LONG	CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	10000	2130	103.5	.5R	465	CLEAN	LEVEL FLT
□	71	10000	2120	103.5	.5R	465	CLEAN	LEVEL FLT
△	89	10000	2080	103.5	.5R	465	CLEAN	LEVEL FLT



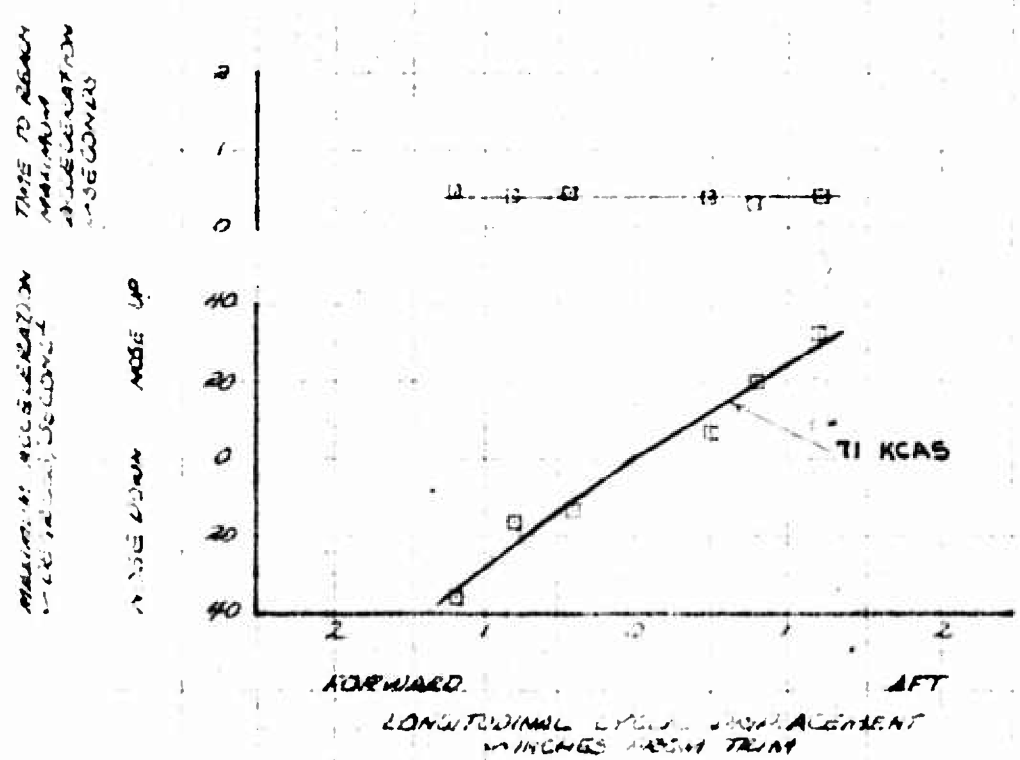
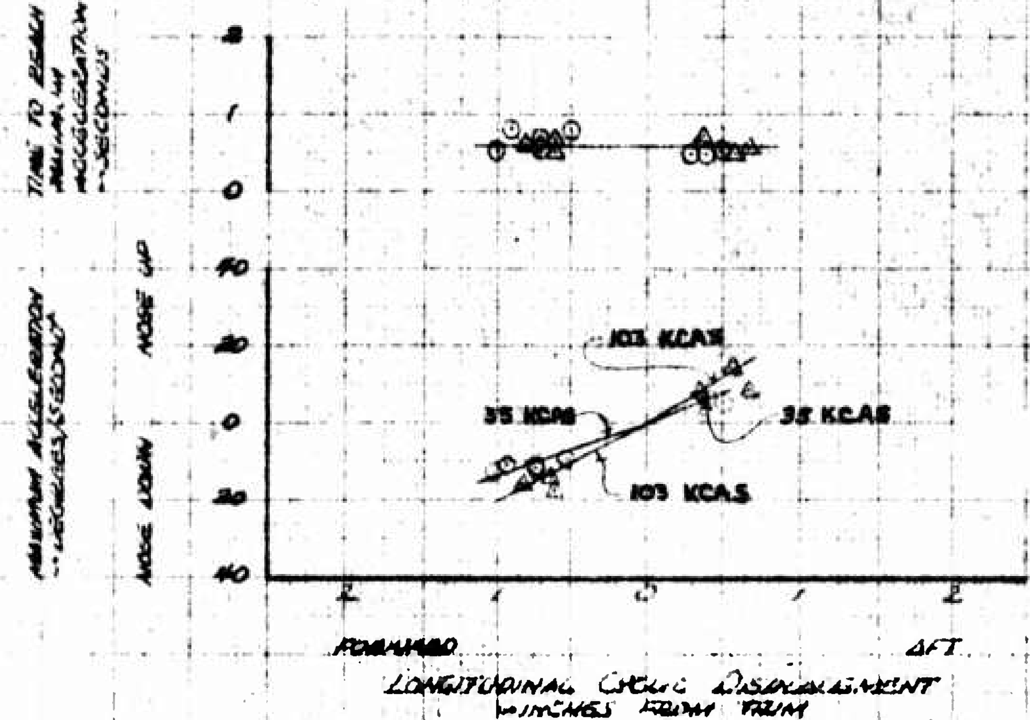
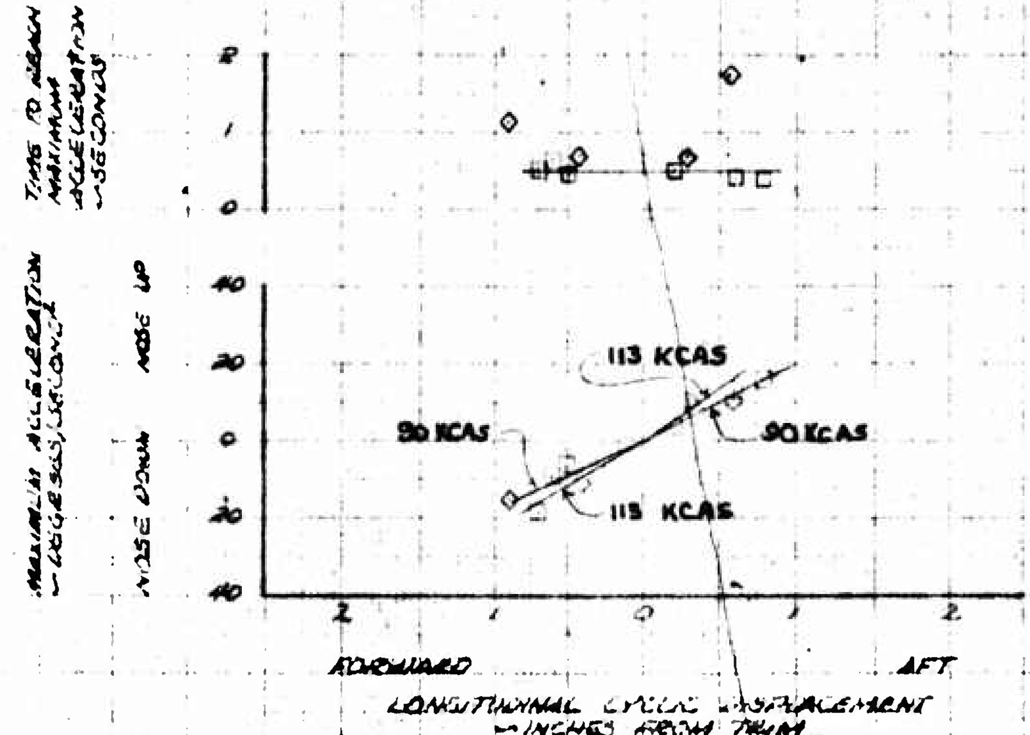


FIGURE No 135
LONGITUDINAL CONTROL SENSITIVITY
CH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.62	466	XM-7	LEVEL FLT
□	90	5000	2100	103.5	.54	465	XM-7	LEVEL FLT
△	103	5000	2160	103.5	.52	465	XM-7	LEVEL FLT
◇	113	5000	2080	103.5	.52	466	XM-7	LEVEL FLT





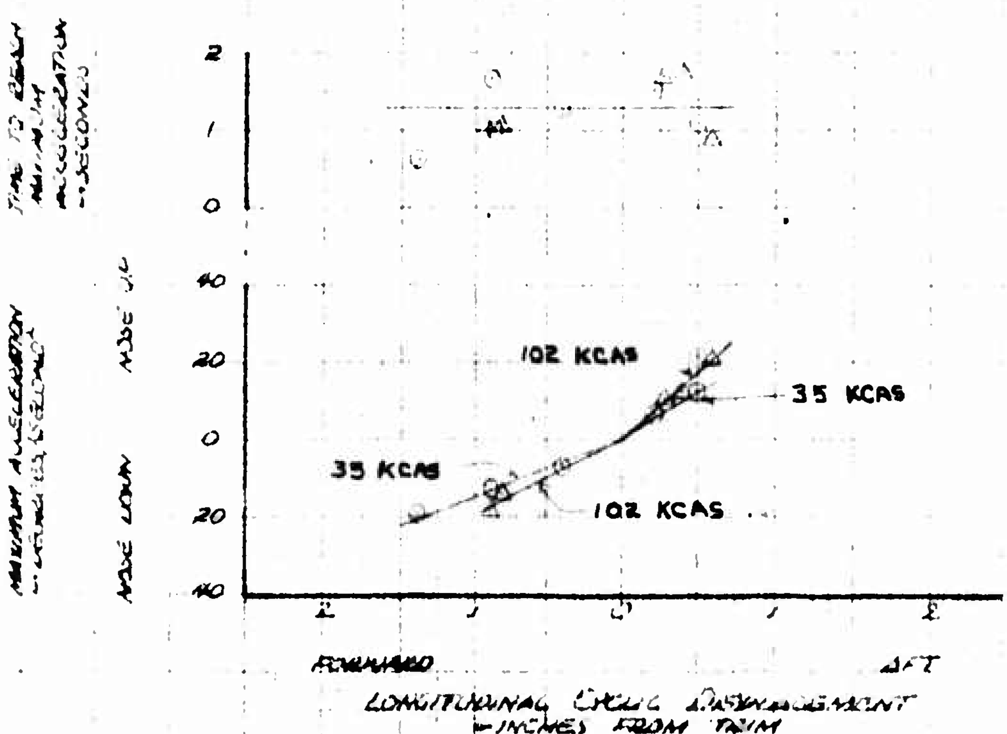
FOR OFFICIAL USE ONLY

FIGURE NO 136

LONGITUDINAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG G.W ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2170	101.5	2.89 LT	465	XM-8	LEVEL FLT
□	90	5000	2140	101.5	2.89 LT	465	XM-8	LEVEL FLT
△	102	5000	2180	101.5	2.89 LT	465	XM-8	LEVEL FLT



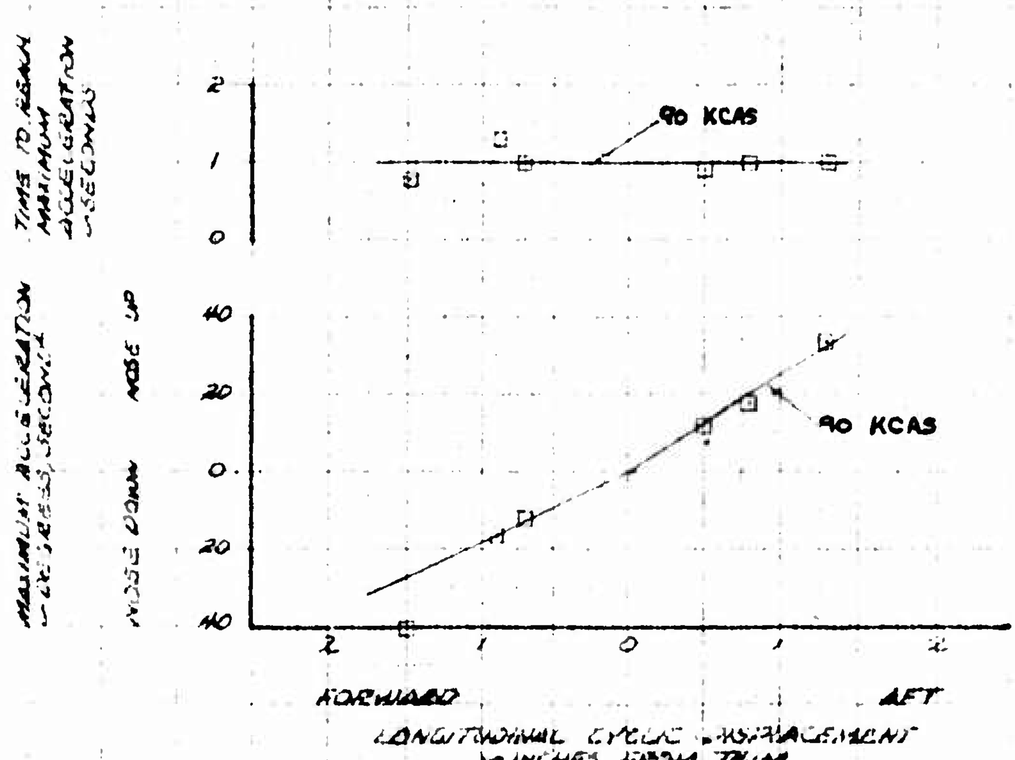


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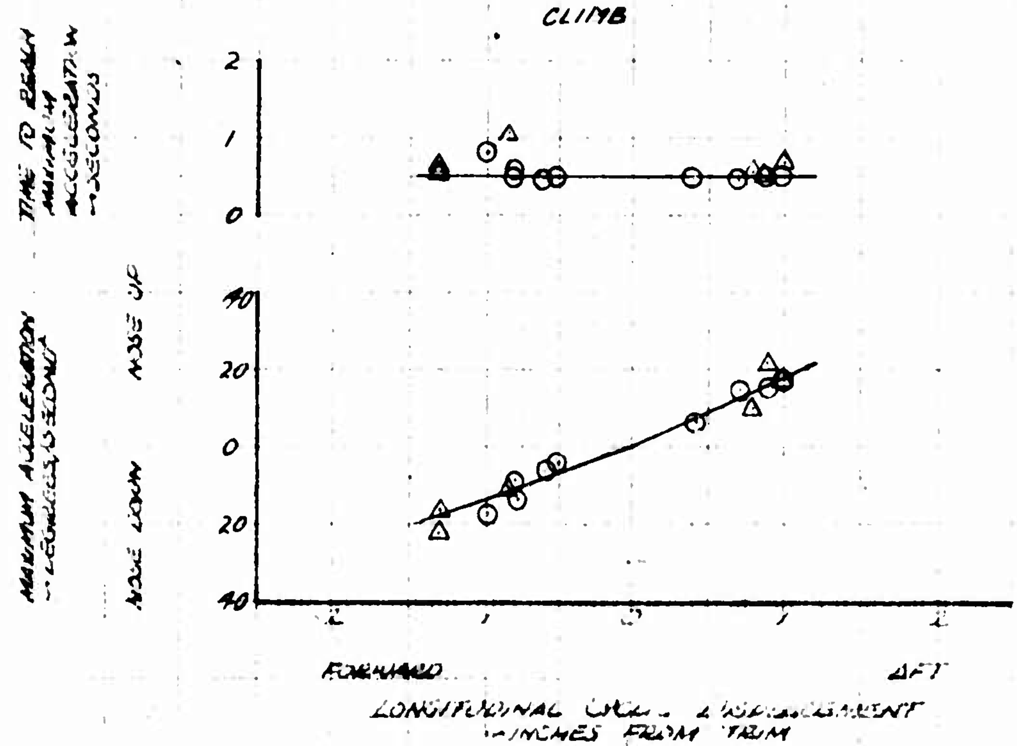
FIGURE NO 137
LONGITUDINAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	55	5000	2100	103.5	.5R	465	XM-7	NOTED
△	55	5000	2100	103.3	2.89L	465	XM-8	NOTED

CLIMB



AUTOROTATION

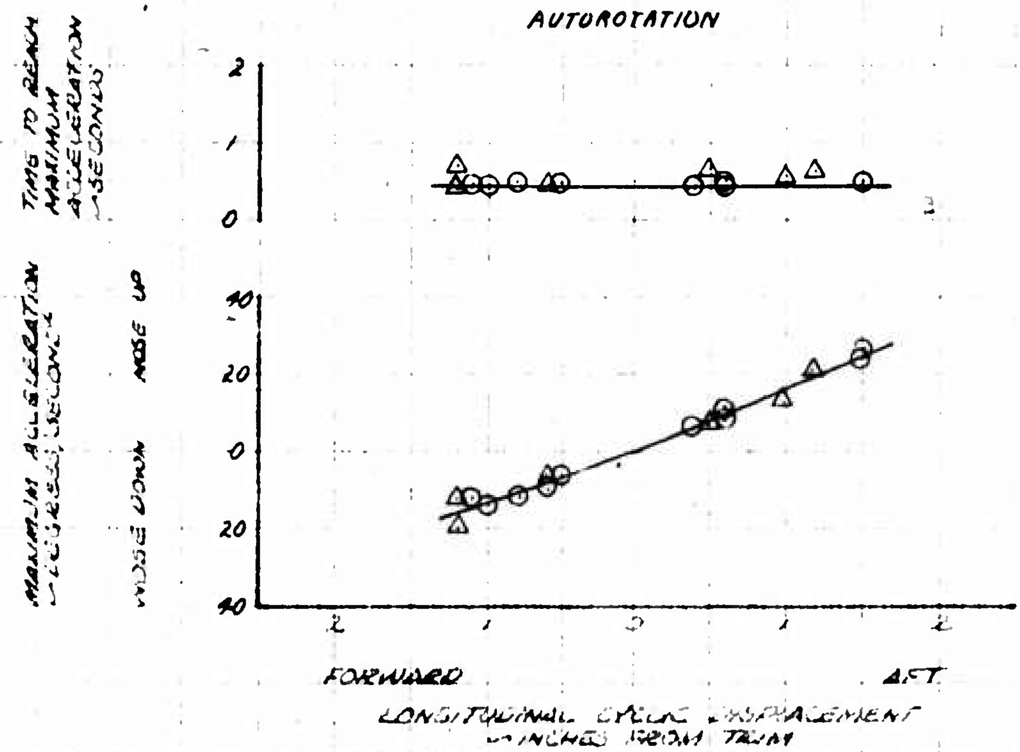
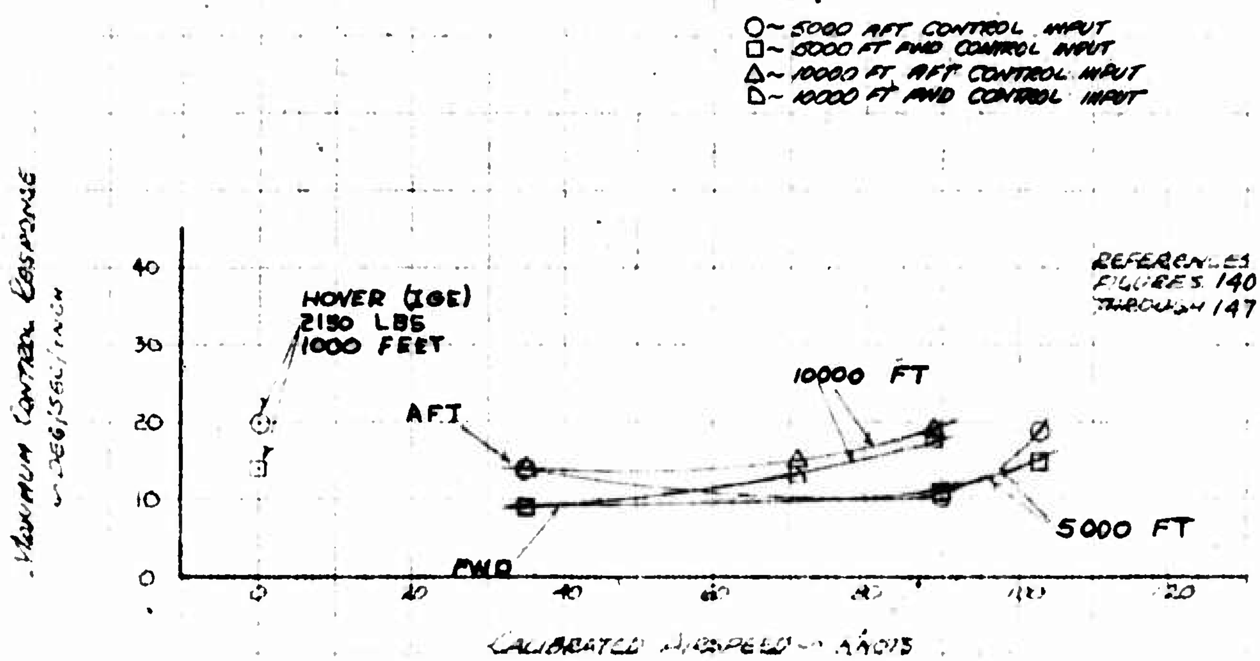


FIGURE NO 138

SUMMARY OF LONGITUDINAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT
10000	2120	103.5	.5RT	465	CLEAN	LEVEL FLT



AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2620	103.5	.5RT	465	CLEAN	LEVEL FLT

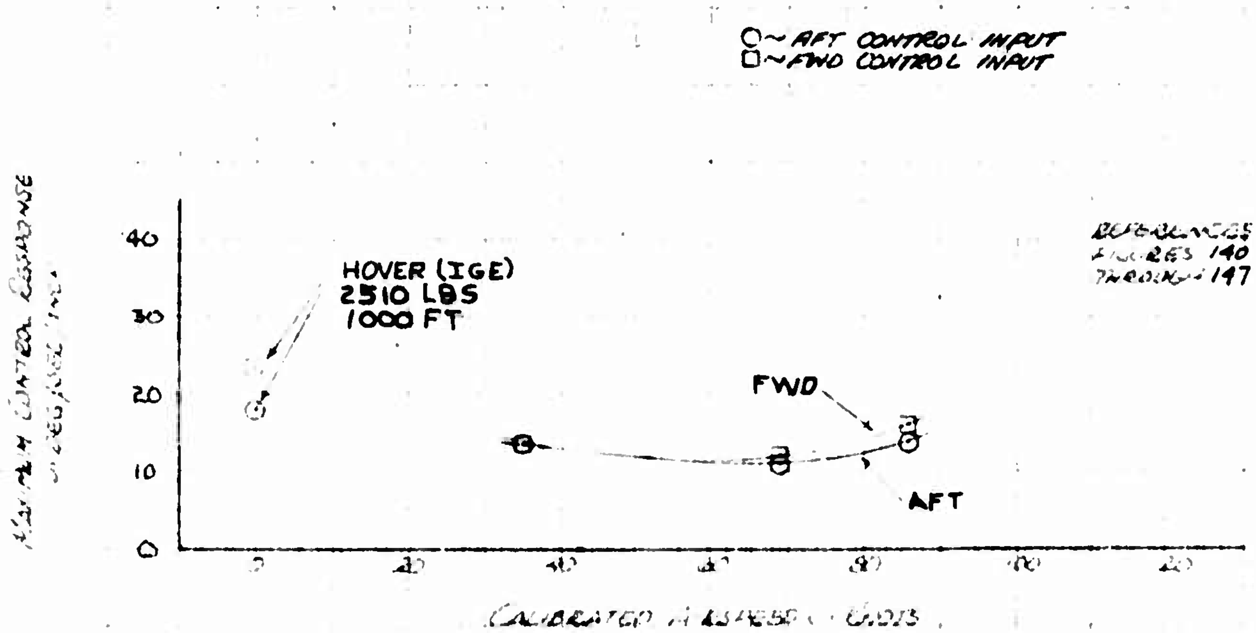


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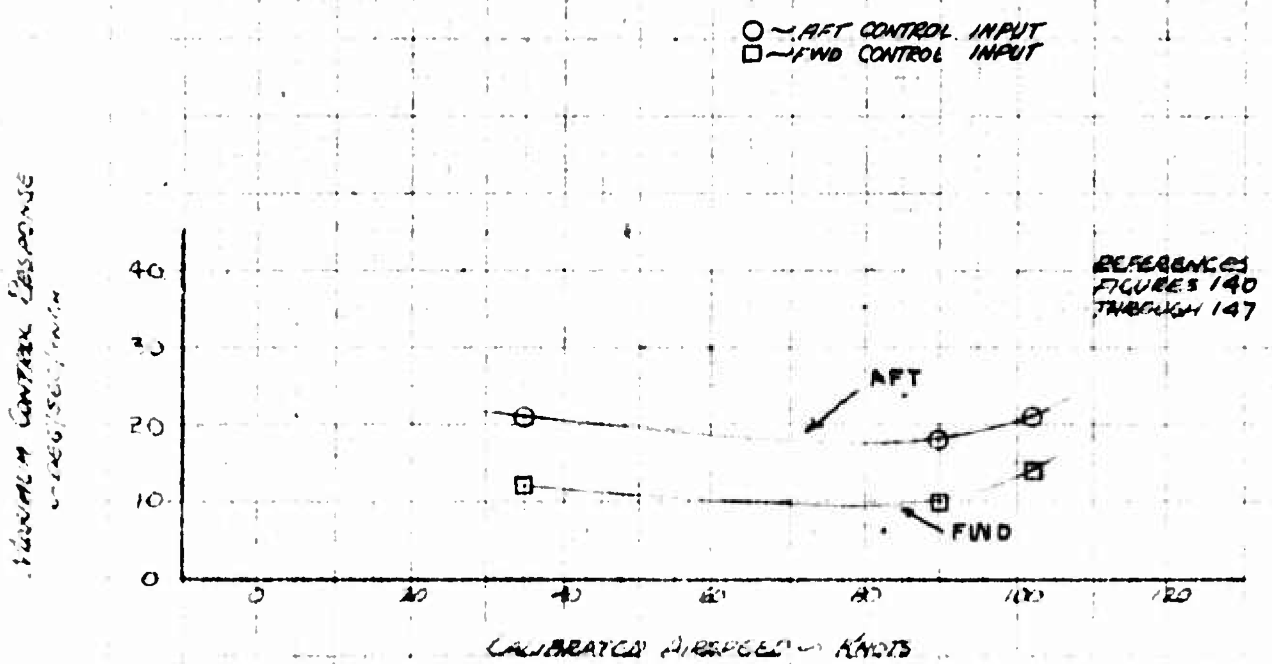
Figure No 139

Summary of Longitudinal Control Response

OH-6A USA S/N 62-4214

AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2160	101.5	2.8 LT	465	XM-8	LEVEL FLT



AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
5000	2120	103.5	5 RT	465	XM-7	LEVEL FLT.

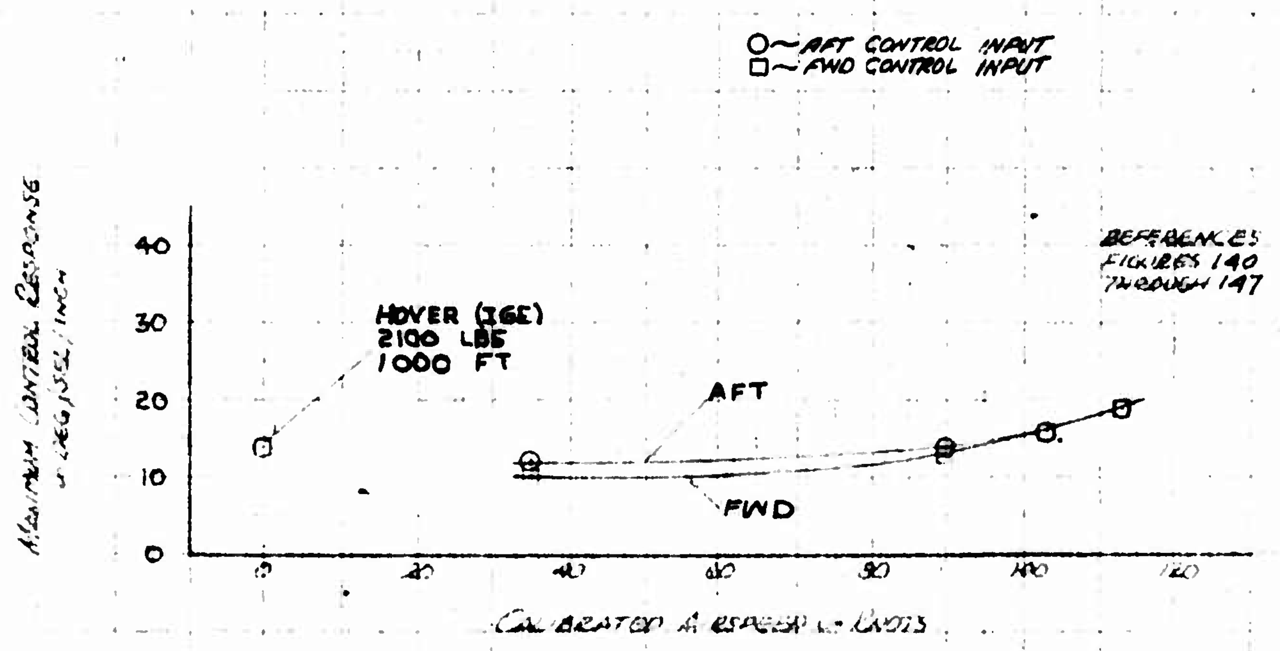
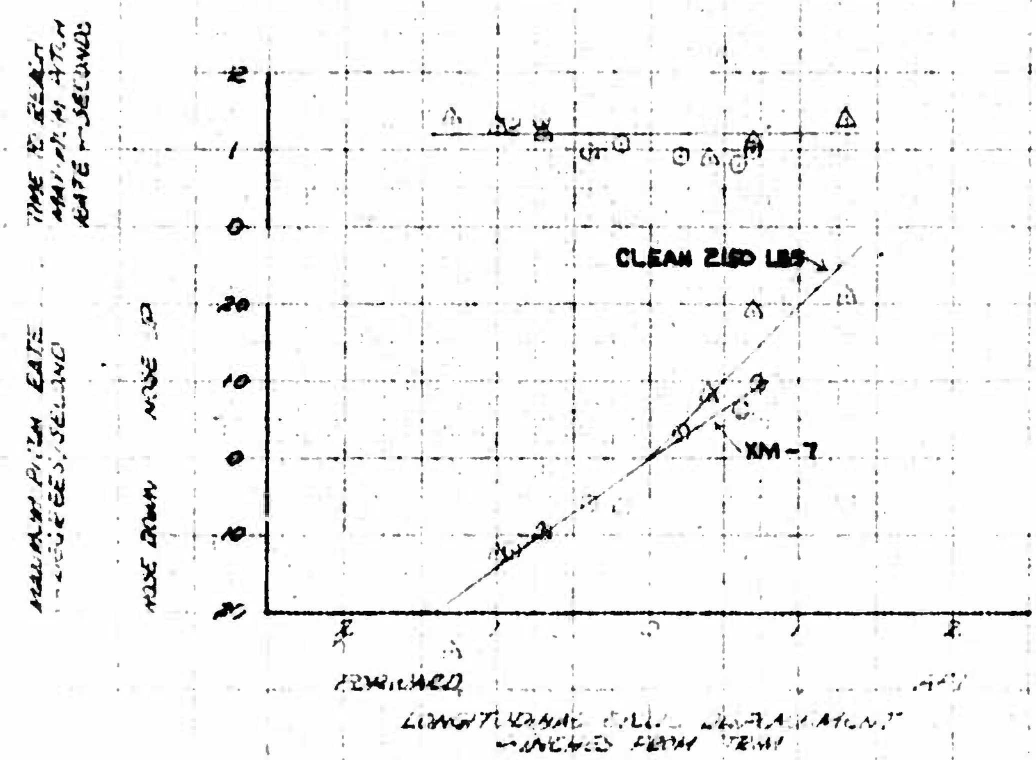


FIGURE NO 140
LONGITUDINAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG HD ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	ZERO	1000	2100	103.5	.5RT	465	XM-7	HOVER
□	ZERO	1000	2510	103.5	.5RT	465	CLEAN	HOVER
△	ZERO	1000	2150	103.5	.5RT	465	CLEAN	HOVER



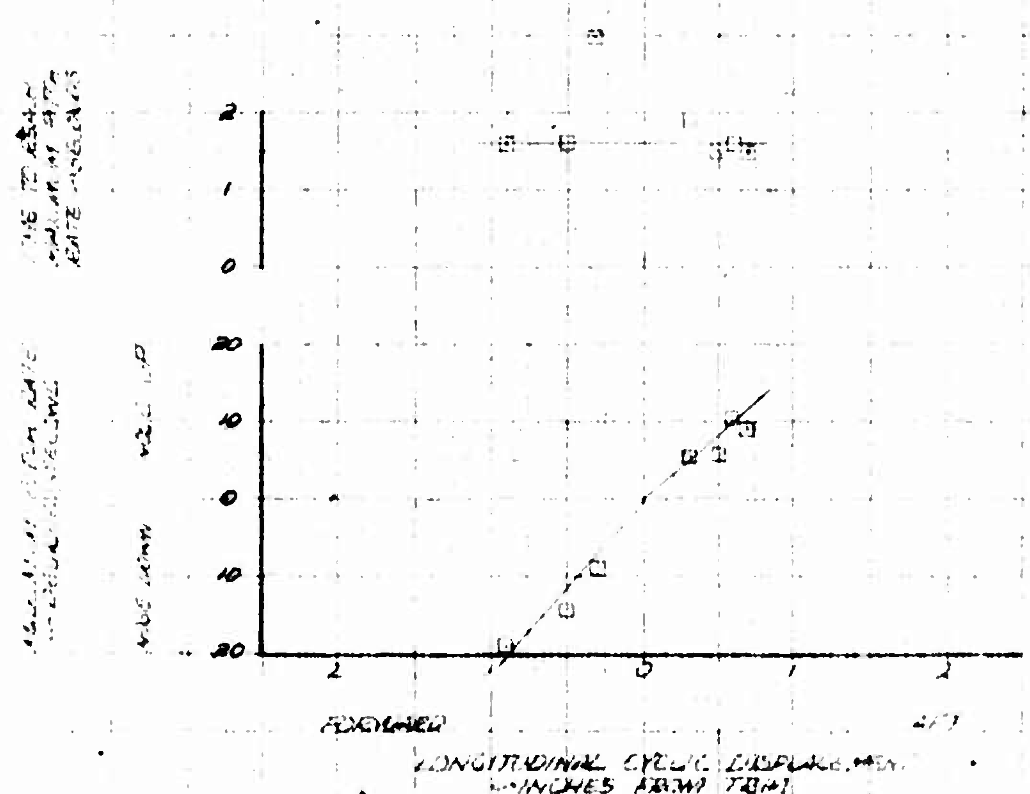


FIGURE NO 141

LONGITUDINAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.5R	465	CLEAN	LEVEL FLT
□	90	5000	2090	103.5	.5R	465	CLEAN	LEVEL FLT
△	103	5000	2100	103.5	.5R	465	CLEAN	LEVEL FLT

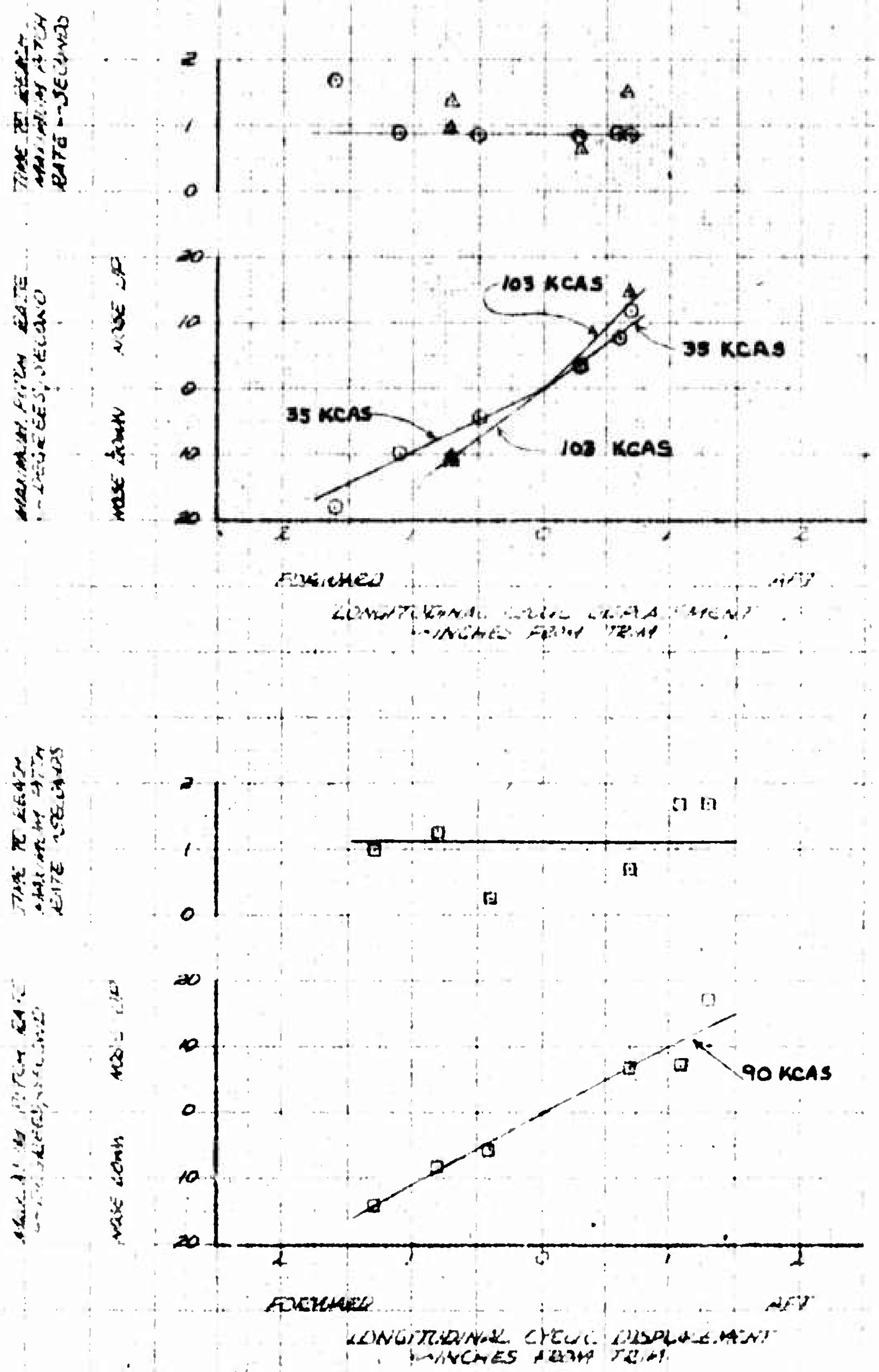


FIGURE NO 142
LONGITUDINAL CONTROL RESPONSE
OH-4A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2100	103.5	.6Lt	465	CLEAN	NOTED
□	55	10000	2100	103.5	.5Lt	465	CLEAN	NOTED

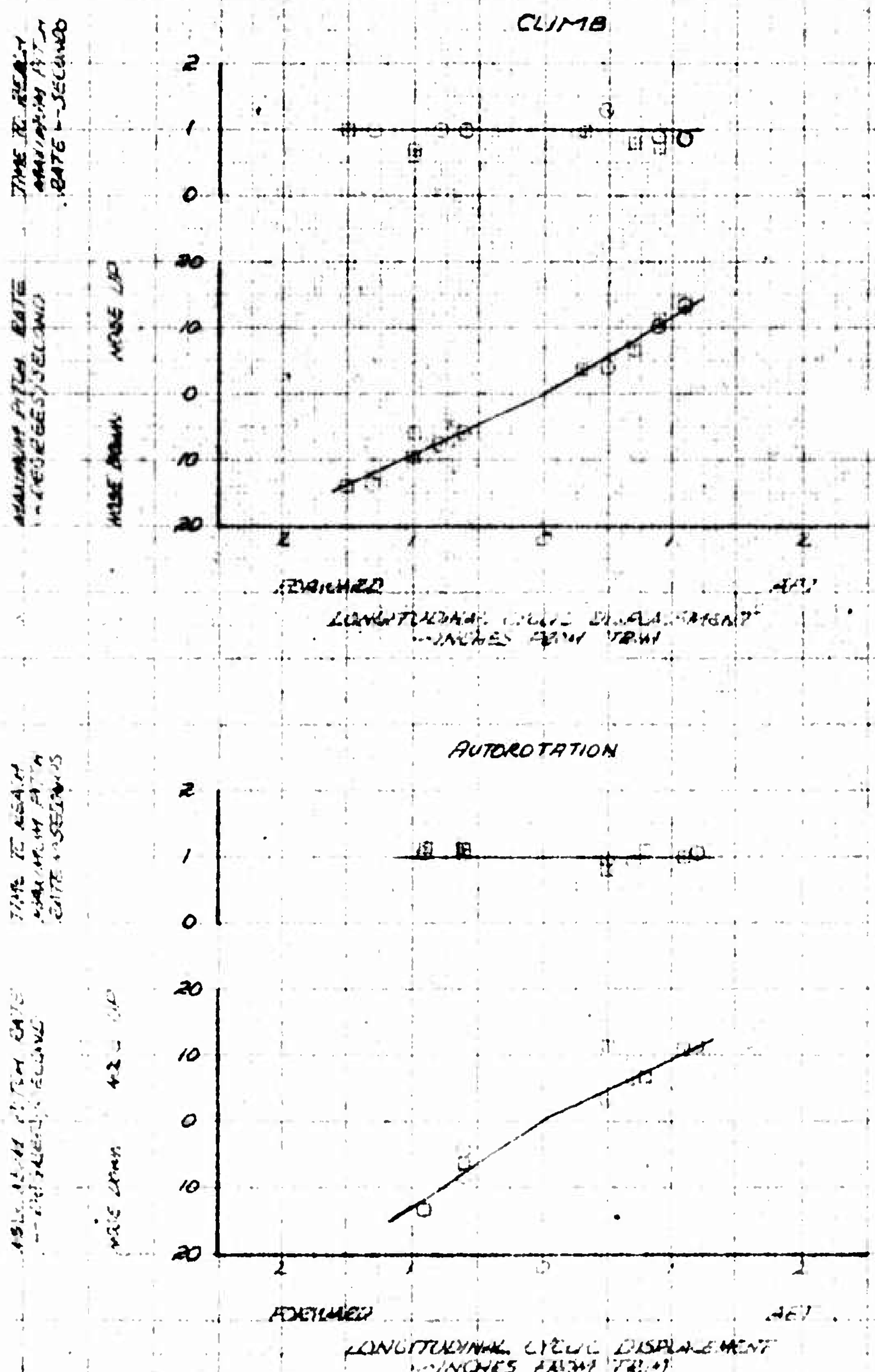


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FIGURE NO 143
LONGITUDINAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	.5R	465	CLEAN	LEVEL FLT
□	69	5000	2620	103.5	.5R	466	CLEAN	LEVEL FLT
△	86	5000	2550	103.5	.5R	465	CLEAN	LEVEL FLT
○	55	5000	2700	103.5	.5R	465	CLEAN	CLIMB
◻	35	5000	2480	103.5	.5R	467	CLEAN	AUTOROTATION

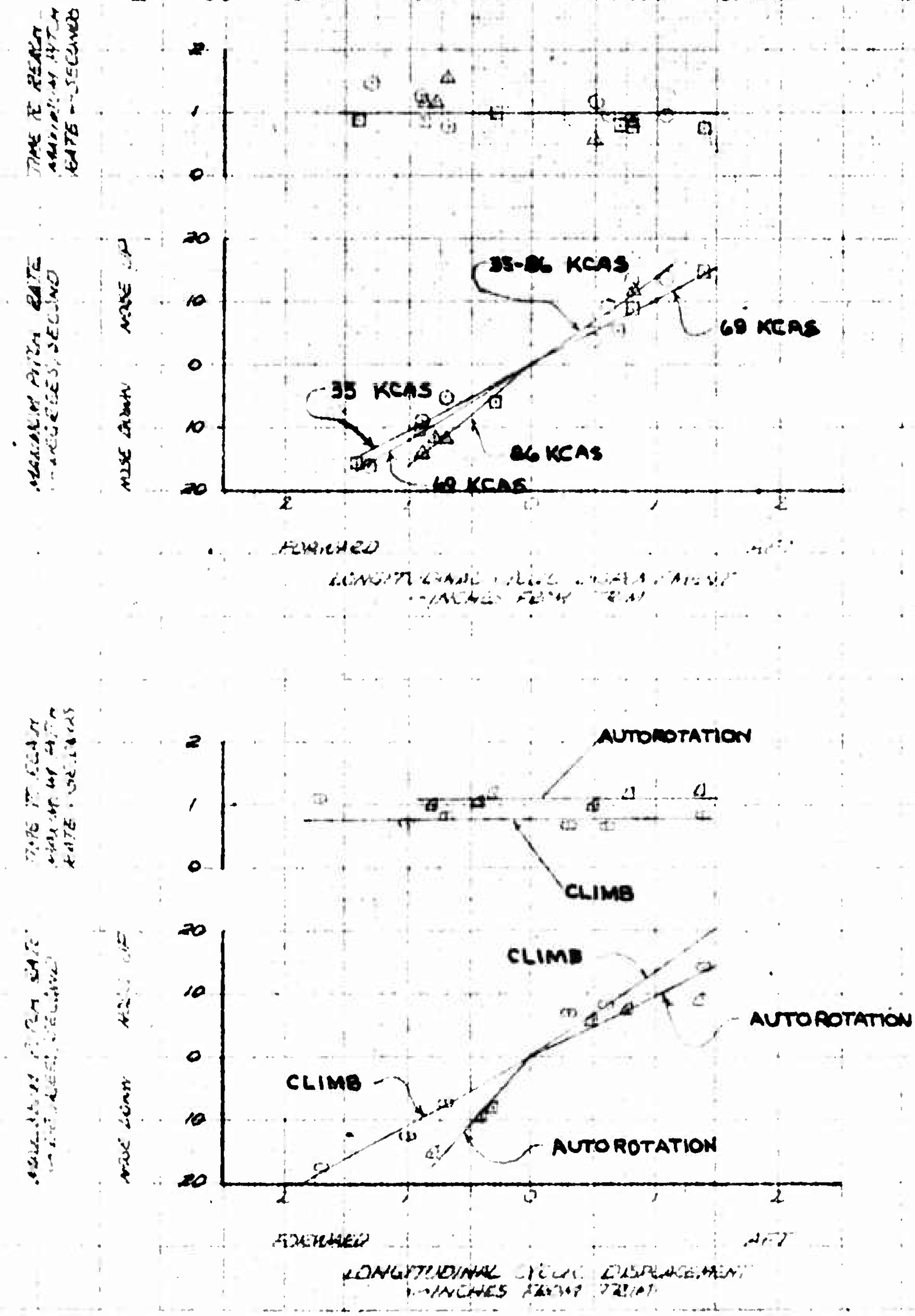
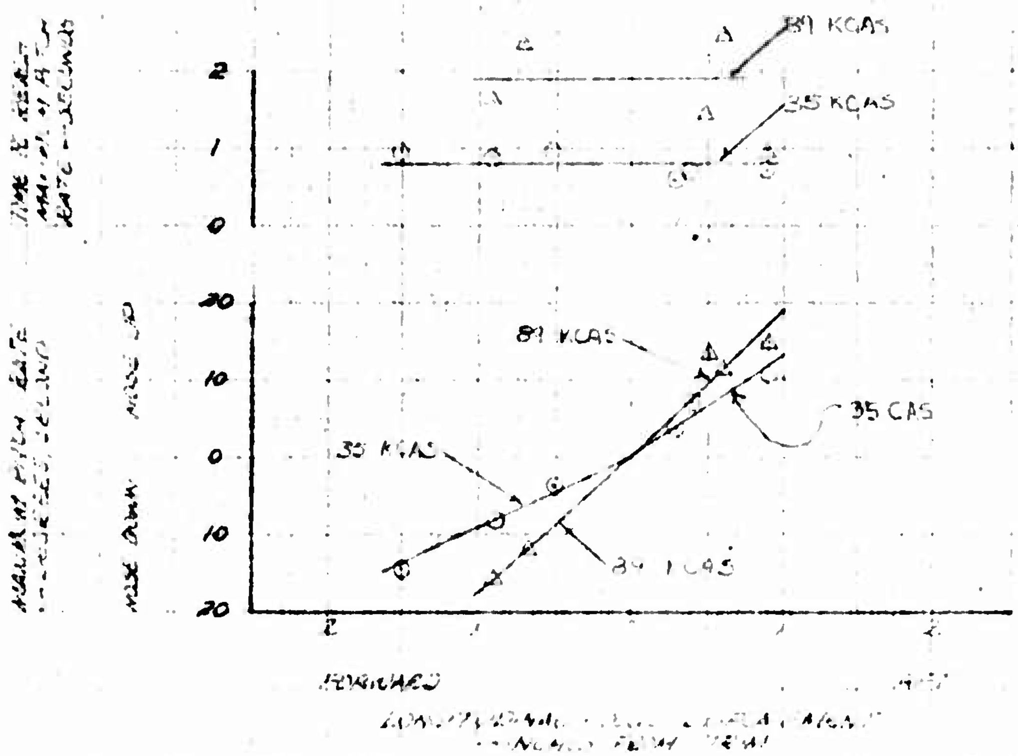


FIGURE NO 144

LONGITUDINAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	ALTITUDE ~FT	AVG GW ~LB	AVG CG ~IN	LAT CG	ROTOR RPM	CONFIGURATION	FLT COND
○	35	10000	2130	103.5	5R	465	CLEAN	LEVEL FLT
□	71	10000	2120	103.5	5R	465	CLEAN	LEVEL FLT
Δ	89	10000	2080	103.5	5R	465	CLEAN	LEVEL FLT



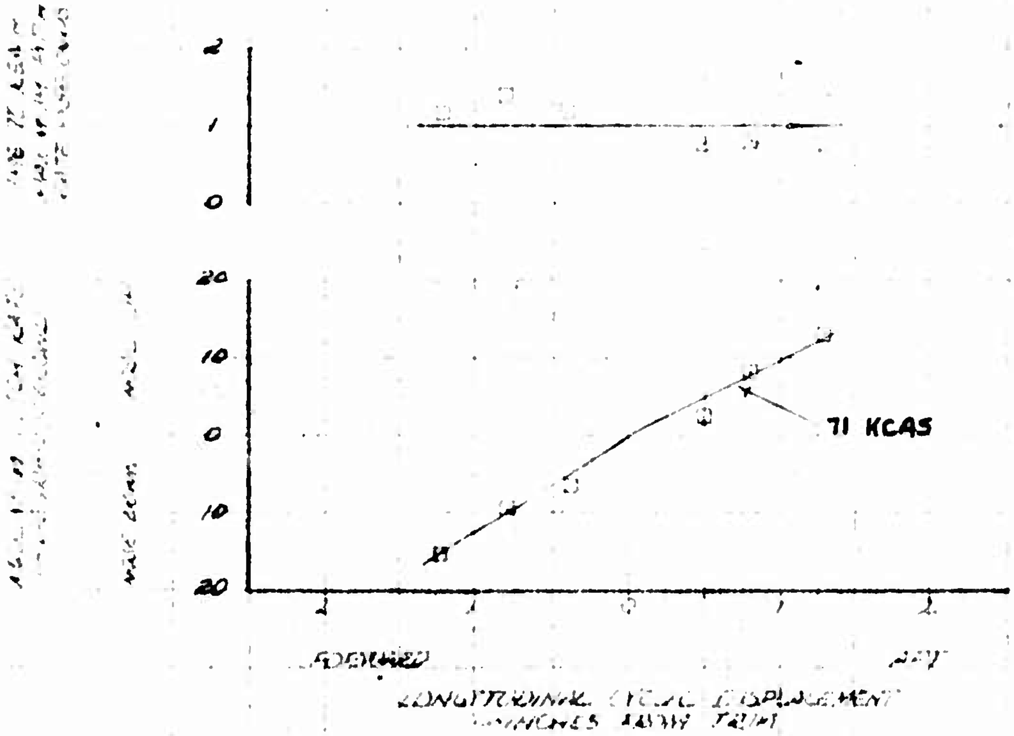
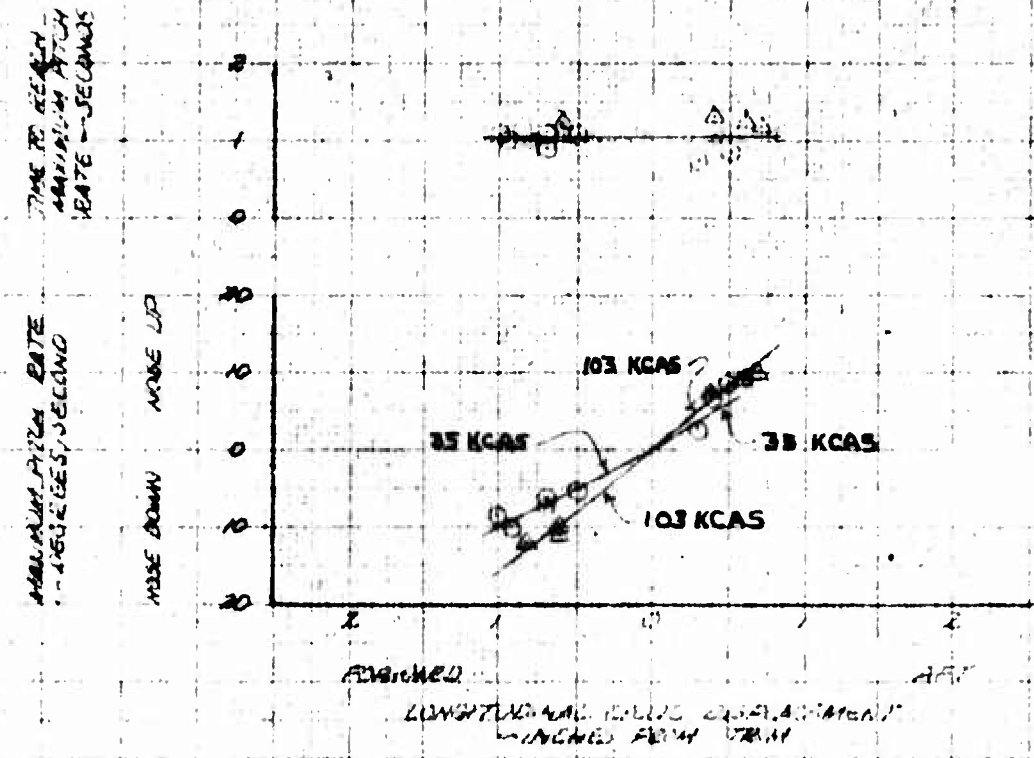


FIGURE NO 145

LONGITUDINAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.5A	465	XM-7	LEVEL FLT
□	90	5000	2100	103.5	.5R	466	XM-7	LEVEL FLT
△	103	5000	2160	103.5	.5R	465	XM-7	LEVEL FLT
◇	113	5000	2080	103.6	.5R	465	XM-7	LEVEL FLT



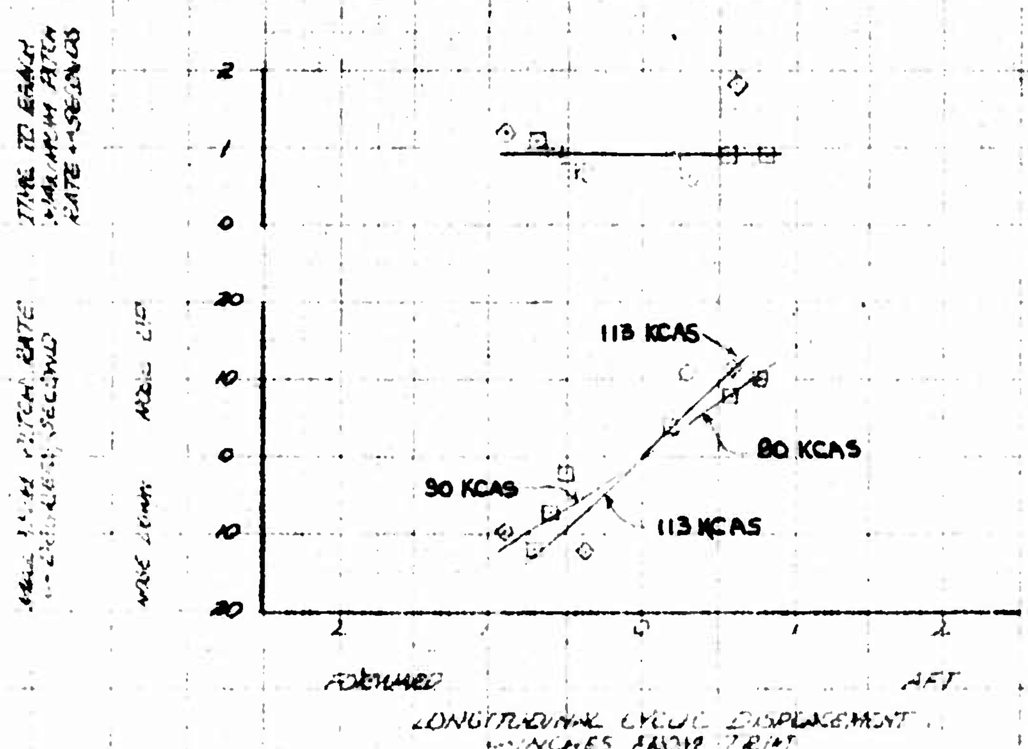
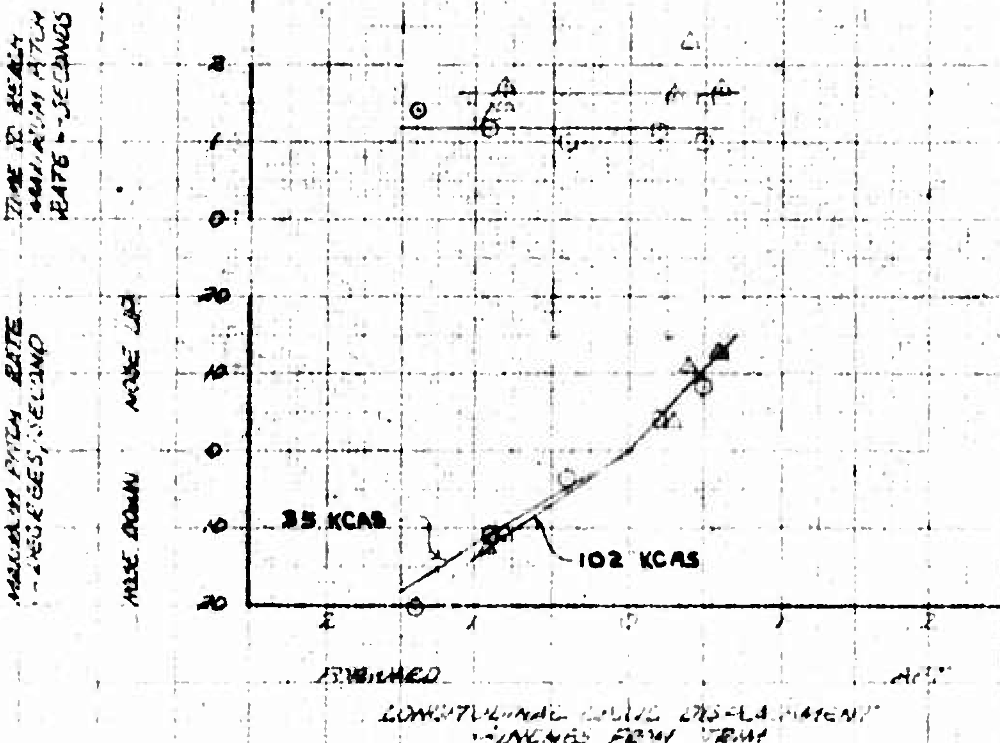


FIGURE NO 146
LONGITUDINAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2170	101.5	2.89 LT	466	XM-8	LEVEL FLT
□	90	5000	2140	101.5	2.89 LT	466	XM-8	LEVEL FLT
△	102	5000	2180	101.5	2.89 LT	465	XM-8	LEVEL FLT



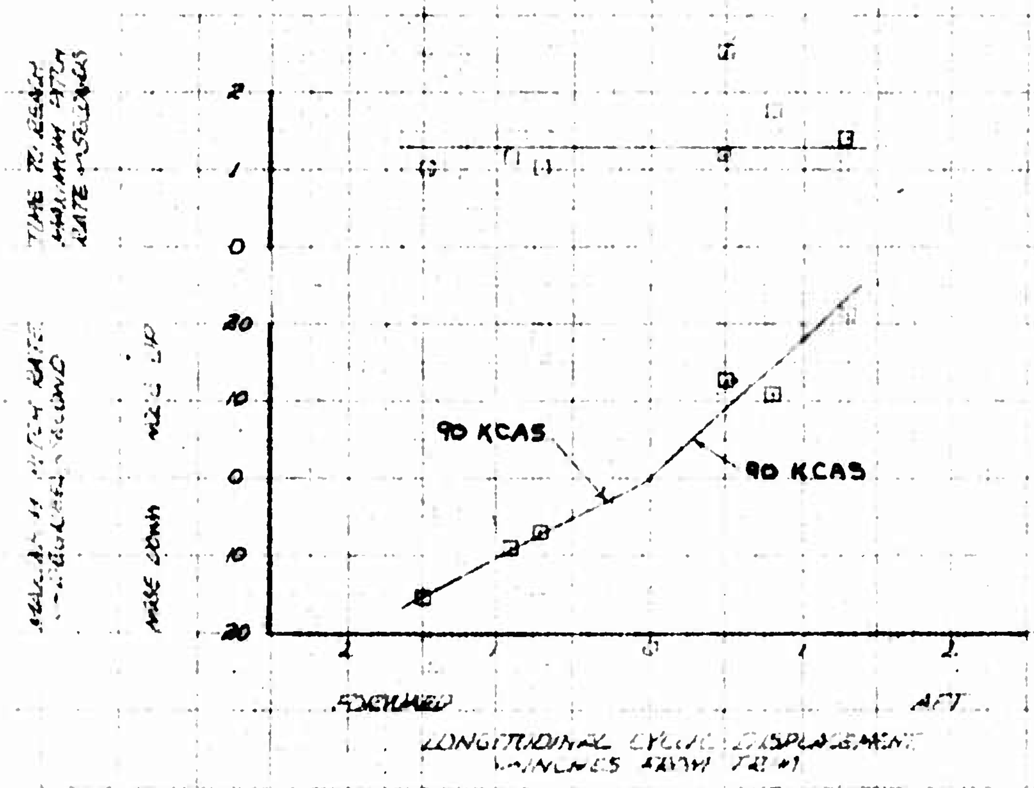


FIGURE NO 147

LONGITUDINAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AVG AIRSPEED ~KCAS	AVG H_p ~FT	AVG GW ~LB	AVG CG LONG ~IN	AVG CG LAT ~IN	ROTOR RPM	CONFIGURATION	FLT COND
O	55	5000	2100	103.5	.5RT	465	XM-7	NOTED
Δ	55	5000	2100	103.3	2.63LT	465	XM-8	NOTED

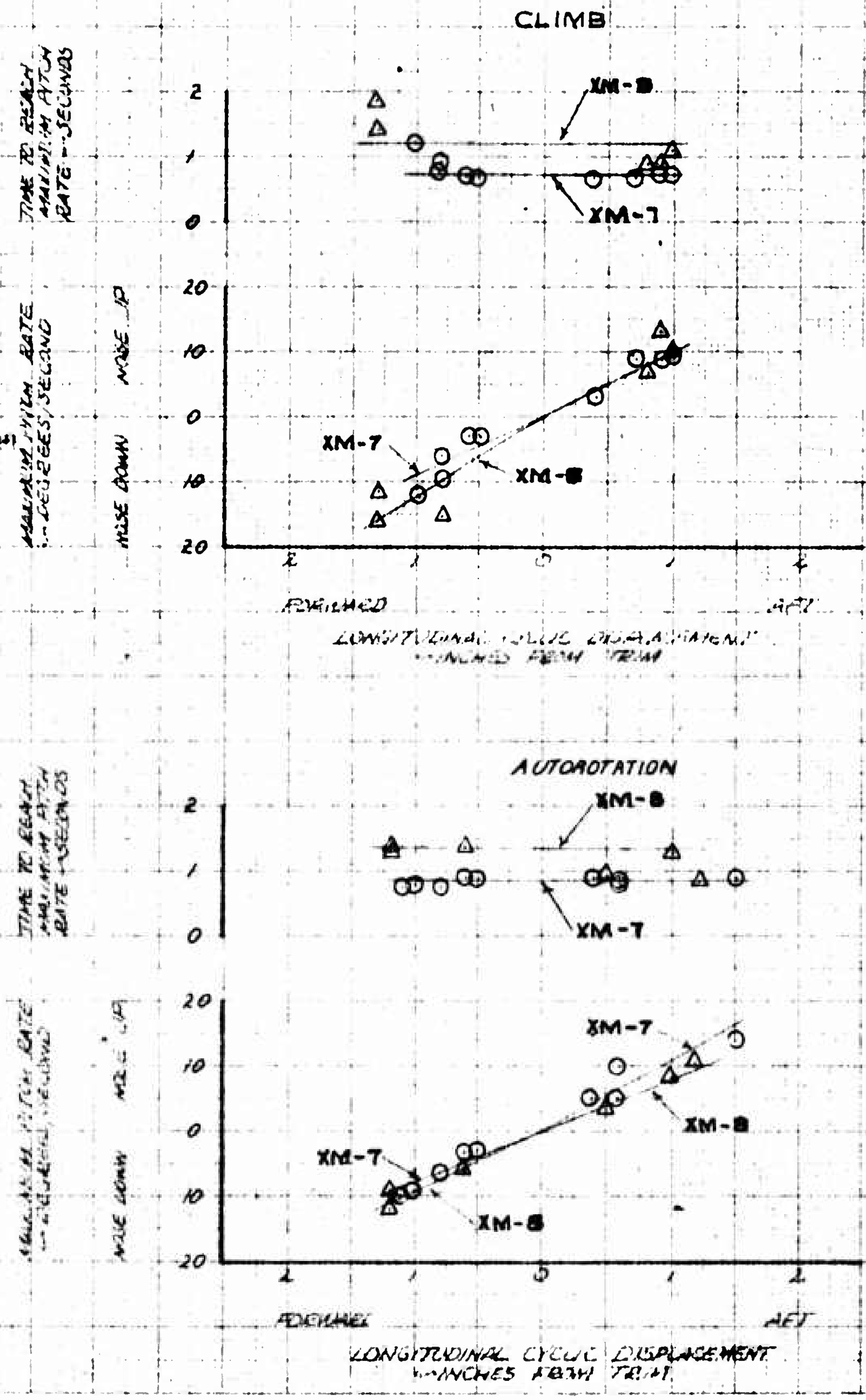


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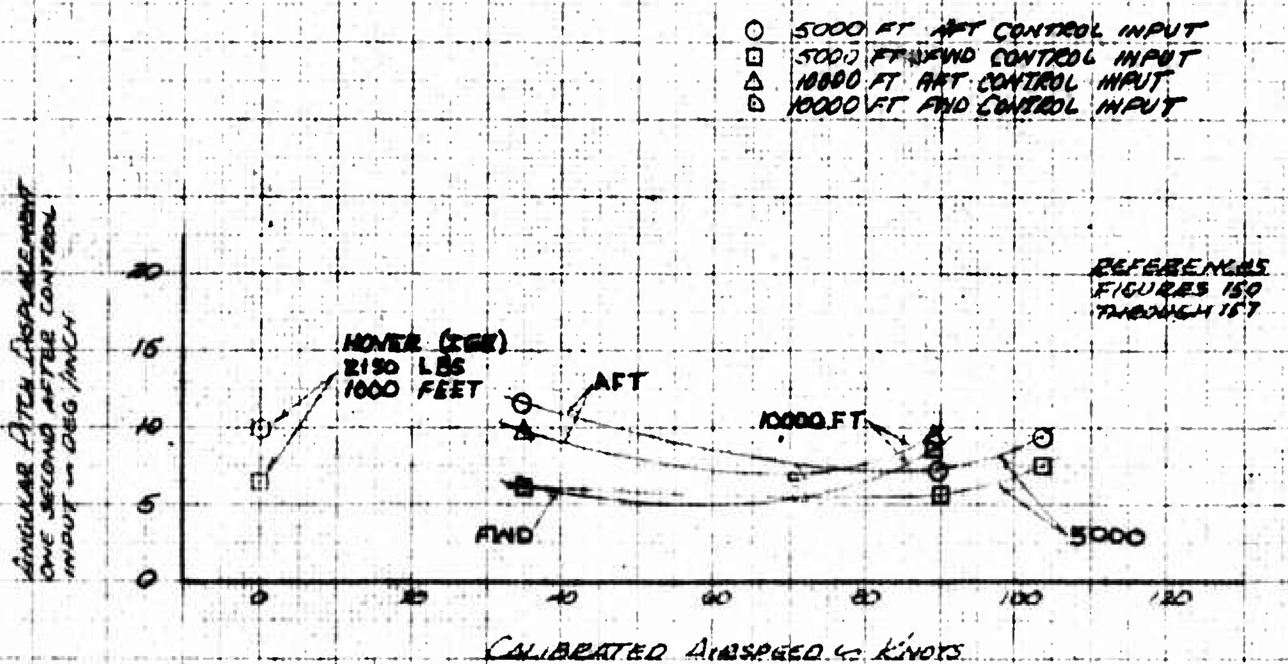
FIGURE No 148
SUMMARY OF ANGULAR PITCH DISPLACEMENT
OH-6A USA S/N 62-4214

AVG H_p ~FT	AVG G.W. ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
5000	2110	103.6	.6 RT	465	CLEAN	LEVEL FLT
10000	2120	103.6	.5 RT	465	CLEAN	LEVEL FLT



AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN. LONG	AVG C.G. ~IN. LAT	ROTOR RPM	CONFIGURATION	FLT COND.
5000	2620	103.5	.5 RT	465	CLEAN	LEVEL FLT

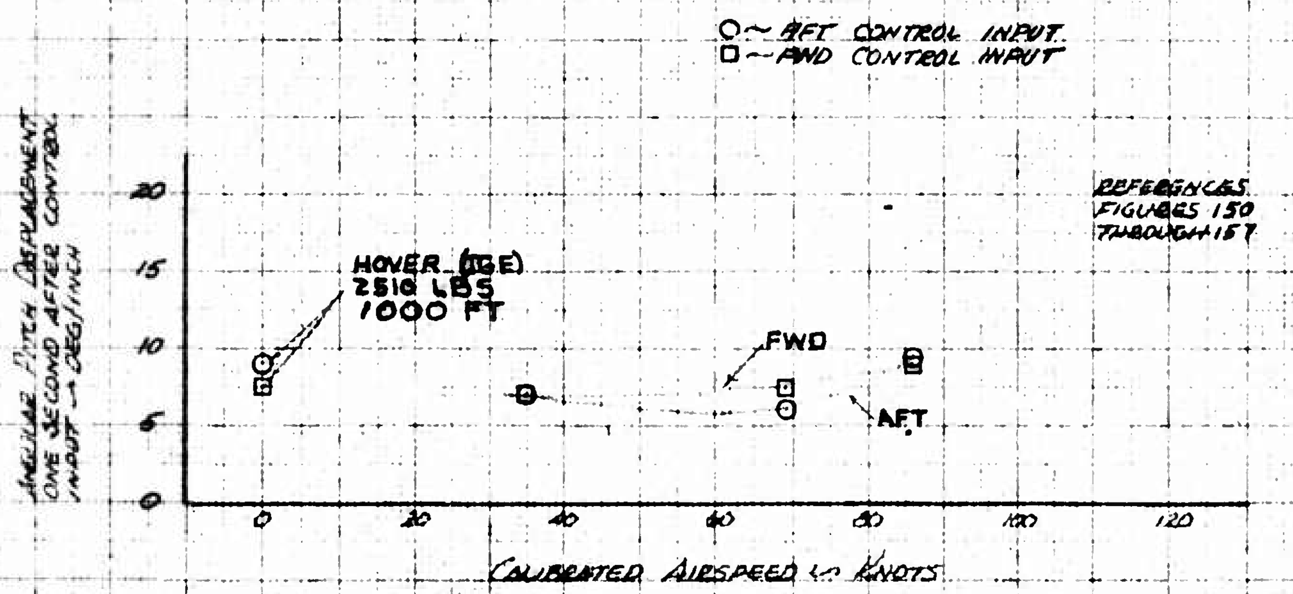
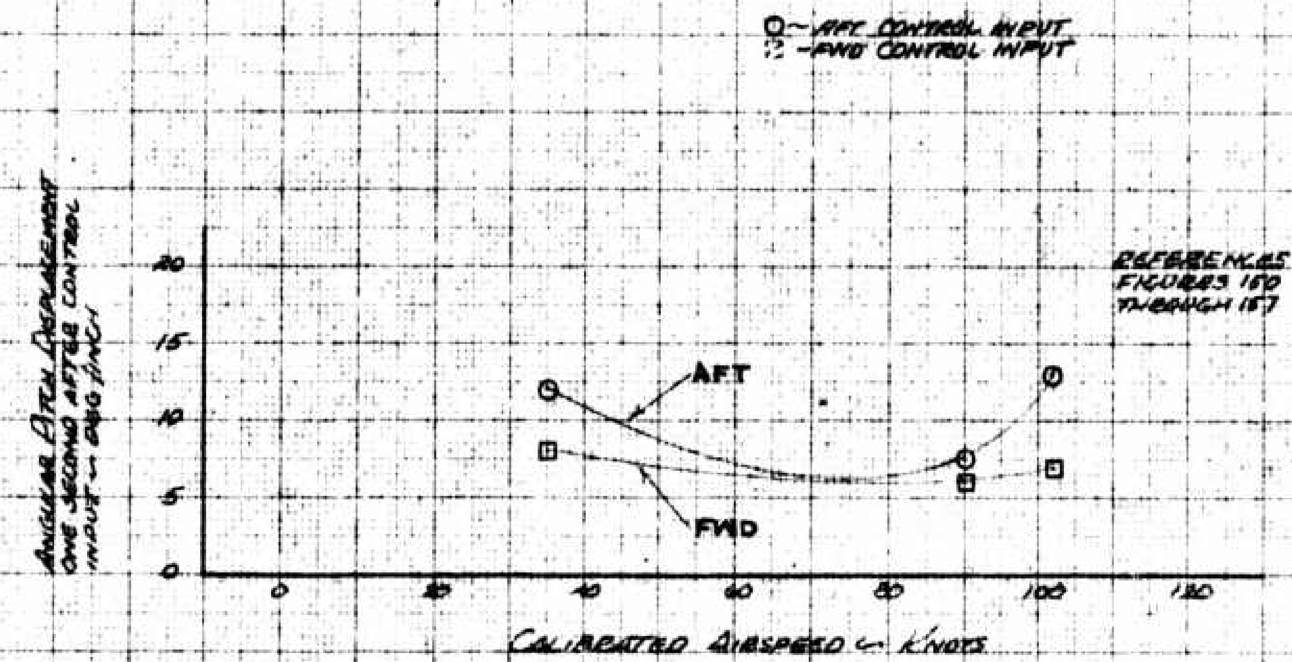


FIGURE NO 149

SUMMARY OF ANGULAR PITCH DISPLACEMENT

OH-6A USA S/N 62-4214

AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
5000	2160	101.5	2.89 LT	466	XM-8	LEVEL FLT



AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
5000	2120	103.5	.5 RT	465	XM-7	LEVEL FLT

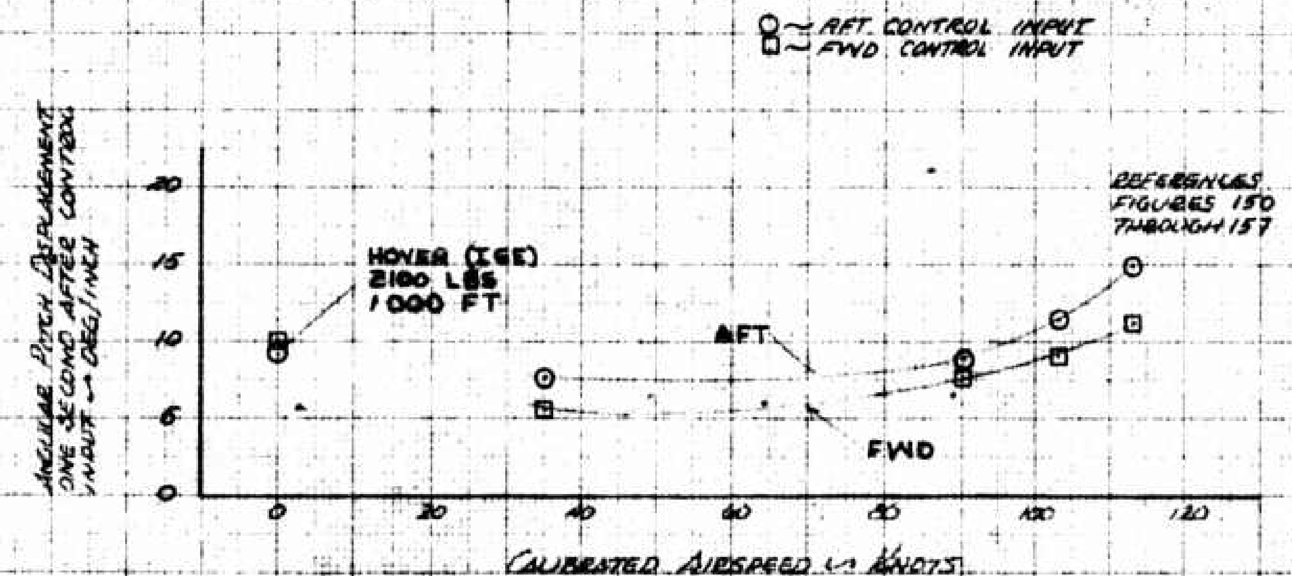


FIGURE No 150
ANGULAR PITCH DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~TAS	AVG Hp ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	ZERO	1000	2100	103.5	.6 RT.	465	XM-7	HOVER
□	ZERO	1000	2510	103.5	.5 RT	465	CLEAN	HOVER
△	ZERO	1000	2150	103.5	.5 RT	465	CLEAN	HOVER

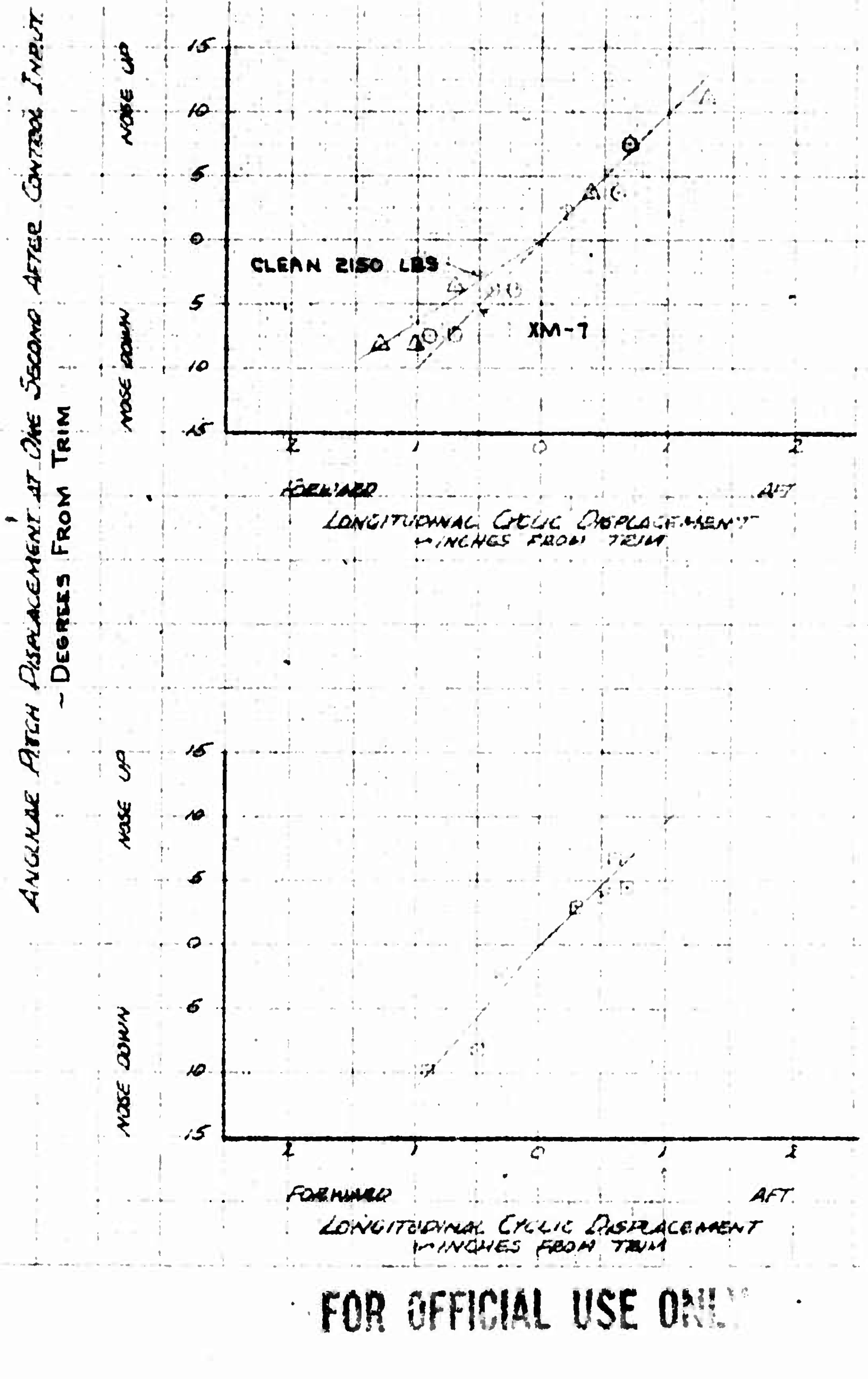


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FIGURE NO 151
ANGULAR PITCH DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.5RT	465	CLEAN	LEVEL FLT
□	90	5000	2090	103.5	.5RT	465	CLEAN	LEVEL FLT
△	103	5000	2100	103.5	.5RT	465	CLEAN	LEVEL FLT

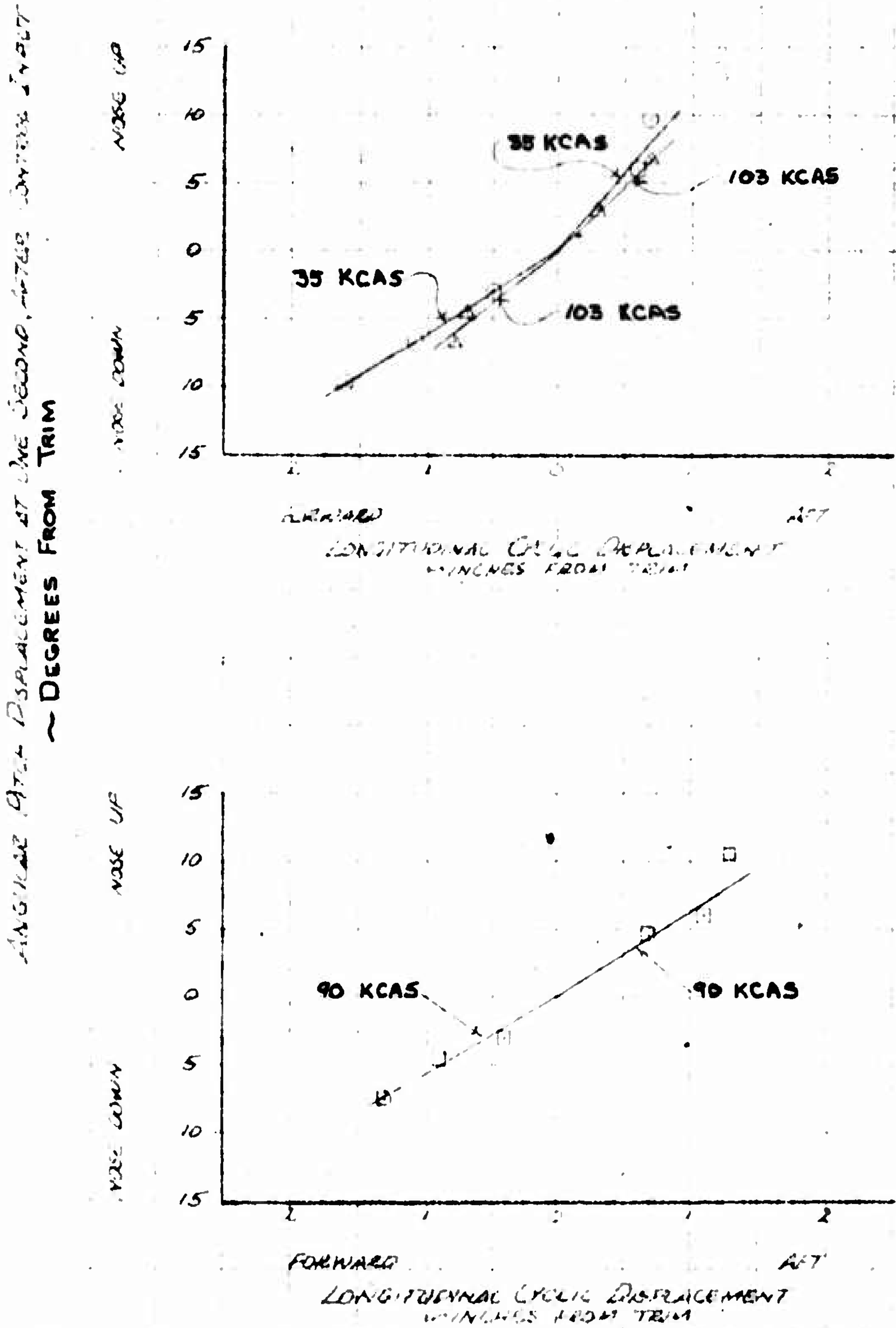

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FIGURE NO 152

ANGULAR PITCH DISPLACEMENT

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2100	103.5	5 rt	465	CLEAN	NOTED
□	55	10000	2100	103.5	5 rt	466	CLEAN	NOTED

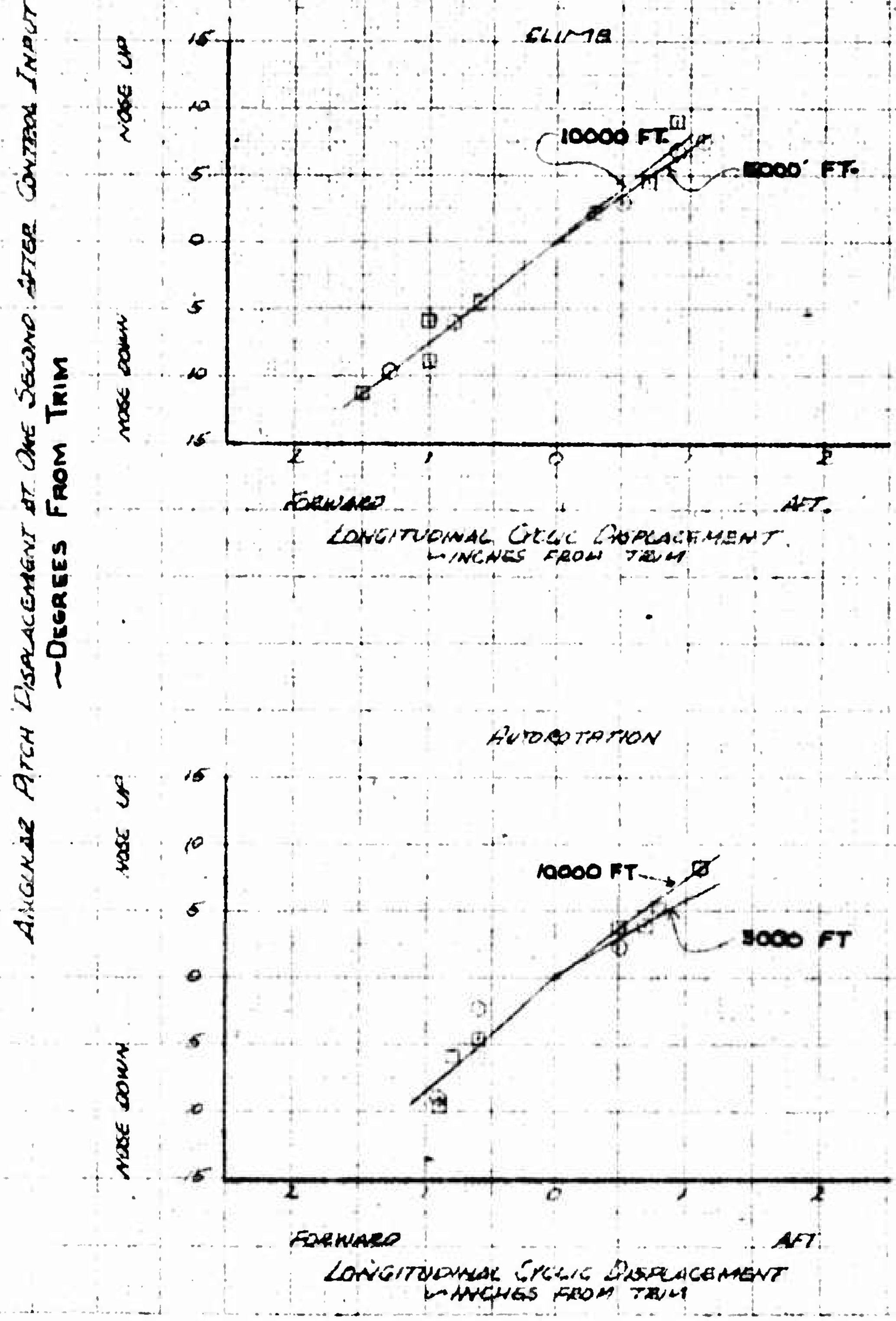

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FIGURE NO 153
ANGULAR PITCH DISPLACEMENT
OH 6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG Hp FEET	AVG G.W. LB	AVG C.G. LOC. IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	5 RT	465	CLEAN	LEVEL FLT
□	69	5000	2620	103.5	5 RT	465	CLEAN	LEVEL FLT
△	86	5000	2550	103.5	5 RT	465	CLEAN	LEVEL FLT
⬡	55	5000	2700	103.5	5 RT	465	CLEAN	CLIMB
◺	55	5000	2480	103.5	5 RT	465	CLEAN	AUTOROTATION

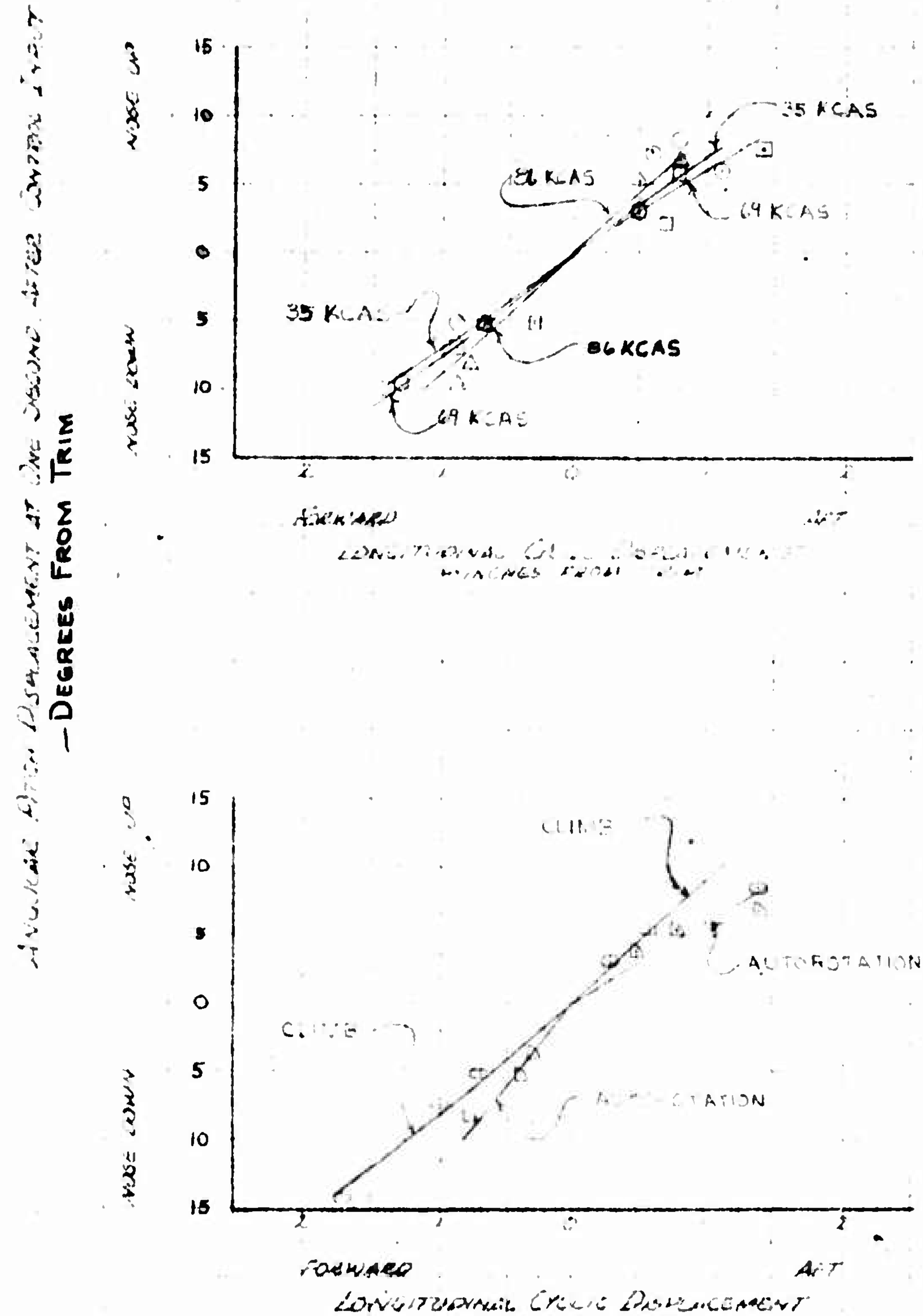

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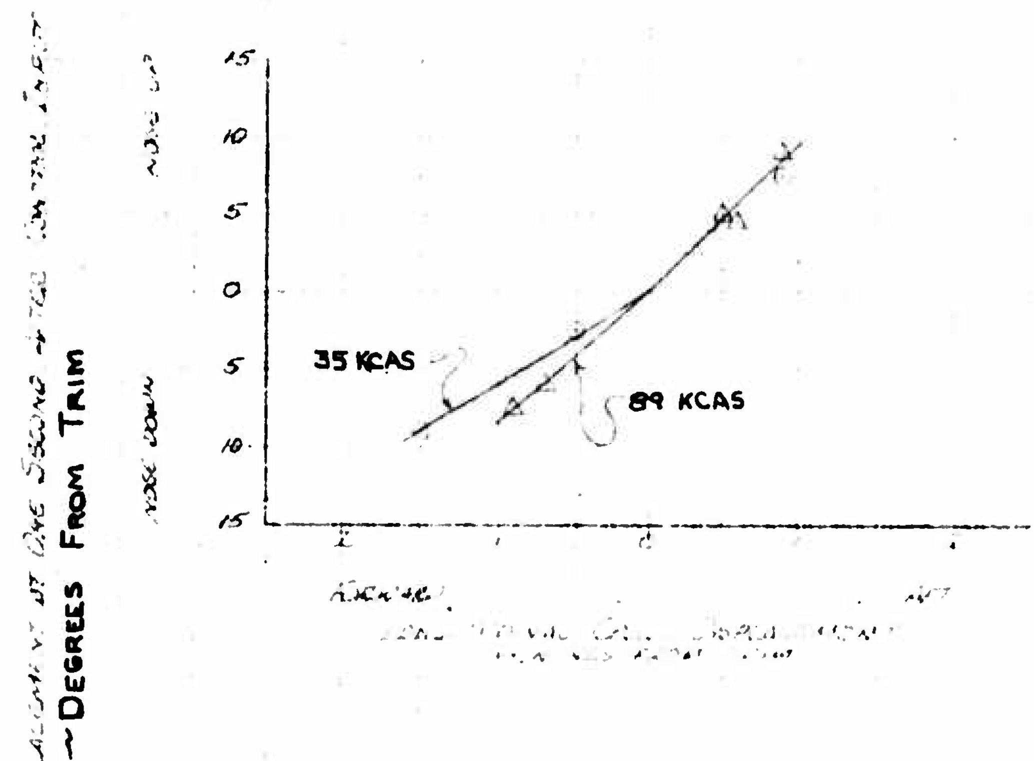
FIGURE [illegible] 154

[illegible]

[illegible] 6A [illegible] 4214

[illegible]	AIRSPEED ~KCAS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
○	35	10000	2130	103.5	5 rt	466	CLEAN	LEVEL FLT
□	71	10000	2120	103.5	5 rt	465	CLEAN	LEVEL FLT
△	89	10000	2080	103.5	5 rt	465	CLEAN	LEVEL FLT



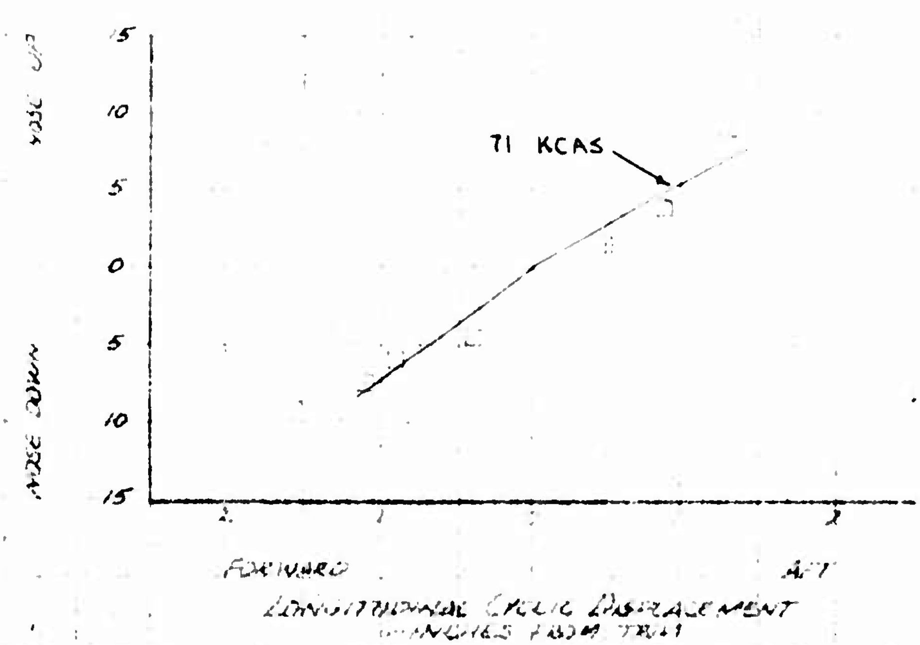


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FIGURE No 155

ANGULAR PITCH DISPLACEMENT

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG Hp FT	AVG G.W. LB	AVG CG LONG IN	AVG CG LAT IN	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2120	103.5	.5 RT	465	XM-7	LEVEL FLT
□	90	5000	2100	103.5	.5 RT	465	XM-7	LEVEL FLT
△	103	5000	2160	103.5	.5 RT	465	XM-7	LEVEL FLT
◇	113	5000	2080	103.5	.5 RT	465	XM-7	LEVEL FLT

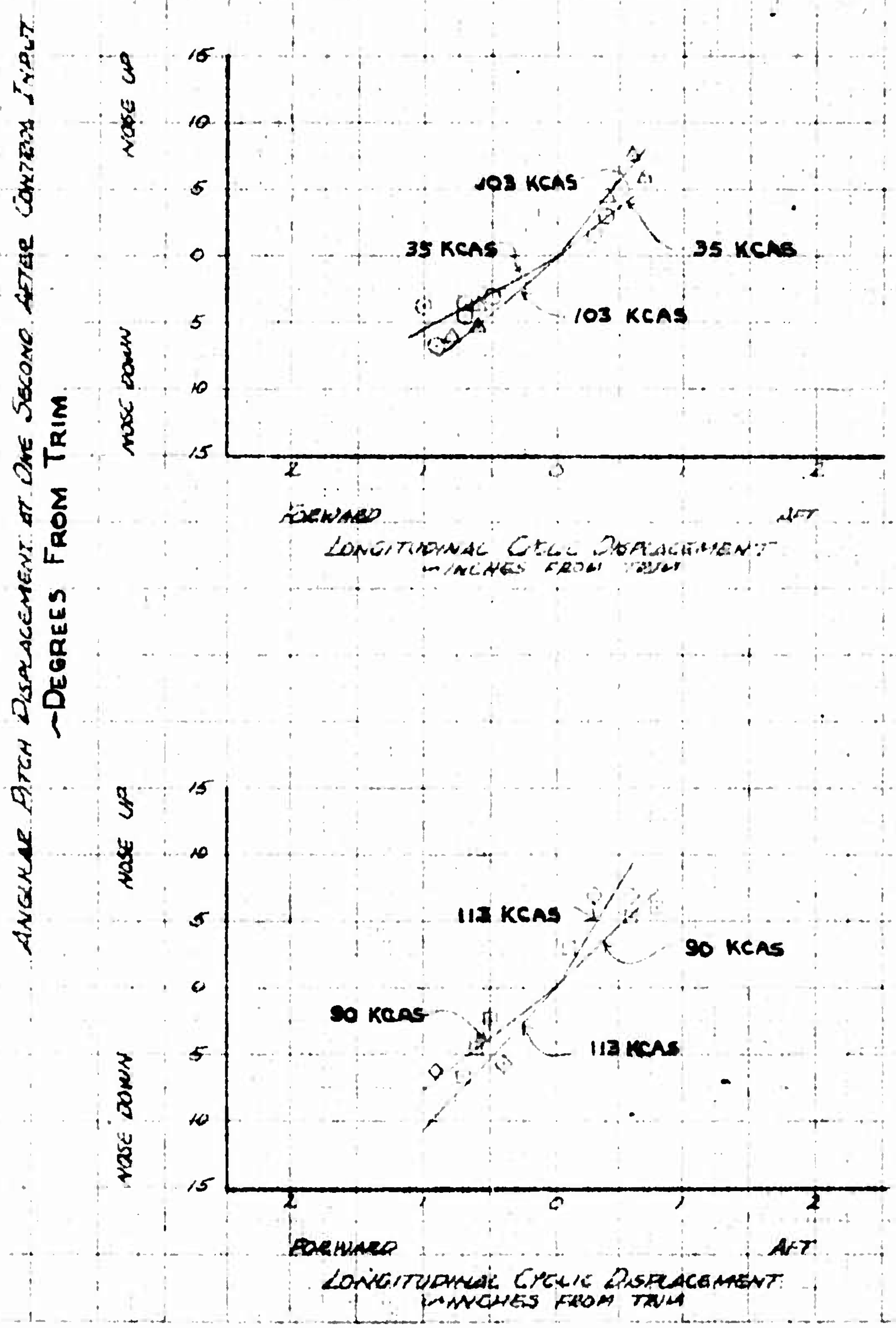

FIGURE No 156
ANGULAR PITCH DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2170	101.5	2.89 LT	465	XM-8	LEVEL FLT
□	90	5000	2140	101.5	2.89 LT	465	XM-8	LEVEL FLT
△	102	5000	2180	101.5	2.89 LT	465	XM-8	LEVEL FLT

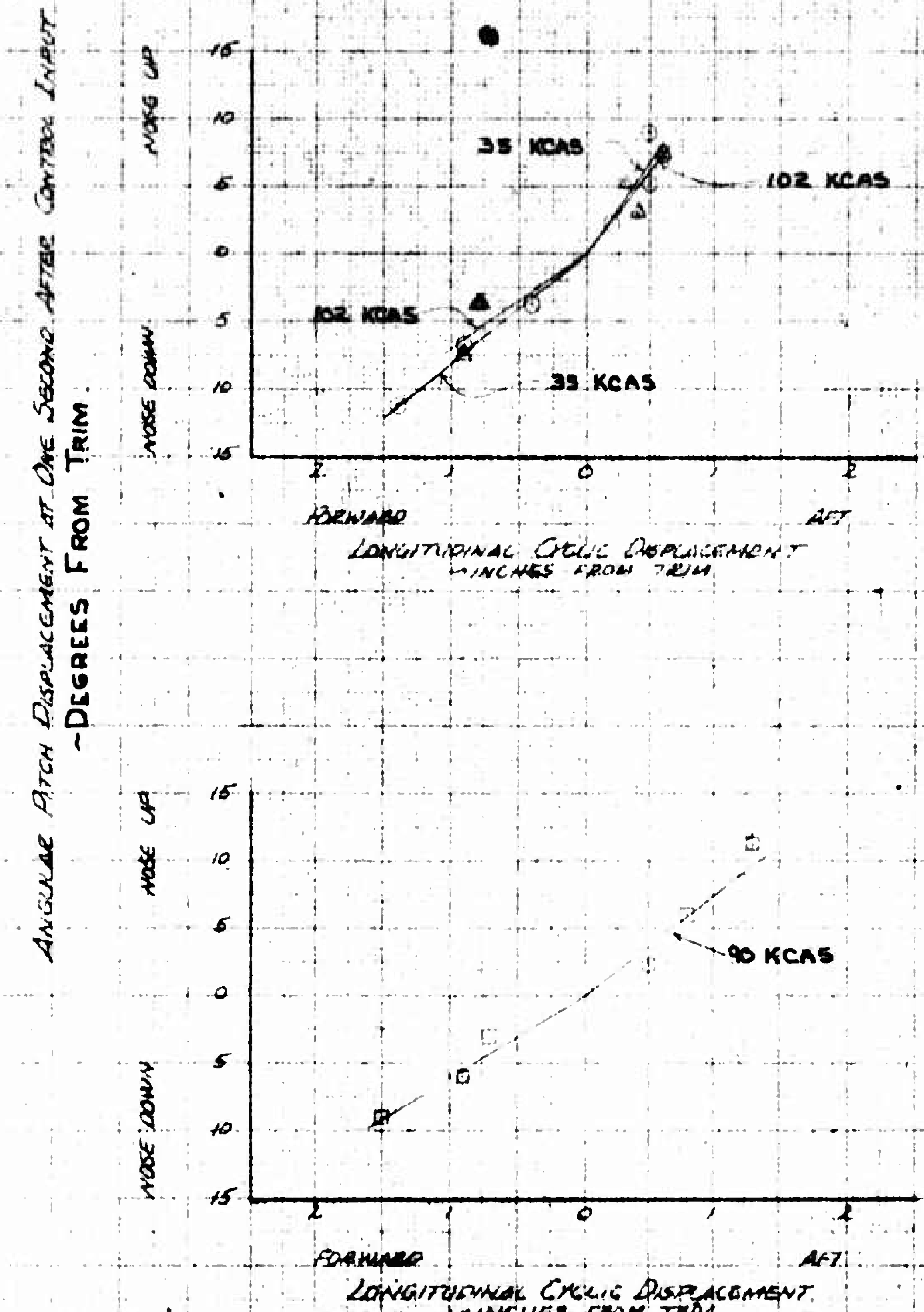

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FIGURE NO 157
ANGULAR PITCH DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
O	55	5000	2100	103.5	[illegible]	465	XM-7	NOTED
△	55	5000	2100	101.5	2.89	465	XM-8	NOTED

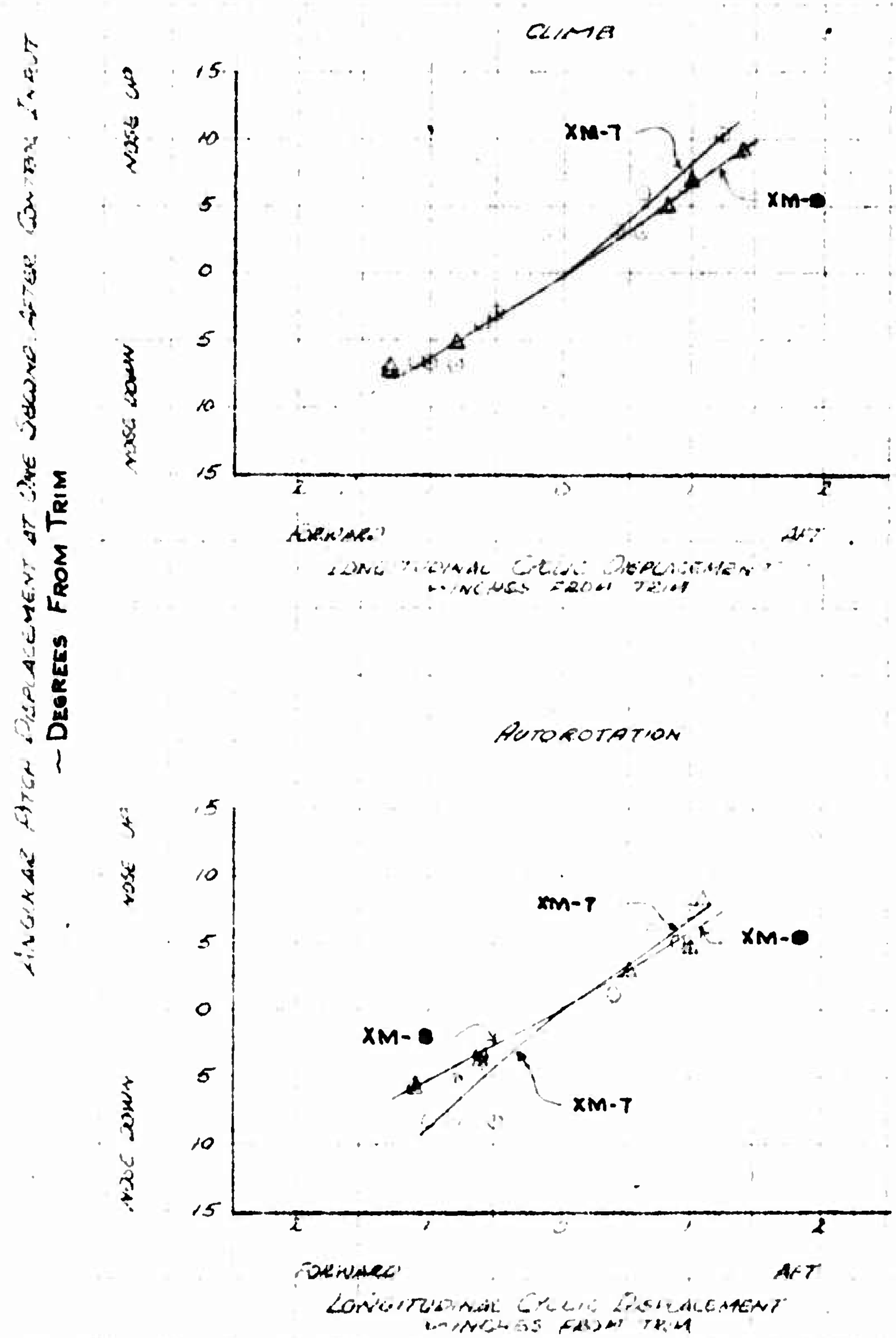
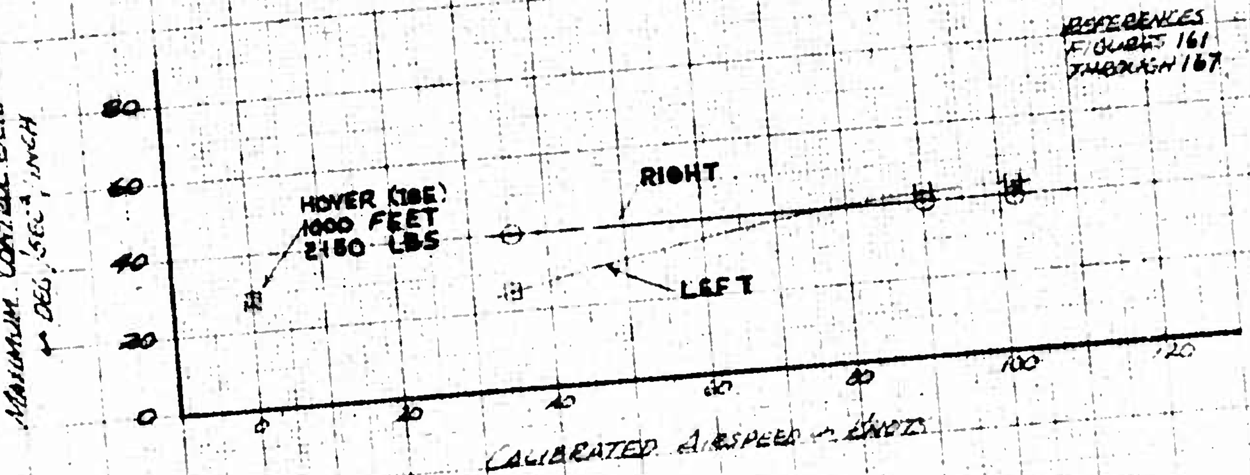


FIGURE NO. 158
SUMMARY OF LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○ LT □	5000	2080	103.5	.5 RT	465	CLEAN	LEVEL FLIGHT



SYM	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○ LT □	5000	2600	103.5	.5 RT	465	CLEAN	LEVEL FLIGHT

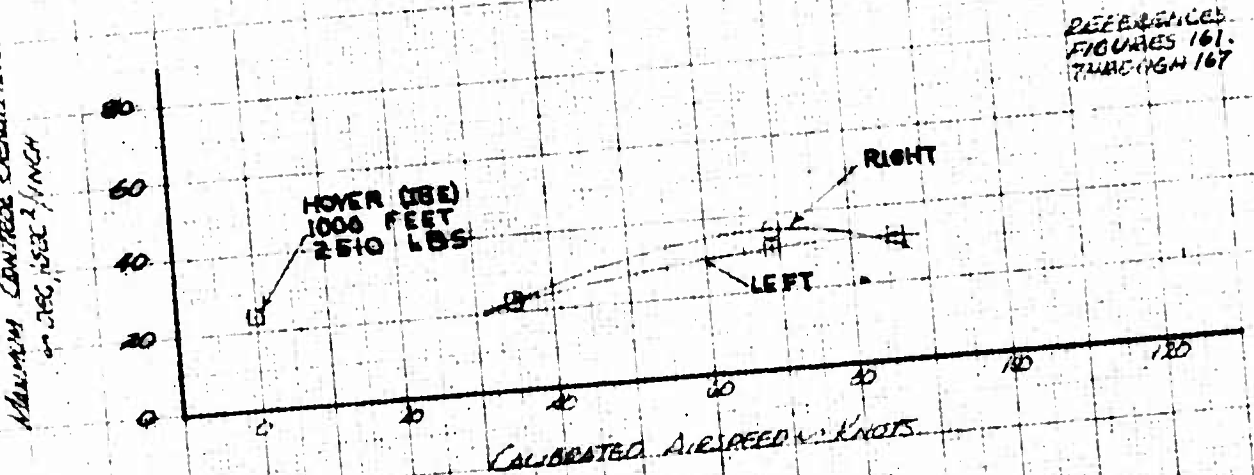


FIGURE No 159
SUMMARY OF LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_D ~FT	AVG G.W ~LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND
△	◻	10000	2100	103.5	.5 RT	465	CLEAN	LEVEL FLIGHT

REFERENCE
FIGURES 161
THROUGH 167

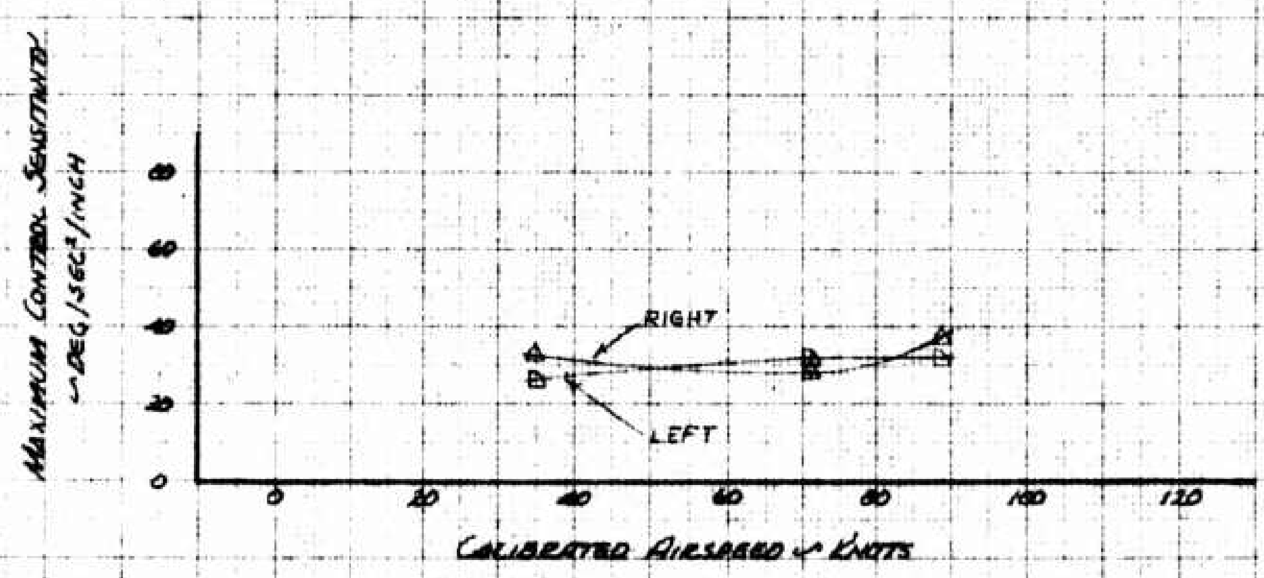
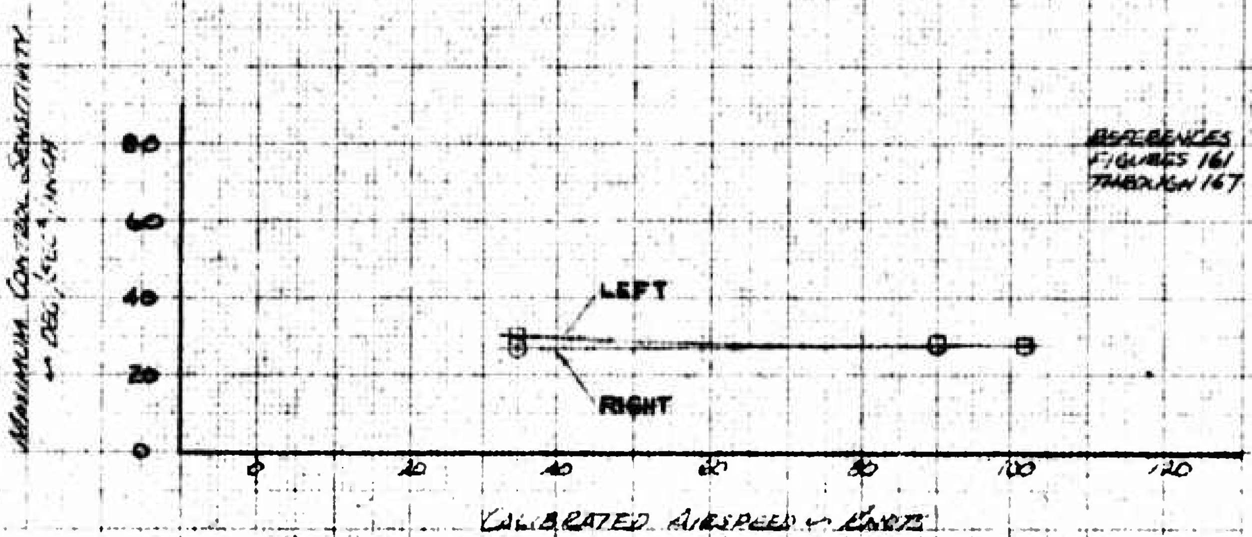


FIGURE NO 160
SUMMARY OF LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM		AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○	LT □	5000	2120	103.3	2.89	465	XM-8	LEVEL FLT



SYM		AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○	LT □	5000	2100	103.5	.5 RT	465	XM-7	LEVEL FLT

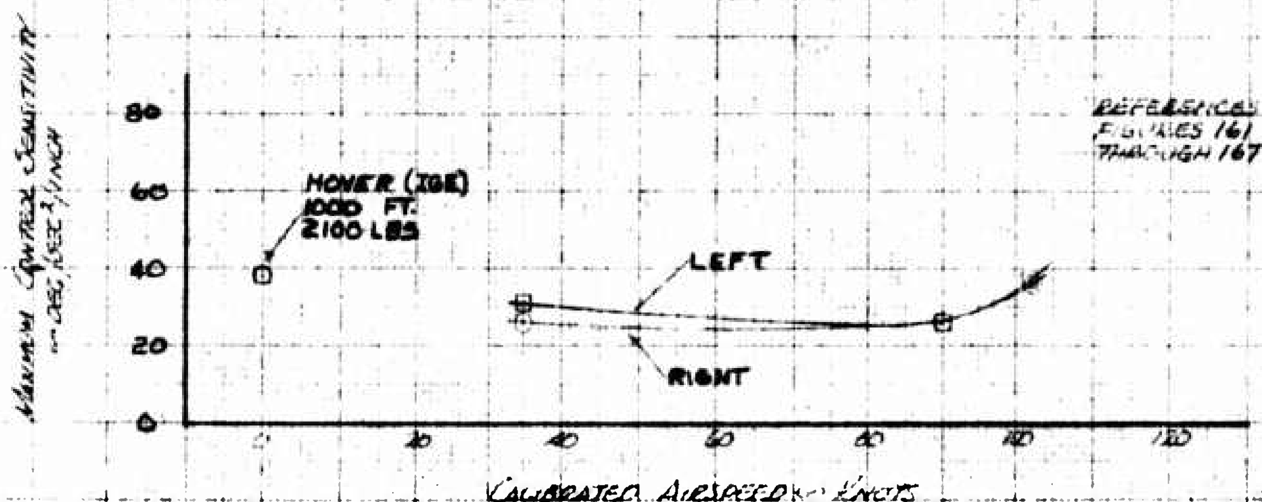
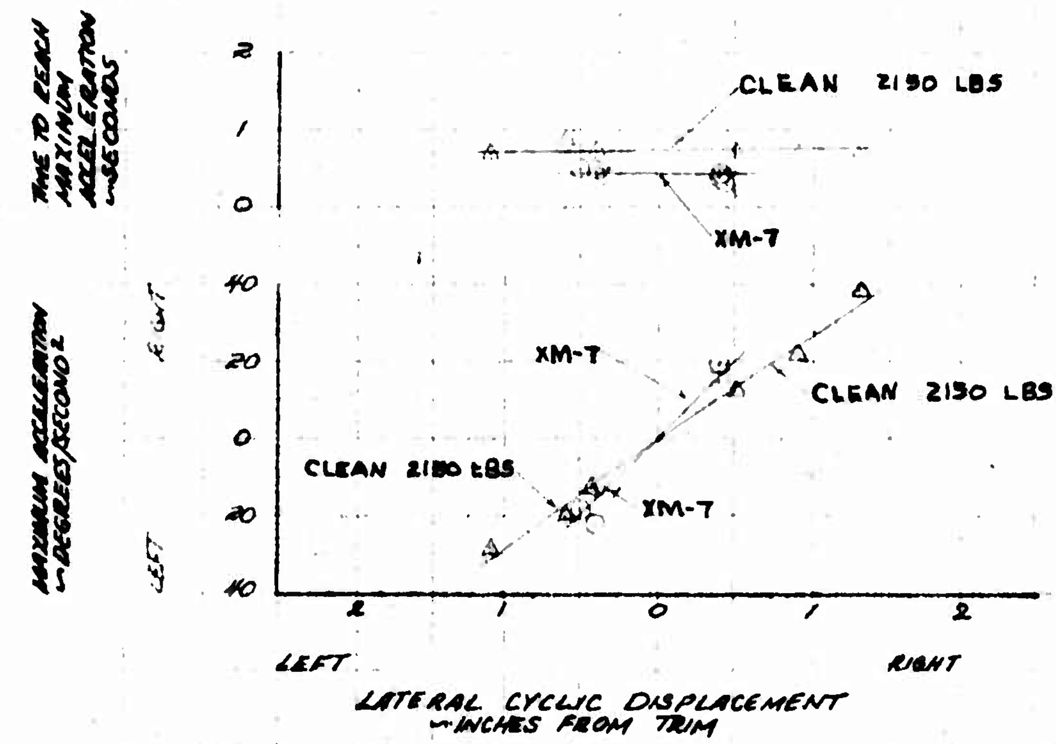


FIGURE NO 161
LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hd ~FT	AVG G.W ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	ZERO	1000	2100	103.5	.5RT	465	XM-7	HOVER (IGE)
△	ZERO	1000	2150	103.5	.5RT	465	CLEAN	HOVER (IGE)
□	ZERO	1000	2510	103.5	.5RT	465	CLEAN	HOVER (IGE)



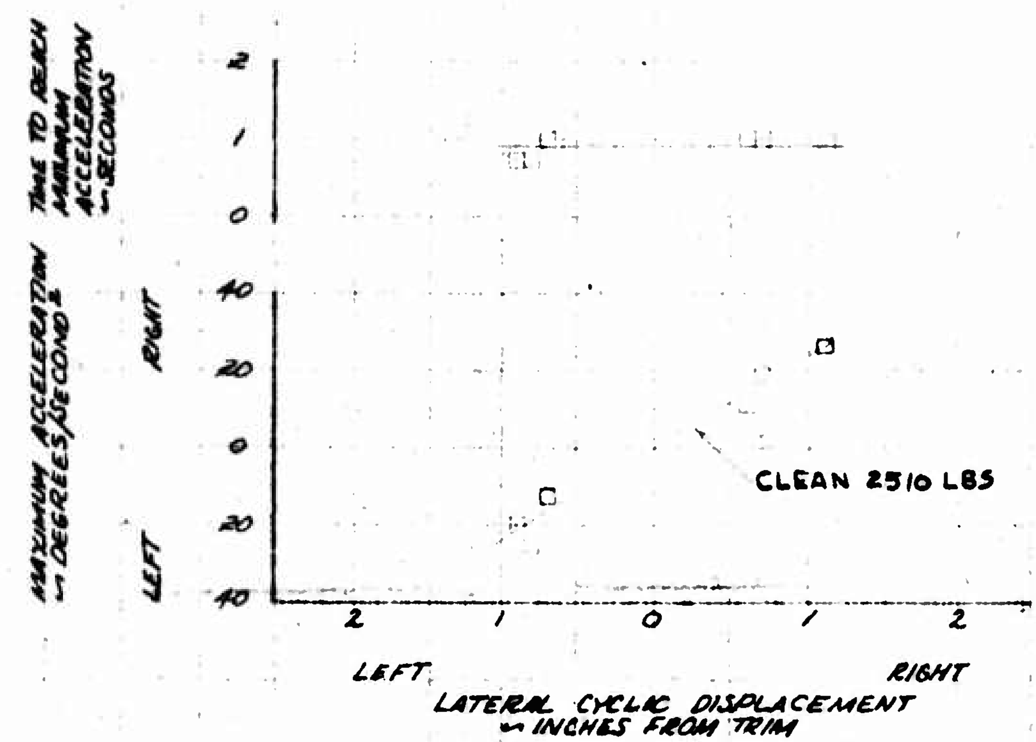
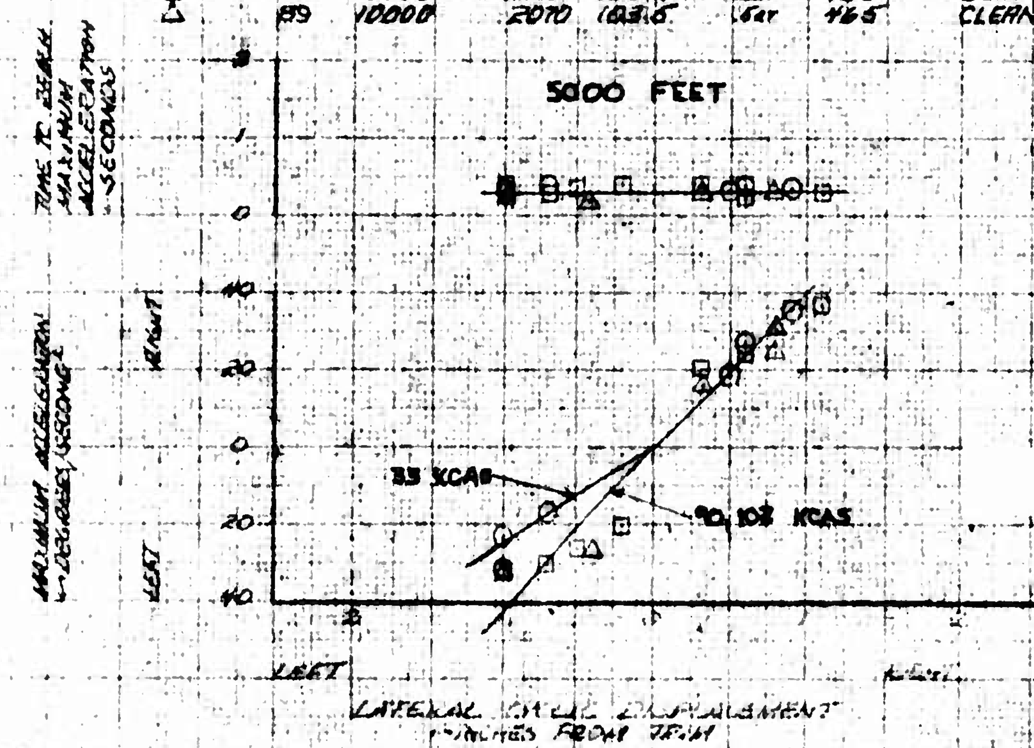


FIGURE NO. 162
LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AVG AIRSPEED ~KCAS	AVG H ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	5000	2110	103.5	.5 RT	466	CLEAN	LEVEL FLT
□	90	5000	2080	104.5	.5 RT	465	CLEAN	LEVEL FLT
△	102	5000	2150	104.6	.5 RT	465	CLEAN	LEVEL FLT
○ (flagged)	35	10000	2130	103.5	.6 RT	466	CLEAN	LEVEL FLT
□ (flagged)	71	10000	2170	103.5	.5 RT	465	CLEAN	LEVEL FLT
△ (flagged)	89	10000	2070	103.6	.6 RT	465	CLEAN	LEVEL FLT



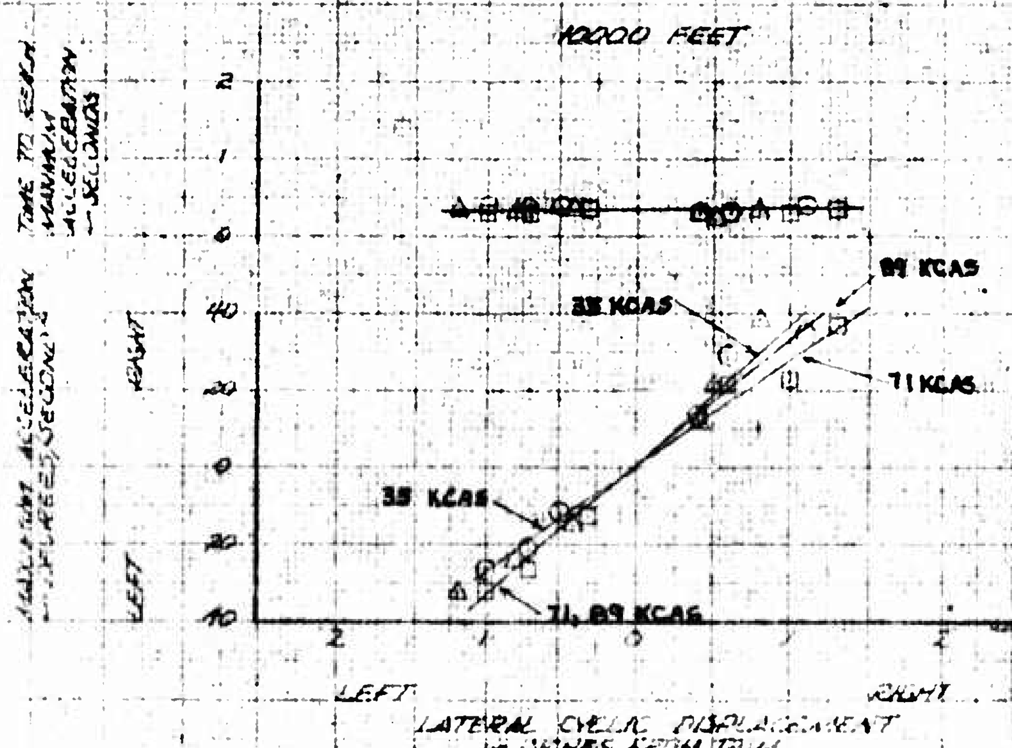
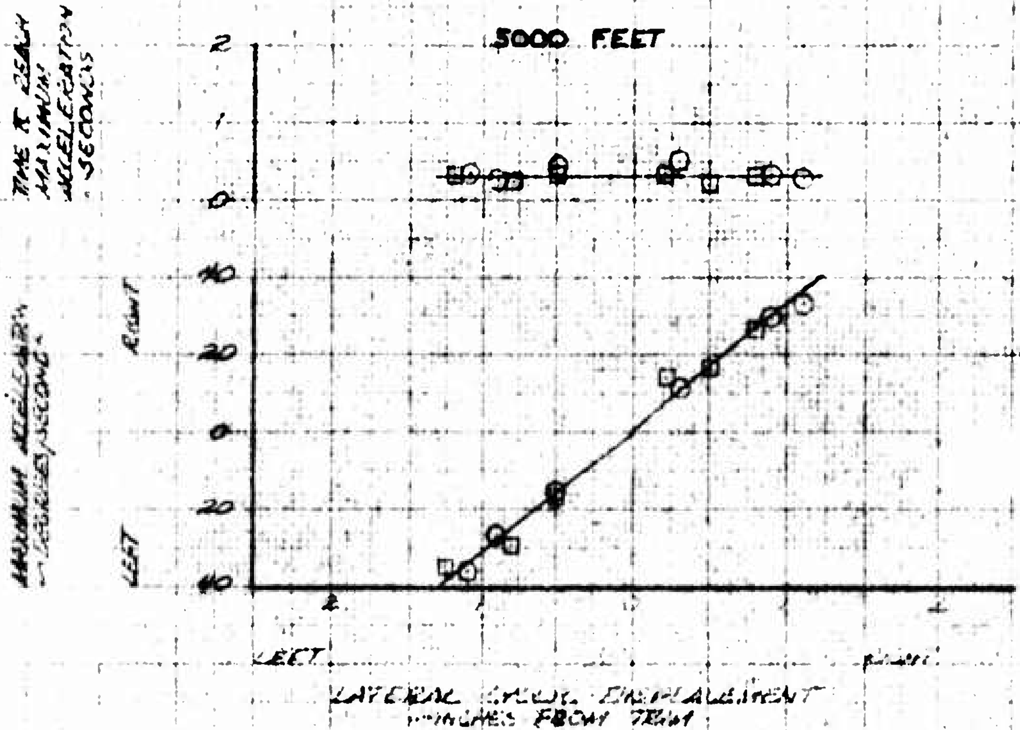


FIGURE NO 163

LATERAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG H. FT	AVG G.W. LB	AVG CG LOC. IN	TRIM LAT	ROTOR RPM	CONFIGURATION	FLT COND.
□	55	5000	2180	103.5	.5 RT	466	CLEAN	AUTOROTATION
○	55	5000	2160	103.5	.5 RT	465	CLEAN	CLIMB
◇	54	10000	2160	103.5	.5 RT	465	CLEAN	AUTOROTATION
△	54	10000	2140	103.5	.5 RT	465	CLEAN	CLIMB



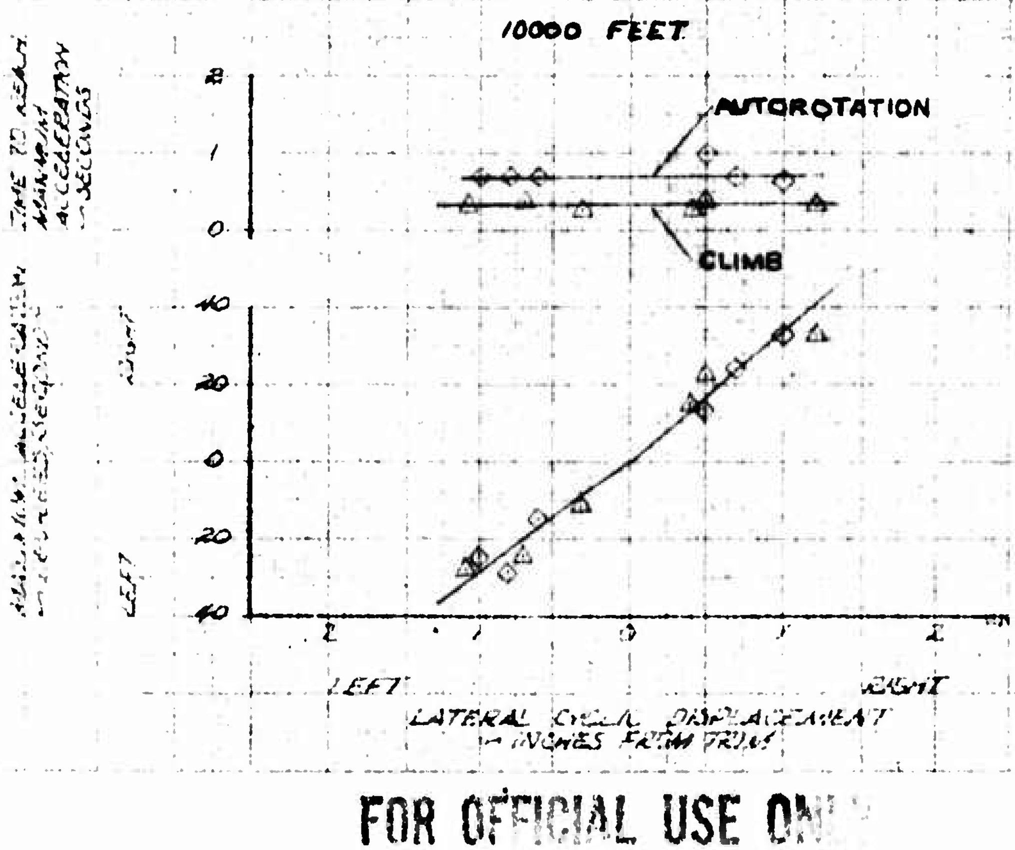
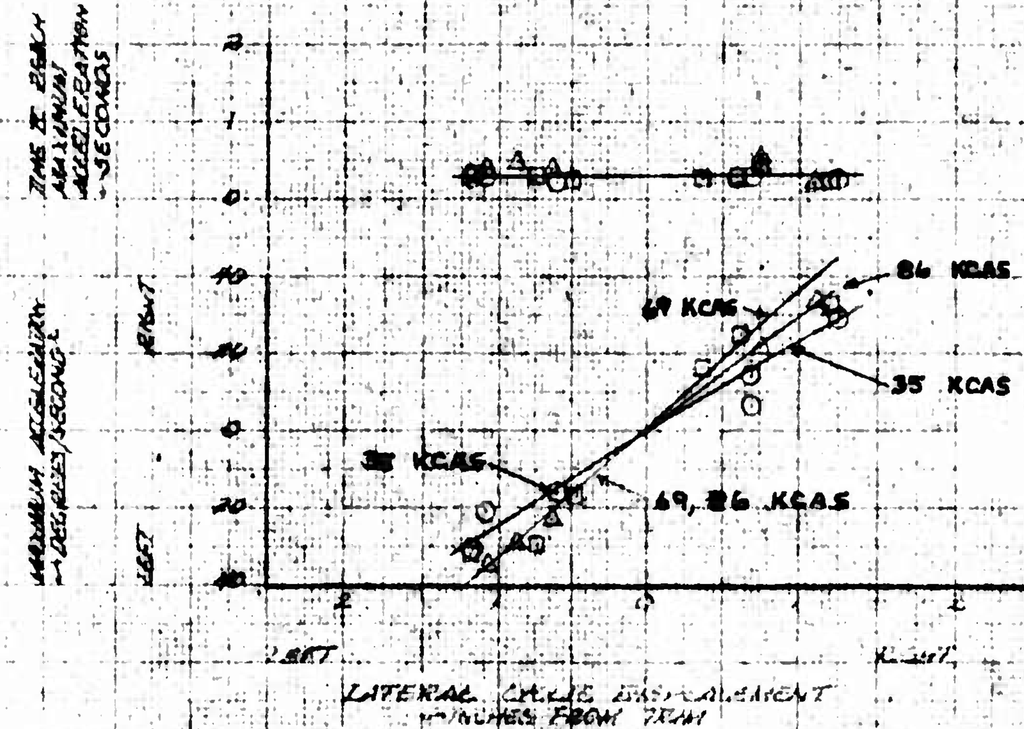


FIGURE NO. 164
LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	.5 RT	466	CLEAN	LEVEL FLT
□	69	5000	2600	103.5	.5 RT	465	CLEAN	LEVEL FLT
△	86	5000	2550	103.5	.5 RT	465	CLEAN	LEVEL FLT
◇	55	5000	2680	103.5	.5 RT	466	CLEAN	CLIMB
▷	55	5000	2520	103.5	.5 RT	465	CLEAN	AUTOROTATION



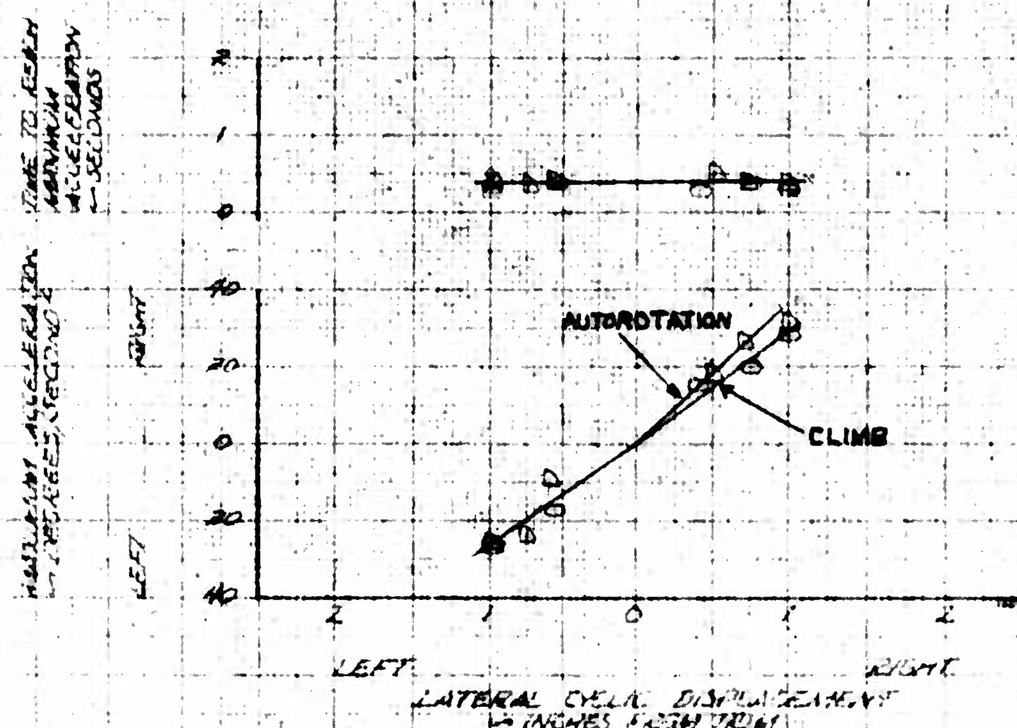


FIGURE NO 168

LATERAL CONTROL SENSITIVITY

CH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	ALTITUDE ~FT	GROSS WT ~LBS	CG LOCATION LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2110	103.5	.5 rt	465	X-M7	LEVEL FLT
□	90	5000	2140	103.5	.5 rt	465	X-M7	LEVEL FLT
△	102	5000	2010	103.5	.5 rt	465	X-M7	LEVEL FLT

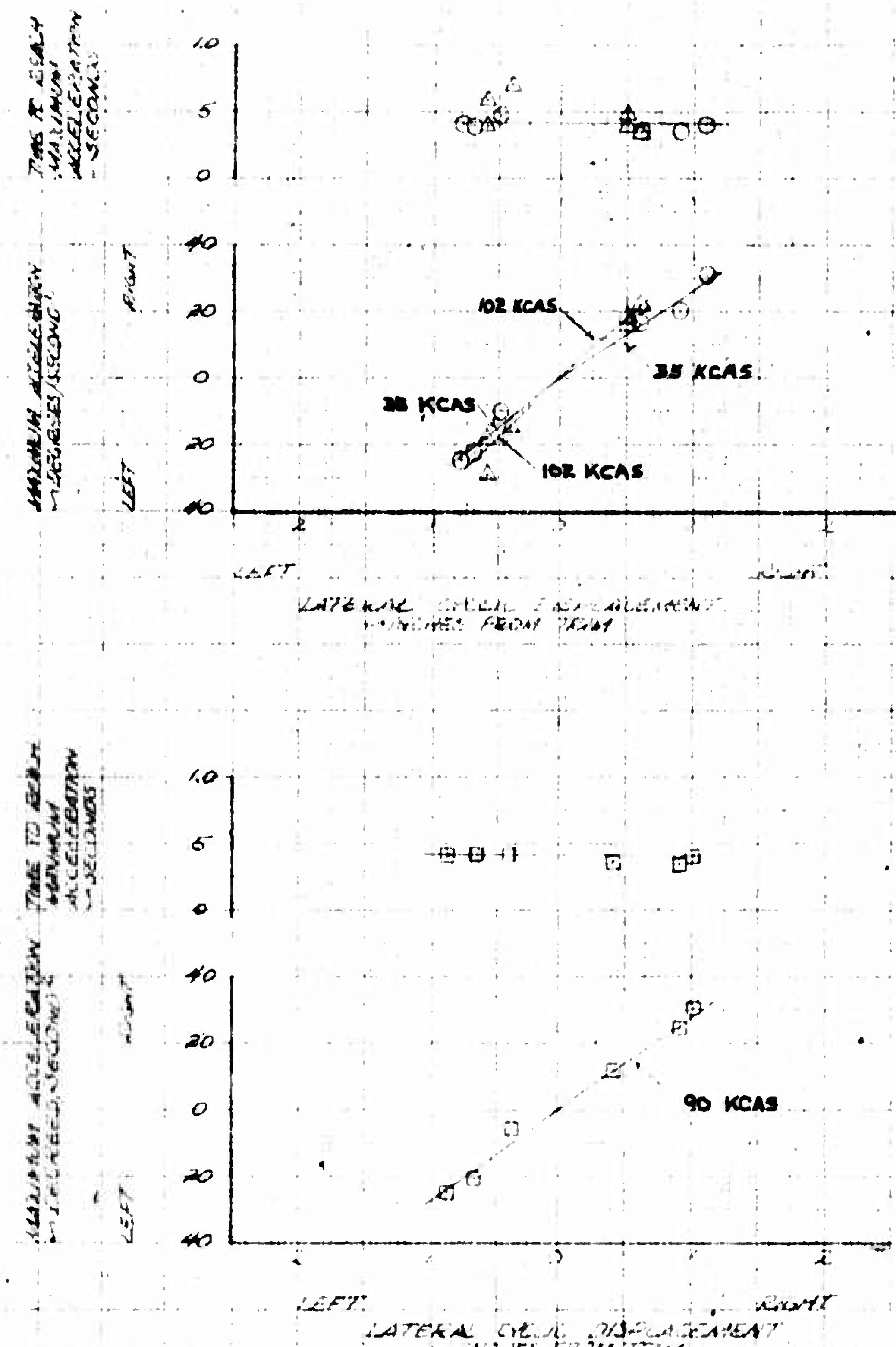


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FIGURE NO 166
LATERAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_D ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
O	55	5000	2150	103.3	2.89 LT	465	X-MB	LEVEL FLT
□	90	5000	2100	103.3	2.89 LT	465	X-MB	LEVEL FLT
△	102	5000	2100	103.3	2.89 LT	465	X-MB	LEVEL FLT

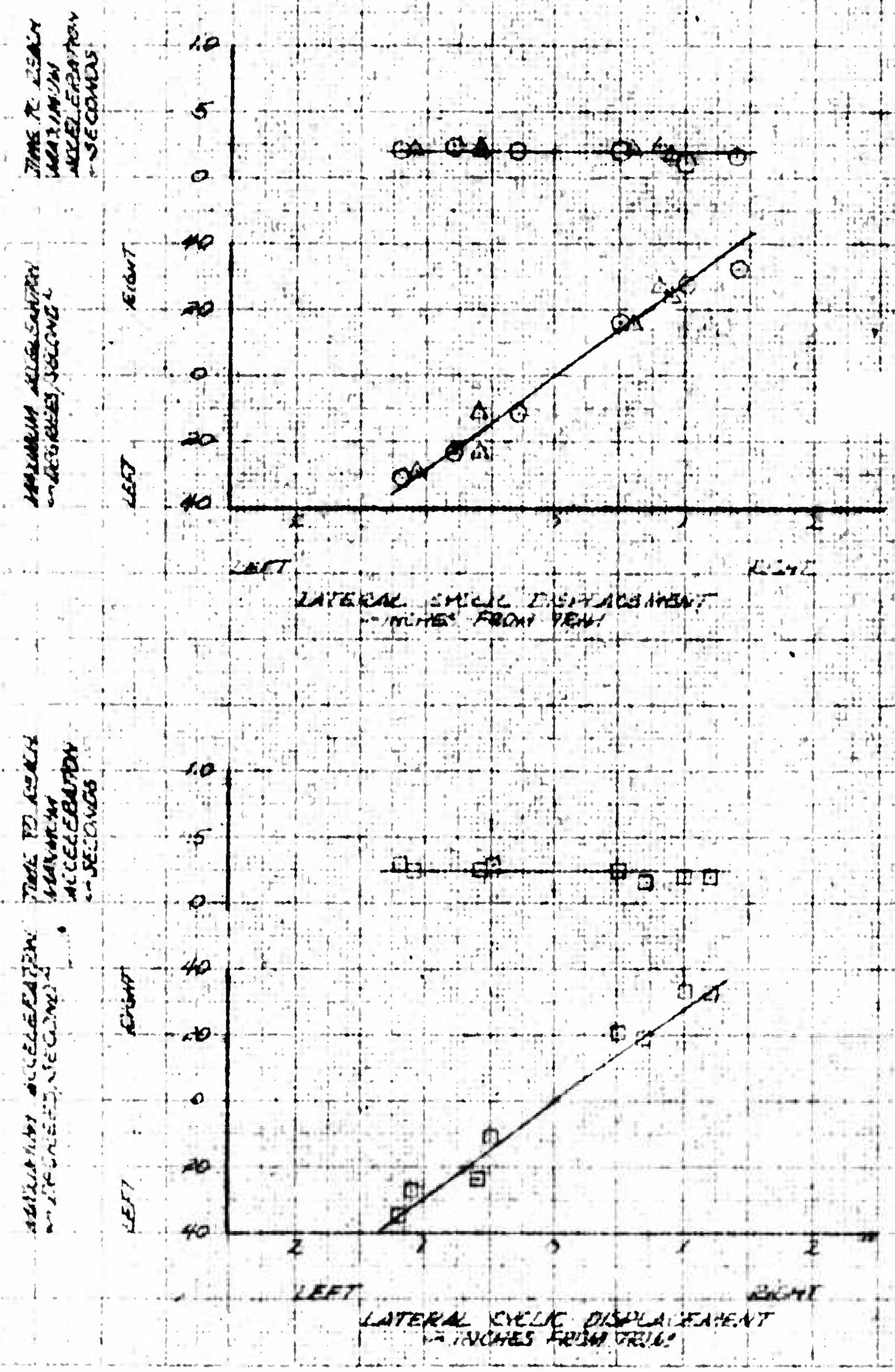

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FIGURE NO. 167
LATERAL CONTROL SENSITIVITY
OH-6A USA #62-4214

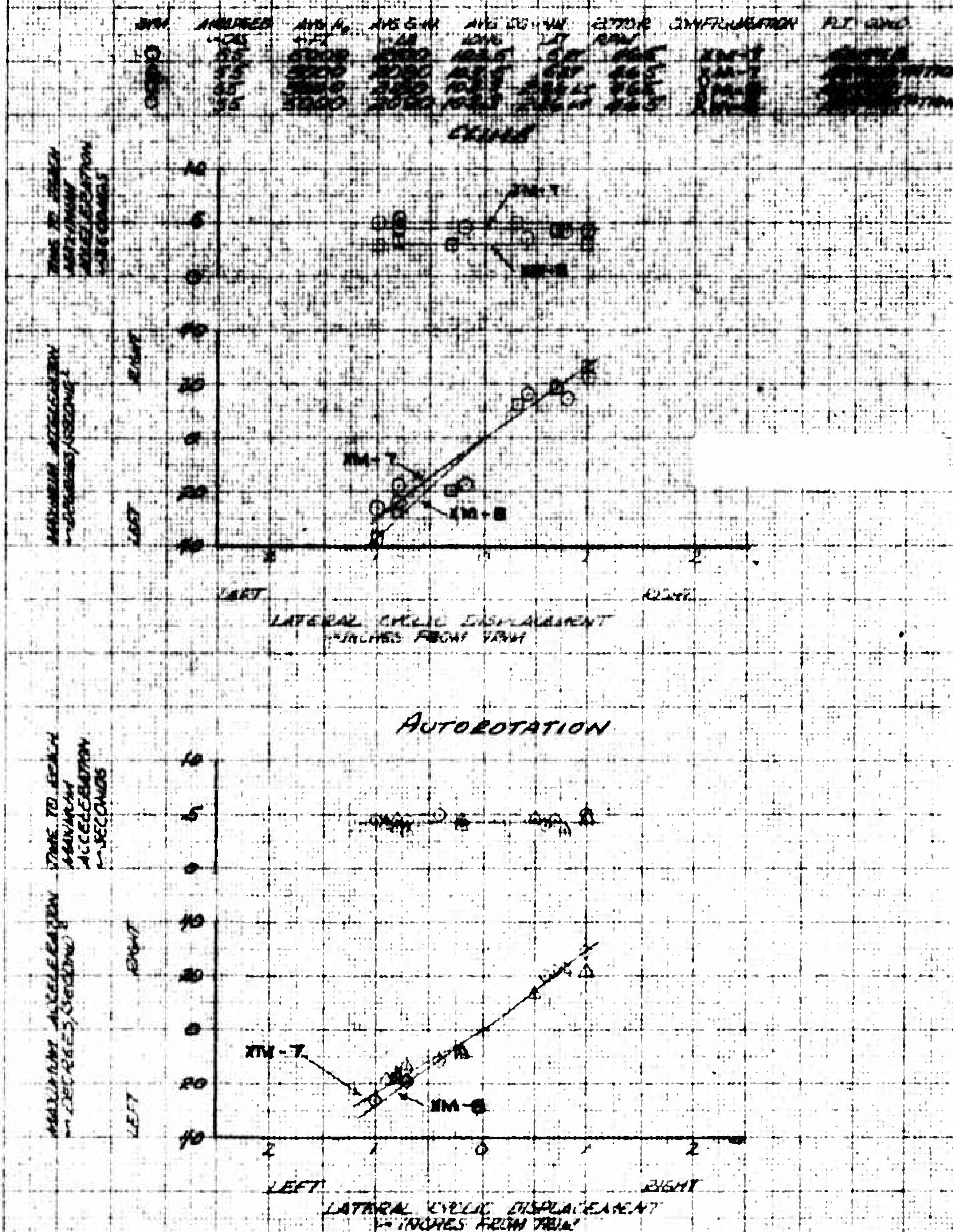
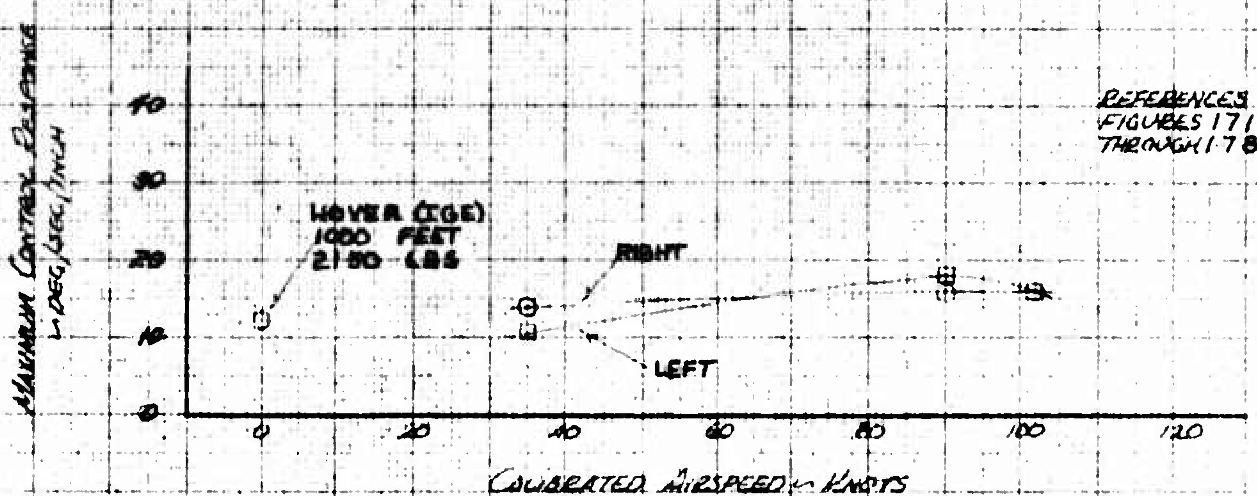


FIGURE No 168
SUMMARY OF LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	□	5000	2080	103.5	.3LT	465	CLEAN	LEVEL FLIGHT



SYM RT	SYM LT	AVG H_p ~FT	AVG G.W ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	□	5000	2600	103.5	.5RT	465	CLEAN	LEVEL FLIGHT

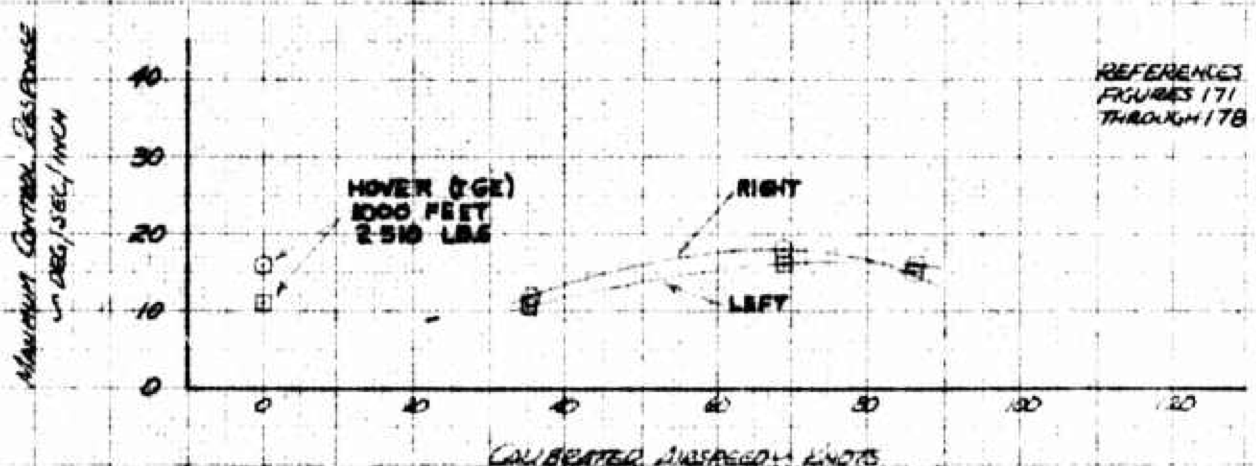


FIGURE NO. 169
SUMMARY OF LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_p FT	AVG G.W. LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
△	◺	10000	2100	103.5	.687	465	CLEAN	LEVEL FLT

REFERENCE
FIGURES 171
THROUGH 178

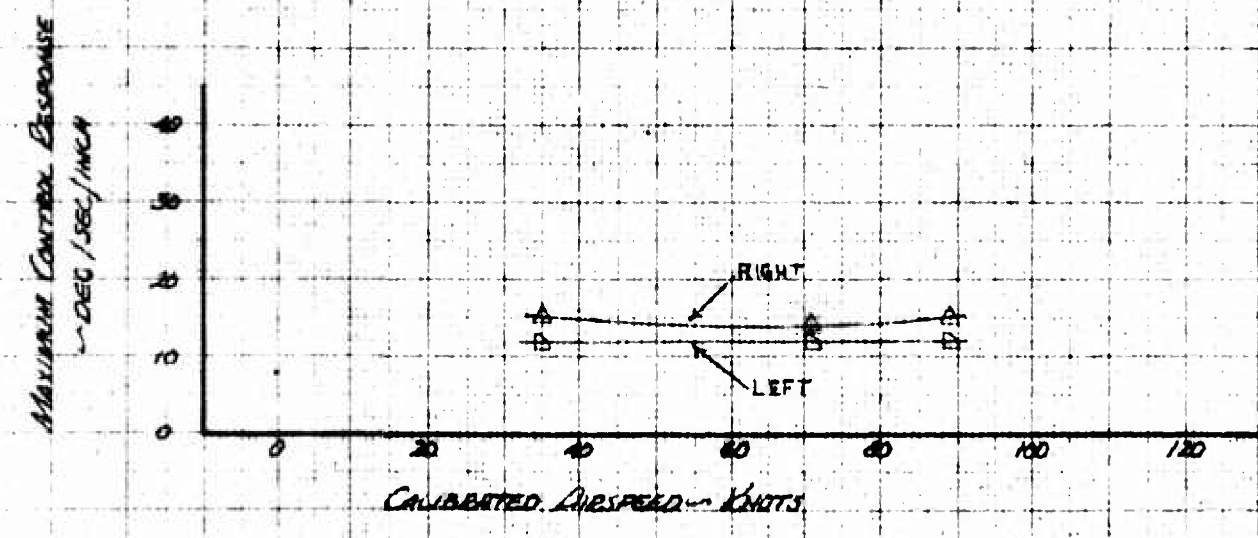


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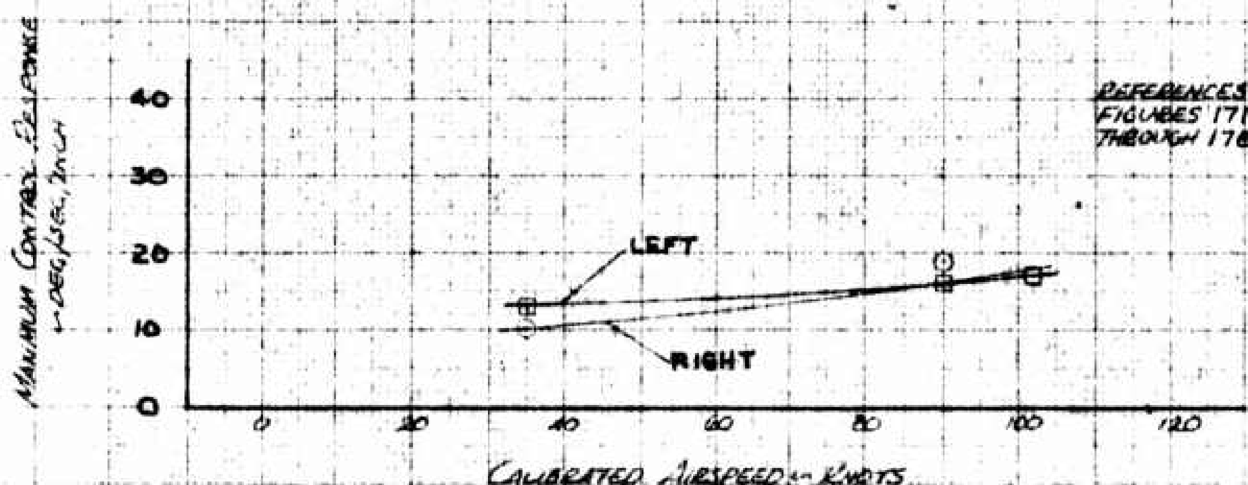
FIGURE NO 170

SUMMARY OF LATERAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT ○ LT □	5000	2120	103.5	2.89	465	XM-8	LEVEL FLT.



SYM	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT ○ LP □	5000	2100	103.5	2.89	465	XM-7	LEVEL FLT.

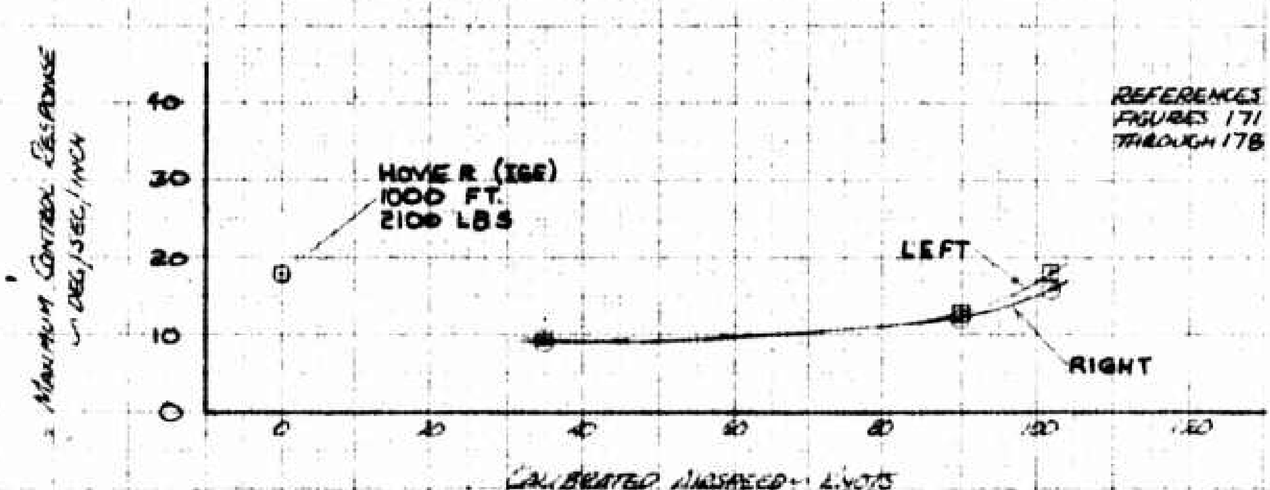


FIGURE NO 171
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG HD ~FT	AVG GW ~LB	AVG CG ~INS	CG ~LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	ZERO	1000	2100	104.6	.5R	465	XM-7	HOVER (IGE)
△	ZERO	1000	2150	103.5	.5R	465	CLEAN	HOVER (IGE)
□	ZERO	1000	2510	103.5	.5R	465	CLEAN	HOVER (IGE)

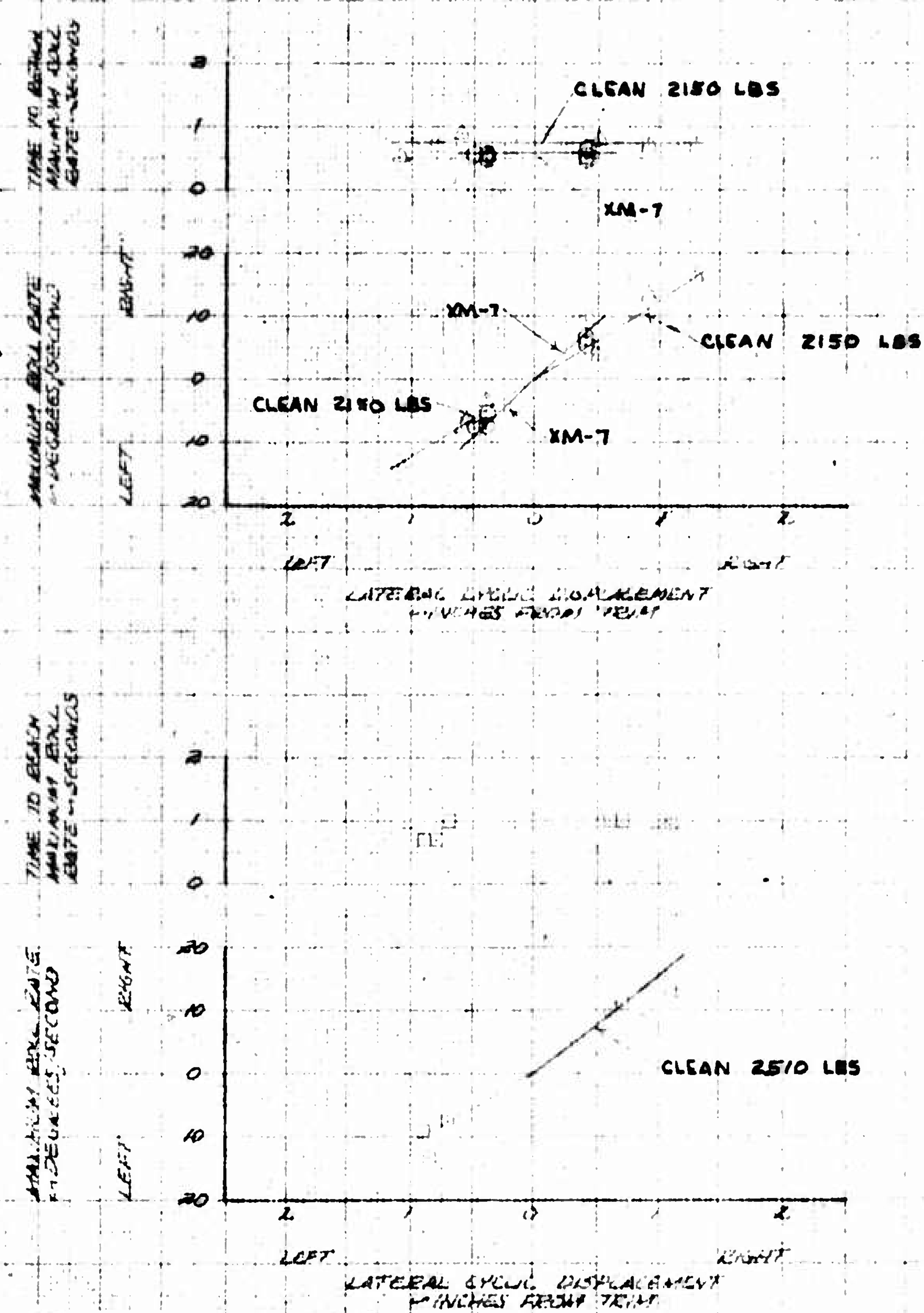


FIGURE No 172
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG Hp FT	AVG G.W. LB	AVG C.G. LONG	AVG C.G. LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2110	103.5	.5Rt	465	CLEAN	LEVEL FLT
□	90	5000	2080	103.5	.5Rt	465	CLEAN	LEVEL FLT
△	102	5000	2150	103.5	.6Rt	465	CLEAN	LEVEL FLT
○	35	10000	2130	103.5	.5Rt	465	CLEAN	LEVEL FLT
□	71	10000	2110	103.5	.5Rt	465	CLEAN	LEVEL FLT
△	89	10000	2070	103.5	.6Rt	465	CLEAN	LEVEL FLT

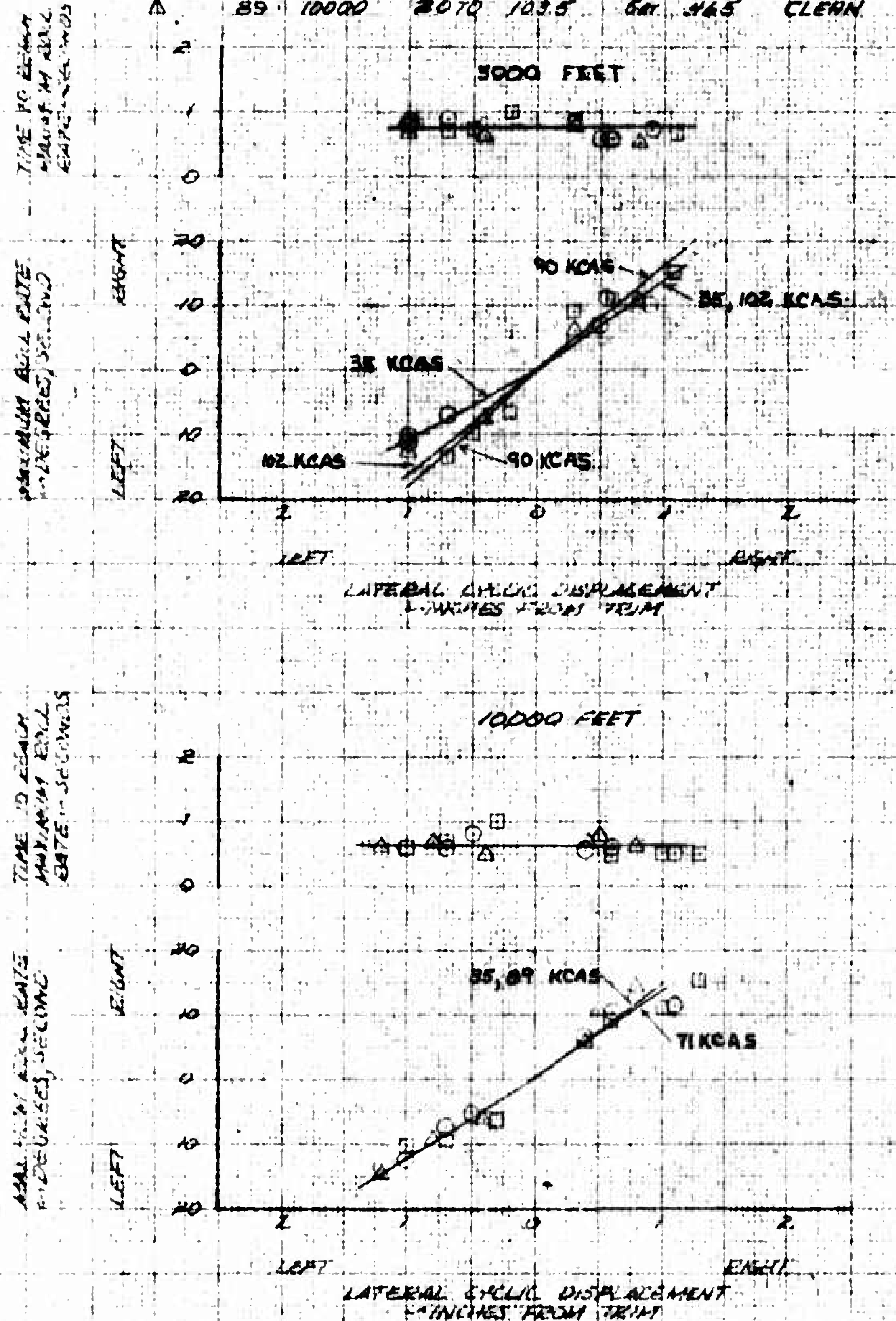
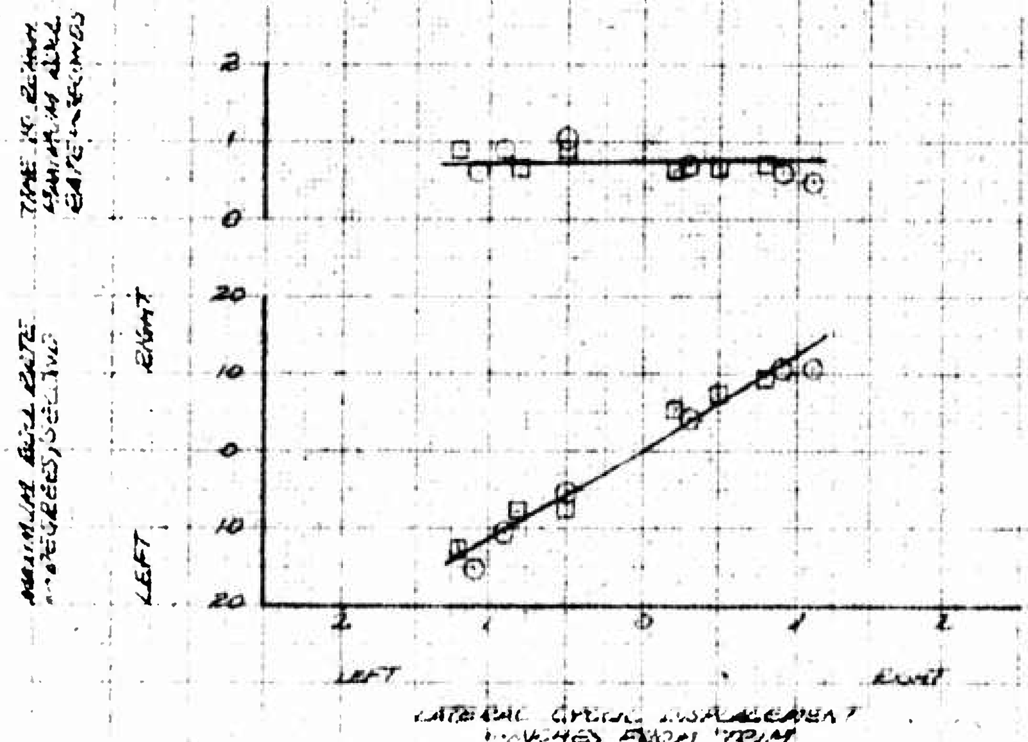


FIGURE NO 173
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
□	65	5000	2180	103.5	.5 RT	465	CLEAN	AUTOROTATION
○	55	5000	2160	103.5	.5 RT	465	CLEAN	CLIMB
◇	64	10000	2160	103.5	.5 RT	465	CLEAN	AUTOROTATION
△	54	10000	2140	103.5	.5 RT	465	CLEAN	CLIMB



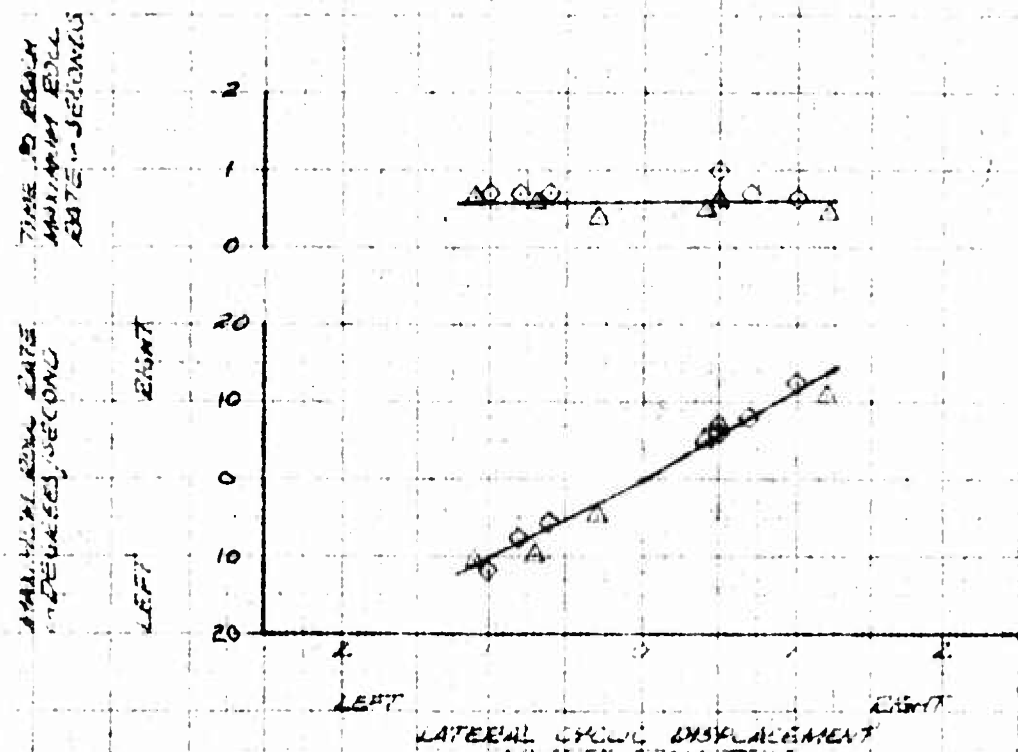


FIGURE NO 174
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	ALTITUDE FT	AVG GROSS WT LB	AVG CG LOCATION LONG IN	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	.5RT	465	CLEAN	LEVEL FLT
□	69	5000	2600	103.5	.5RT	465	CLEAN	LEVEL FLT
△	86	5000	2550	103.5	.5RT	465	CLEAN	LEVEL FLT
◇	55	5000	2680	103.5	.6RT	465	CLEAN	CLIMB
▷	55	5000	2520	103.5	.5RT	465	CLEAN	AUTOROTATION

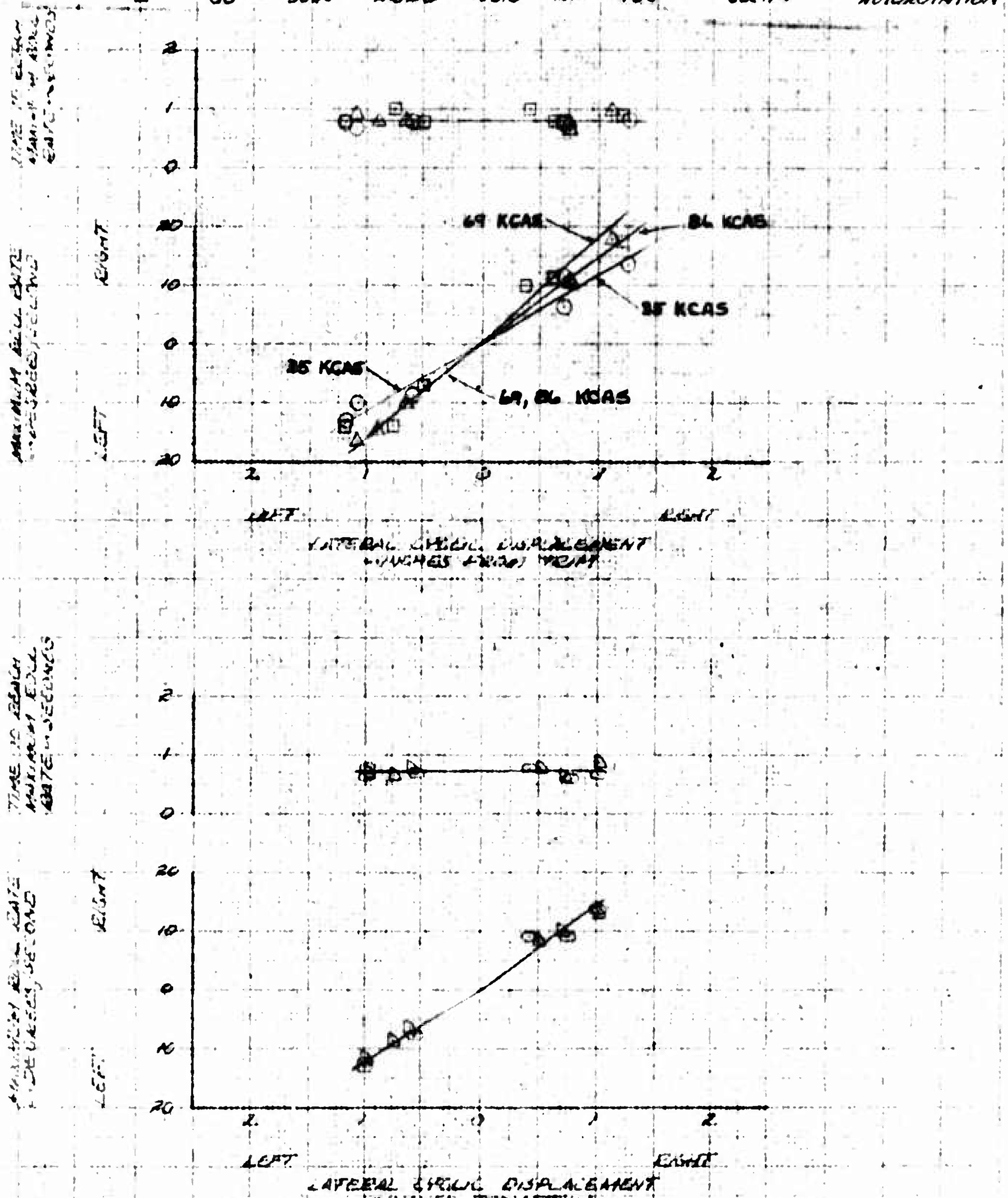
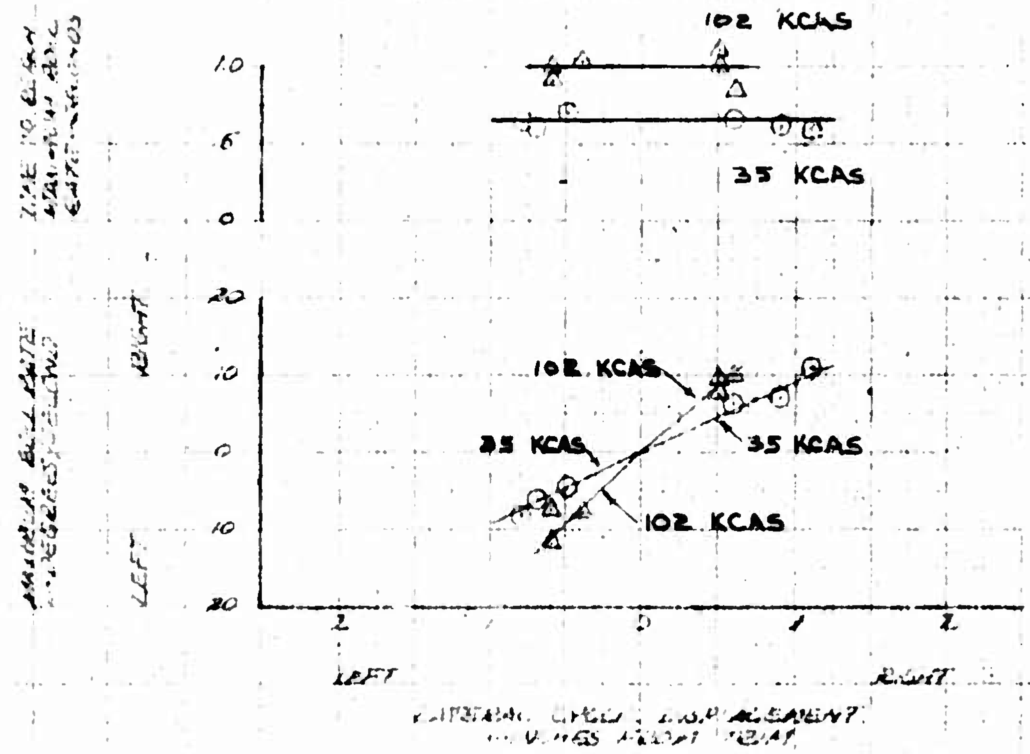


FIGURE NO 175
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED (KCAS)	DENSITY ALT (FT)	GROSS WT (LB)	C.G. LONG (IN)	C.G. LAT (IN)	ROTOR SPEED (RPM)	CONFIGURATION	FLT COND
○	35	5000	2110	103.5	.5 RT	465	X-M7	LEVEL FLT
□	90	5000	2140	103.5	.5 RT	465	X-M7	LEVEL FLT
△	102	5000	2070	103.6	.5 RT	465	X-M7	LEVEL FLT



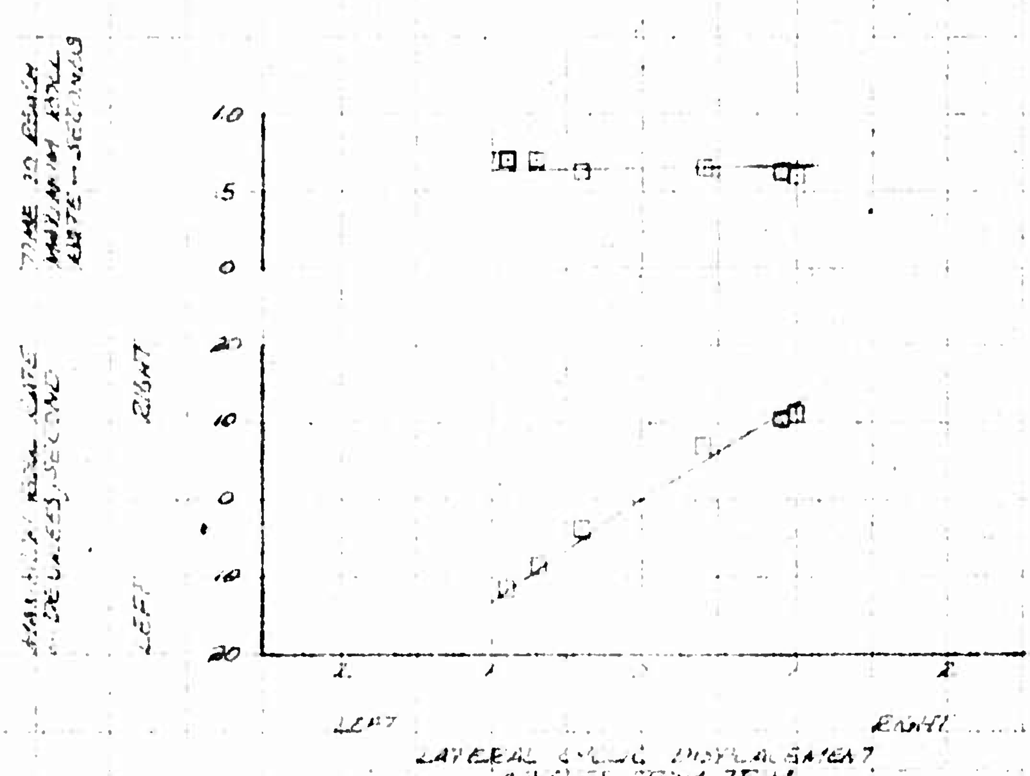


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FIGURE NO 176

LATERAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

○	35	5000	2150	103.3	2.89 LT	465	X-MB	LEVEL FLT
□	90	5000	2100	103.3	2.89 LT	465	X-MB	LEVEL FLT
△	102	5000	2100	103.3	2.89 LT	465	X-MB	LEVEL FLT

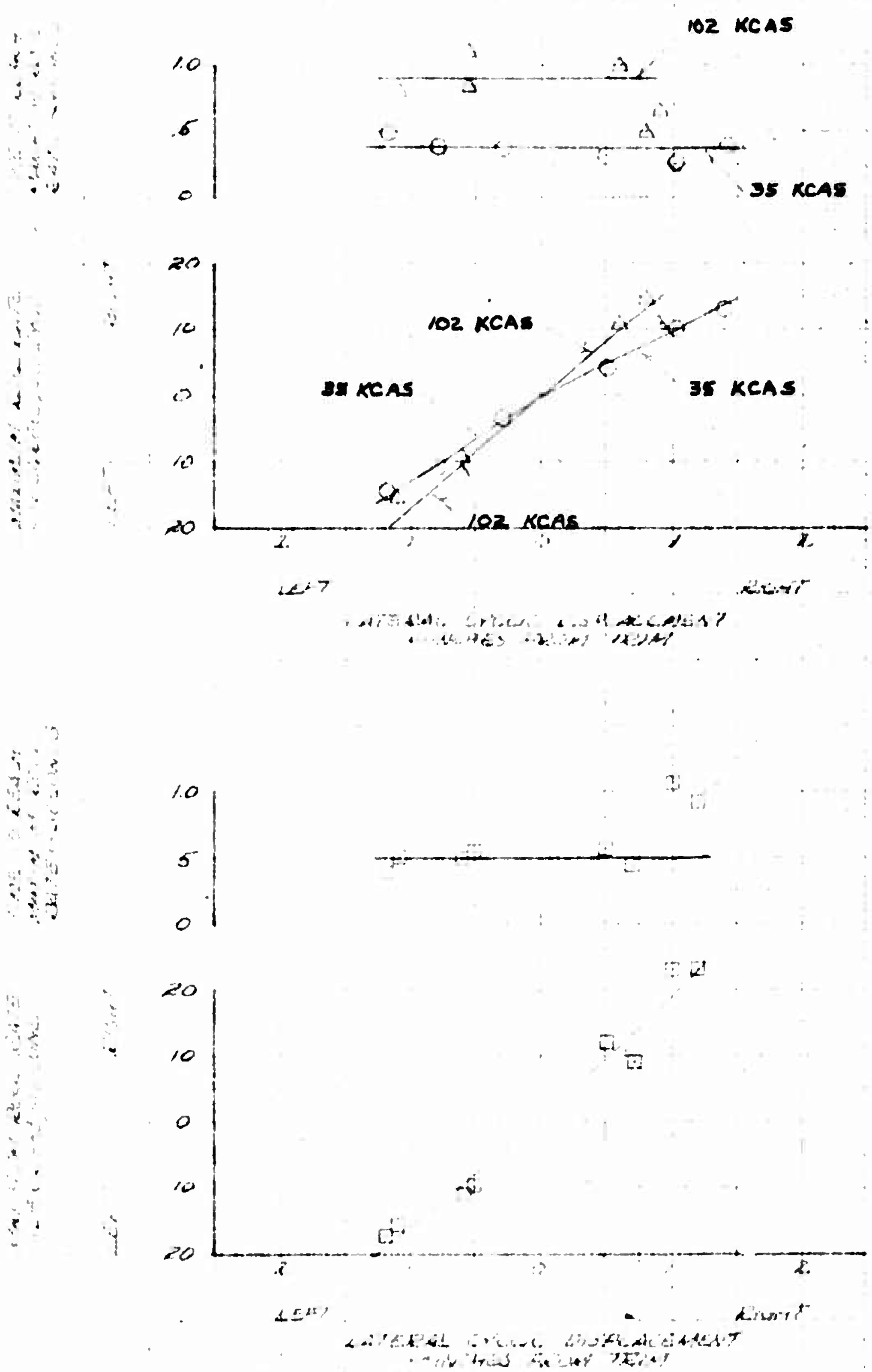

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FIGURE NO 177
LATERAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5900	2100	103.5	.5 RT	465	XM-7	CLIMB
△	55	5000	2080	103.6	.5 RT	465	XM-7	AUTOROTATION
□	55	5000	2180	103.3	2.86 RT	465	XM-8	CLIMB
◇	55	5000	2090	103.3	2.86 RT	465	XM-8	AUTOROTATION

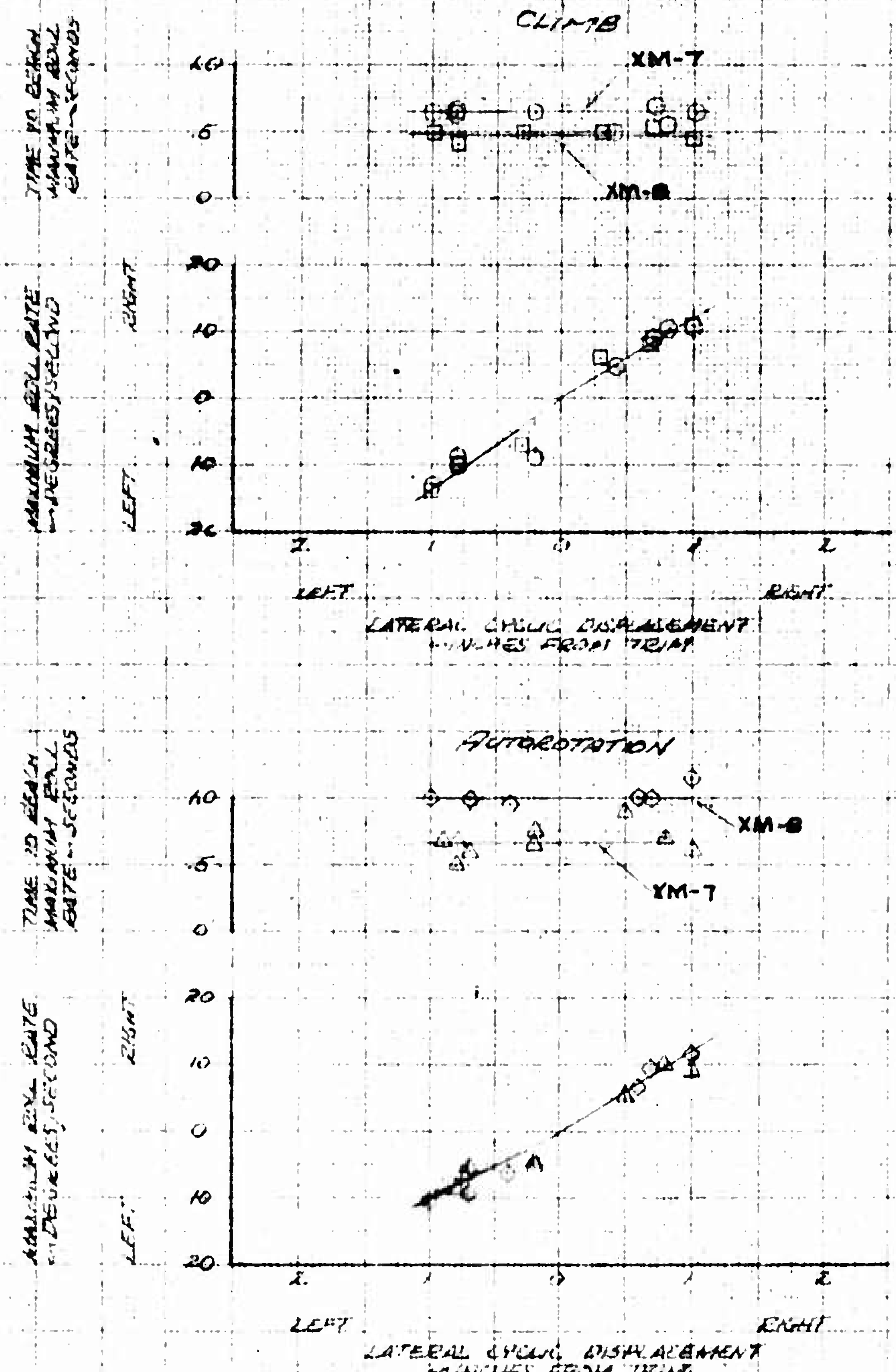
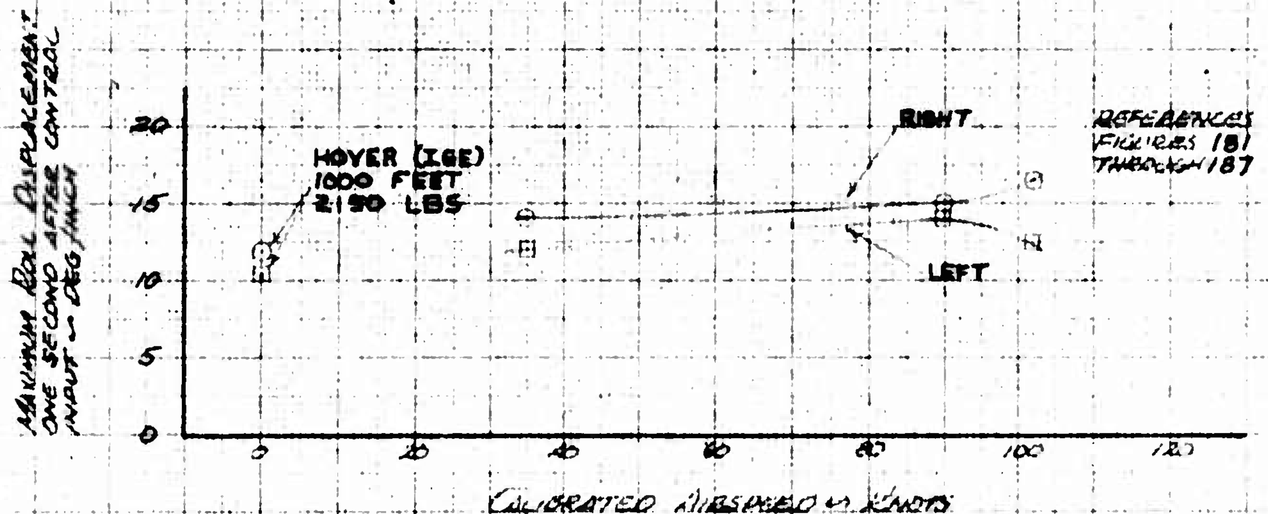


FIGURE NO 178
SUMMARY OF ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG Hp ~ FT	AVG G.W ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	□	5000	2080	103.5	.5RT	465	CLEAN	LEVEL FLIGHT



SYM RT	SYM LT	AVG Hp ~ FT	AVG G.W ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	□	5000	2600	103.5	.5RT	465	CLEAN	LEVEL FLIGHT

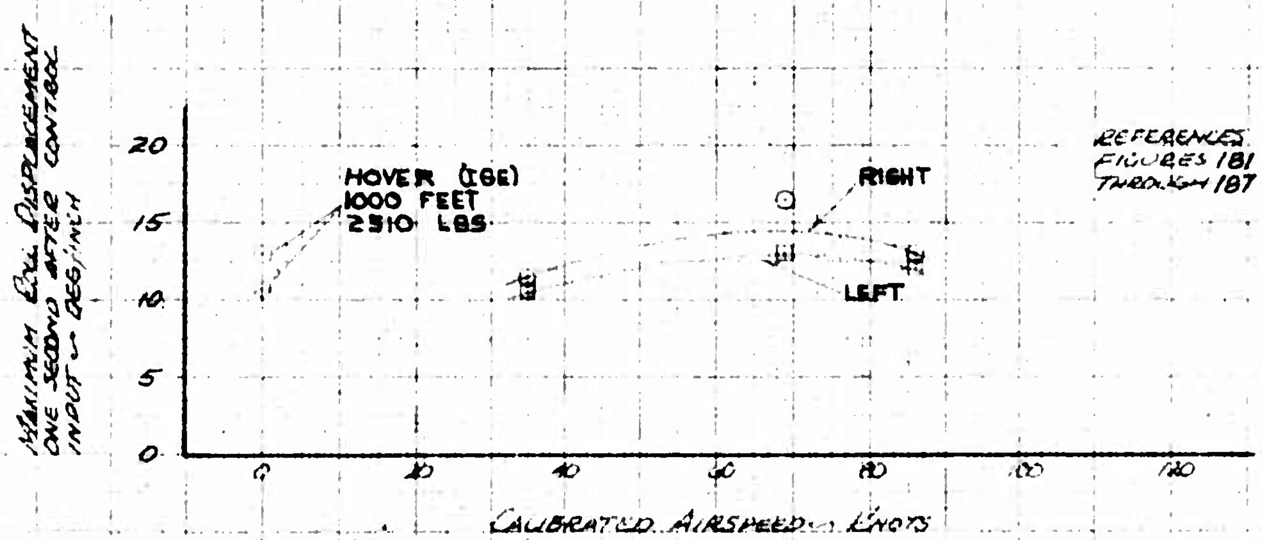


FIGURE NO 179
SUMMARY OF ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_P ~ FT	AVG G.W. ~ LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT.	ROTOR RPM	CONFIGURATION	FLT. COND
△	◺	10000	2100	103.6	.5	465	CLEAN	LEVEL FLT

REFERENCE
FIGURES 181
THROUGH 187

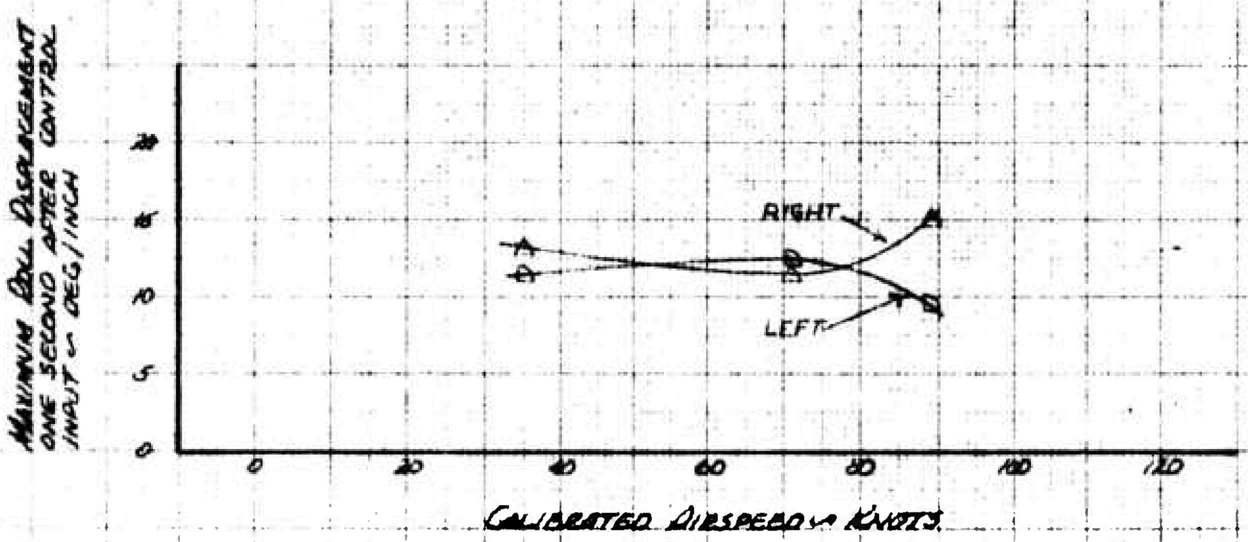


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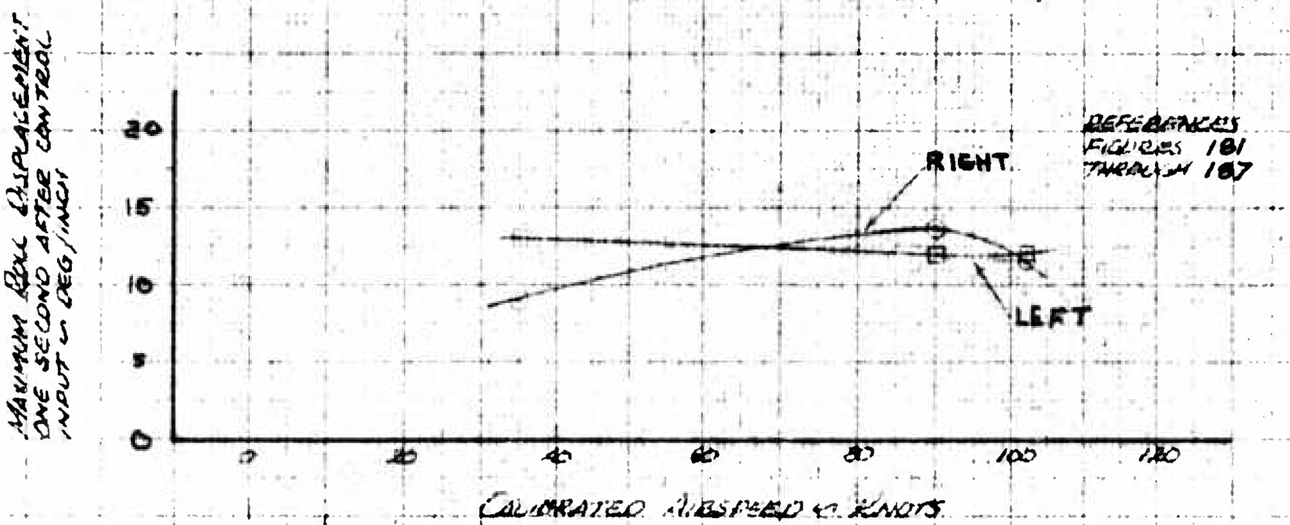
FIGURE No 180

SUMMARY OF ANGULAR ROLL DISPLACEMENT

OH-6A USA S/N 62-4214

SYM		AVG H_D ~ FT	AVG G.W ~ LB	AVG C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○	LT □	3000	2120	1033	2.84 LT	465	XM-8	LEVEL FLT



SYM		AVG H_D ~ FT	AVG G.W ~ LB	AVG C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
RT ○	LT □	5000	2100	103.5	.5 RT	465	XM-7	LEVEL FLT.

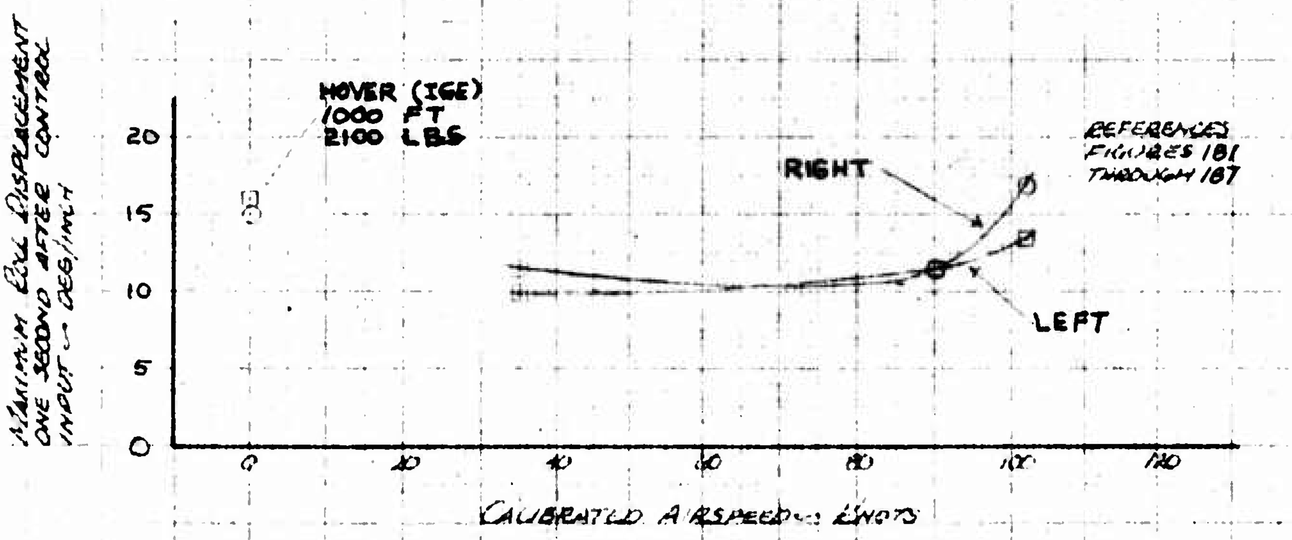


FIGURE NO 101

ANGULAR ROLL DISPLACEMENT

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	ZERO	1000	2100	103.5	.5R	465	XM-7	HOVER (IGE)
△	ZERO	1000	2150	103.5	.5R	465	CLEAN	HOVER (IGE)
□	ZERO	1000	2510	103.5	.5R	465	CLEAN	HOVER (IGE)

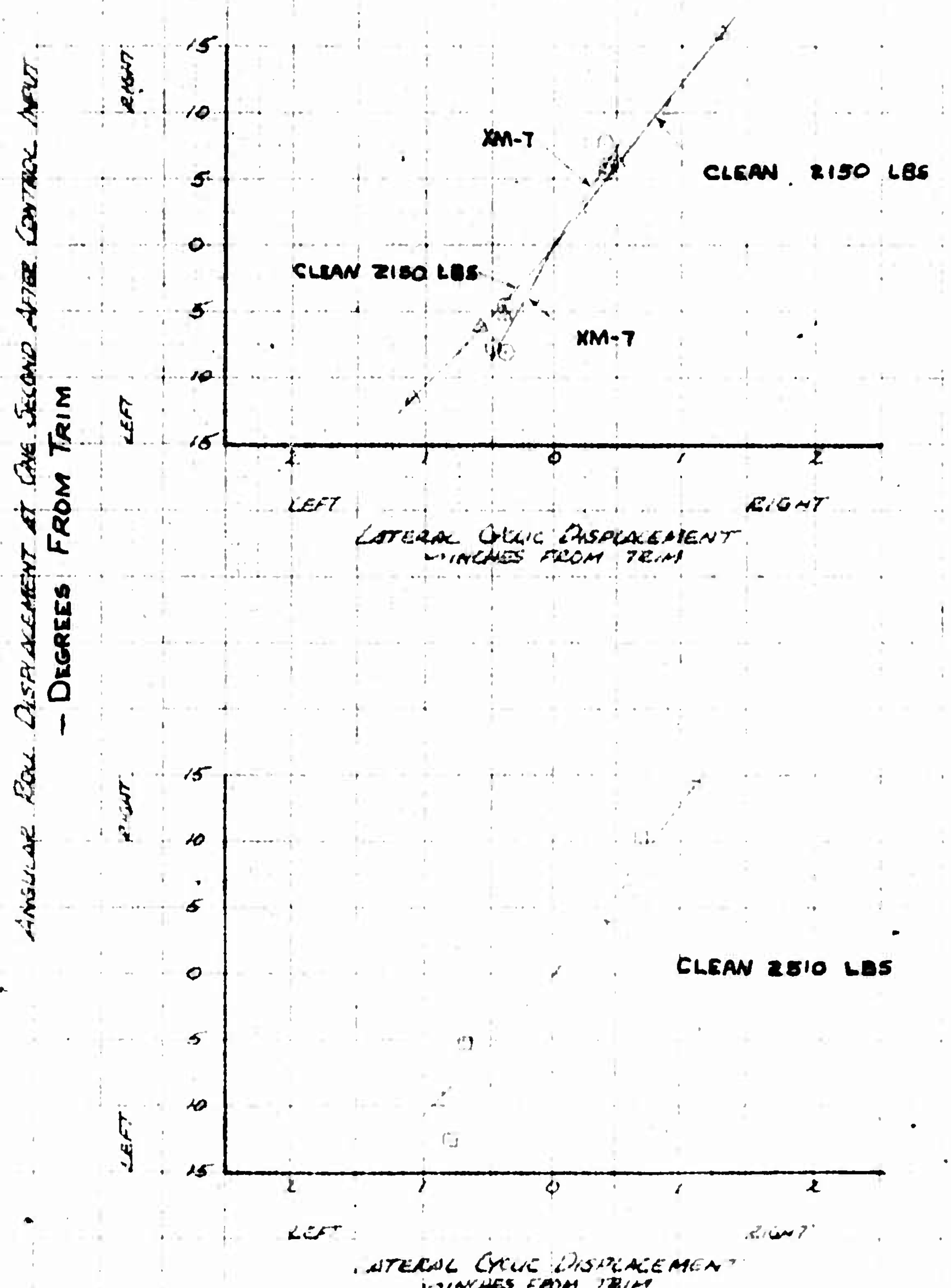
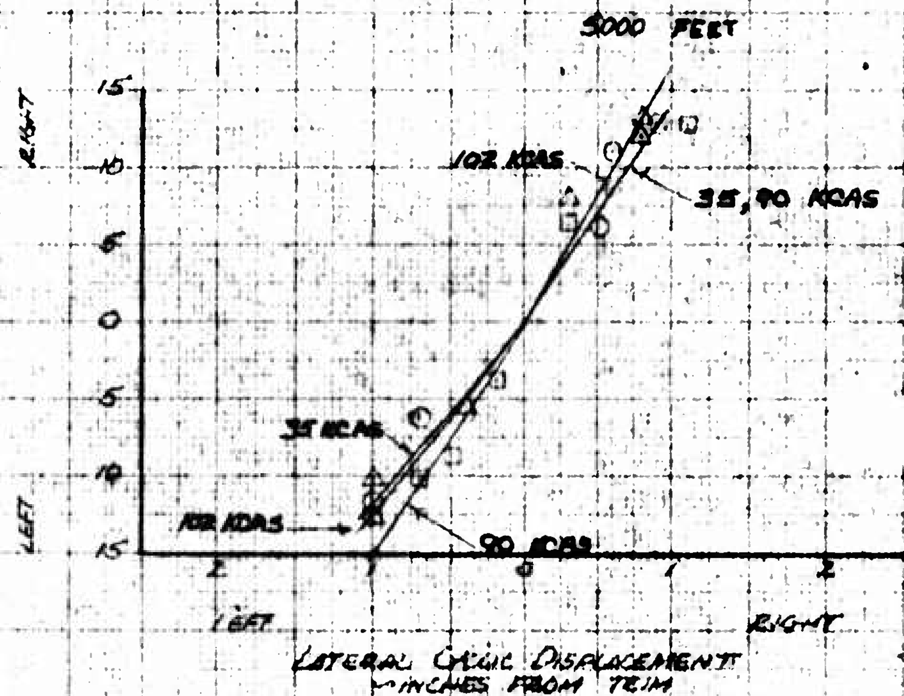


FIGURE NO 182
ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT
□	90	5000	2080	103.5	.5RT	465	CLEAN	LEVEL FLT
△	102	5000	2150	103.5	.5RT	465	CLEAN	LEVEL FLT
○	35	10000	2130	103.5	.5RT	465	CLEAN	LEVEL FLT
□	71	10000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT
△	89	10000	2070	103.5	.6RT	465	CLEAN	LEVEL FLT

ANGULAR ROLL DISPLACEMENT AT ONE SECOND AFTER CONTROL INPUT ~DEGREES FROM TRIM



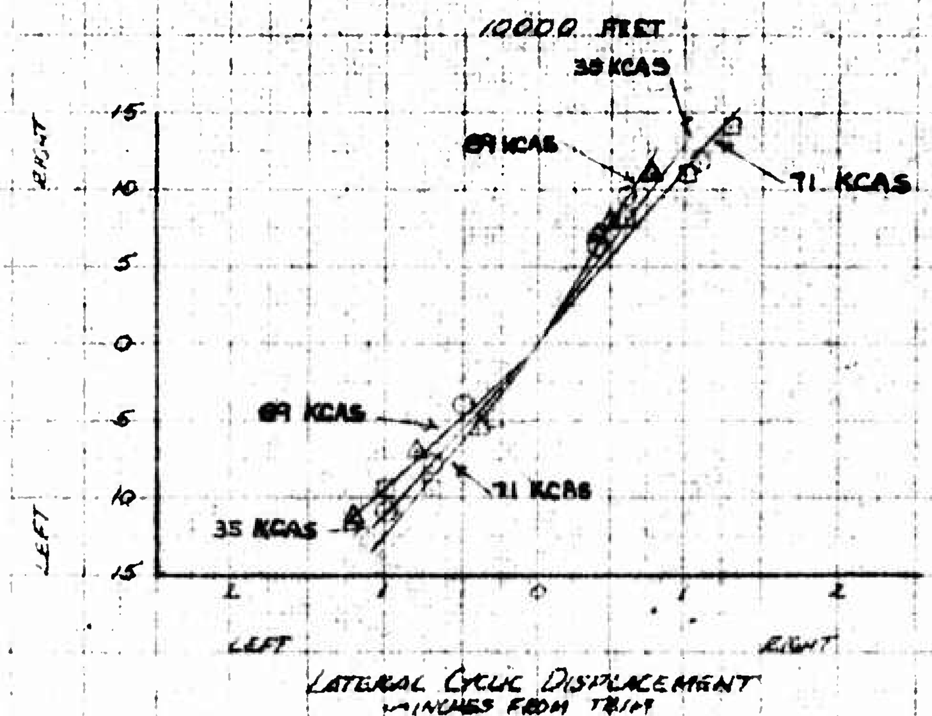


FIGURE NO 183
ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2180	103.5	.5rt	465	CLEAN	AUTOROTATION
□	55	5000	2160	103.5	.5rt	465	CLEAN	CLIMB
◇	64	10000	2160	103.5	.5rt	465	CLEAN	AUTOROTATION
△	64	10000	2140	103.5	.5rt	465	CLEAN	CLIMB

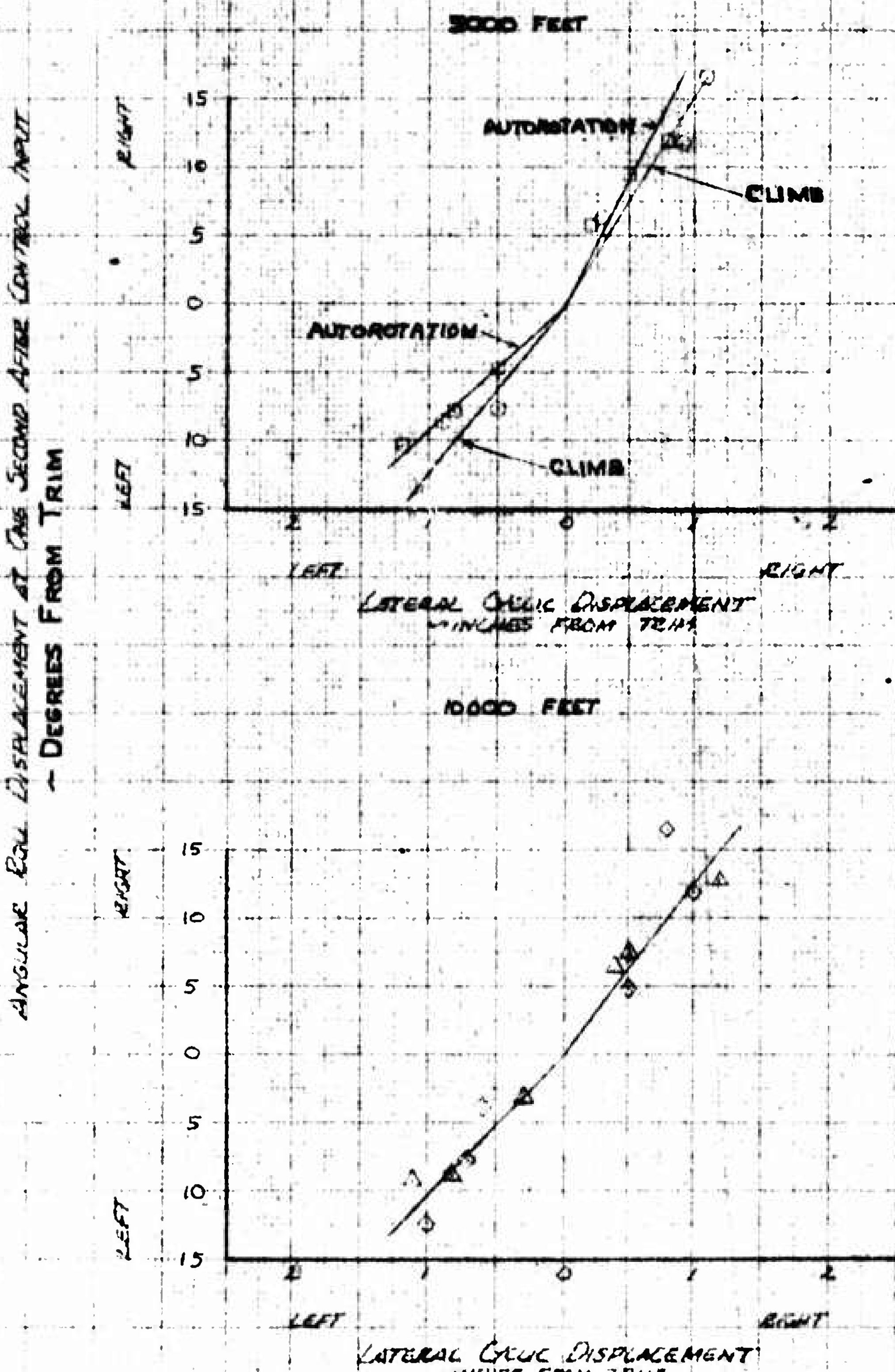


FIGURE NO 184
ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2650	103.5	5 RT	465	CLEAN	LEVEL FLT
□	69	5000	2600	103.5	5 RT	466	CLEAN	LEVEL FLT
◇	86	5000	2650	103.5	5 RT	465	CLEAN	LEVEL FLT
◇	65	5000	2680	103.5	5 RT	465	CLEAN	CLIMB
D	55	5000	2520	103.5	5 RT	465	CLEAN	AUTOROTATION

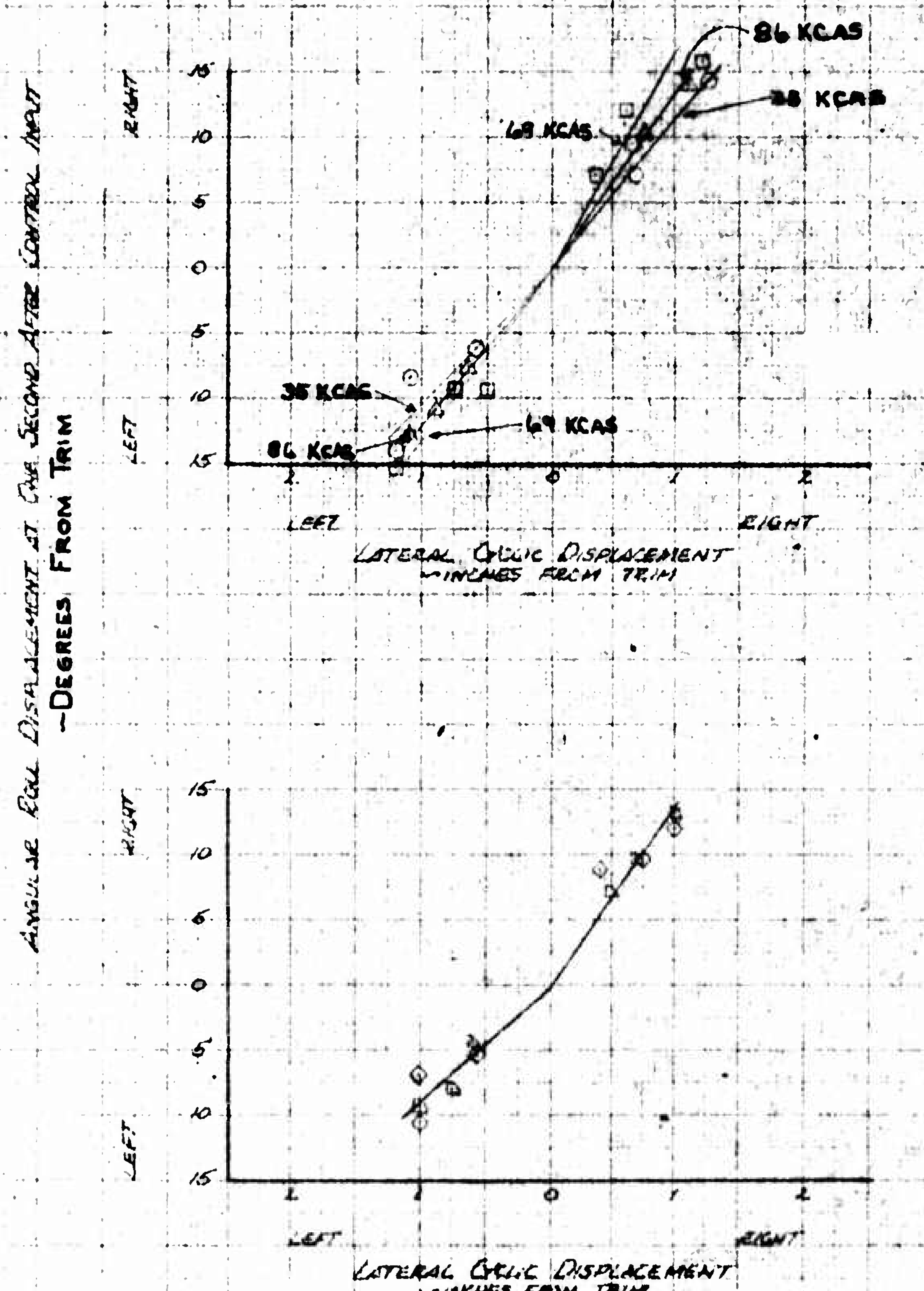


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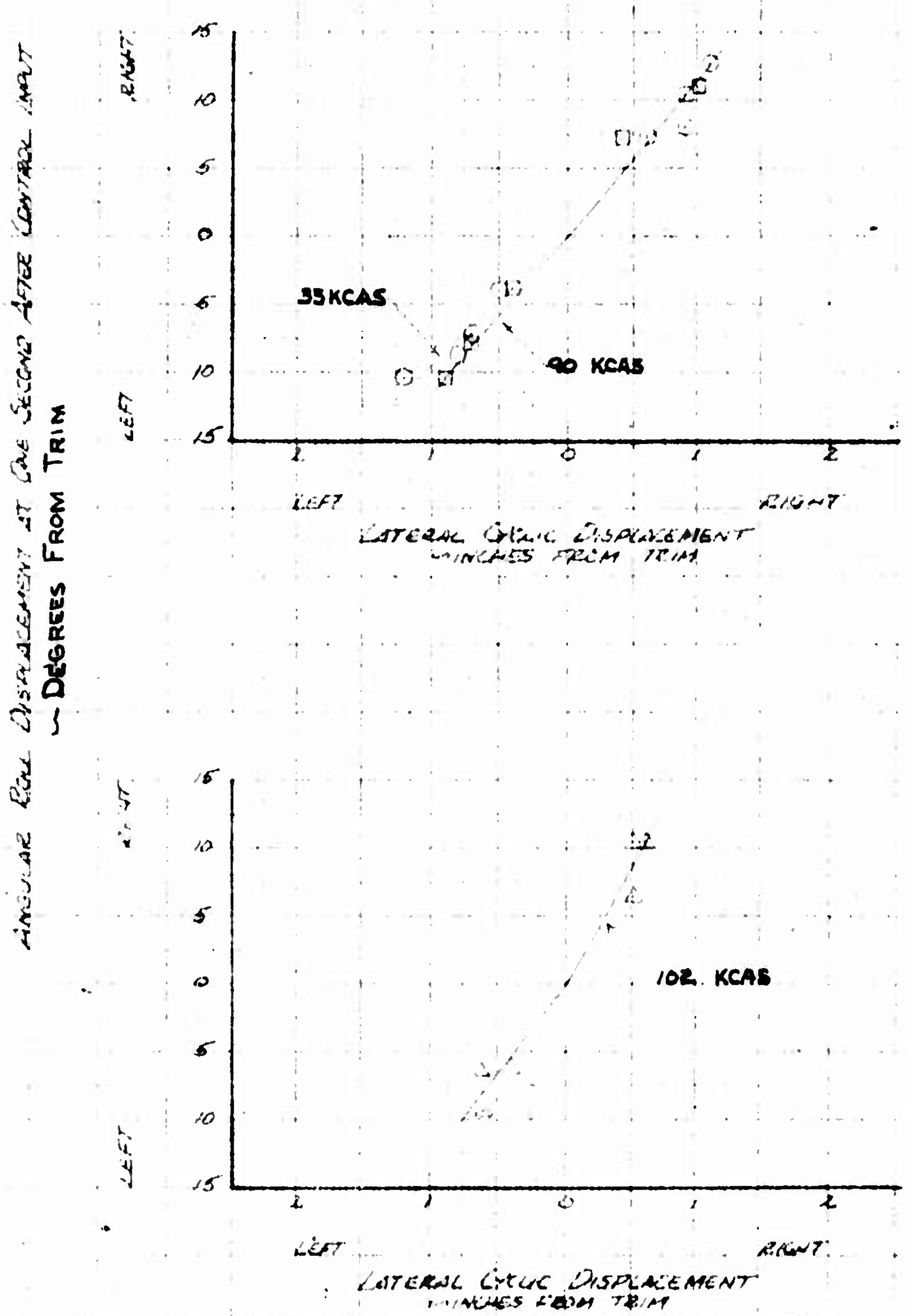
FIGURE NO 185
ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2110	103.5	.5Rt	465	XM-7	LEVEL FLT
□	90	5000	2140	103.5	.5Rt	465	XM-7	LEVEL FLT
△	102	5000	2070	103.5	.5Rt	465	XM-7	LEVEL FLT



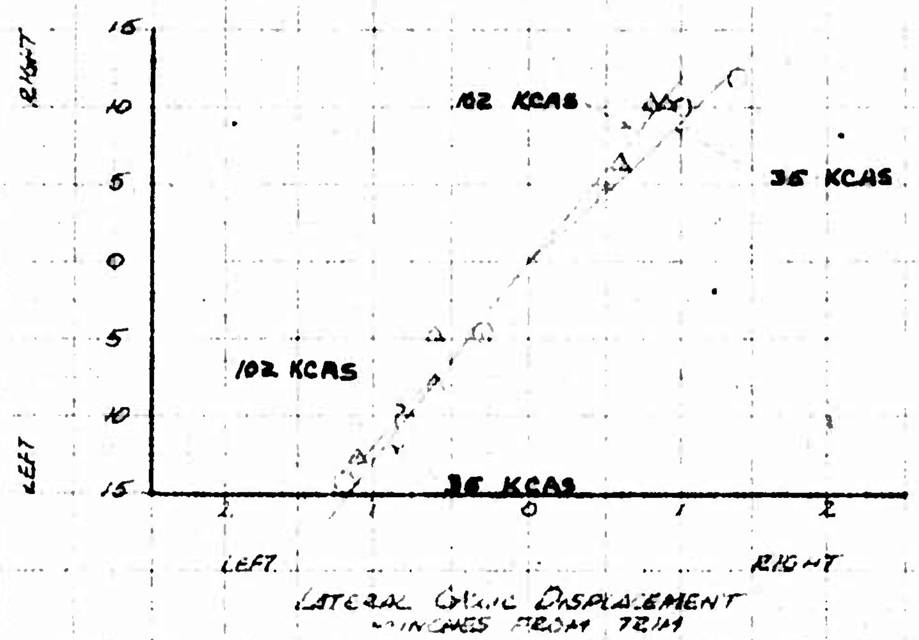
FOR OFFICIAL USE ONLY

FIGURE No 186

ANGULAR ROLL DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG HD ~FT	AVG GW ~LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2150	103.3	2.89 LT	465	XM-8	LEVEL FLT
□	90	5000	2100	103.3	2.89 LT	465	XM-8	LEVEL FLT
△	102	6000	2100	103.3	2.89 LT	465	XM-8	LEVEL FLT

ANGULAR ROLL DISPLACEMENT AT ONE SECOND AFTER CONTROL INPUT ~DEGREES FROM TRIM



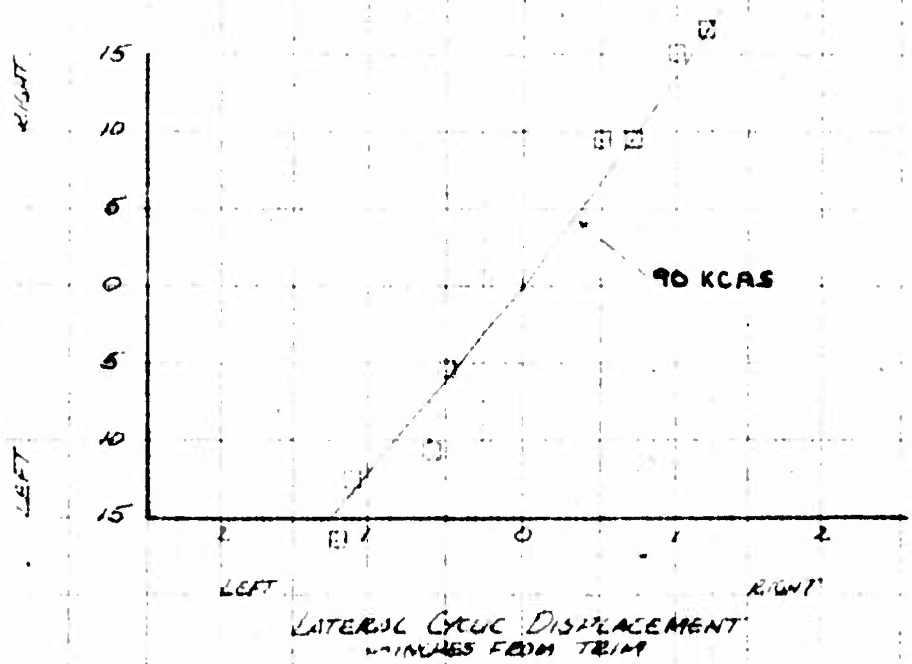


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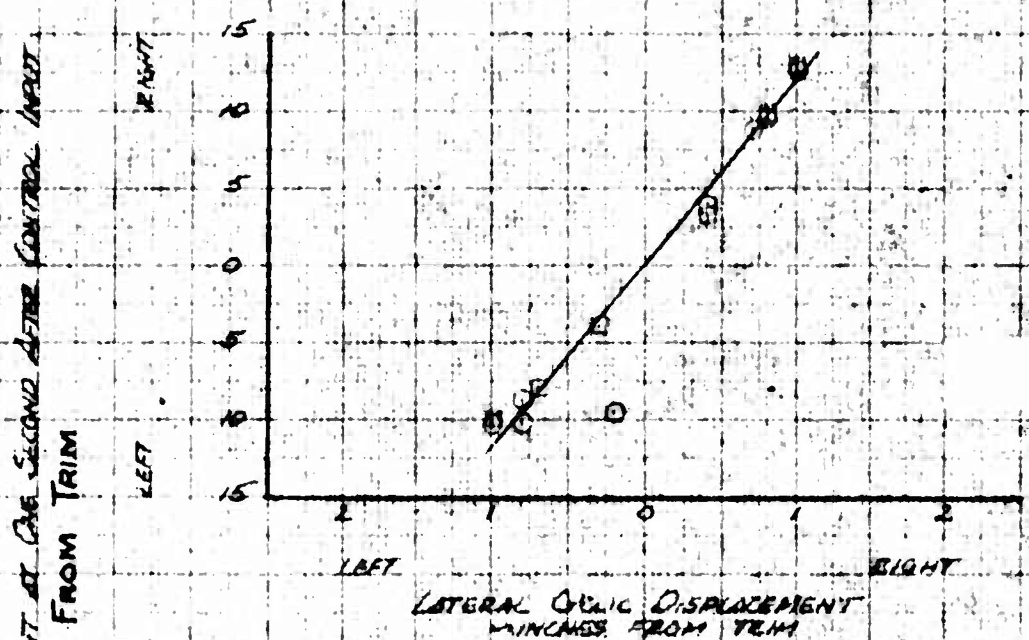
Figure No 187
Angular Roll Displacement
OH-6A USA S/N 62-4214

Sym	Airspeed ~CAS	Avg Hp ~FT	Avg GW ~LB	Avg CG ~IN Long	Avg CG ~IN Lat	Rotor RPM	Configuration	FLT Cond
○	56	5000	2100	103.5	.5RT	465	XM-7	CLIMB
□	55	5000	2080	103.5	.5RT	466	XM-8	CLIMB
△	55	5000	2180	103.3	2.86 LT	465	XM-7	AUTOROTATION
◇	55	5000	2090	103.3	2.86 LT	466	XM-8	AUTOROTATION

Climb



Autorotation

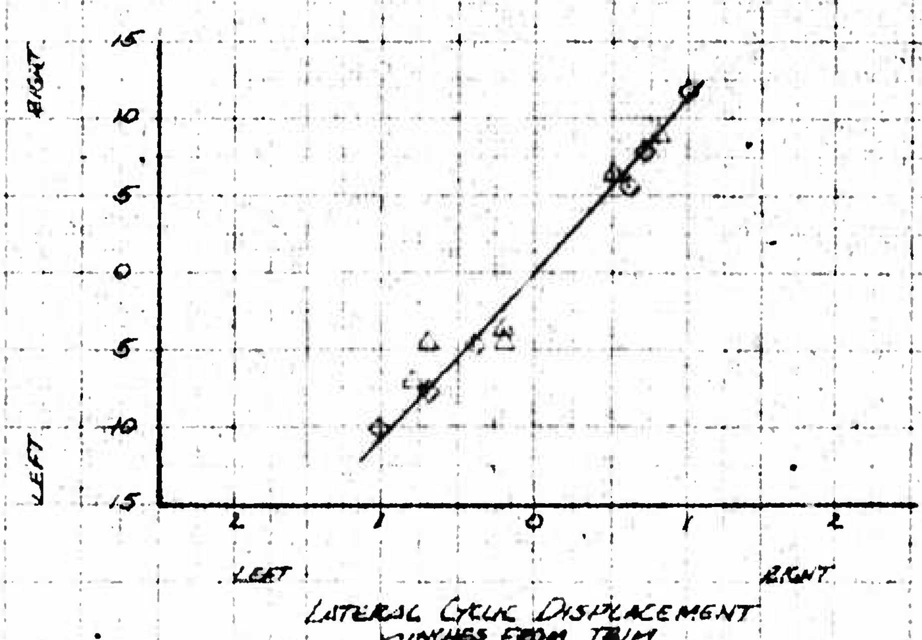


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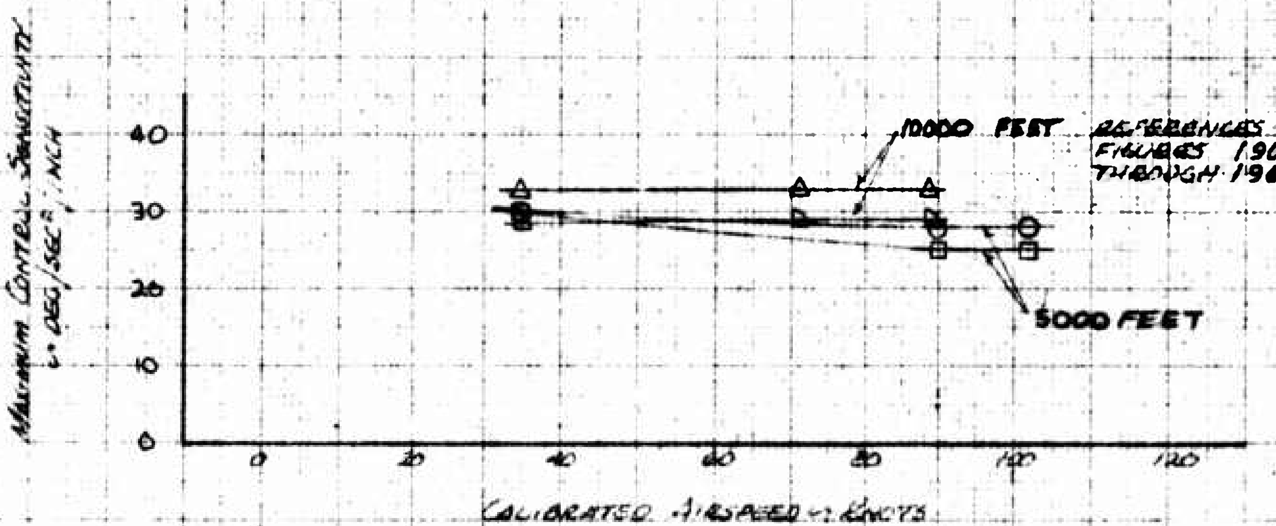
FIGURE No 189

SUMMARY OF DIRECTIONAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	□	5000	2100	103.5	.5RT	465	CLEAN	LEVEL FLT.
▷	△	10000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT.



SYM RT	SYM LT	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	□	5000	2630	103.5	.5RT	465	CLEAN	LEVEL FLT

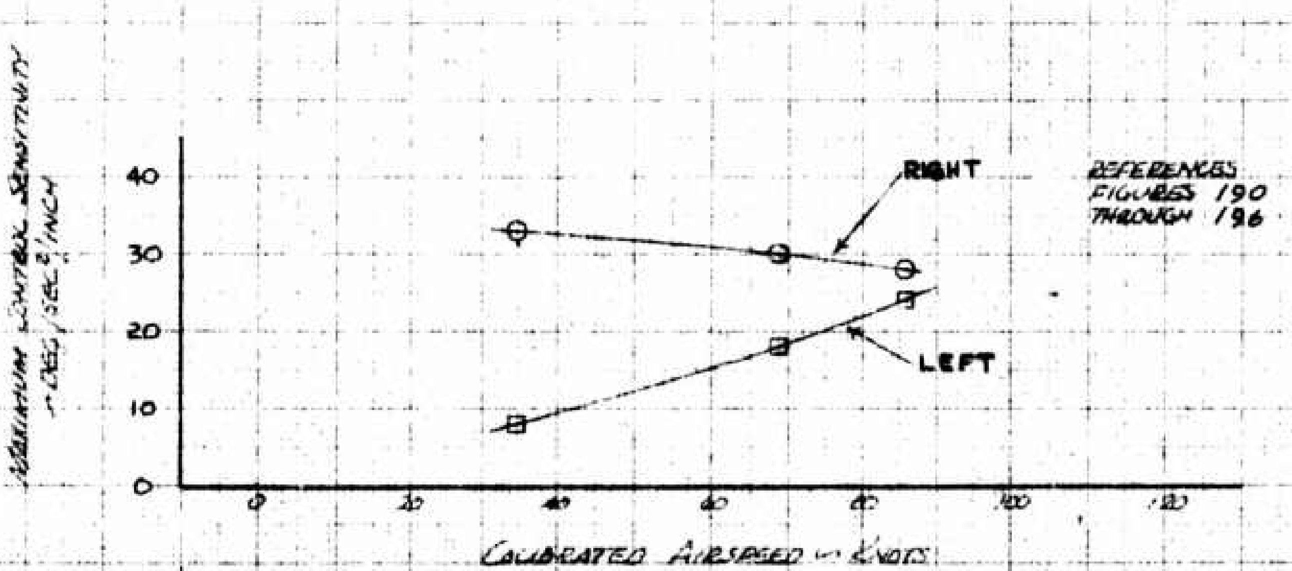
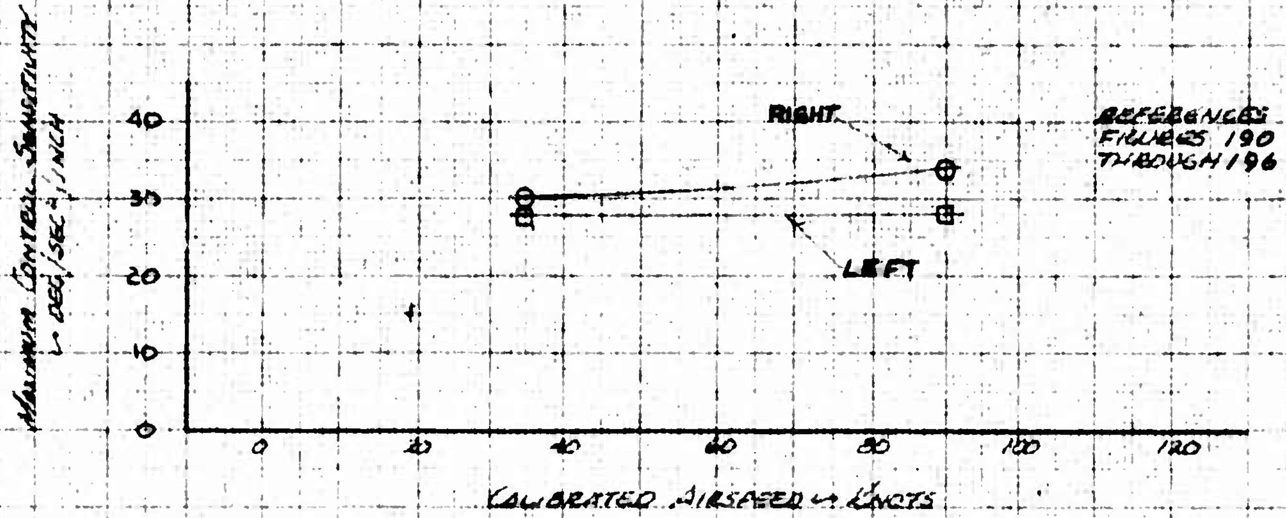


FIGURE NO 189

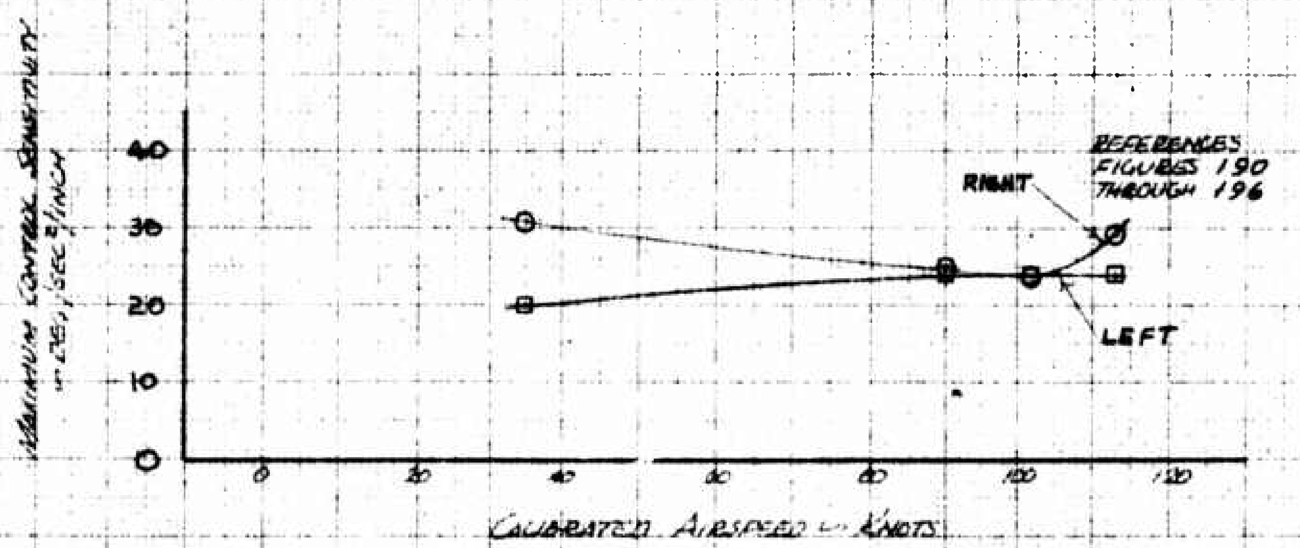
SUMMARY OF DIRECTIONAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM		AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT. O	LT □	5000	2140	103.3	2.86 LT	465	XM-8	LEVEL FLT



SYM		AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT. O	LT □	5000	2140	103.5	.5 RT	465	XM-7	LEVEL FLT



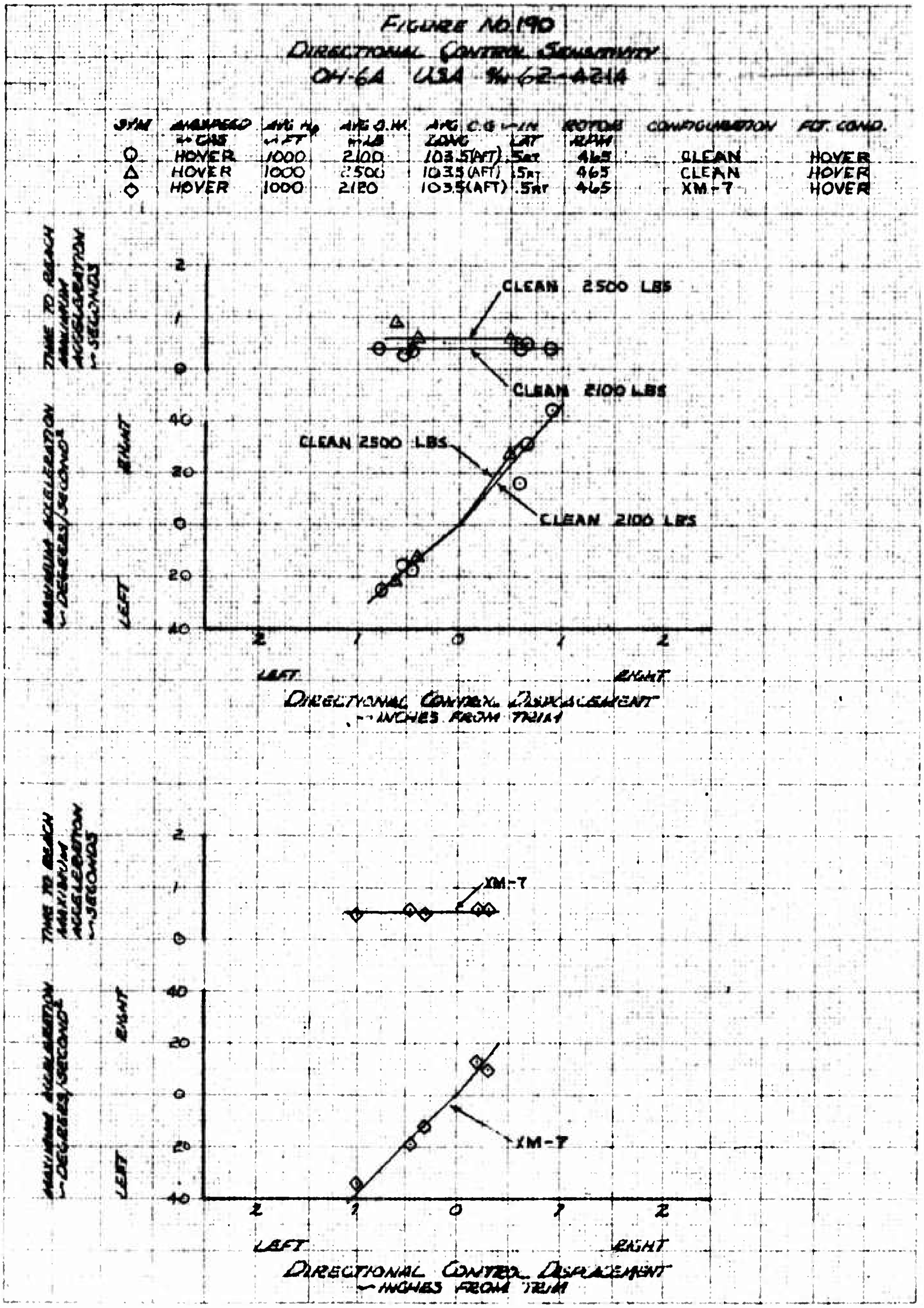


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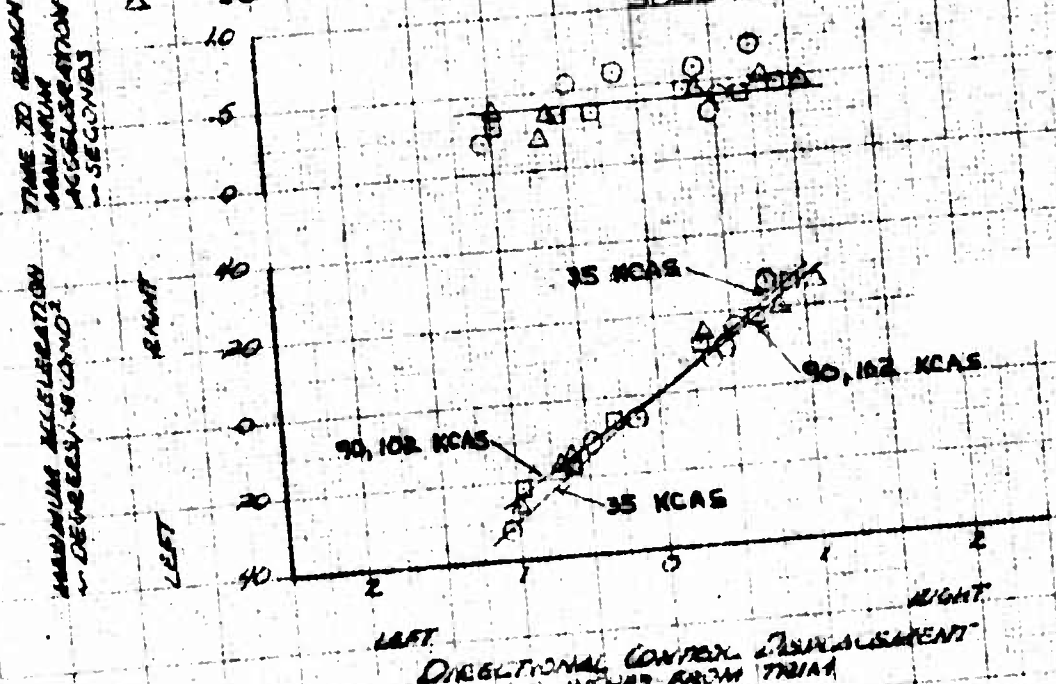
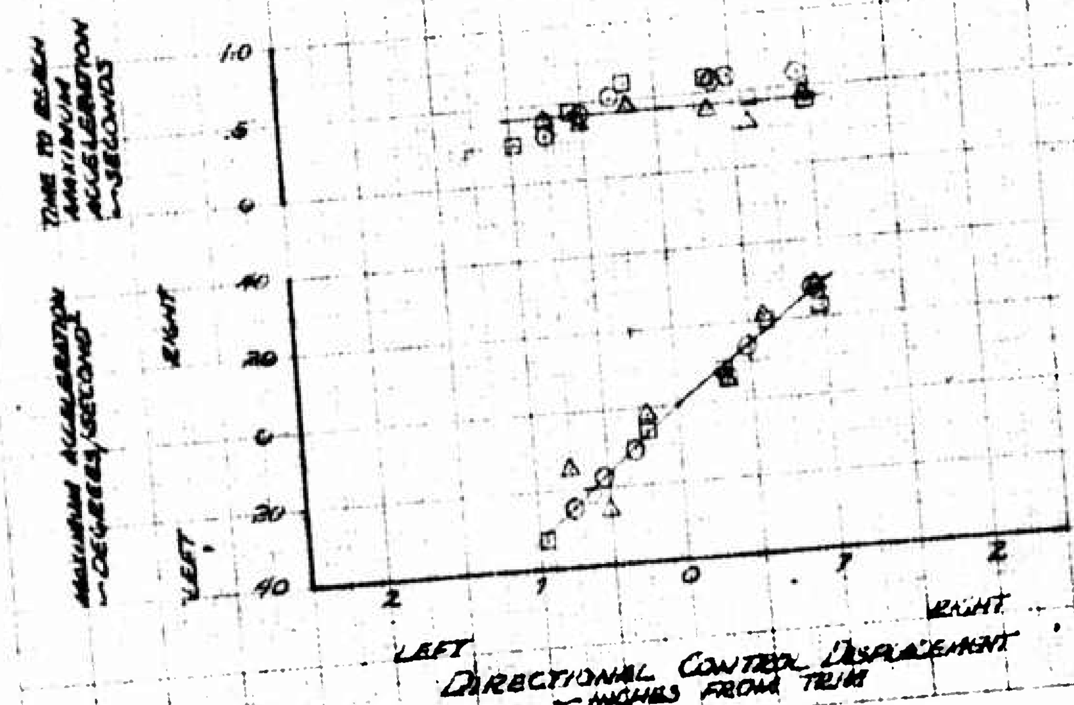
FIGURE NO. 191
DIRECTIONAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	5000	2130	103.5	.5RT	465	CLEAN	LEVEL FLT
□	90	5000	2100	103.5	.5RT	465	CLEAN	LEVEL FLT
△	102	5000	2070	103.5	.5RT	465	CLEAN	LEVEL FLT
⊙	35	10000	2140	103.5	.5RT	465	CLEAN	LEVEL FLT
⊡	71	10000	2120	103.5	.5RT	465	CLEAN	LEVEL FLT
⧊	85	10000	2090	103.5	.5RT	466	CLEAN	LEVEL FLT

5000 FEET



10000 FEET



FOR OFFICIAL USE ONLY

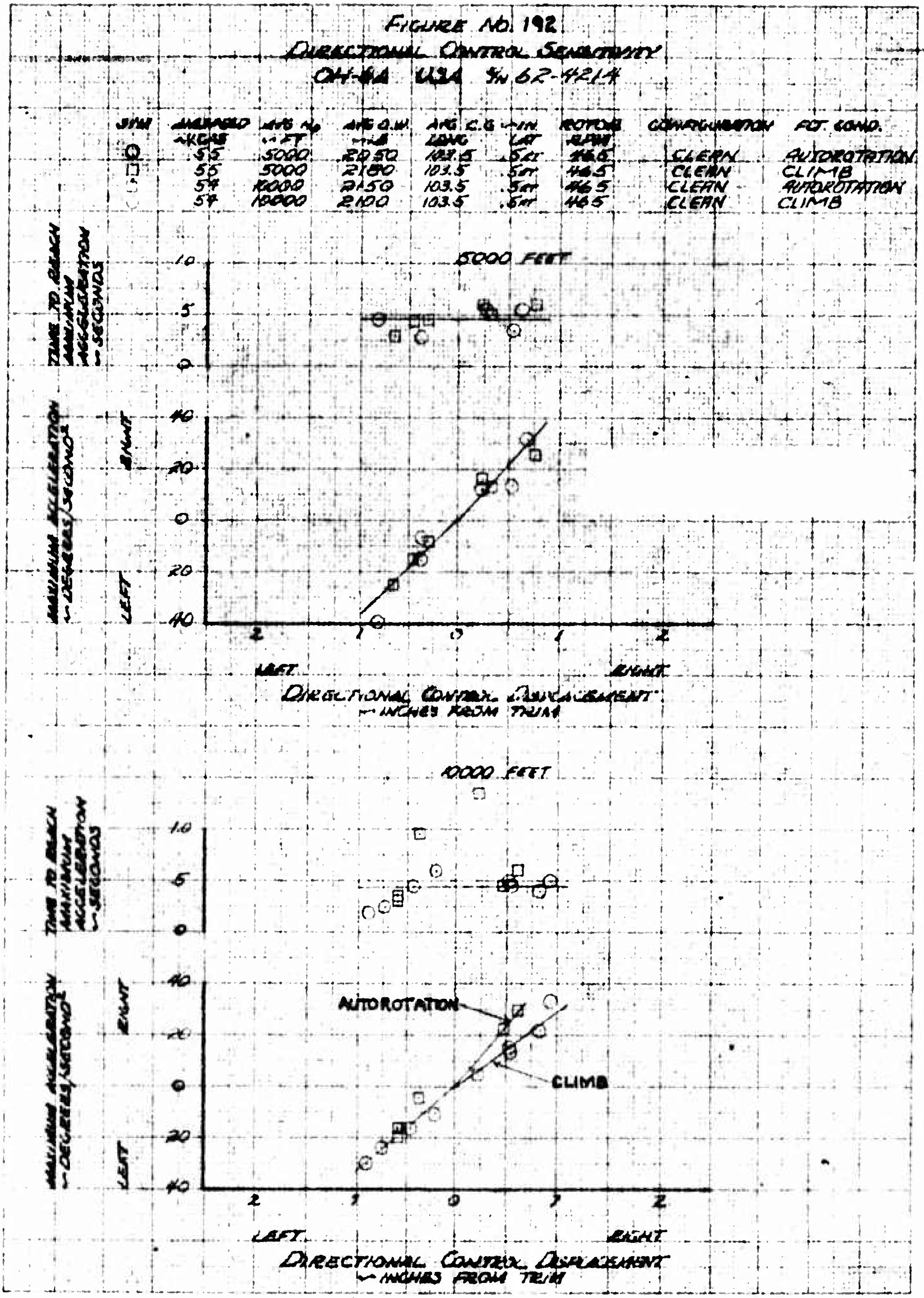


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FIGURE NO. 193

DIRECTIONAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~ KCAS	AVG H_p ~ FT	AVG G.W. ~ LB	AVG C.G. ~ IN LONG	AVG C.G. ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	5000	2670	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLT
□	69	5000	2630	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLT
△	86	5000	2570	103.5 (AFT)	.5 RT	465	CLEAN	LEVEL FLT
⊙	55	5000	2700	103.5 (AFT)	.5 RT	466	CLEAN	CLIMB
⊡	55	5000	2680	103.5 (AFT)	.5 RT	[illegible]	CLEAN	AUTOROTATION

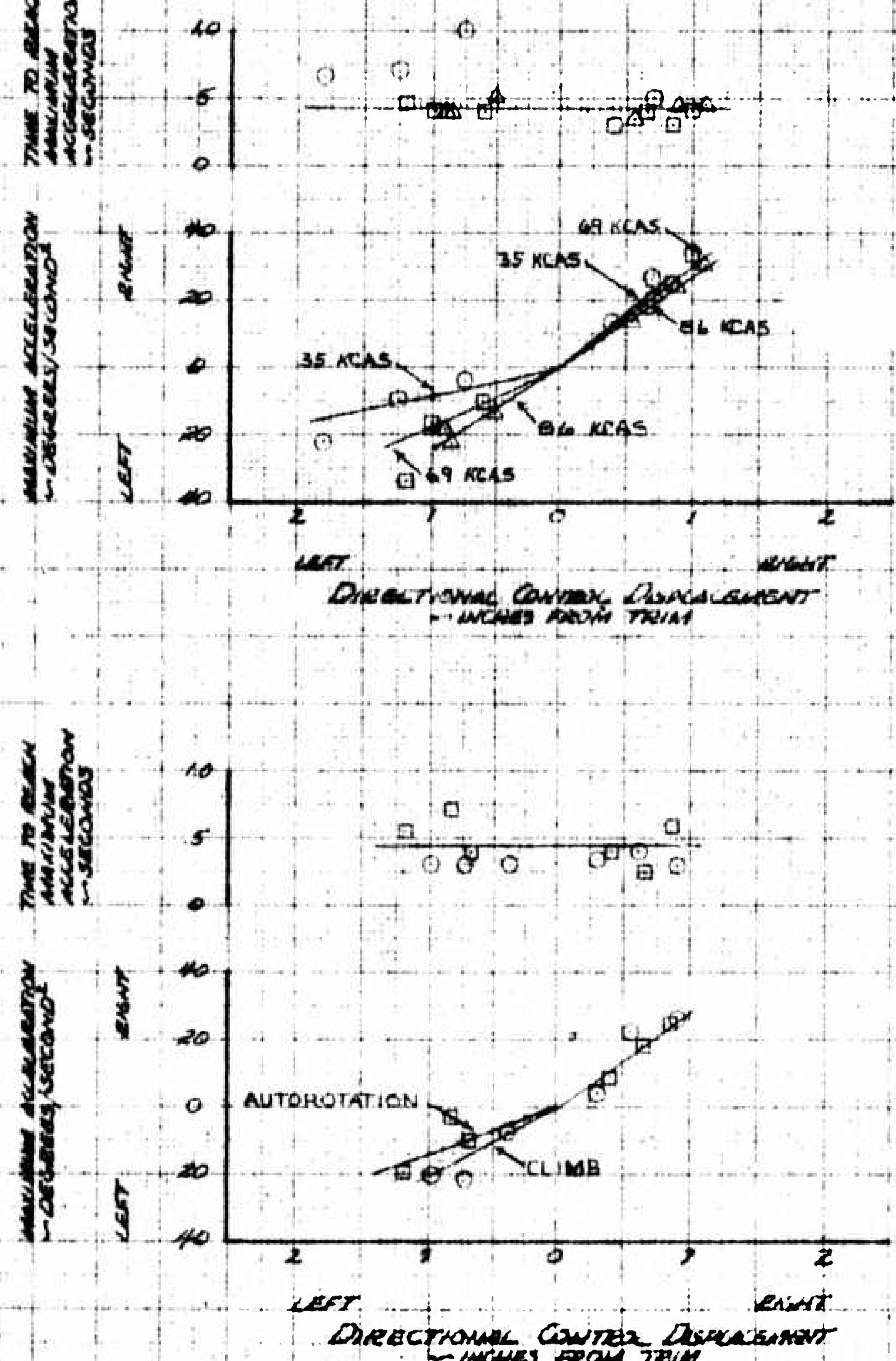

FIGURE NO. 194

DIRECTIONAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	5000	2170	103.5	.5 RT	466	XM-7	LEVEL FLT
□	90	5000	2150	103.5	.5 RT	465	XM-7	LEVEL FLT
◇	102	5000	2060	103.5	.5 RT	465	XM-7	LEVEL FLT
△	113	5000	2130	103.5	.5 RT	465	XM-7	LEVEL FLT

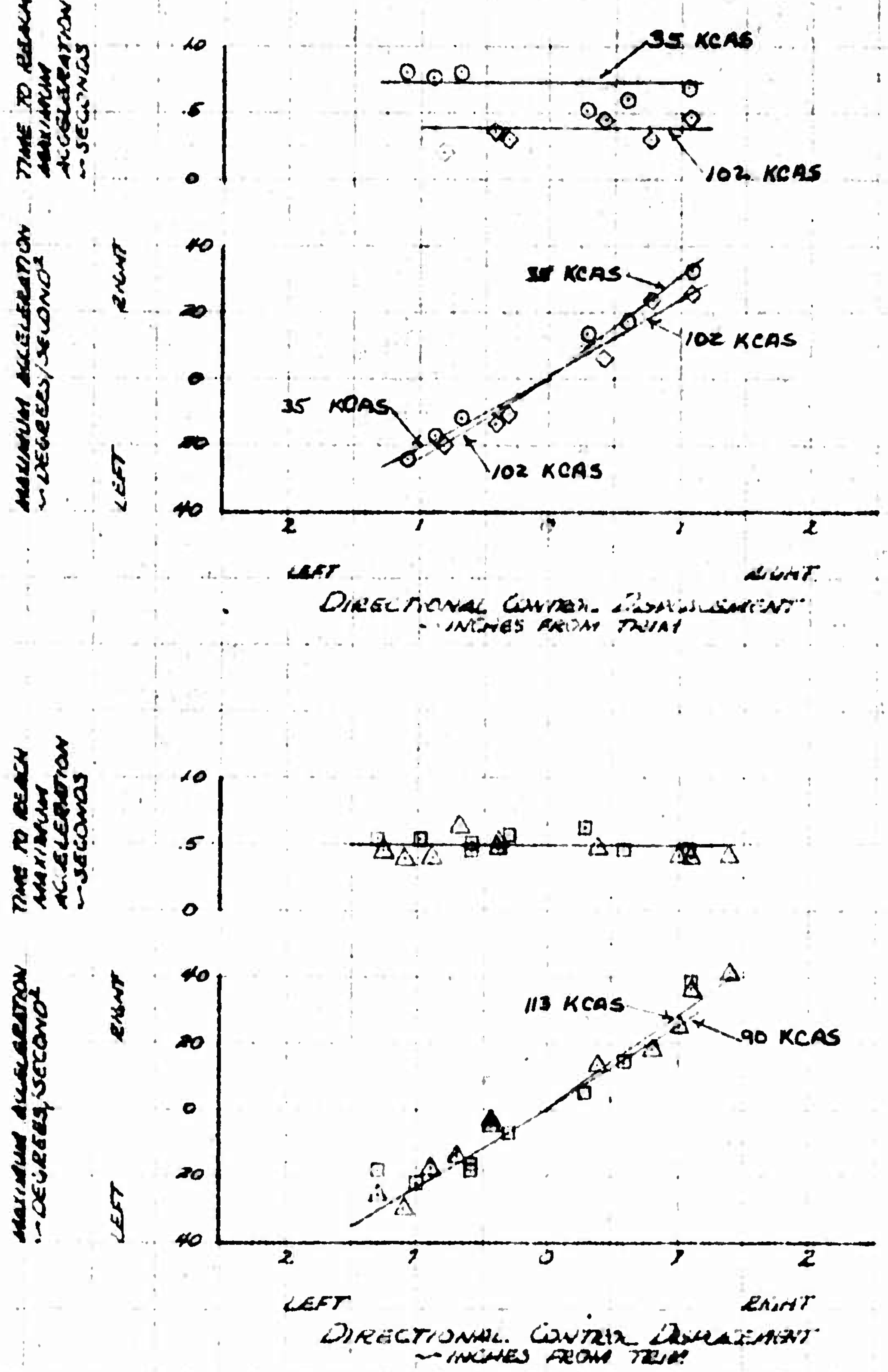

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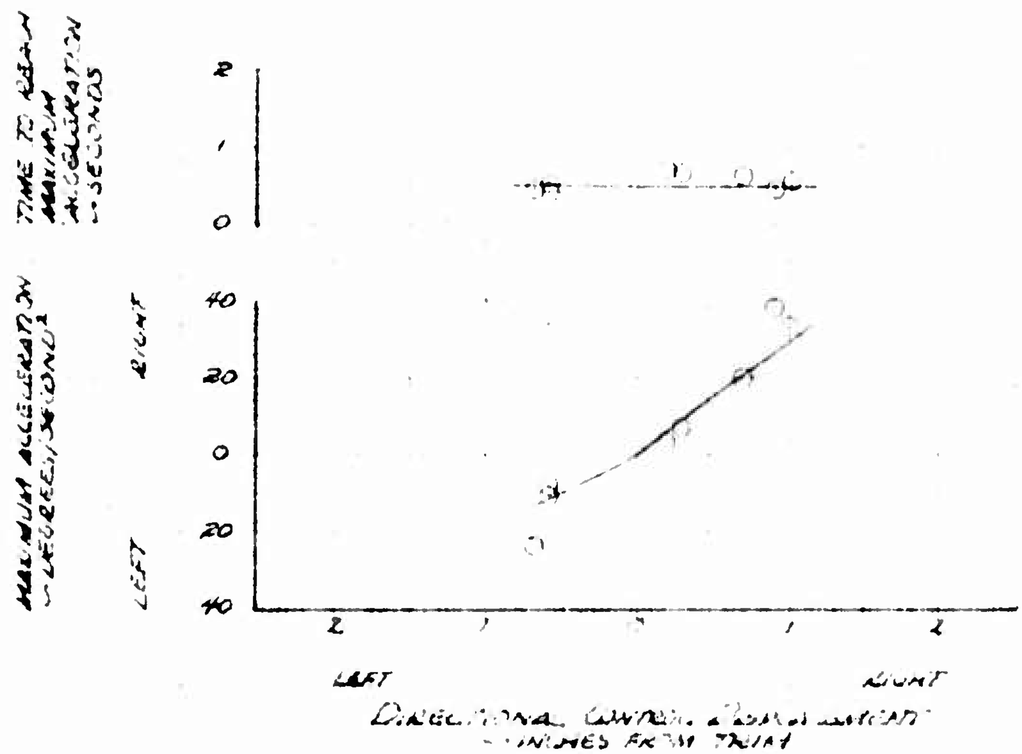
FIGURE NO. 195

DIRECTIONAL CONTROL SENSITIVITY

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~CAS	AVG ALT ~FT	AVG GW ~LB	AVG C.G. LONG	C.G. LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	56	5000	2140	103.5	.5 RT	465	XM-7	CLIMB
△	55	5000	2120	103.5	.5 RT	465	XM-7	AUTOROTATION



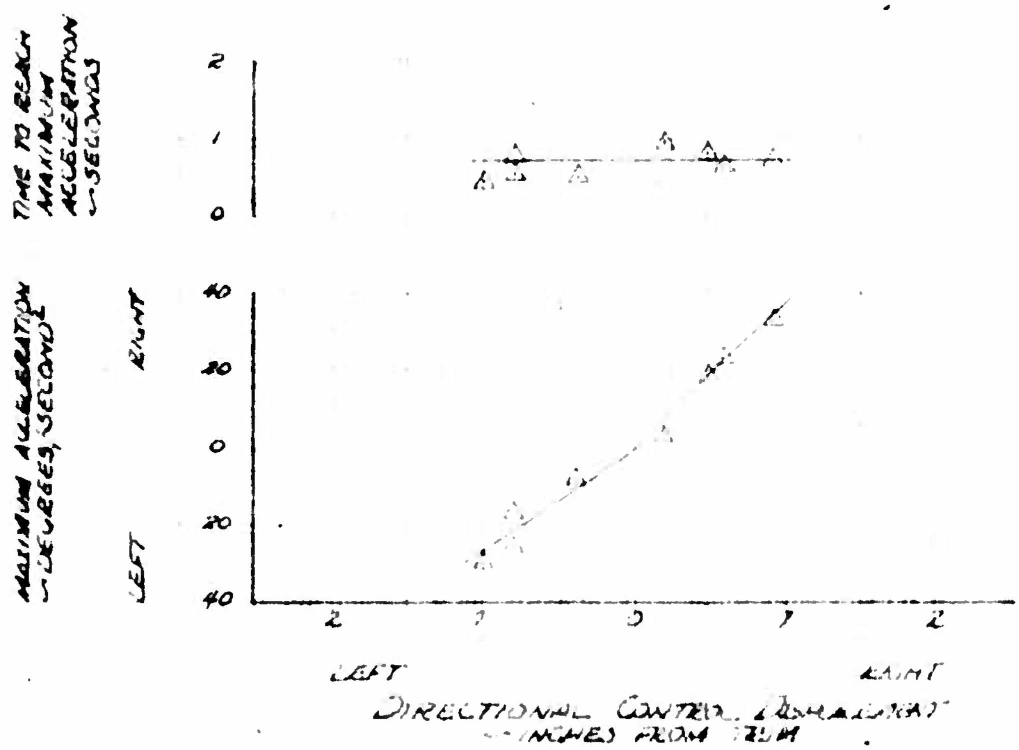


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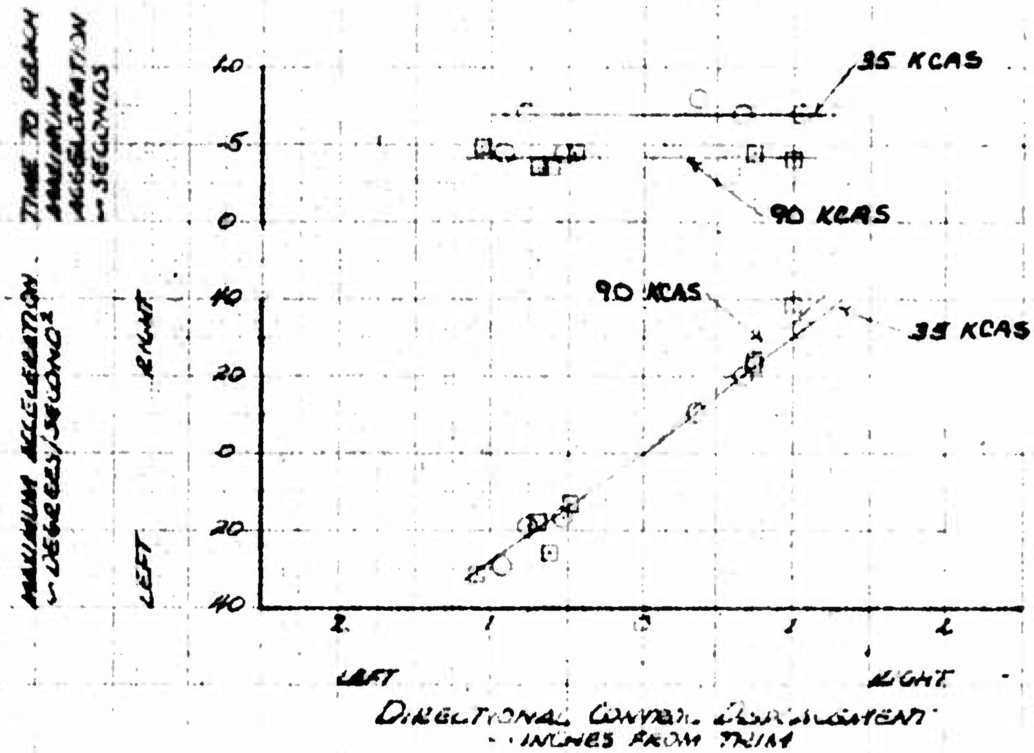
FIGURE NO. 196
DIRECTIONAL CONTROL SENSITIVITY
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	5000	2160	103.3	2.86 LT	465	XM-8	LEVEL FLT
□	90	5000	2120	103.3	2.86 LT	465	XM-8	LEVEL FLT
◇	55	5000	2090	103.3	2.86 LT	466	XM-8	CLIMB
▷	55	5000	2060	103.3	2.86 LT	465	XM-8	AUTOROTATION



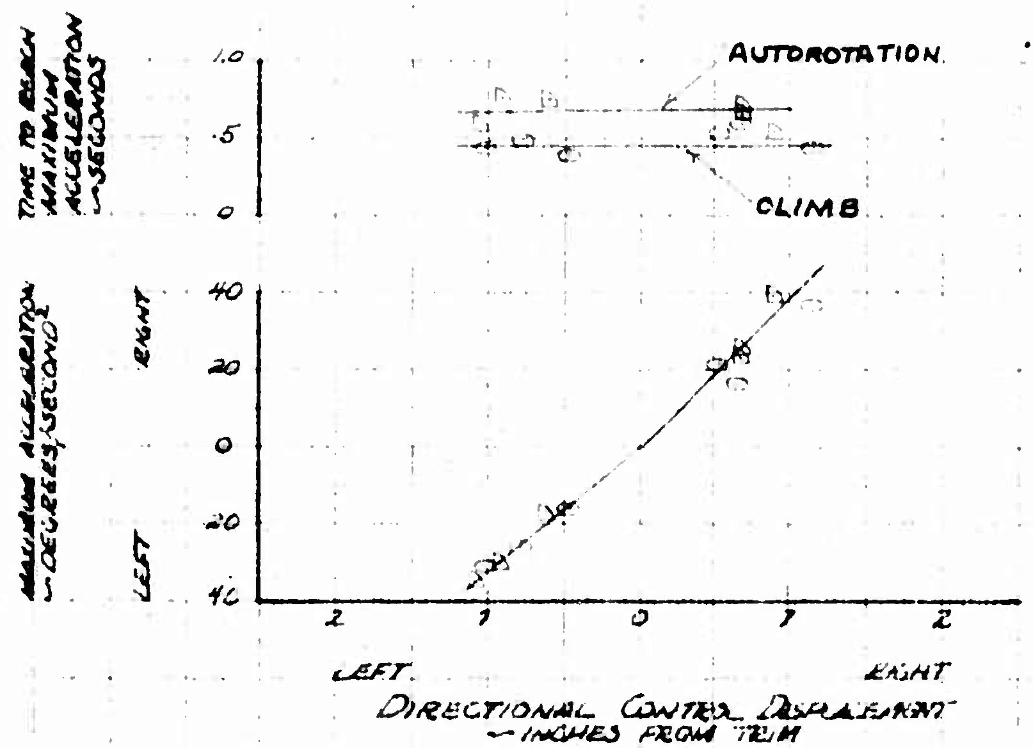
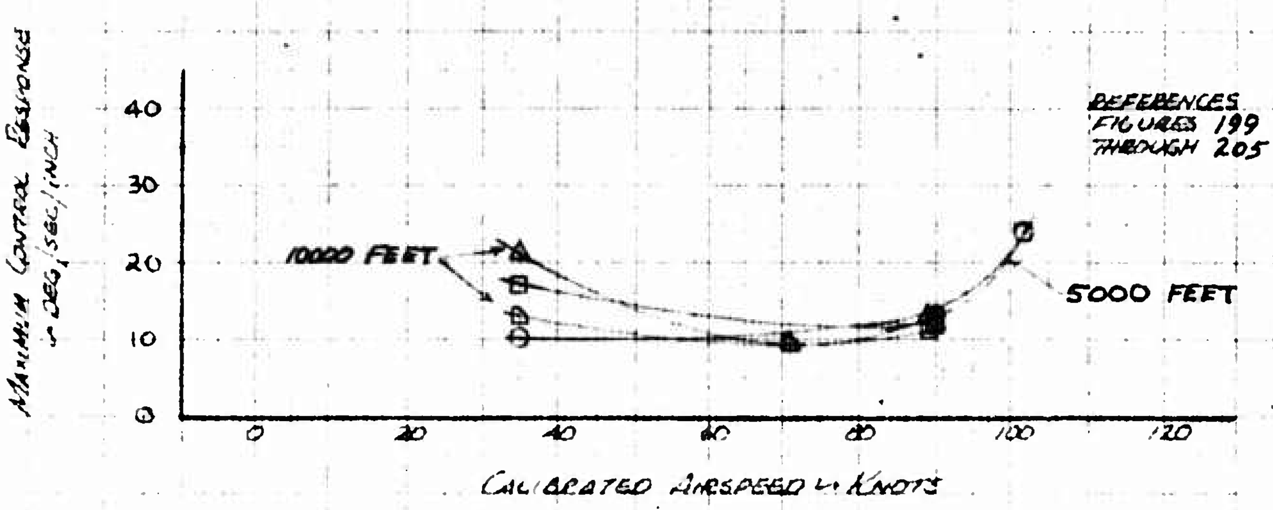


FIGURE NO 197
SUMMARY OF DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AVG H_D ~FT	AVG G.W. ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
RT ○ LT □	5000	2100	103.5	.5RT	465	CLEAN	LEVEL FLT.
RT △ LT ◇	10000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT.



SYM	AVG H_D ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	AVG C.G. ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
RT ○ LT □	5000	2630	103.5	.5RT	465	CLEAN	LEVEL FLT.

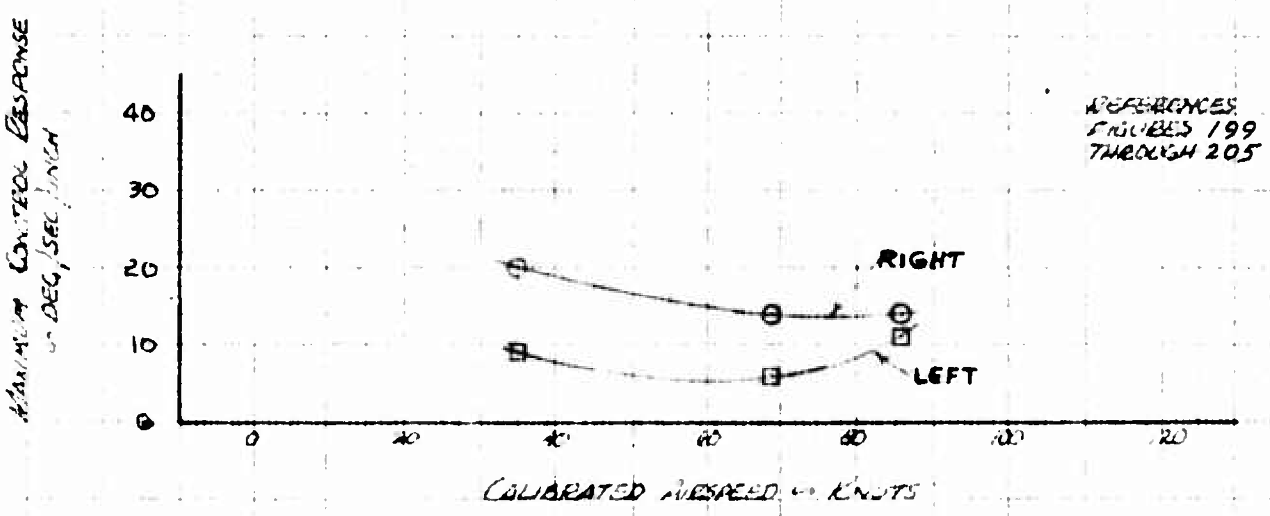
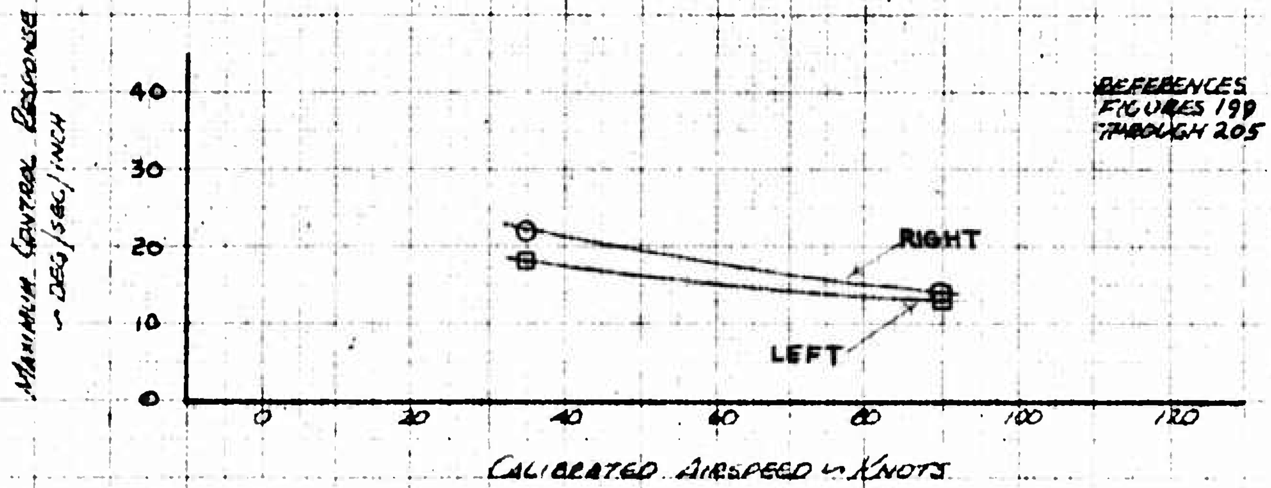


FIGURE NO 198
SUMMARY OF DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT ○ LT □	5000	2140	103.3	2.86 LT	465	XM-8	LEVEL FLT



SYM	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT ○ LT □	5000	2140	103.5	.5 RT	465	XM-7	LEVEL FLT

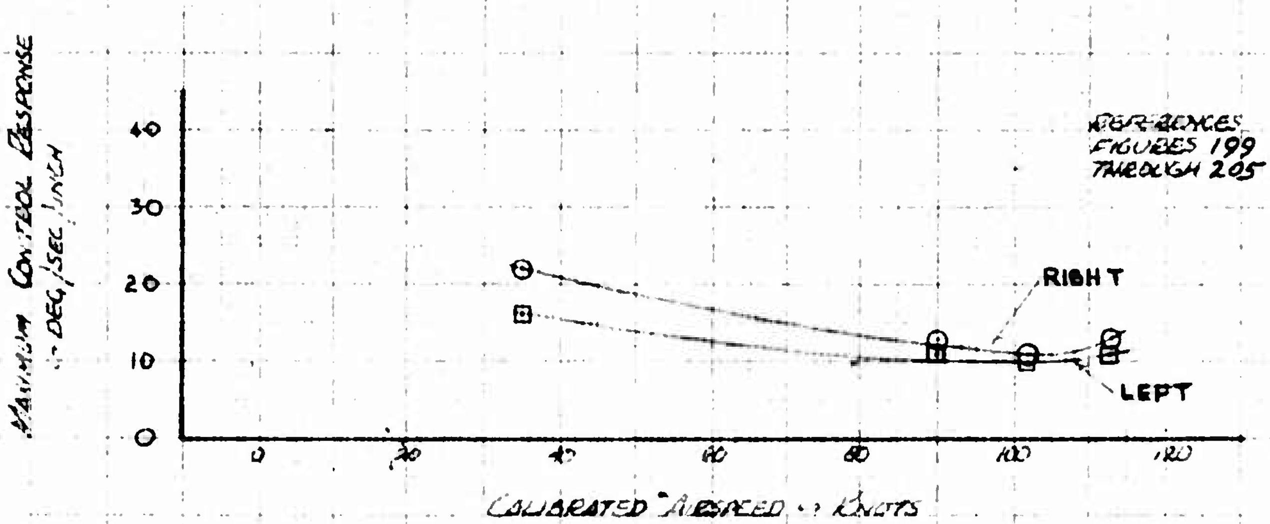
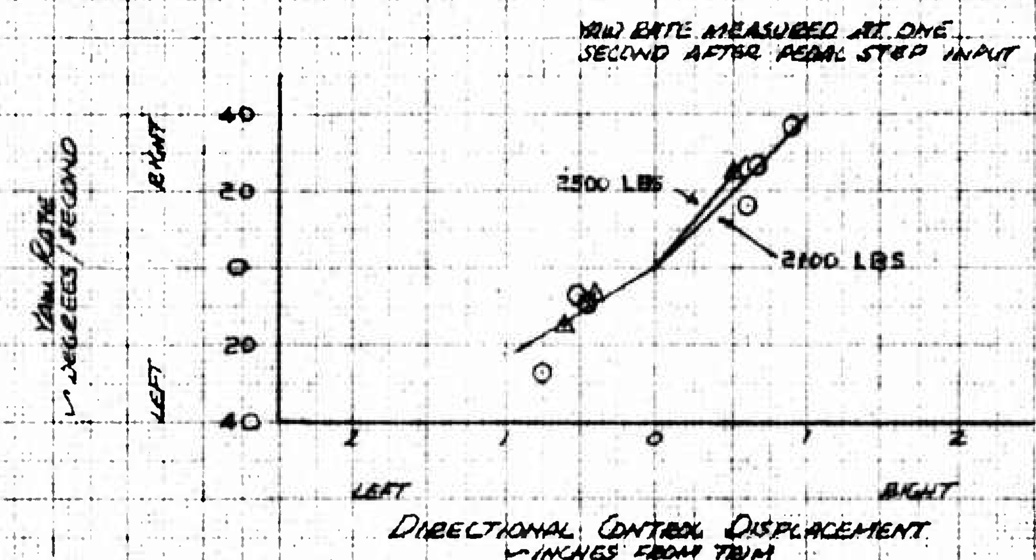


FIGURE No 199
DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_P ~FT	AVG G.W ~LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	HOVER	1000	2100	103.5(AFT)	.5RT	469	CLEAN	HOVER
△	HOVER	1000	2500	103.5(AFT)	.5RT	465	CLEAN	HOVER
◇	HOVER	1000	2120	103.5(AFT)	.5RT	465	XM-7	HOVER



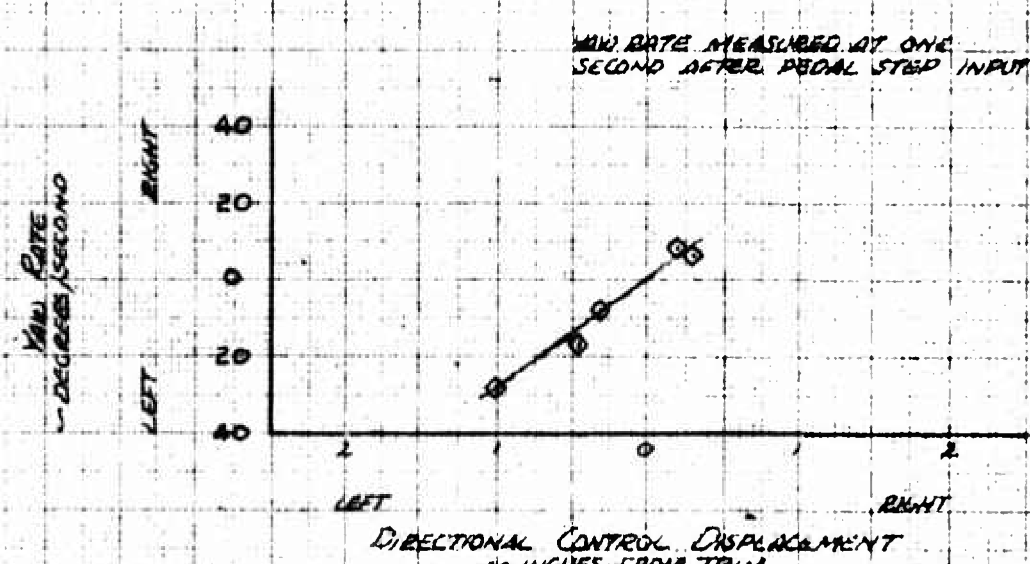


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FIGURE NO 200
DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	[illegible]	2130	103.5	.5 RT	465	CLEAN	LEVEL FLT
□	90	[illegible]	2100	103.5	.5 RT	465	CLEAN	LEVEL FLT
△	102	[illegible]	2090	103.5	.5 RT	465	CLEAN	LEVEL FLT
○	35	[illegible]	2140	103.5	.5 RT	465	CLEAN	LEVEL FLT
□	71	[illegible]	2120	103.5	.5 RT	465	CLEAN	LEVEL FLT
△	89	[illegible]	2090	103.5	.5 RT	465	CLEAN	LEVEL FLT

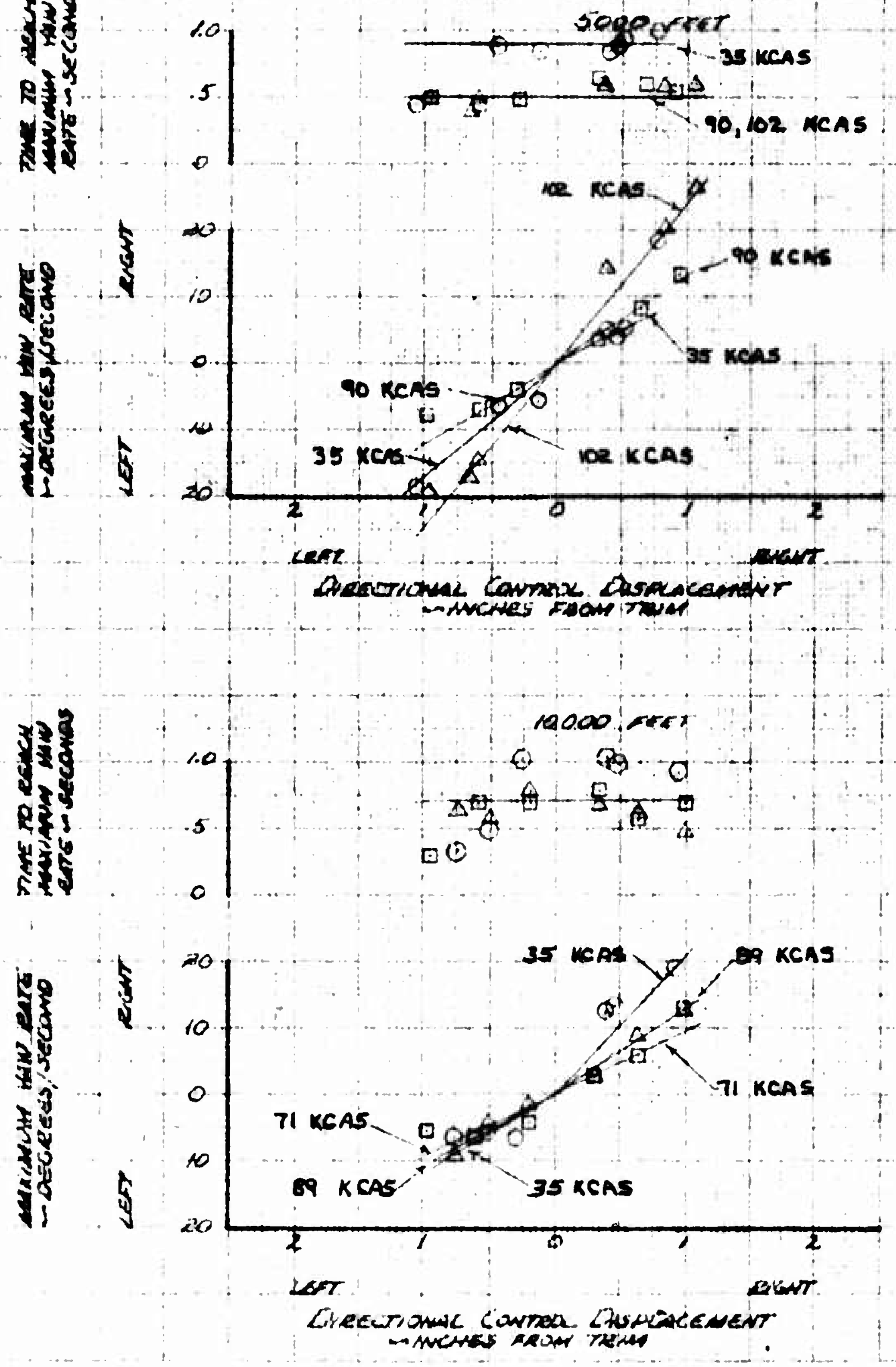
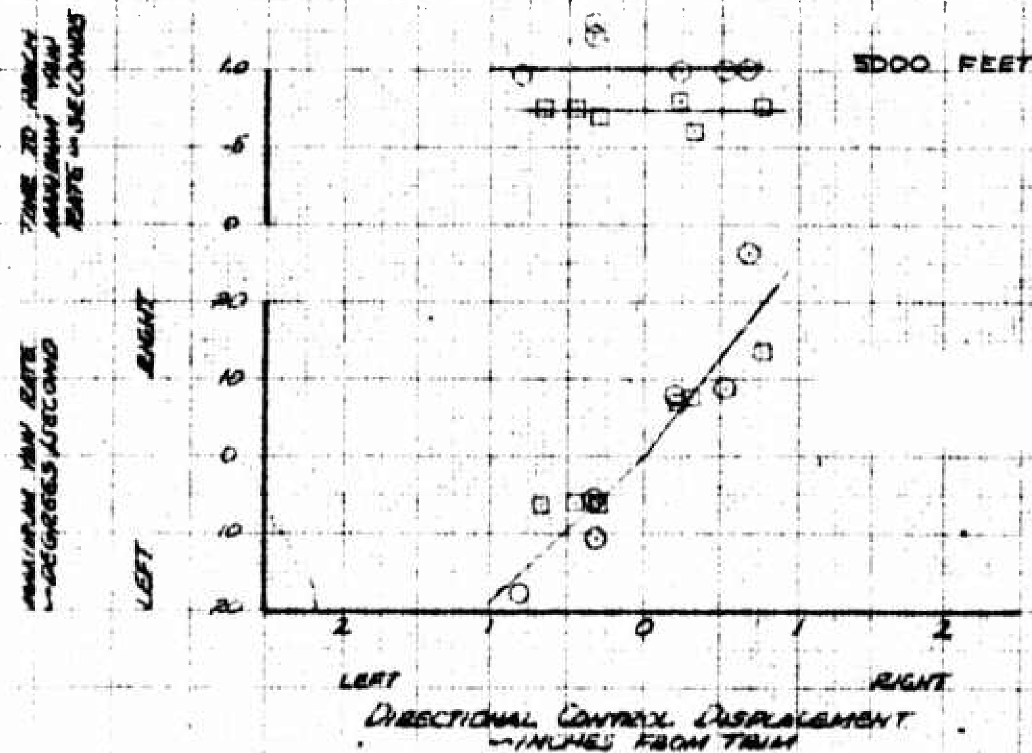


FIGURE NO 201
DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	55	5000	2050	103.5	.5 RT	465	CLEAN	AUTOROTATION
□	55	5000	2180	103.5	.5 RT	465	CLEAN	CLIMB
◇	54	10000	2150	103.6	.5 RT	466	CLEAN	AUTOROTATION
⬡	54	10000	2100	103.5	.5 RT	465	CLEAN	CLIMB



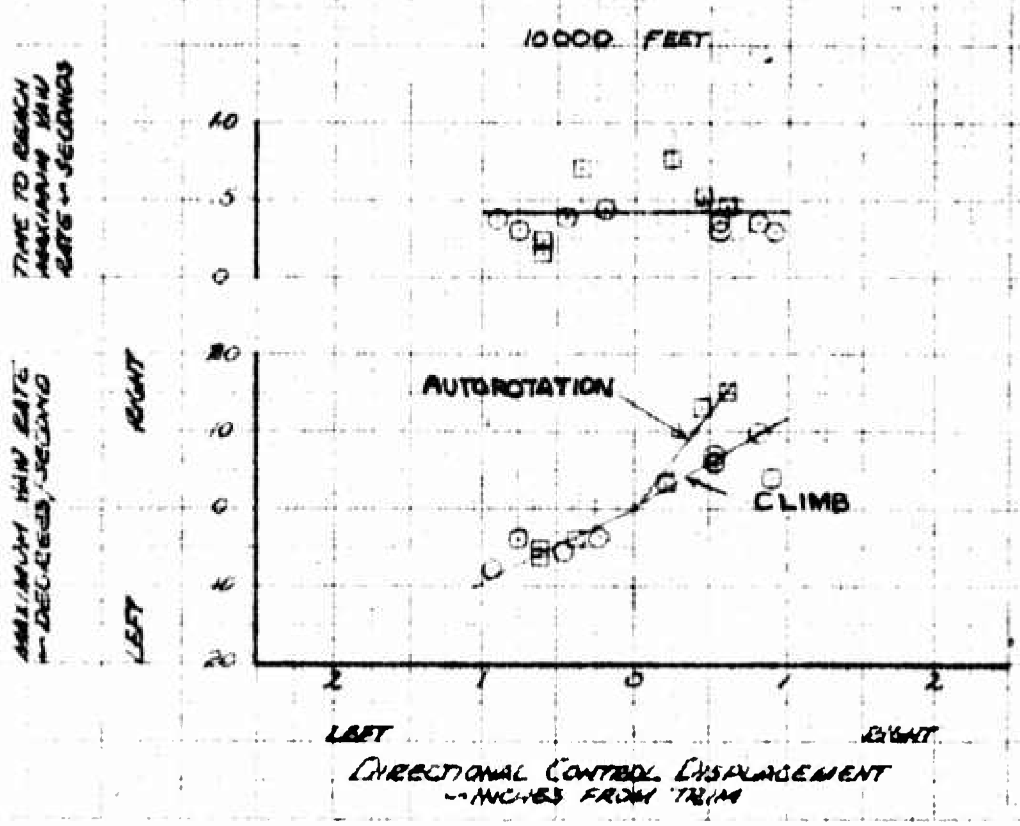
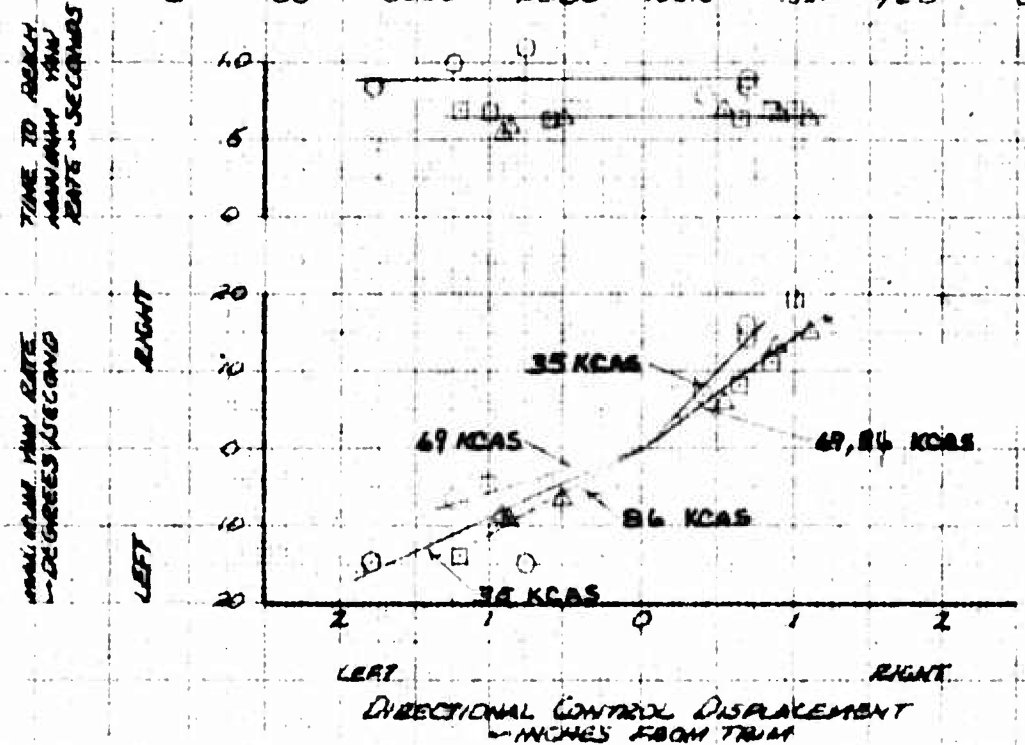


FIGURE NO 202

DIRECTIONAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG G.W. ~LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	5000	2670	103.5	.5 rt	465	CLEAN	LEVEL FLT
□	69	5000	2630	103.5	.5 rt	465	CLEAN	LEVEL FLT
△	86	5000	2670	103.5	.5 rt	465	CLEAN	LEVEL FLT
⊡	55	5000	2700	103.5	.5 rt	465	CLEAN	CLIMB
⊡	55	5000	2680	103.5	.5 rt	465	CLEAN	AUTOROTATION



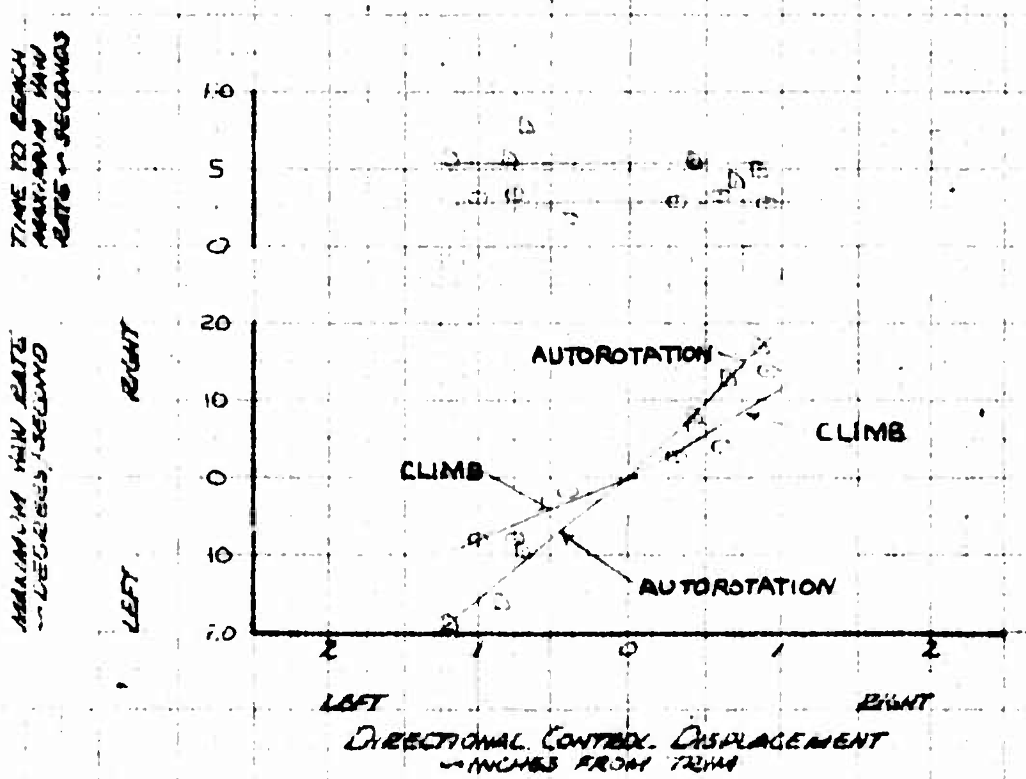


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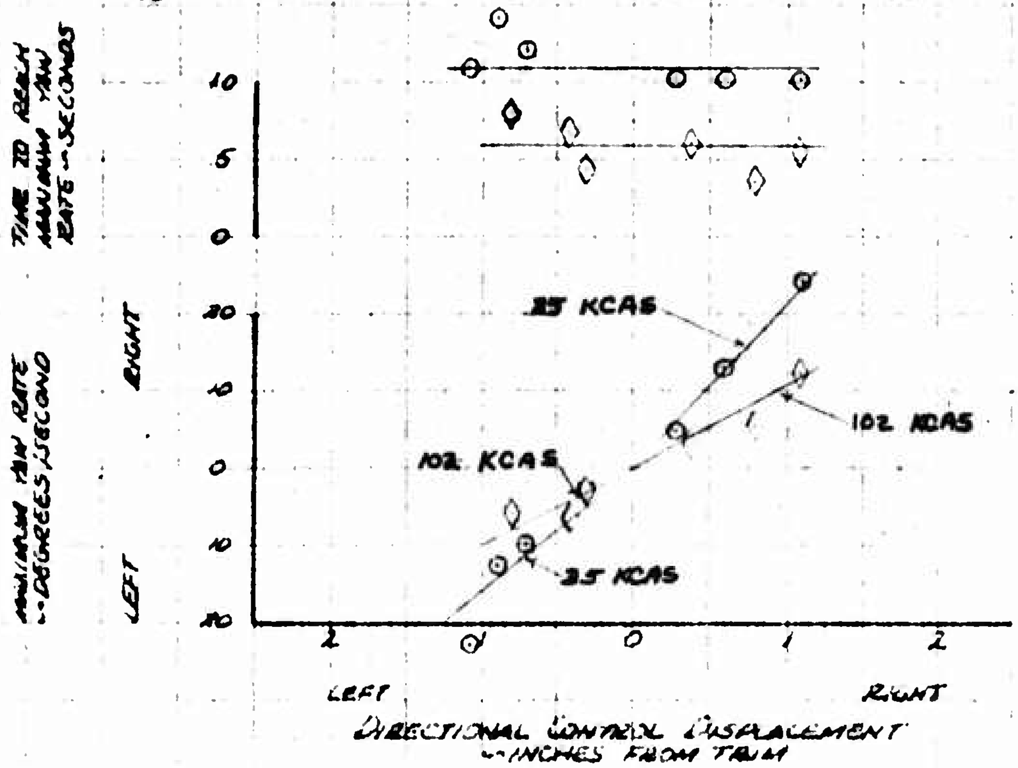
FIGURE NO 203

DIRECTIONAL CONTROL RESPONSE

OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG G.W. ~LB	AVG C.G. ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	35	5000	2170	103.5	.5RT	465	XM-7	LEVEL FLT
□	90	5000	2150	103.5	.5RT	465	XM-7	LEVEL FLT
◇	102	5000	2060	103.5	.5RT	465	X-M7	LEVEL FLT
△	113	5000	2130	103.5	.5RT	466	XM-7	LEVEL FLT



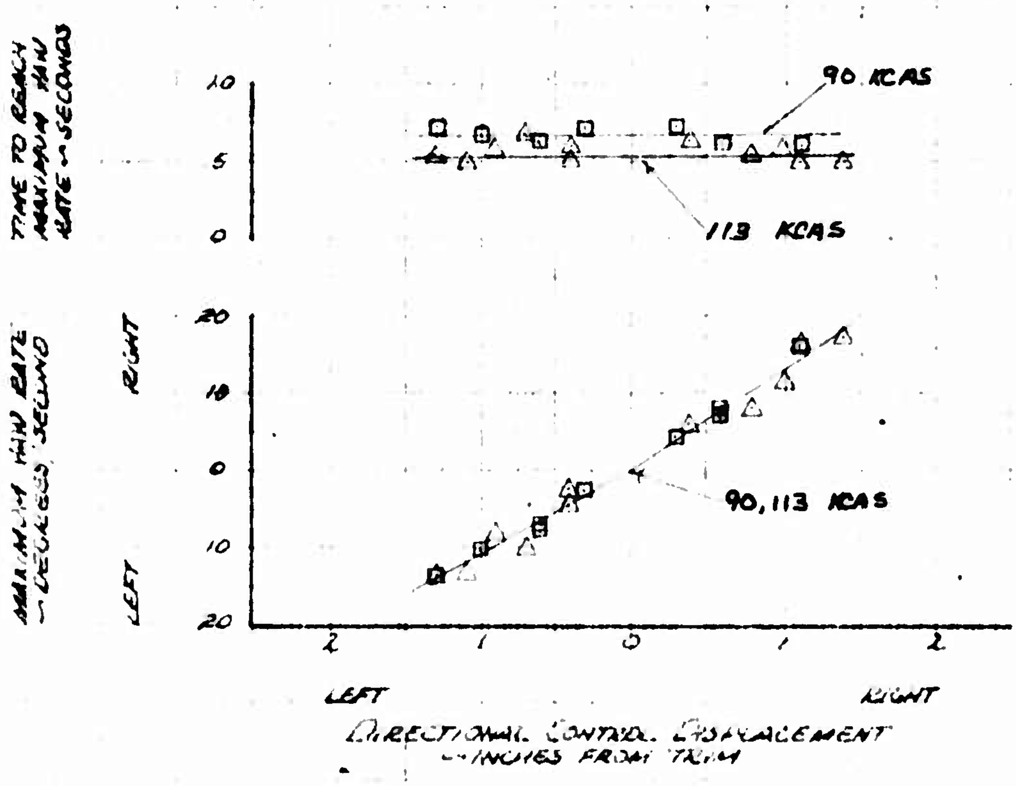
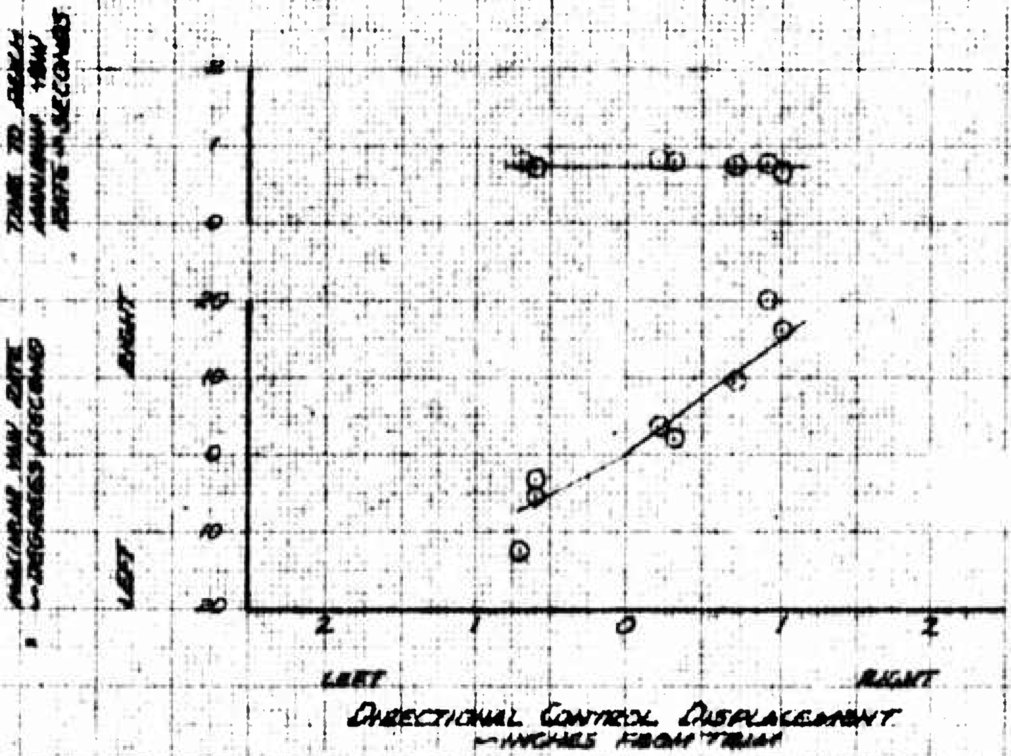


FIGURE NO 204
DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~ CAS	AVG H_p ~ FT	AVG G.W. ~ LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND.
O	65	5000	2140	103.5	.6 rt	466	XM-7	CLIMB
△	65	5000	2120	103.5	.6 rt	466	XM-7	AUTOROTATION



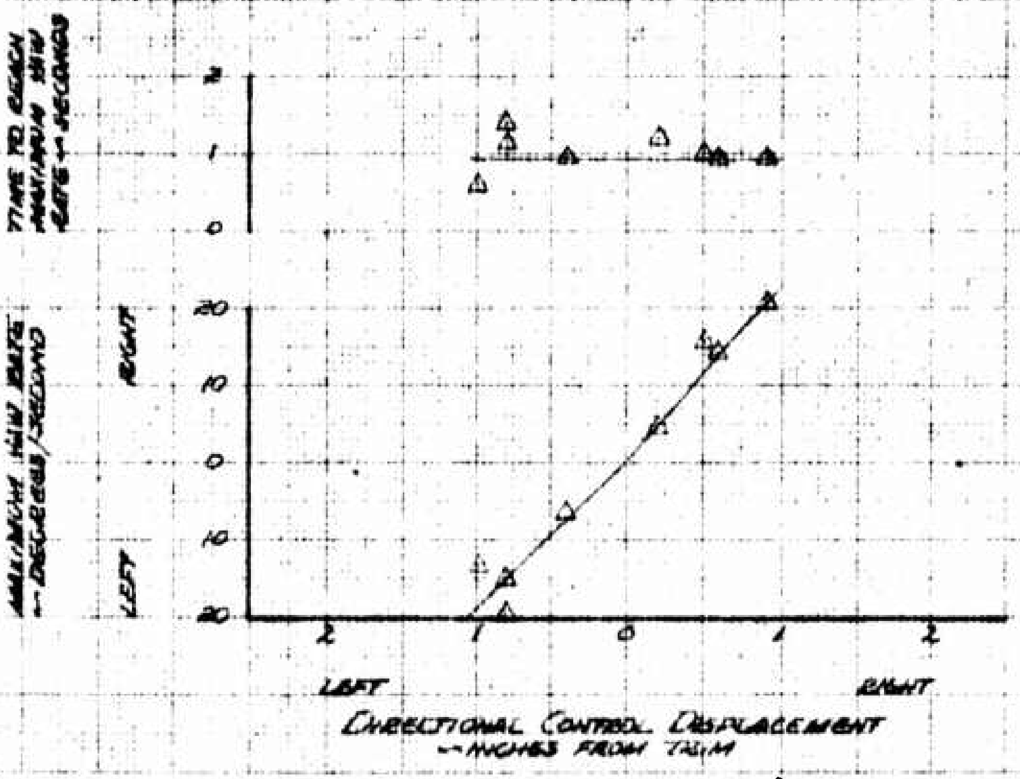


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FIGURE NO 205
DIRECTIONAL CONTROL RESPONSE
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_d ~FT	AVG G.W. ~LB	AVG CG ~IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	35	5000	2160	103.3	2.86 LT	465	XM-8	LEVEL FLT
□	90	5000	2120	103.3	2.86 LT	465	XM-8	LEVEL FLT
○	55	5000	2090	103.3	2.86 LT	465	XM-8	CLIMB
□	55	5000	2060	103.3	2.86 LT	465	XM-8	AUTOROTATION

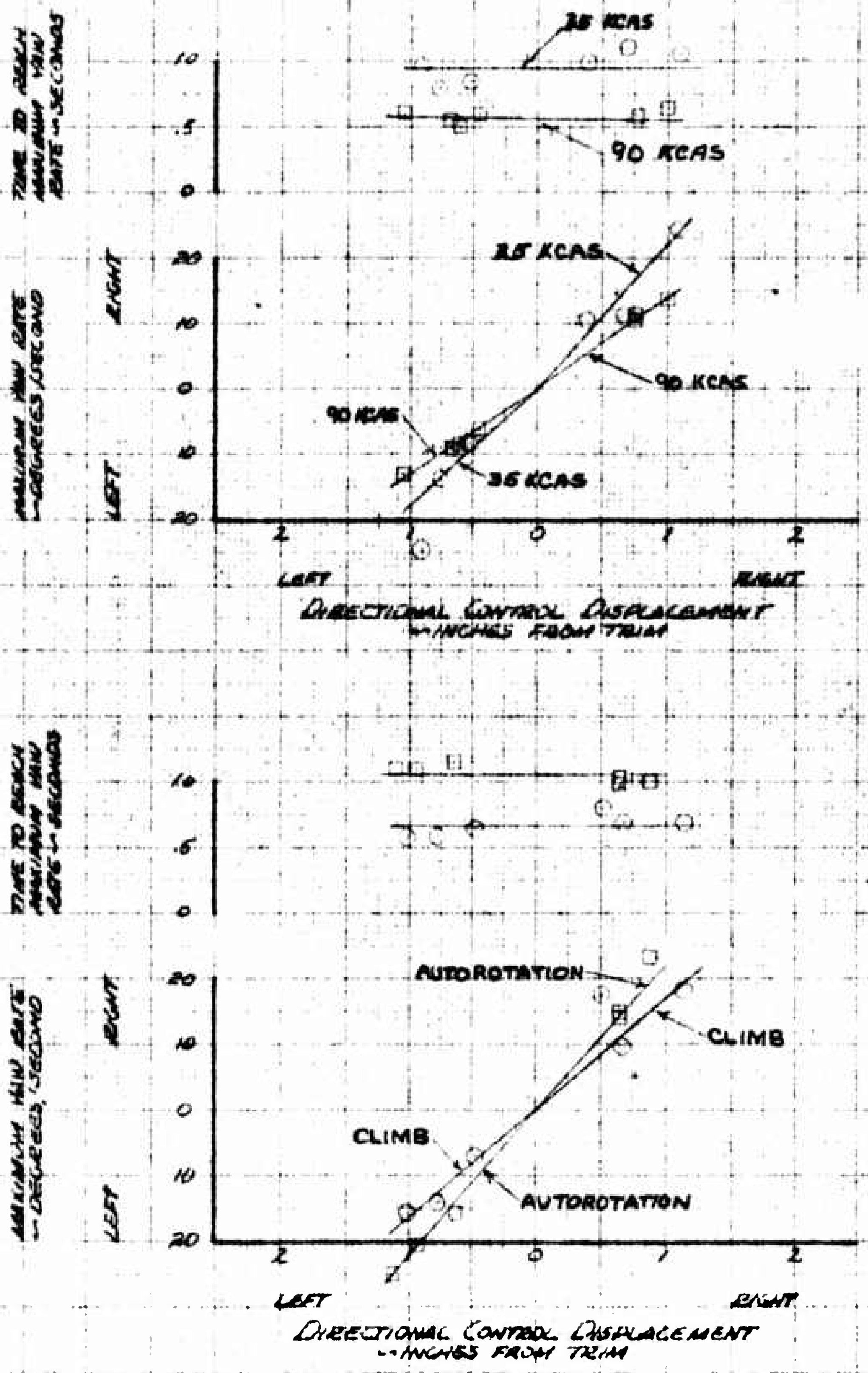

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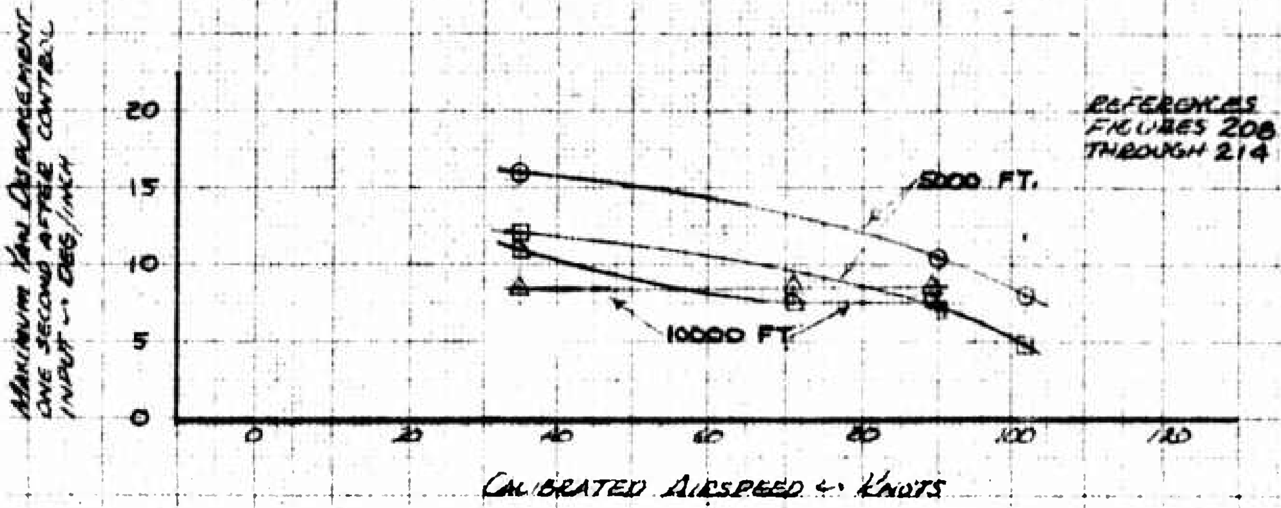
FIGURE No 206
SUMMARY OF ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM RT	SYM LT	AVG H_p ~FT	AVG GW ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	□	5000	2100	103.5	.5RT	465	CLEAN	LEVEL FLT.
△	◱	10000	2110	103.5	.5RT	465	CLEAN	LEVEL FLT.



SYM RT	SYM LT	AVG H_p ~FT	AVG GW ~LB	AVG C.G ~IN LONG	AVG C.G ~IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
○	□	5000	2630	103.5	.5RT	465	CLEAN	LEVEL FLT

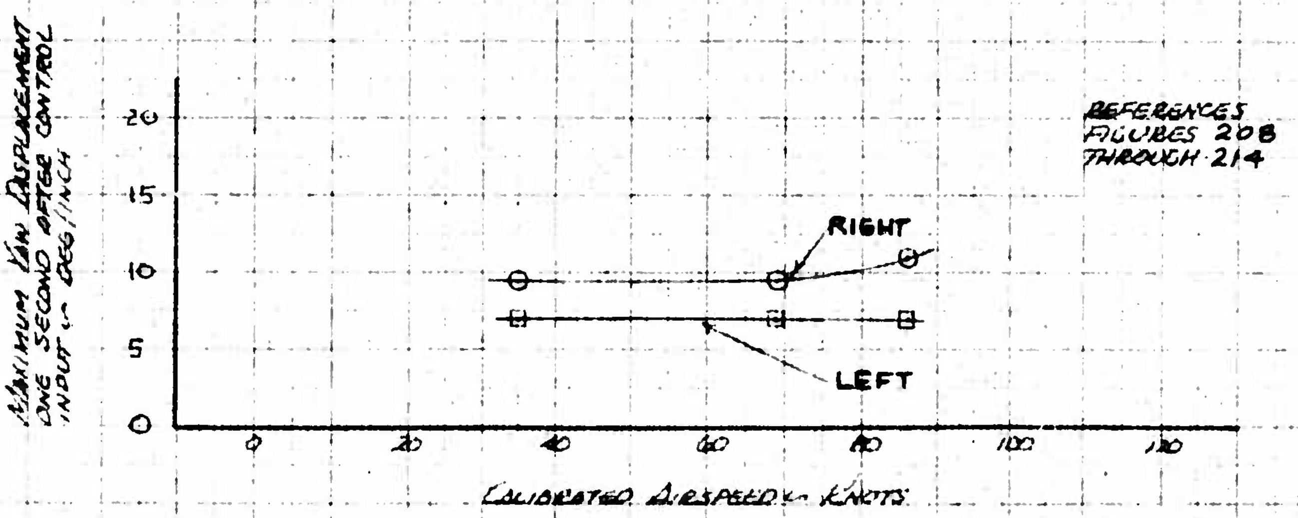
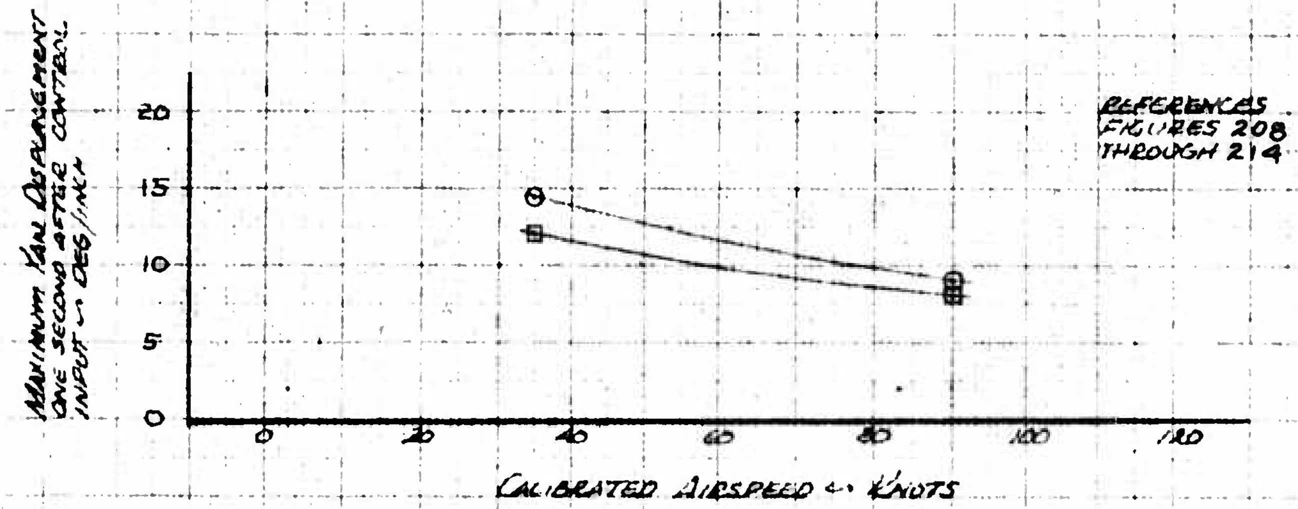


FIGURE No 207

SUMMARY OF ANGULAR YAW DISPLACEMENT

OH-6A USA S/N 62-4214

SYM	AVG H_p ~ FT	AVG GW ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT. O LT. □	5000	2140	103.3	2.8 LT	465	XM-8	LEVEL FLT.



SYM	AVG H_p ~ FT	AVG GW ~ LB	AVG C.G ~ IN LONG	AVG C.G ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT. COND.
RT O LT □	5000	2140	103.5	.5 RT.	465	XM-7	LEVEL FLT.

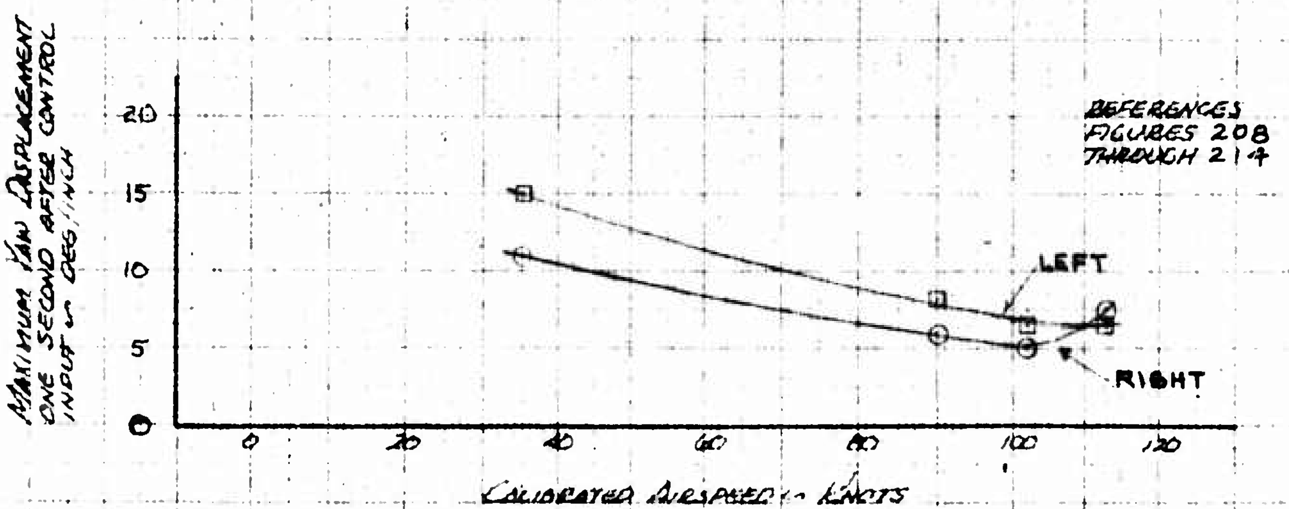


FIGURE No. 208
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~CAS	AVG H_p ~FT	AVG G.W ~LB	AVG CG ~ IN LONG	AVG CG ~ IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	ZERO	1000	2100	103.5 (AFT)	.5 RT	465	CLEAN	HOVER
□	ZERO	1000	2500	103.5 (AFT)	.5 R	465	CLEAN	HOVER
△	ZERO	1000	2120	103.6 (AFT)	.5 RT	465	XM-7	HOVER

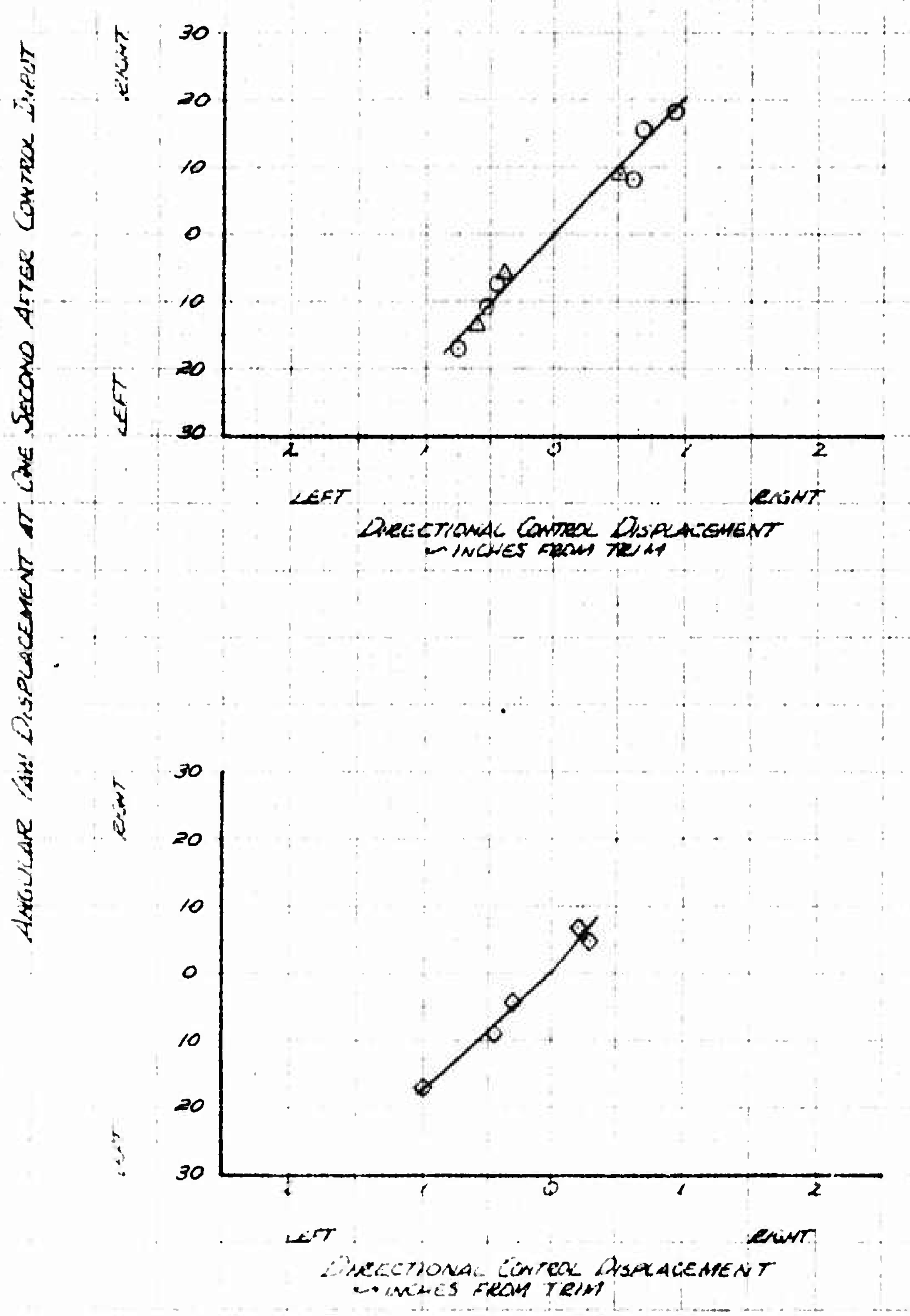


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FIGURE NO. 209
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_p ~FT	AVG G.W ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2130	103.6	.5	465	CLEAN	LEVEL FLT
□	90	5000	2100	103.5	.5	465	CLEAN	LEVEL FLT
◇	102	5000	2070	103.5	.5	465	CLEAN	LEVEL FLT
⊙	35	10000	2140	103.5	.5	465	CLEAN	LEVEL FLT
⊡	71	10000	2120	103.5	.5	465	CLEAN	LEVEL FLT
◁	89	10000	2090	103.5	.5	465	CLEAN	LEVEL FLT

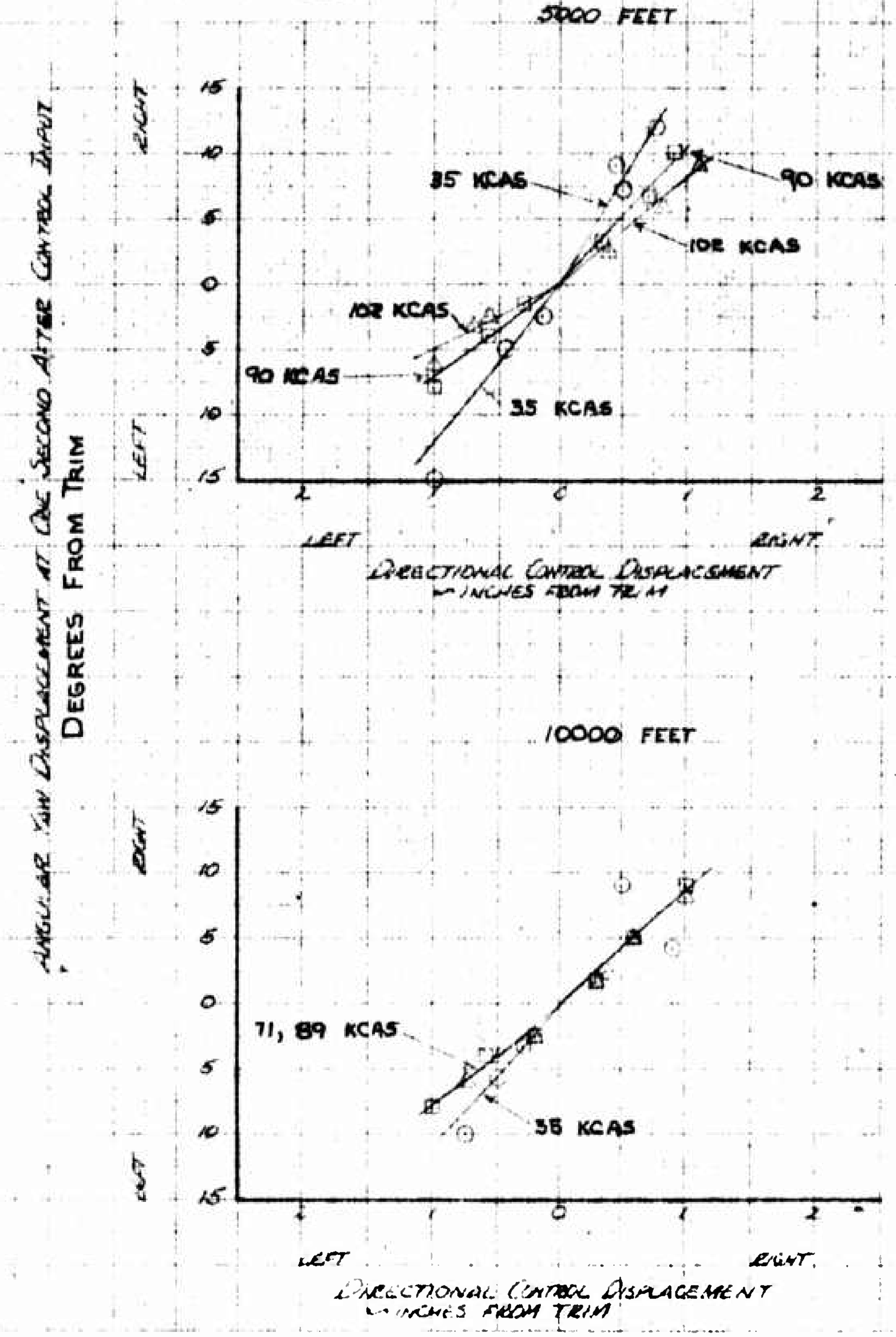

FIGURE NO. 210
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG H_P ~FT	AVG G.W ~LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT COND.
○	55	5000	2050	103.5	.5R	465	CLEAN	AUTOROTATION
□	56	5000	2180	103.5	.5R	465	CLEAN	CLIMB
○	54	10000	2150	103.5	.5R	465	CLEAN	AUTOROTATION
□	54	10000	2100	103.5	.5R	465	CLEAN	CLIMB

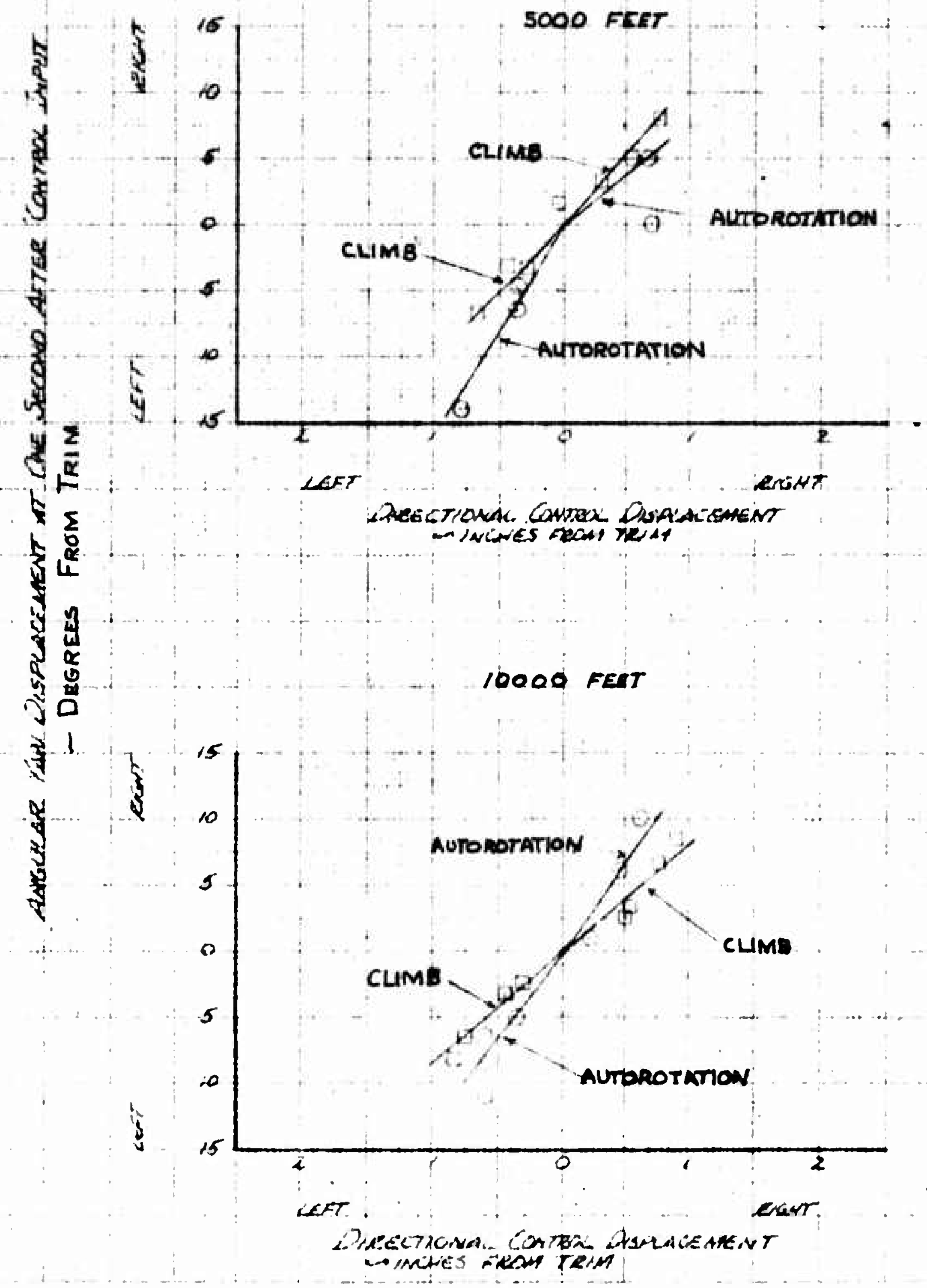

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FIGURE No. 211
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG G.W ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2670	103.5	.5RT	465	CLEAN	LEVEL FLT
□	69	5000	2630	103.5	.5RT	465	CLEAN	LEVEL FLT
△	86	5000	2570	103.5	.5RT	465	CLEAN	LEVEL FLT
◇	55	5000	2700	103.5	.5RT	465	CLEAN	CLIMB
◁	55	5000	2680	103.5	.5RT	465	CLEAN	AUTOROTATION

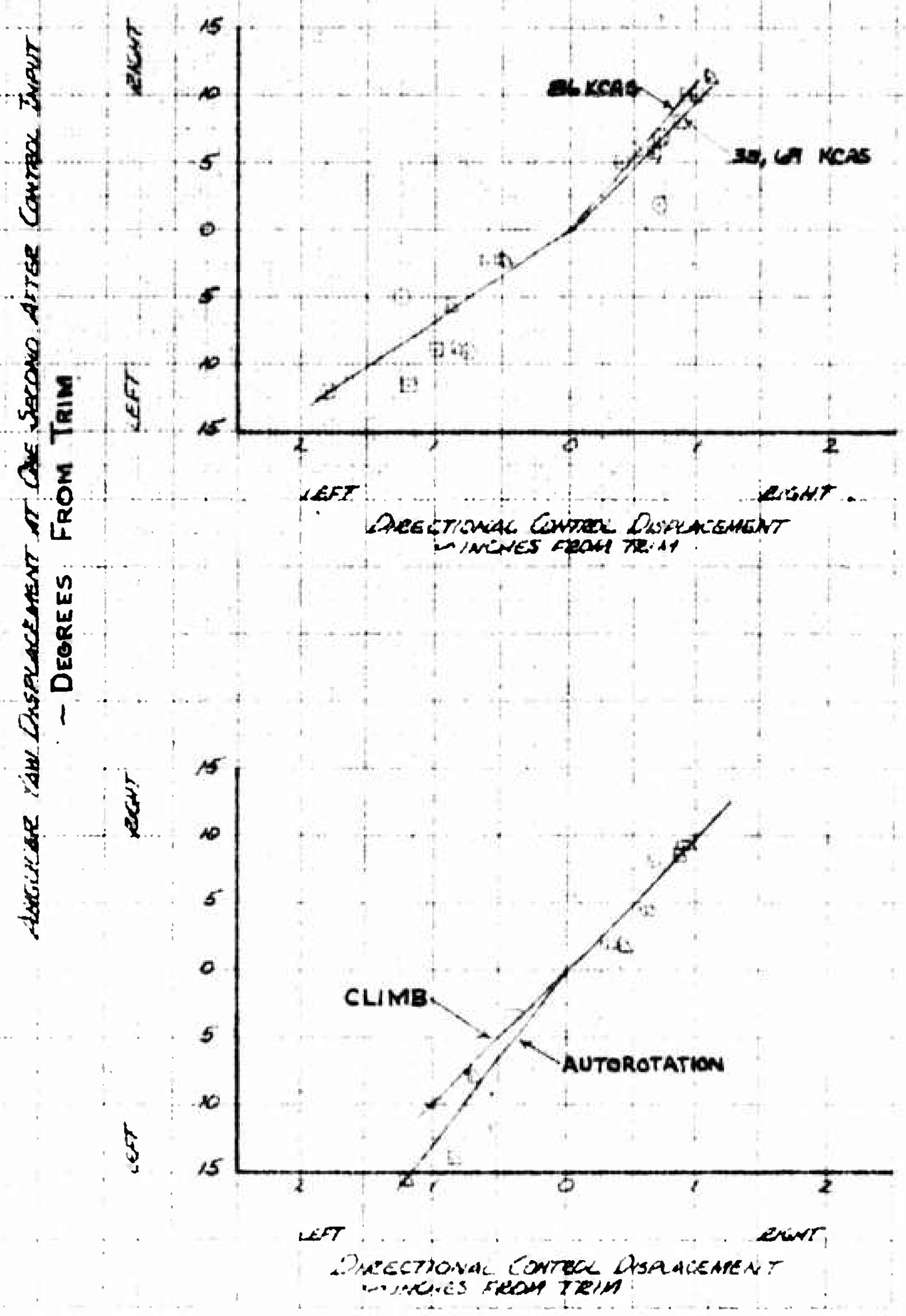

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FIGURE NO. 212
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~KCAS	AVG Hp ~FT	AVG GW ~LB	AVG CG ~IN LONG	AVG CG ~IN LAT	ROTOR RPM	CONFIGURATION	FLT COND
○	35	5000	2170	103.5	.5 RT	465	XM-7	LEVEL FLT
□	90	5000	2050	103.5	.6 RT	465	XM-7	LEVEL FLT
◇	102	5000	2060	103.6	.5 RT	465	XM-7	LEVEL FLT
△	113	5000	2130	103.5	.5 RT	465	XM-7	LEVEL FLT

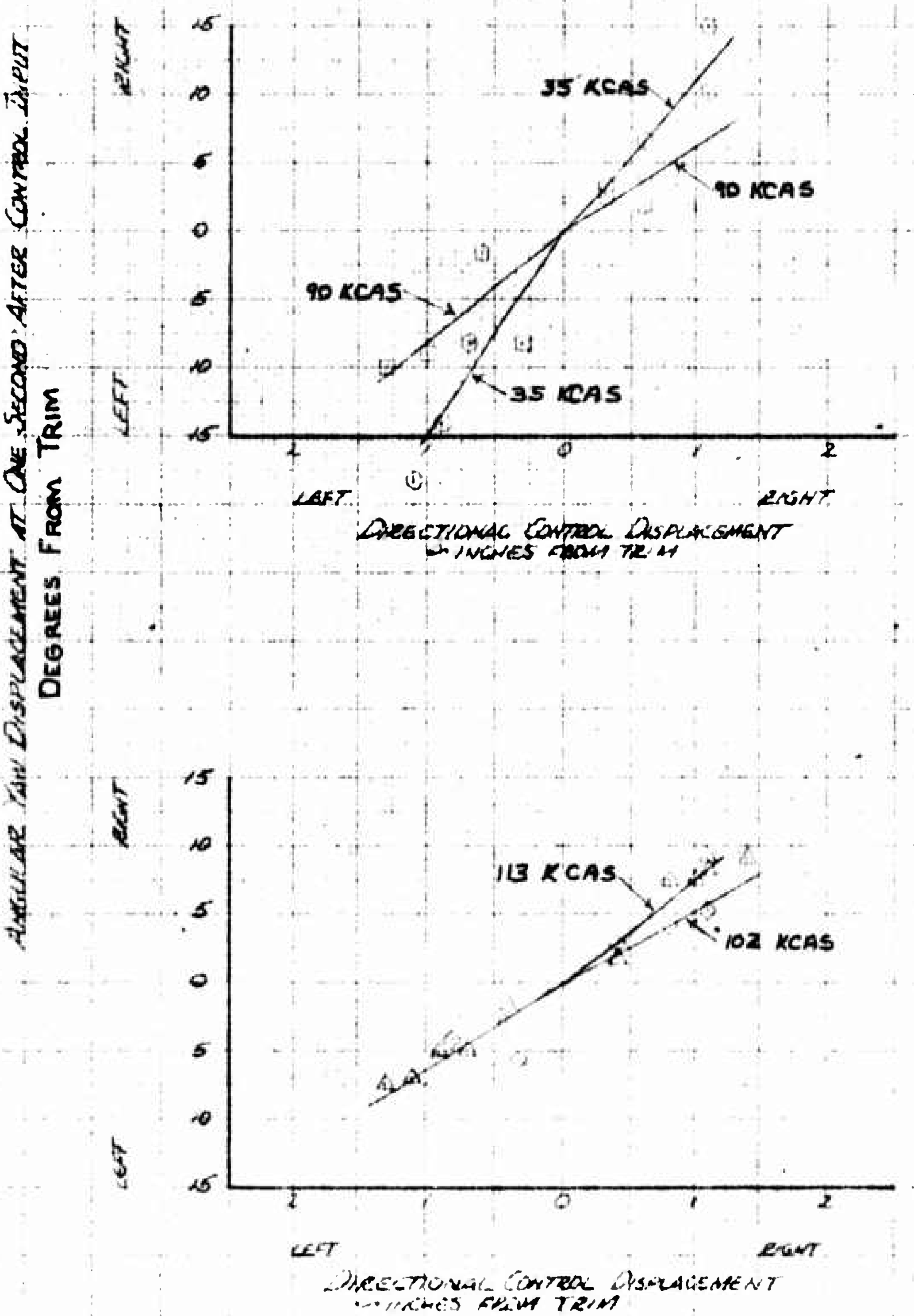

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FIGURE NO. 213
ANGULAR YAW DISPLACEMENT
OH-6A USA S/N 62-4214

SYM	AIRSPEED ~CAS	AVG Hp ~FT	AVG G.W. ~LB	AVG CG ~ IN LONG	LAT	ROTOR RPM	CONFIGURATION	FLT. COND
○	55	5000	2140	103.5	.5 RT	465	XM-7	CLIMB
△	55	5000	2120	103.5	.5 RT	465	XM-7	AUTOROTATION

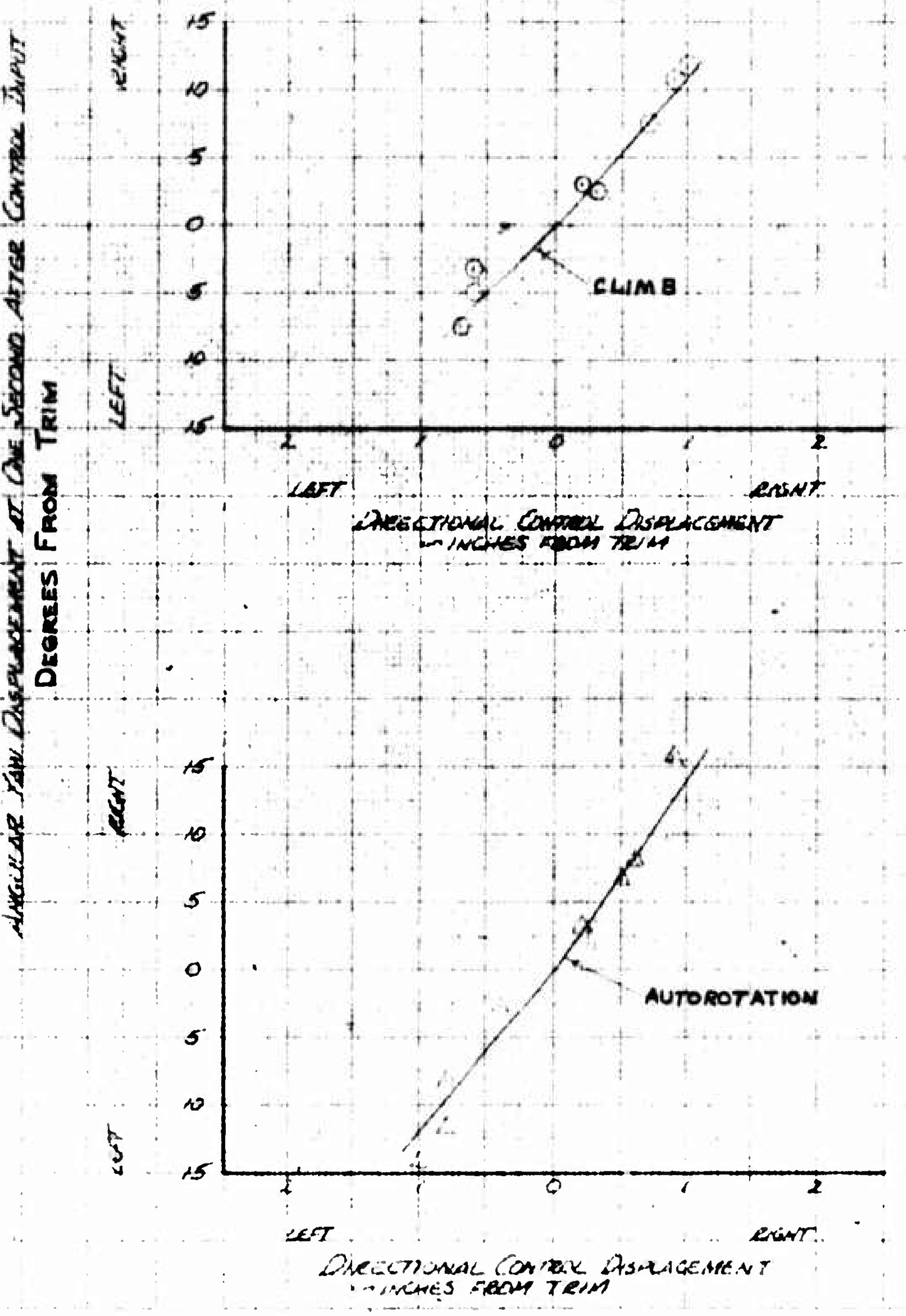


FIGURE NO. 215

AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2160 LBS.
LONG C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 90 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

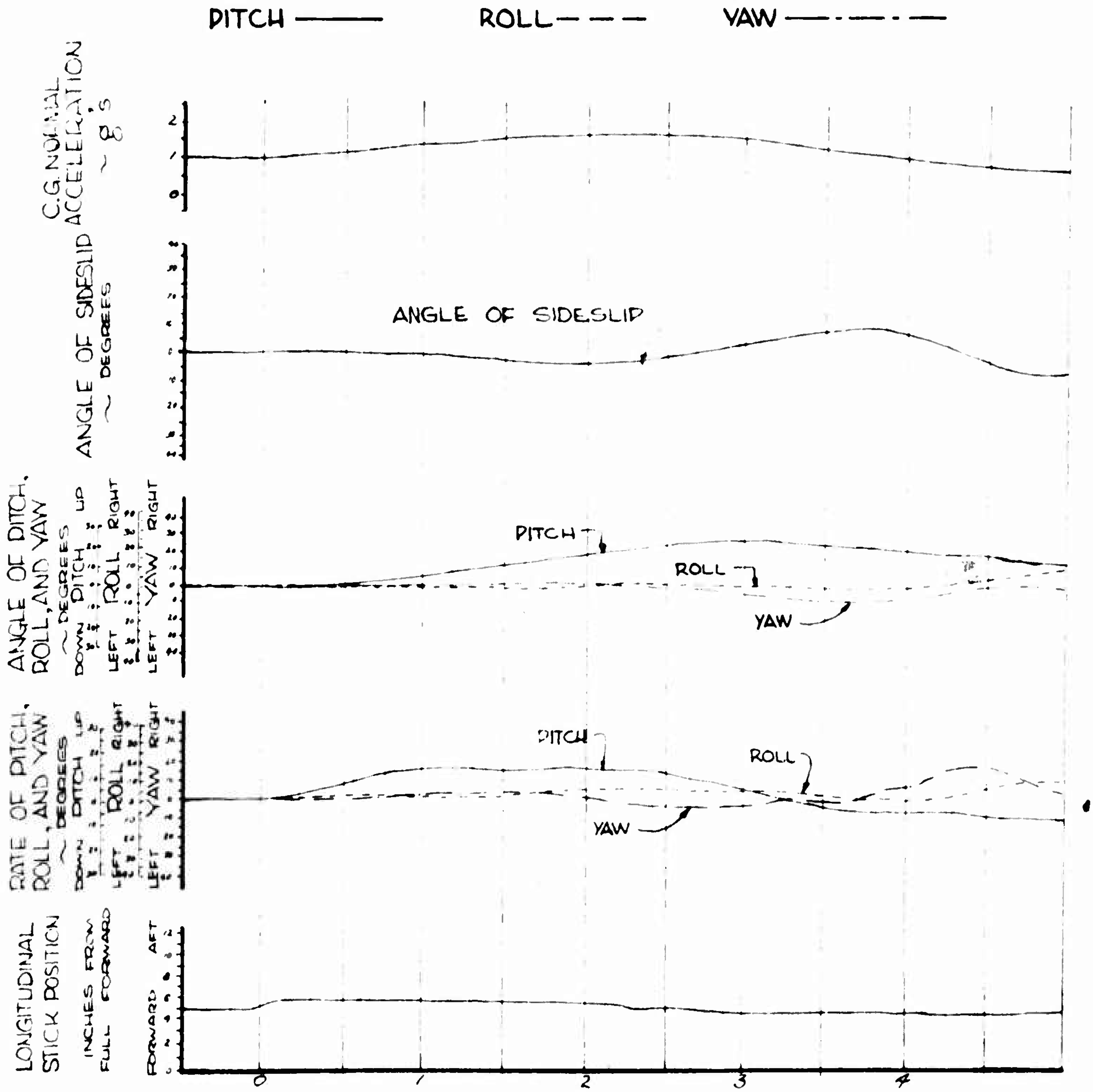


FIGURE NO. 216

AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2170 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 102 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

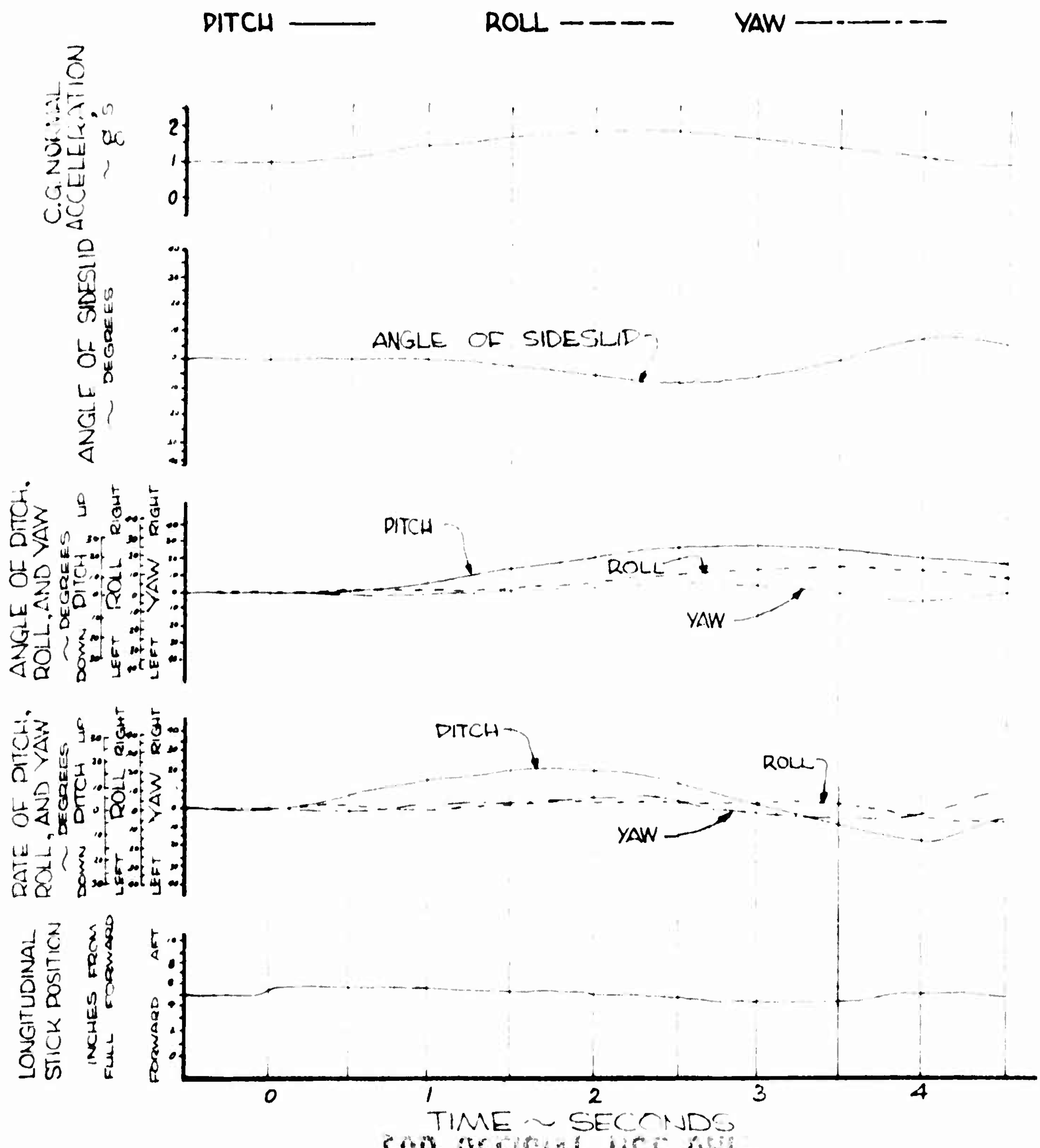


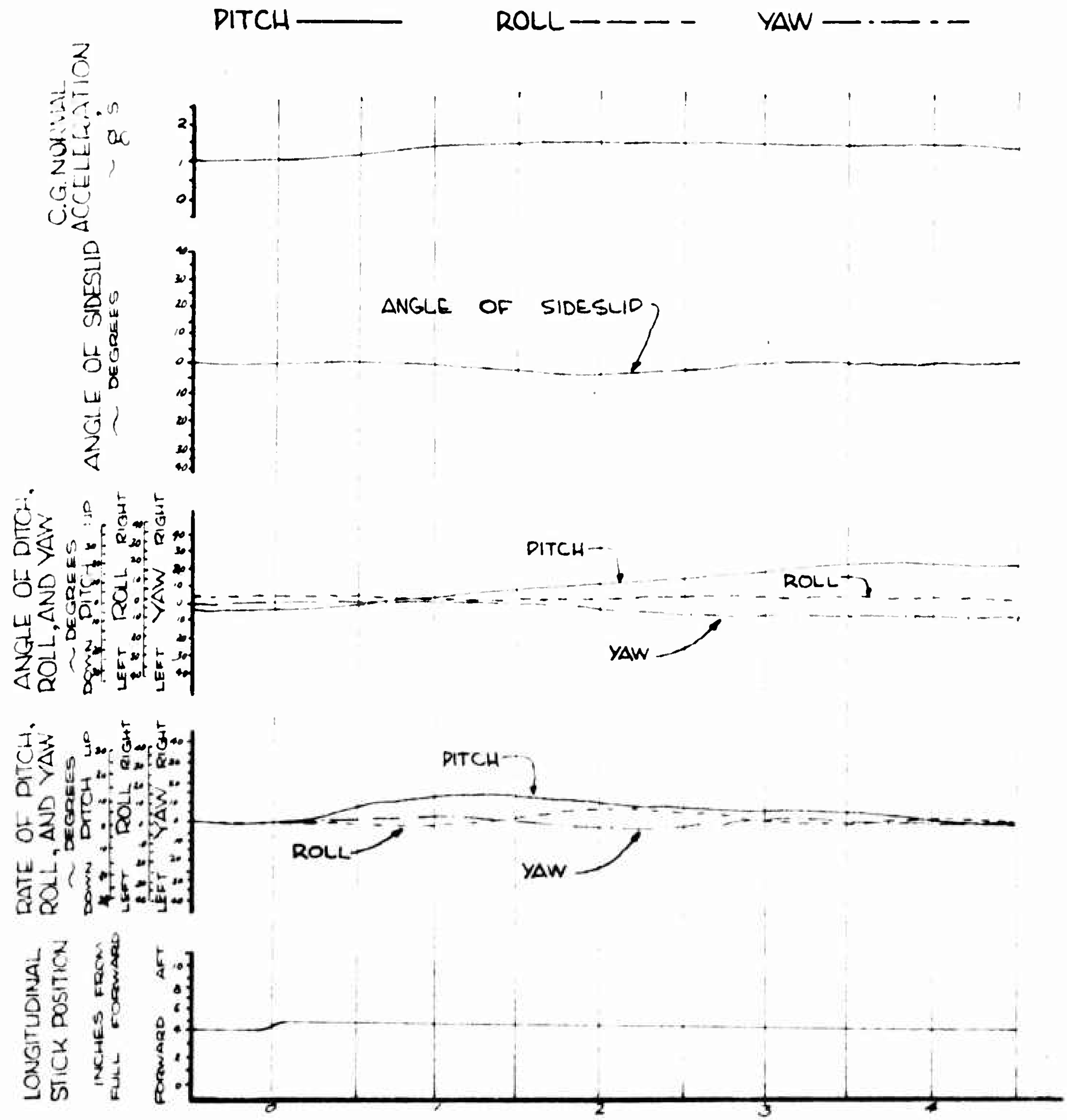
FIGURE NO. 217

AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2120 LBS.
LONG. C.G. LOCATION: 97 INCHES (FWD)
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 109 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM



AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2120 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN (RT)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 113 KNOTS (V_{KE})
DENSITY ALTITUDE: 5000 RPM
ROTOR SPEED: 465 RPM

PITCH ———— ROLL — — — — YAW — - — - —

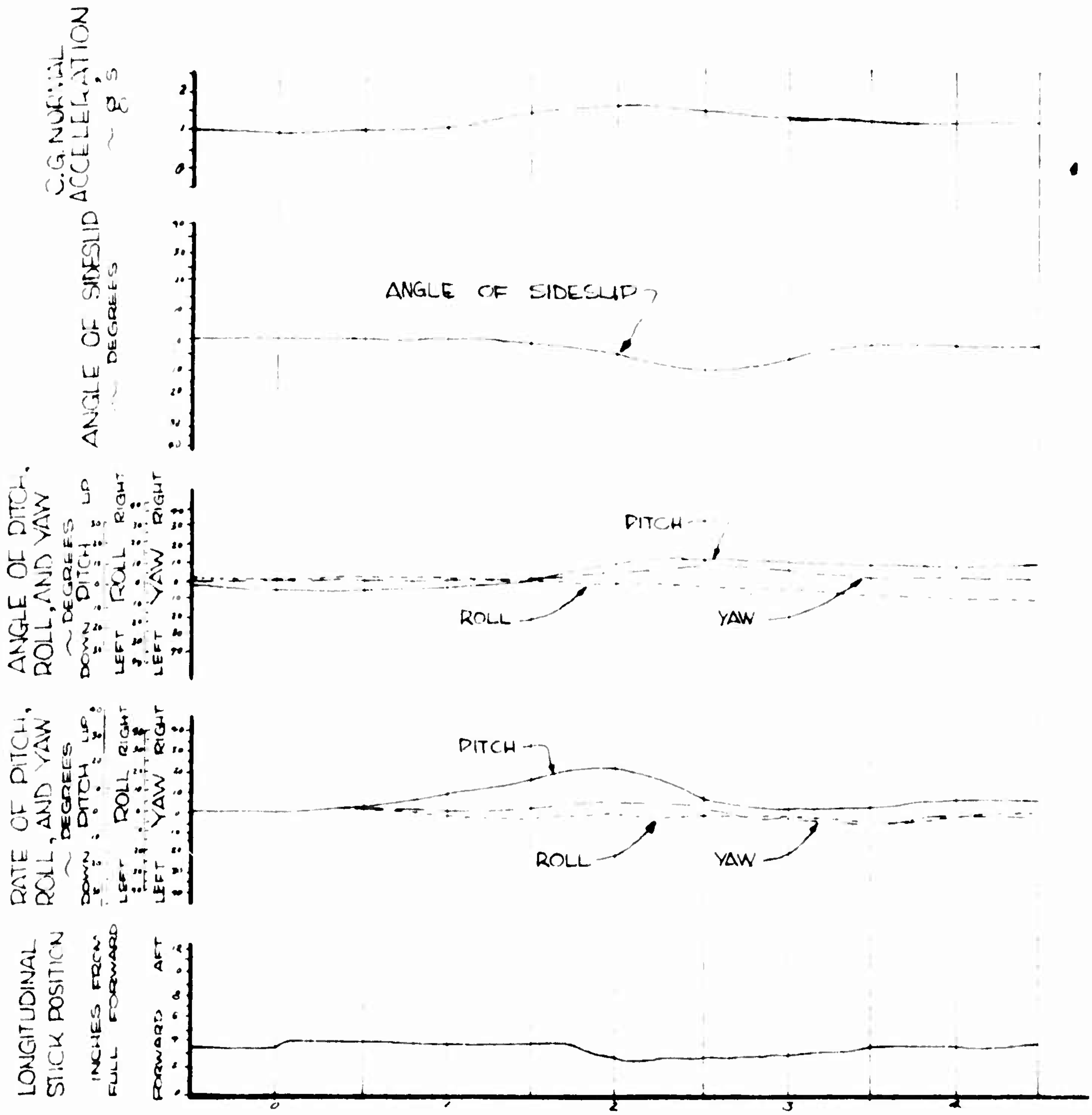


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FIGURE NO. 219

AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2120 LBS.
LONG C.G. LOCATION: 97 INCHES (FWD)
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 113 KNOTS (V_{NE})
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

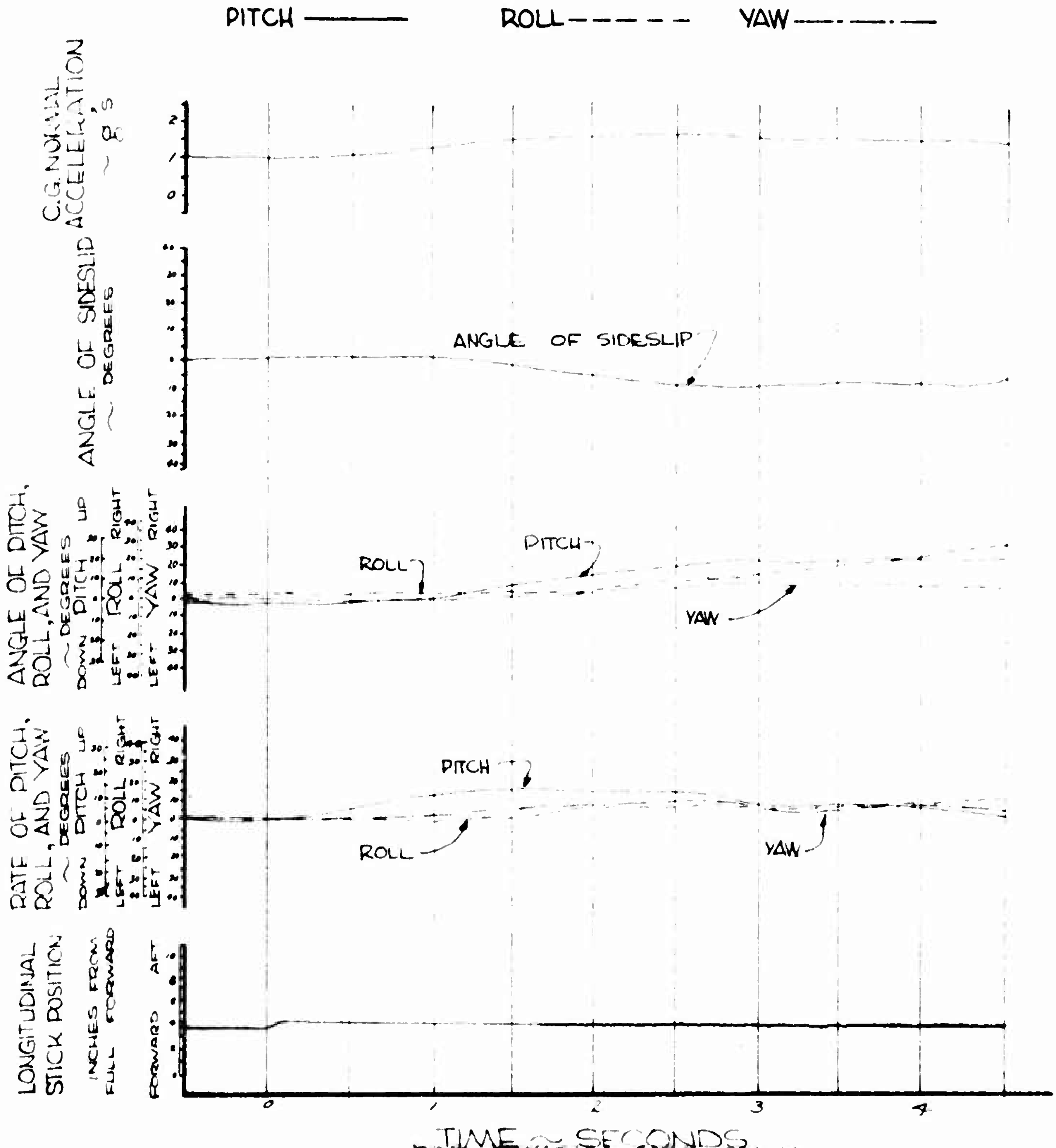

FIGURE NO. 220

AFT LONGITUDINAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7
FULL LONGITUDINAL TRAVEL: 12.6 INCHES
AVERAGE GROSS WEIGHT: 2110 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 113 KNOTS (V_{NE})
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

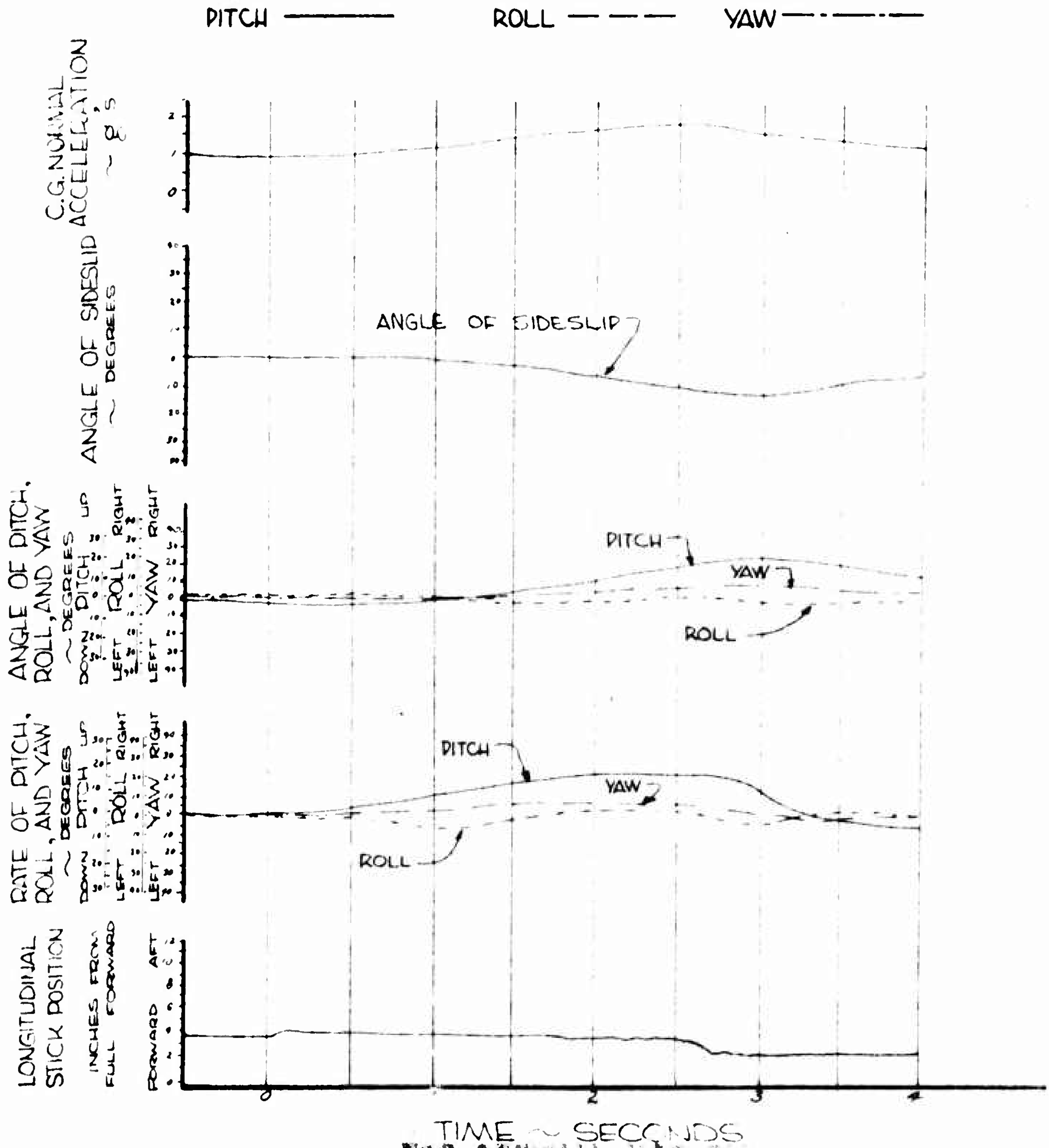

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FIGURE NO. 221

RIGHT DIRECTIONAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2570 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 69 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

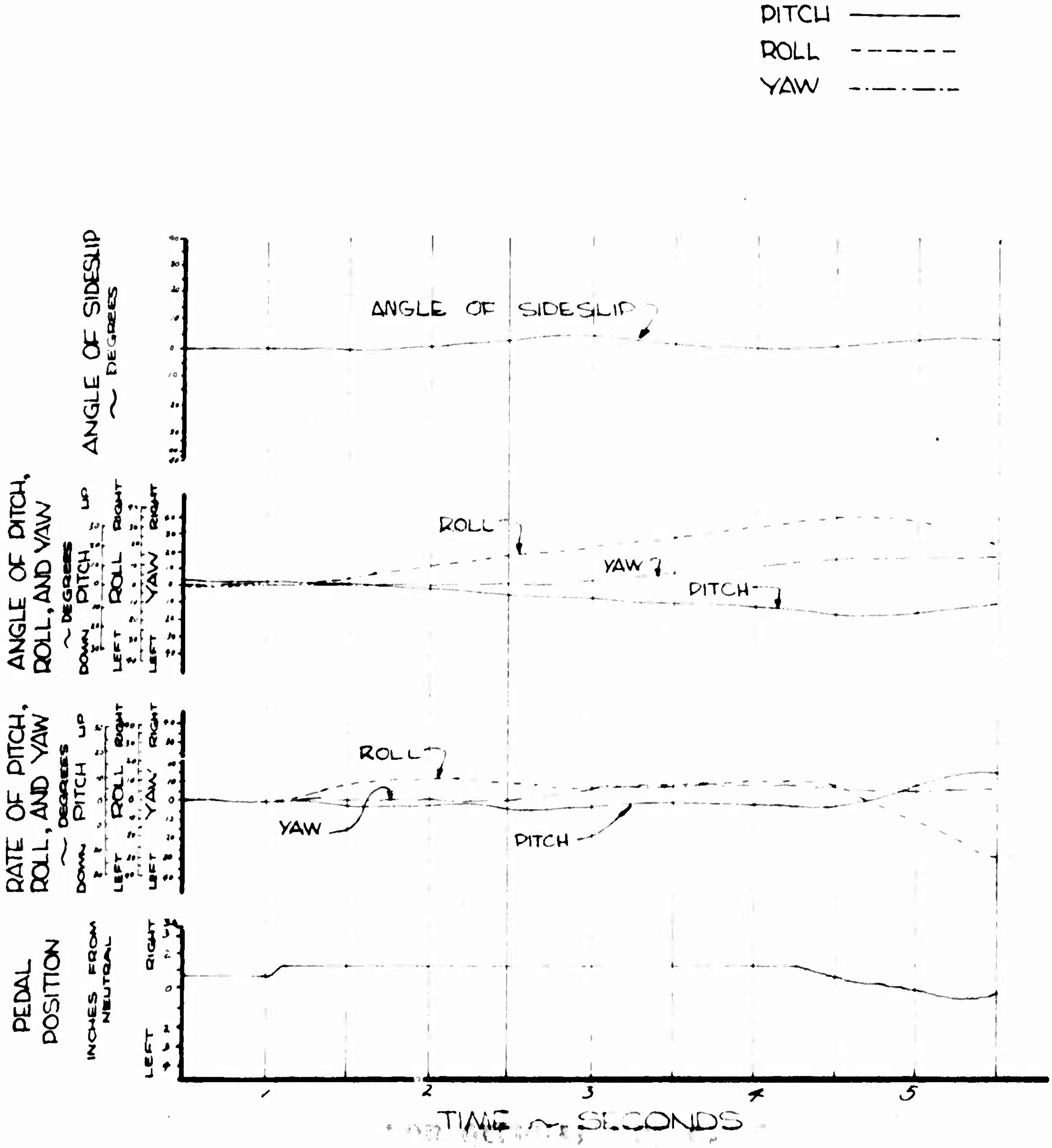

FIGURE NO. 222

RIGHT DIRECTIONAL STEP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
FULL PEDAL TRAVEL: 7.6 INCHES
AVERAGE GROSS WEIGHT: 2620 LBS
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 86 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

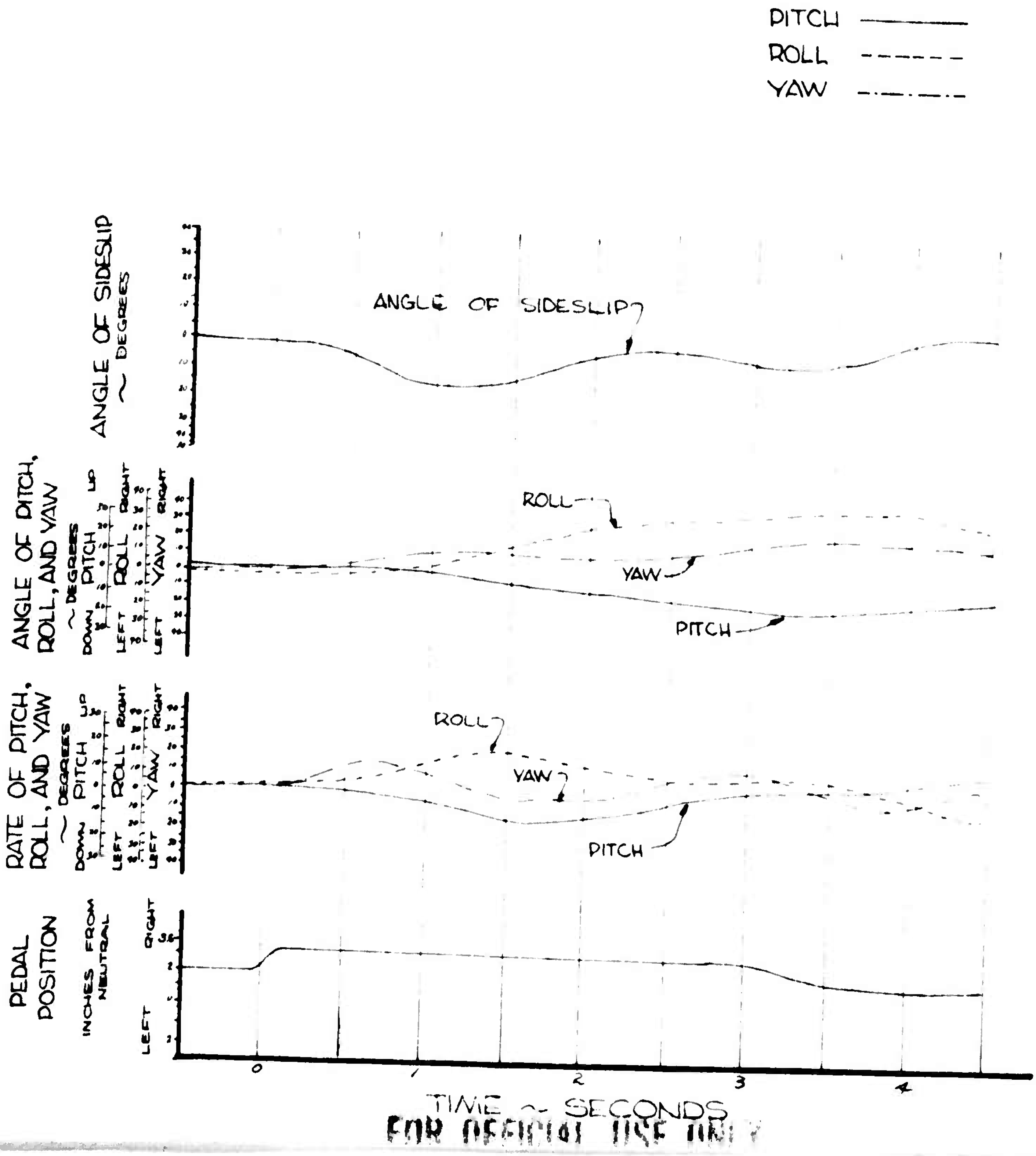

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FIGURE NO. 223

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL DOWN (20°) FLIGHT CONDITION: HOVER (IGE)
AVERAGE GROSS WEIGHT: 2130 LBS TRIM CAS: ZERO
LONG C.G. LOCATION: 102 INCHES DENSITY ALTITUDE: 3700 FEET
LATERAL C.G. LOCATION: 2.77 IN (LT) ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK ROLL - - - - and LAT STICK YAW — - — - — and PEDAL

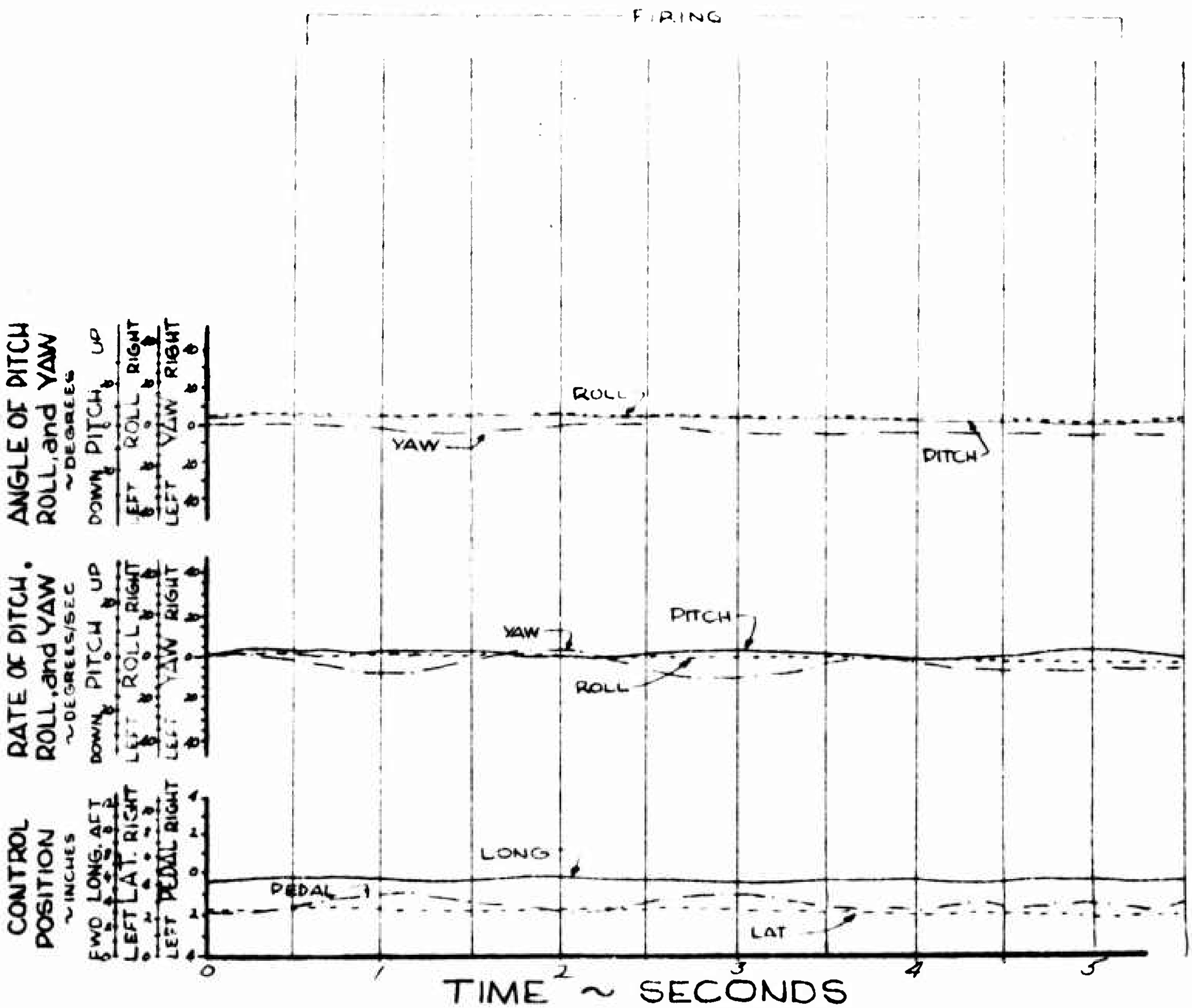


FIGURE NO. 224

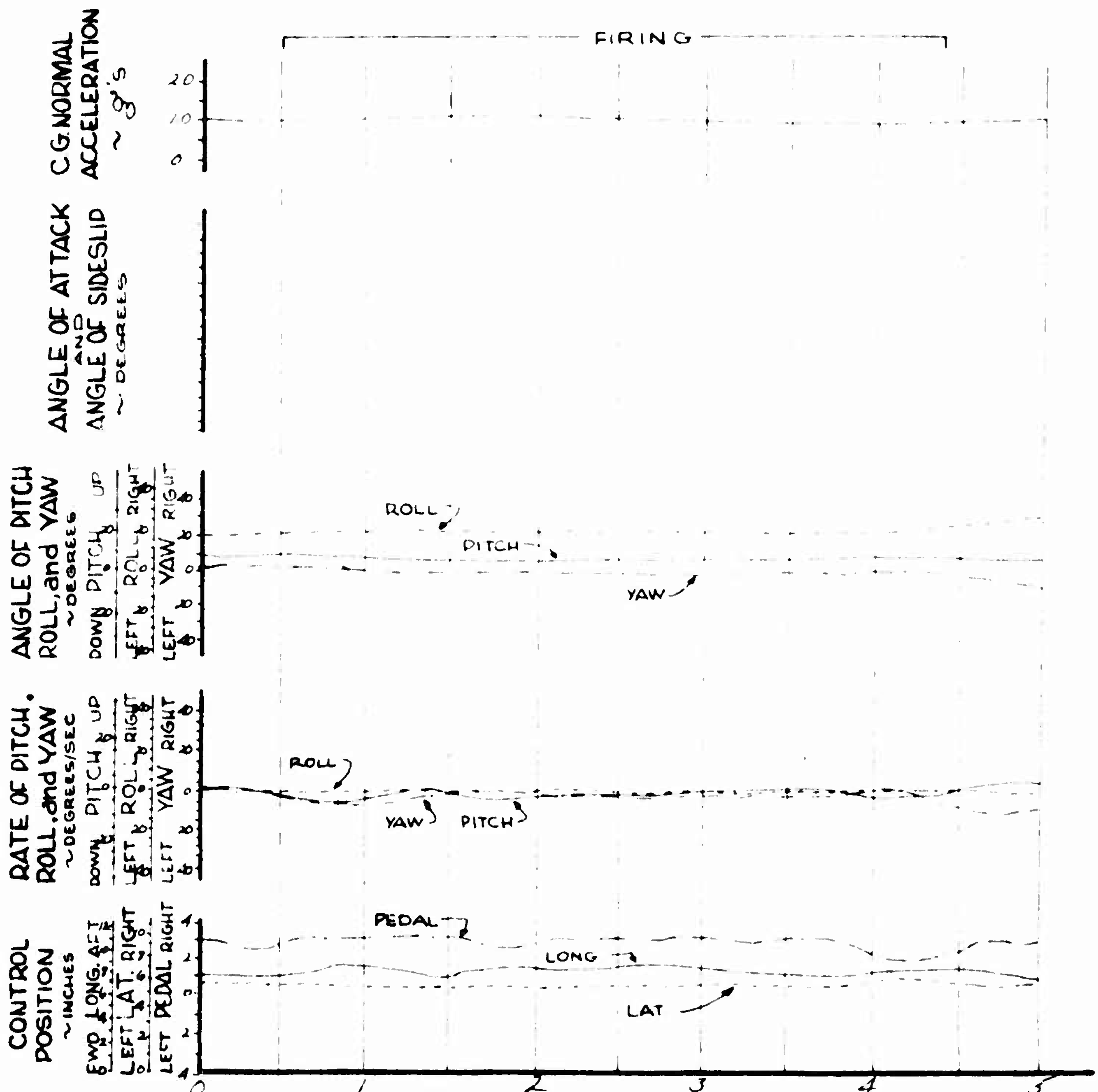
TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL DOWN (10°)
AVERAGE GROSS WEIGHT: 2140 LBS.
LONG. C.G. LOCATION: 102 INCHES
LATERAL C.G. LOCATION: 2.77 IN (LT)

FLIGHT CONDITION: LT. SIDEWARD FLIGHT (1G
TRIM CAS: EST. 20-30 KNOTS
DENSITY ALTITUDE: 3900 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL - - - - and LAT. STICK
YAW — - — - — and PEDAL



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TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL UP (10°)
AVERAGE GROSS WEIGHT: 2120 LBS.
LONG. C.G. LOCATION: 102 INCHES
LATERAL C.G. LOCATION: 2.77 IN. (LT.)

FLIGHT CONDITION: LT. SIDEWARD FLIGHT
TRIM CAS: EST. 20-30 KNOTS
DENSITY ALTITUDE: 3900 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL - - - - and LAT. STICK
YAW — - — - — and PEDAL

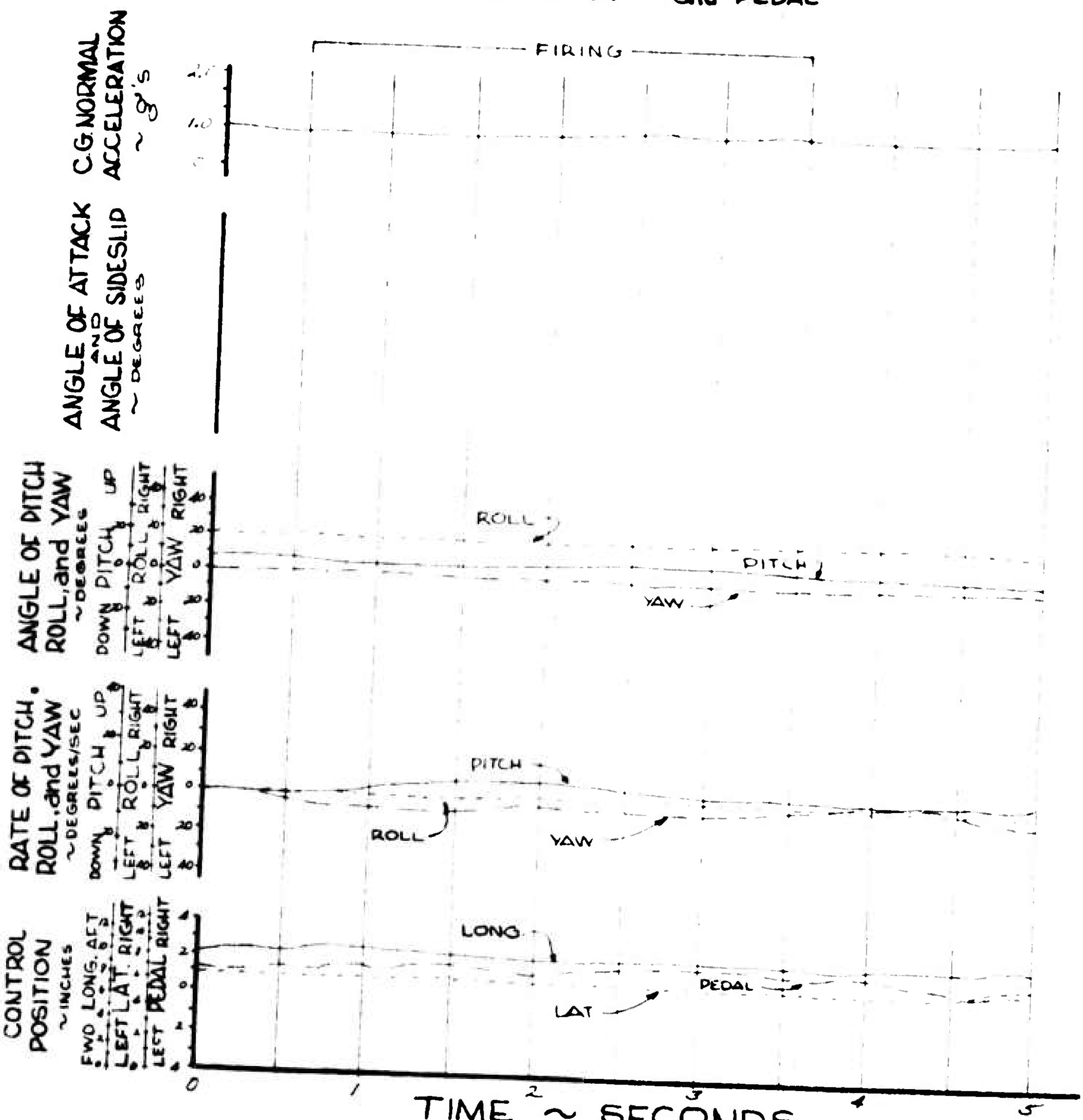


FIGURE NO. 226

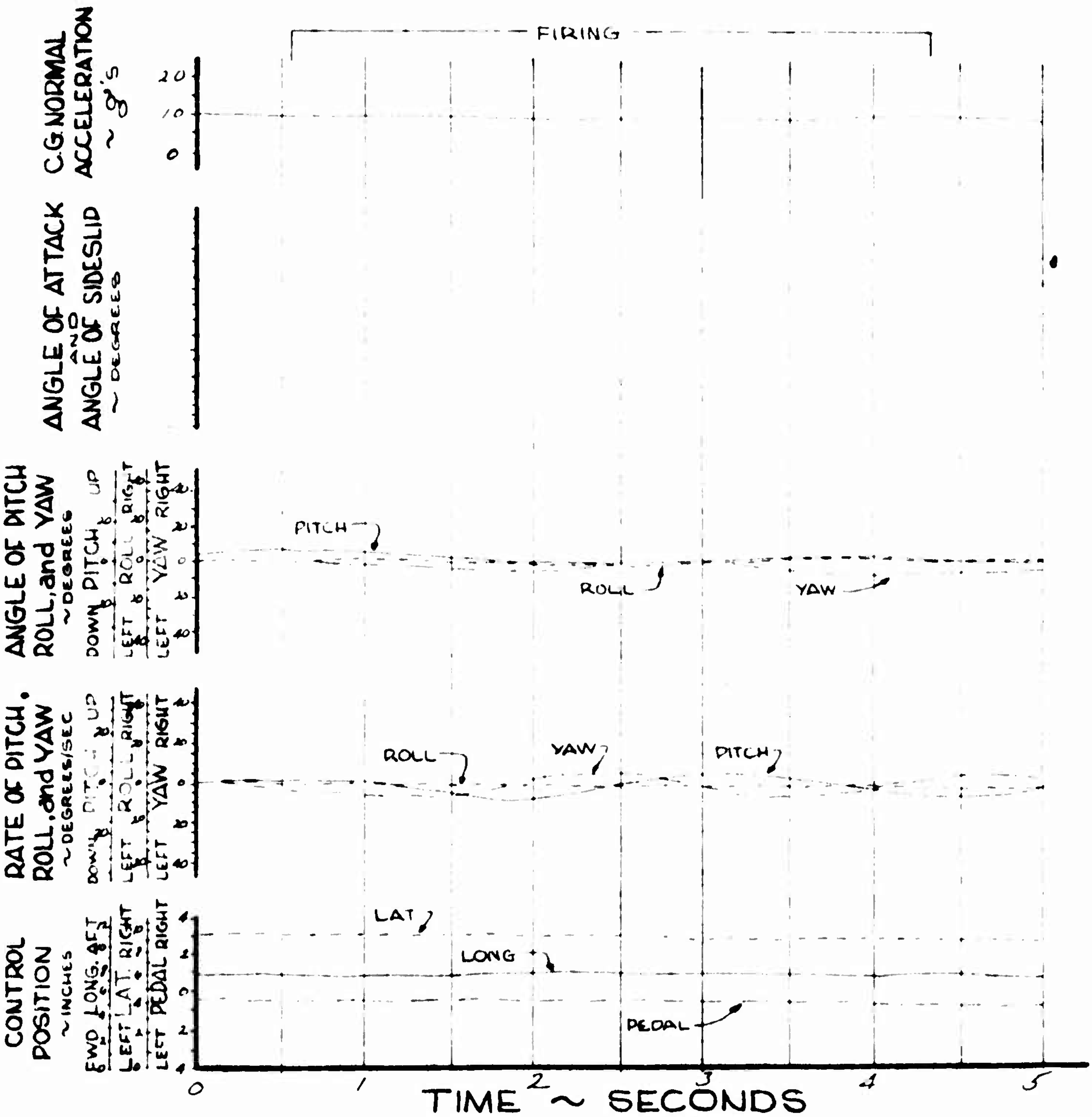
TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL UP
AVERAGE GROSS WEIGHT: 2090 LBS.
LONG. C.G. LOCATION: 102 INCHES
LATERAL C.G. LOCATION: 2.77 IN (LT)

FLIGHT CONDITION: LEVEL FLIGHT (YAWED 45° RT.)
TRIM CAS: 35 KNOTS (EST.)
DENSITY ALTITUDE: 4200 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL - - - - and LAT. STICK
YAW — - — - — and PEDAL



TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL DOWN
AVERAGE GROSS WEIGHT: 2170 LBS.
LONG. C.G. LOCATION: 102 INCHES
LATERAL C.G. LOCATION: 2.77 IN. (LT)

FLIGHT CONDITION: LEVEL FLIGHT (UNYAWED)
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 4400 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL – – – – and LAT. STICK
YAW — - — - — and PEDAL

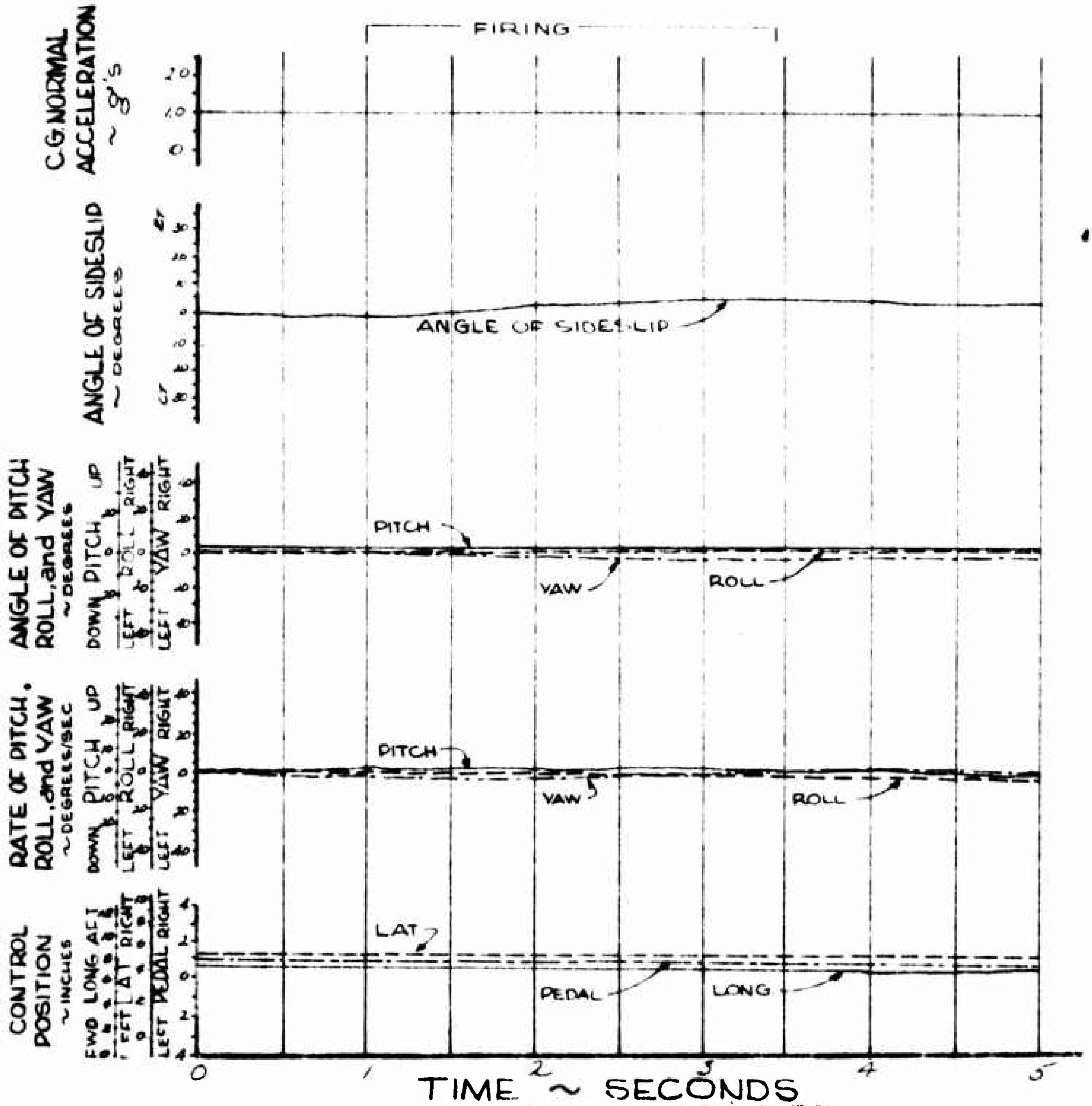


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FIGURE NO. 228

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL DOWN (60°) FLIGHT CONDITION: LEVEL FLIGHT (UNYAWED)
AVERAGE GROSS WEIGHT: 2130 LBS. TRIM CAS: 114 KNOTS
LONG. C.G. LOCATION: 102 INCHES DENSITY ALTITUDE: 4400 FEET
LATERAL C.G. LOCATION: 2.77 IN (LT) ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK ROLL - - - - and LAT. STICK YAW —-—-— and PEDAL

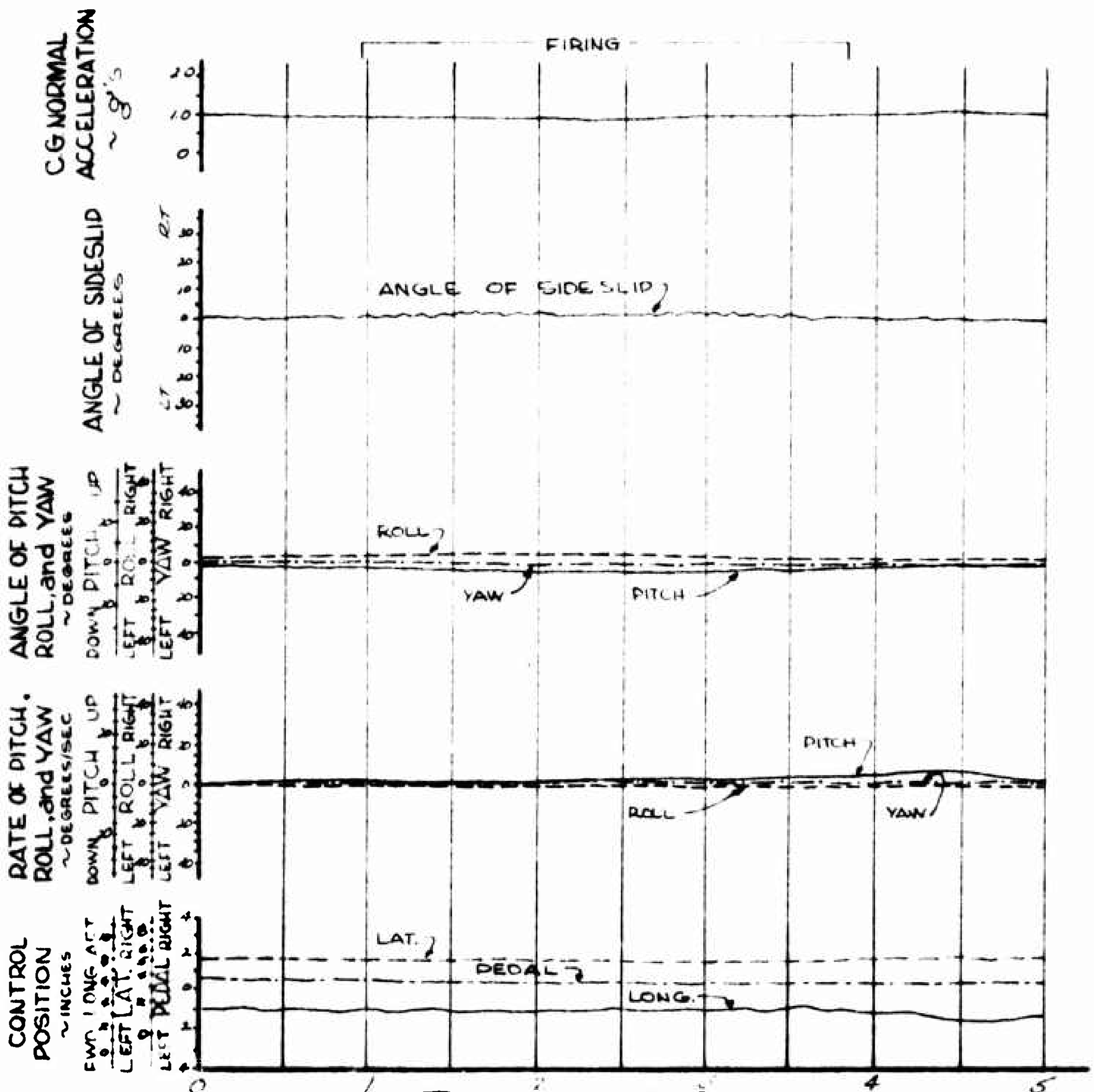

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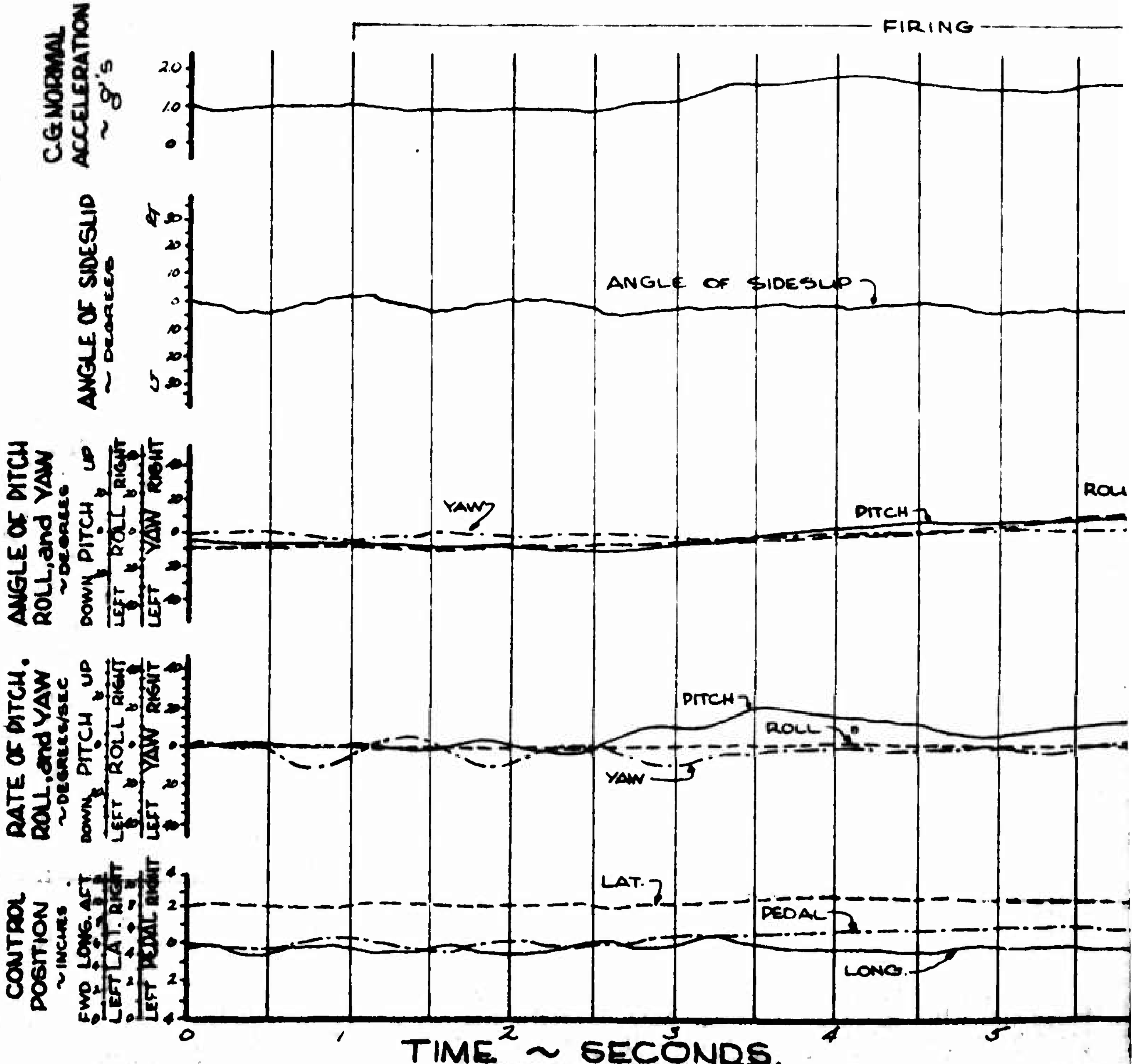
FIGURE NO. 229

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-7 FULL DOWN (20°) FLIGHT CONDITION: RT. ROLLING PULL-OUT
AVERAGE GROSS WEIGHT: 2020 LBS. TRIM CAS: 80 KNOTS
LONG. C.G. LOCATION: 102 INCHES DENSITY ALTITUDE: 4100 FEET
LATERAL C.G. LOCATION: 2.77 IN. (LT.) ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK ROLL - - - - and LAT. STICK YAW — - — - and PEDAL.



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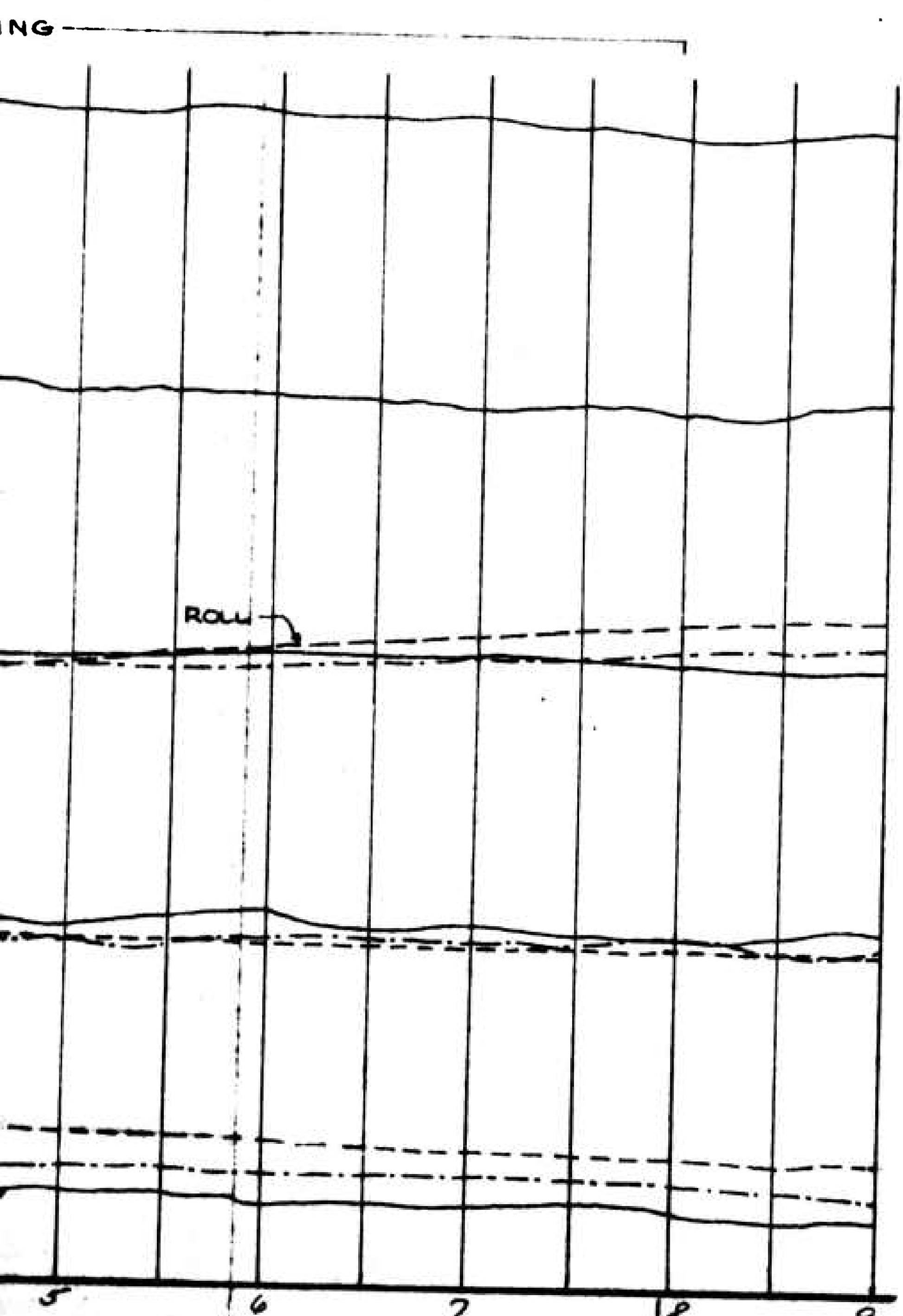
G

NG PULL-OUT

FEET
M



1 2

FIGURE NO. 230

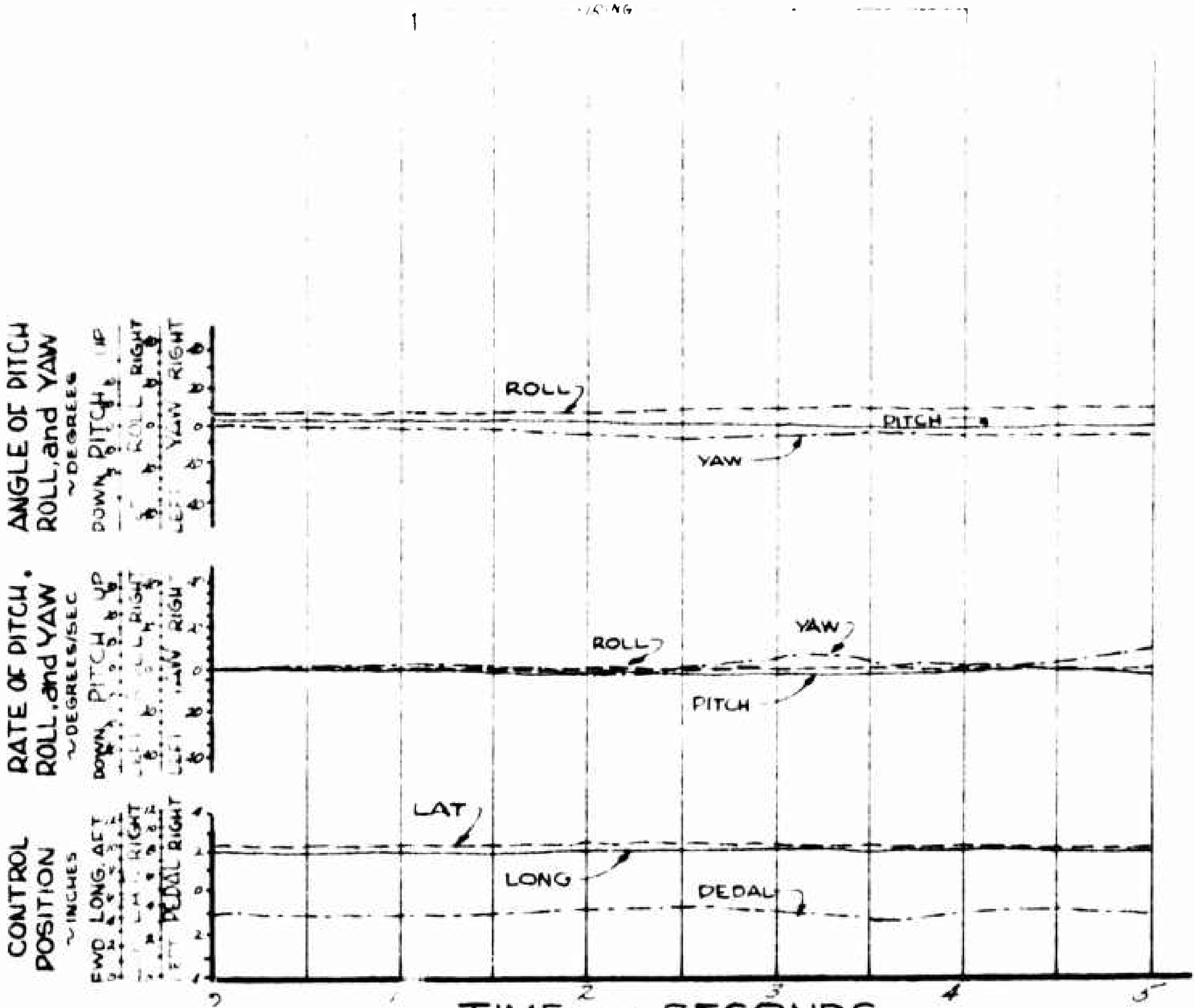
TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8 FULL UP (10°)
AVERAGE GROSS WEIGHT: 2100 LBS.
LONG. C.G. LOCATION: 101 INCHES
LATERAL C.G. LOCATION: 2.84 IN. (LT.)

FLIGHT CONDITION: HOVER (IGE)
TRIM CAS: ZERO
DENSITY ALTITUDE: 4200 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL - - - - and LAT STICK
YAW — - — - — and PEDAL



TIME ~ SECONDS

FIGURE NO. 231

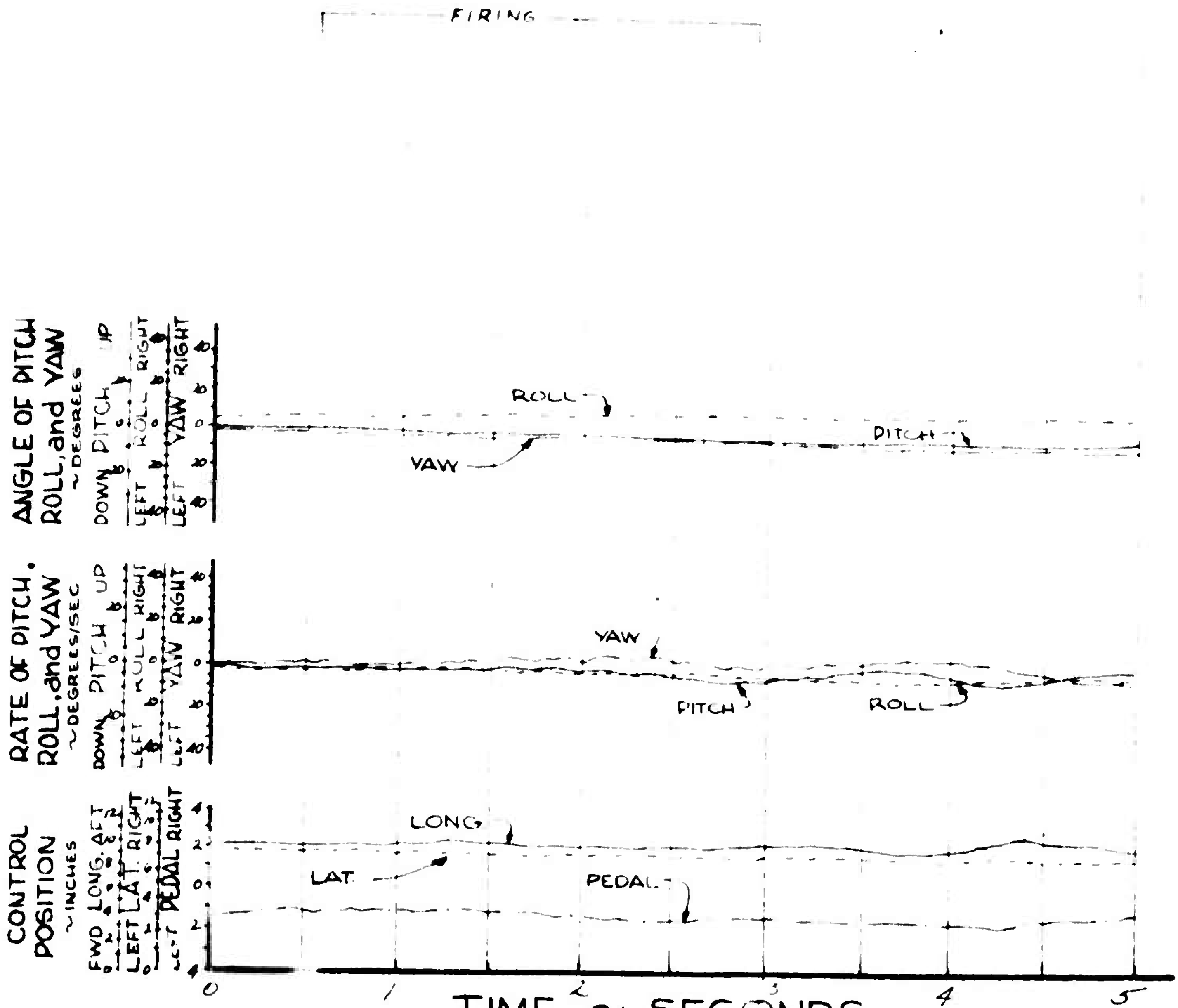
TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8 FULL DOWN (20°)
AVERAGE GROSS WEIGHT: 2110 LBS.
LONG. C.G. LOCATION: 101 INCHES
LATERAL CG LOCATION: 2.84 IN. (LT)

FLIGHT CONDITION: HOVER (IGE)
TRIM CAS: ZERO
DENSITY ALTITUDE: 4200 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK
ROLL - - - - and LAT STICK
YAW — - - - — and PEDAL



FOR OFFICIAL USE ONLY

FIGURE NO. 232

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

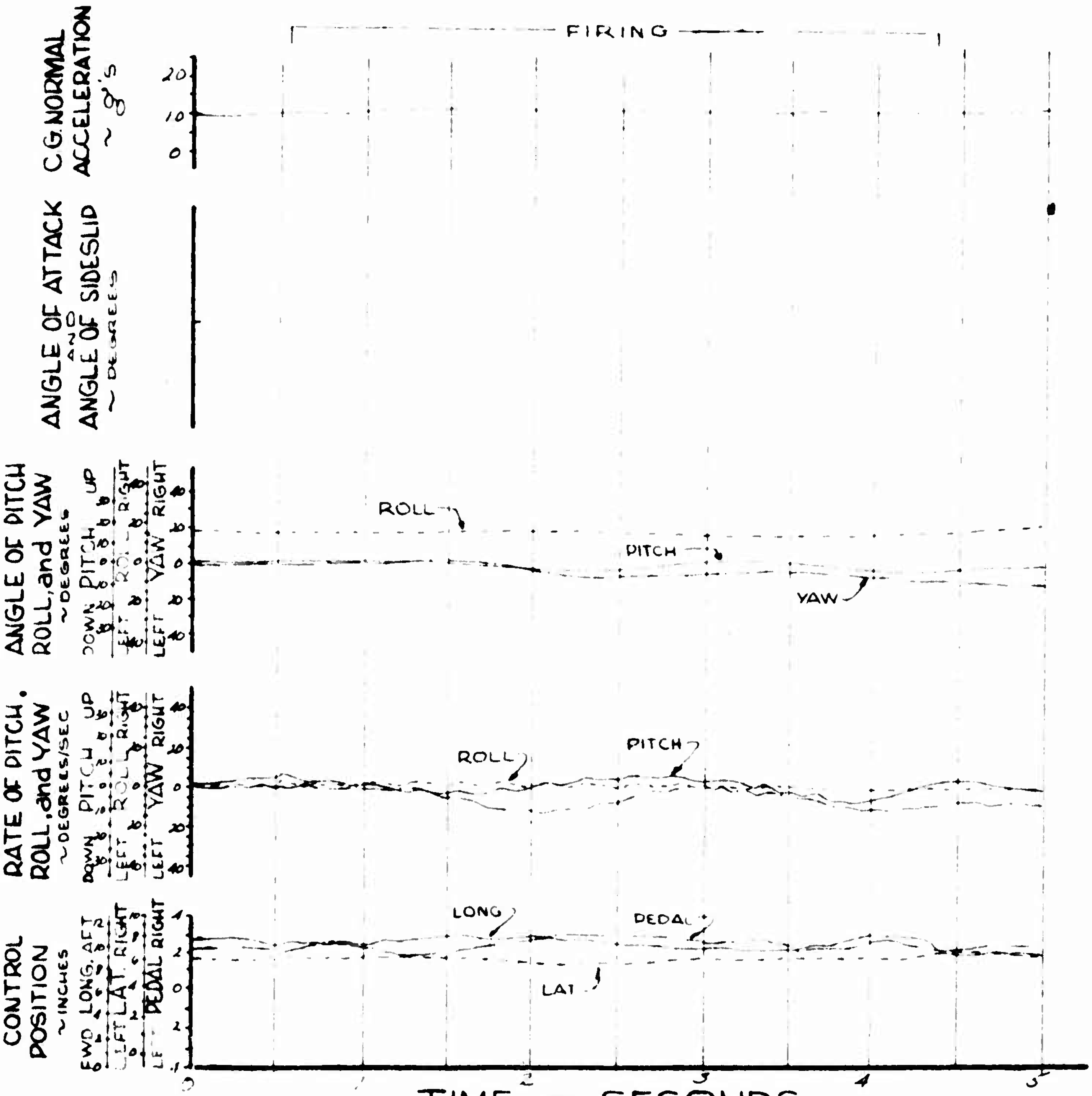
CONFIGURATION: XM-8 FULL DOWN (20°) FLIGHT CONDITION: LT SIDEWARD FLIGHT (1(

AVERAGE GROSS WEIGHT: 2090 LBS TRIM CAS: EST. 20-30 KNOTS

LONG. C.G. LOCATION: 101 INCHES DENSITY ALTITUDE: 4200 FEET

LATERAL C.G. LOCATION: 2.84 IN (LT.) ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK ROLL ---- and LAT. STICK YAW -·-·- and PEDAL



FOR OFFICIAL USE ONLY

FIGURE NO. 233

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

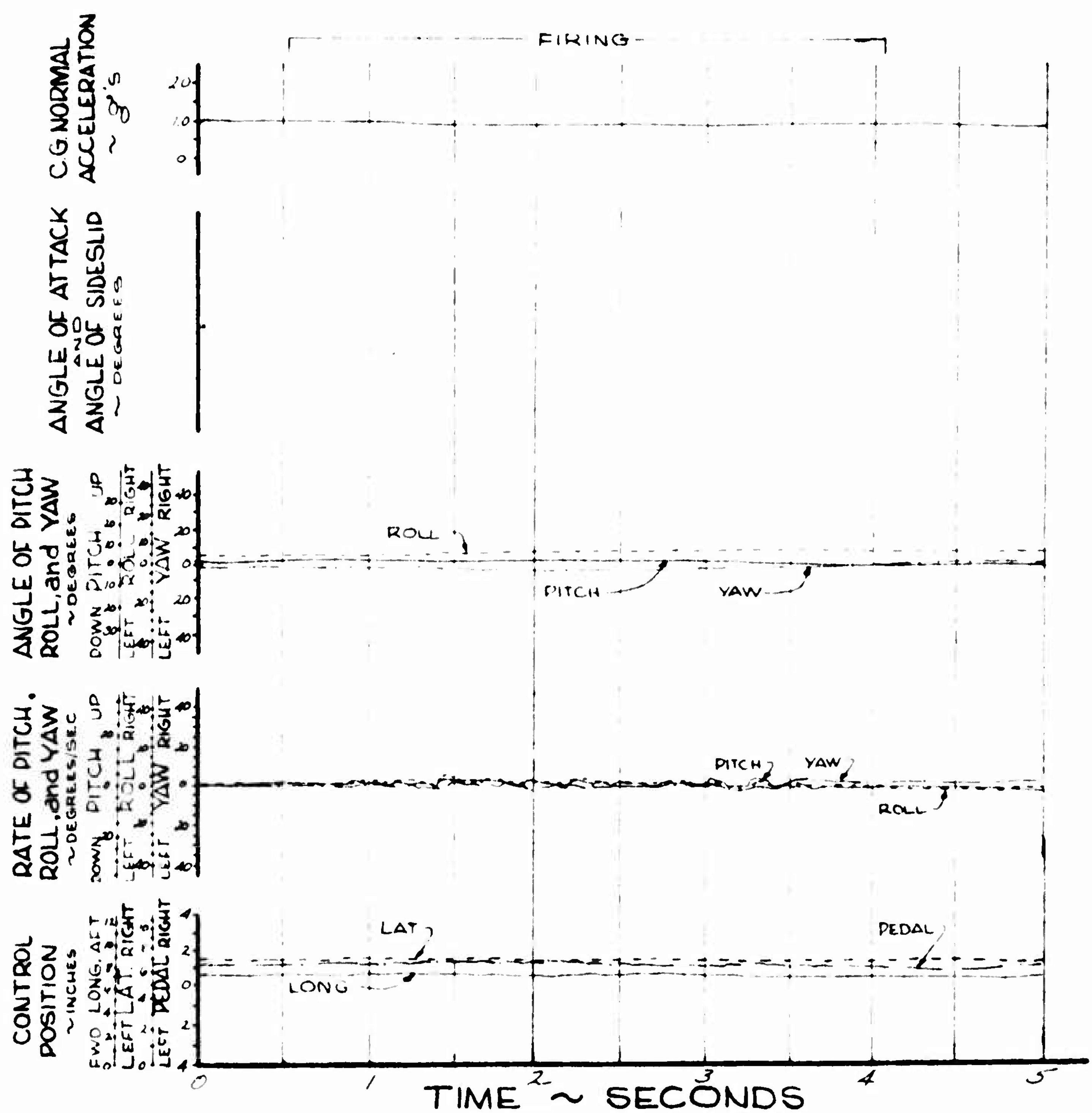
CONFIGURATION: XM-8 FULL DOWN (20°) FLIGHT CONDITION: LEVEL FLIGHT UNYAWE

AVERAGE GROSS WEIGHT: 2080 LBS. TRIM CAS: 35 KNOTS

LONG. C.G. LOCATION: 101 INCHES DENSITY ALTITUDE: 4600 FEET

LATERAL C.G. LOCATION: 2.84 IN. (LT.) ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK ROLL - - - - and LAT. STICK YAW — - — - and PEDAL



FOR OFFICIAL USE ONLY

FIGURE NO. 234

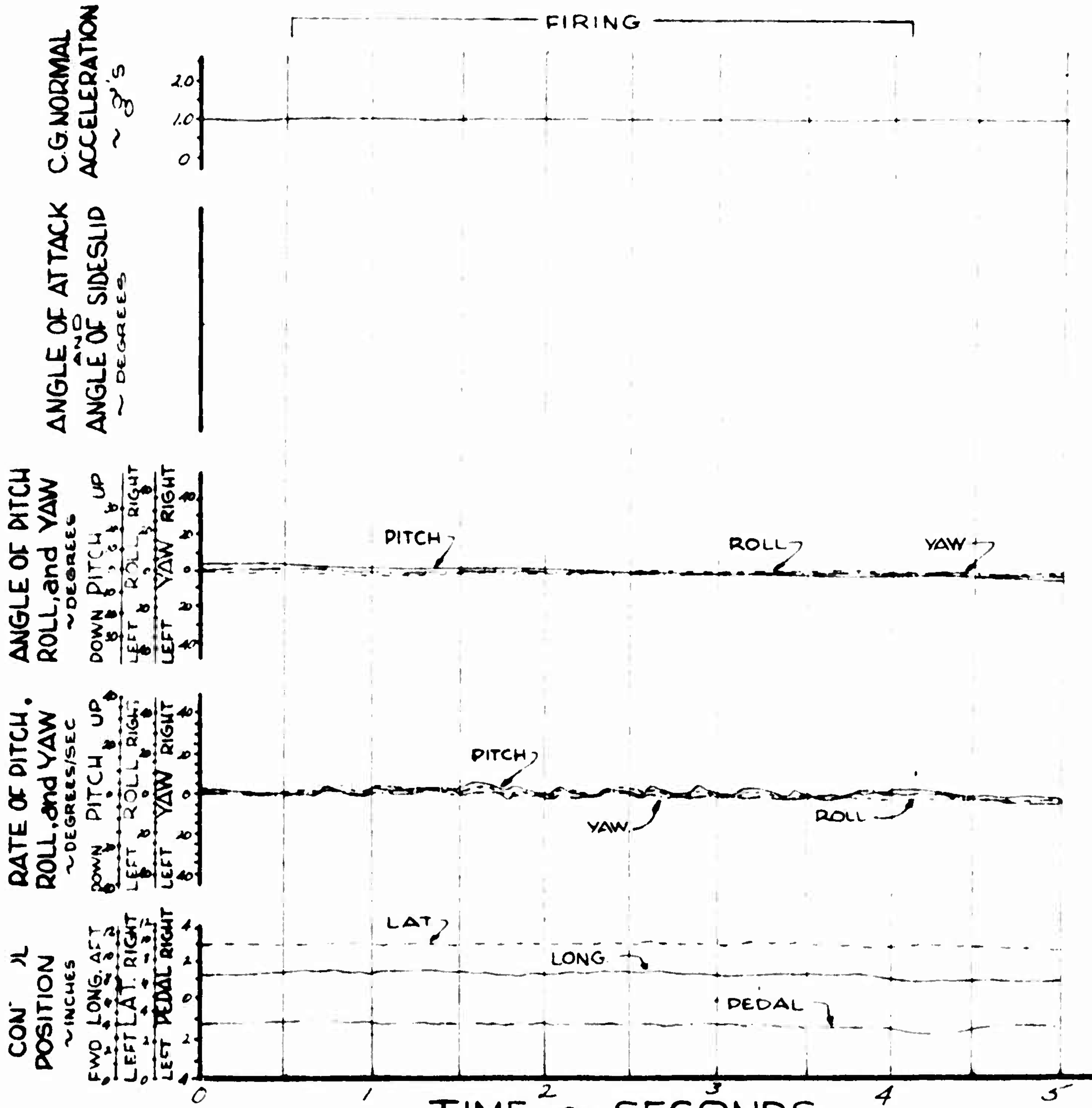
TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8 FULL DOWN (20°)
AVERAGE GROSS WEIGHT: 2070 LBS.
LONG. C.G. LOCATION: 101 INCHES
LATERAL C.G. LOCATION: 2.84 IN (LT)

FLIGHT CONDITION: LEVEL FLIGHT YAWED 45° RT. (IGE)
TRIM CAS: 35 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH and LONG STICK ———
ROLL and LAT. STICK - - - -
YAW and PEDAL —·—·—



TIME ~ SECONDS

FOR OFFICIAL USE ONLY

FIGURE NO. 235

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8 FULL DOWN (20°)	FLIGHT CONDITION: LEVEL FLIGHT (UNYAWED)
AVERAGE GROSS WEIGHT: 2060 LBS	TRIM CAS: 80 KNOTS
LONG. C.G. LOCATION: 101 INCHES	DENSITY ALTITUDE: 4800 FEET
LATERAL C.G. LOCATION: 2.84 IN (LT)	ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK ROLL - - - - and LAT STICK YAW — - — - — and PEDAL

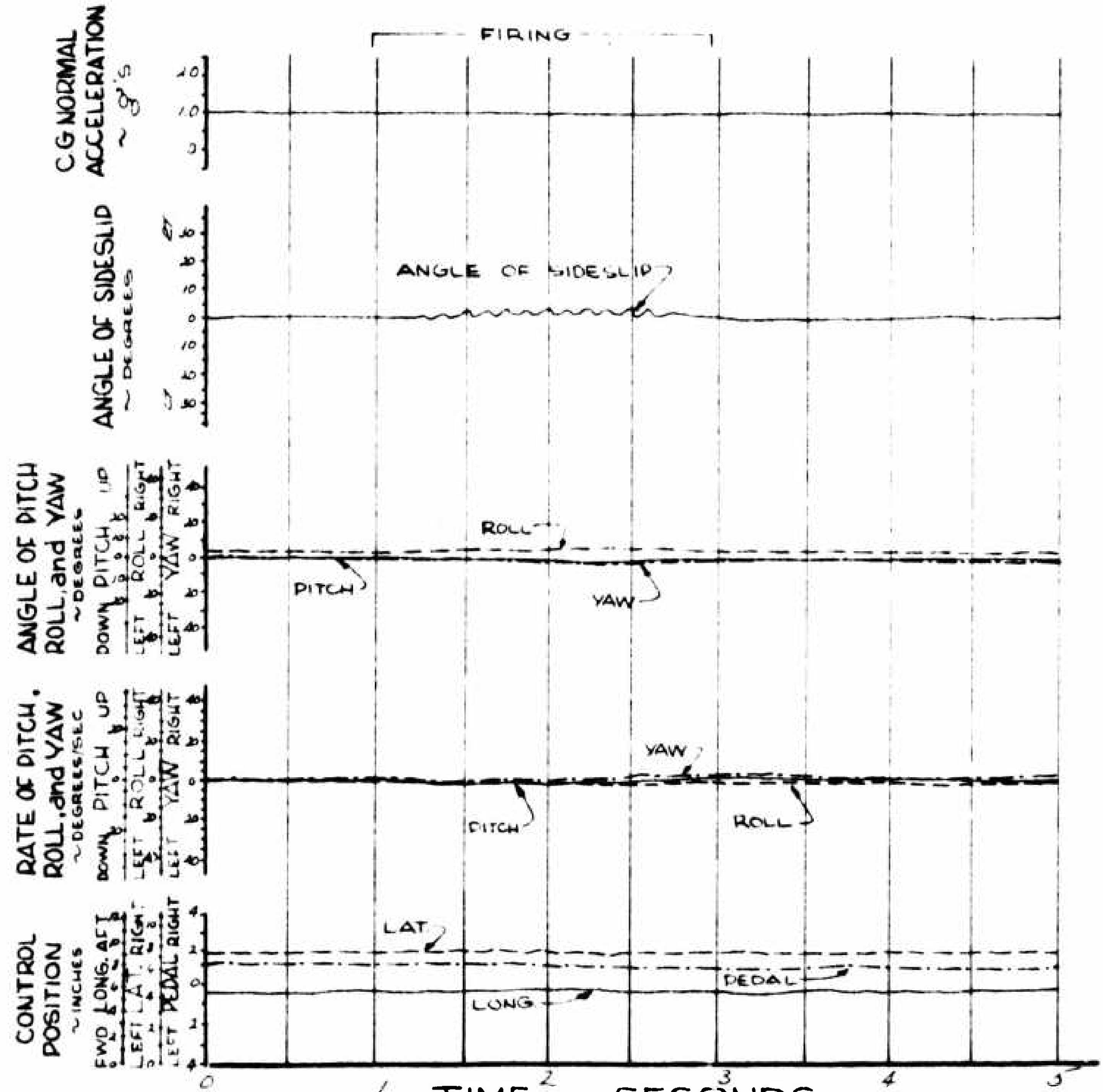


FIGURE NO. 236

TIME HISTORY OF ARMAMENT FIRING

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: XM-8 FULL DOWN (20°) FLIGHT CONDITION: DIVING PULLOUT
AVERAGE GROSS WEIGHT: 2040 LBS. TRIM CAS: 80 KNOTS
LONG. C.G. LOCATION: 101 INCHES DENSITY ALTITUDE: 4600 FEET
LATERAL C.G. LOCATION: 2.84 IN. (LT.) ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK   ROLL - - - - and LAT. STICK   YAW — - — - — and PEDAL

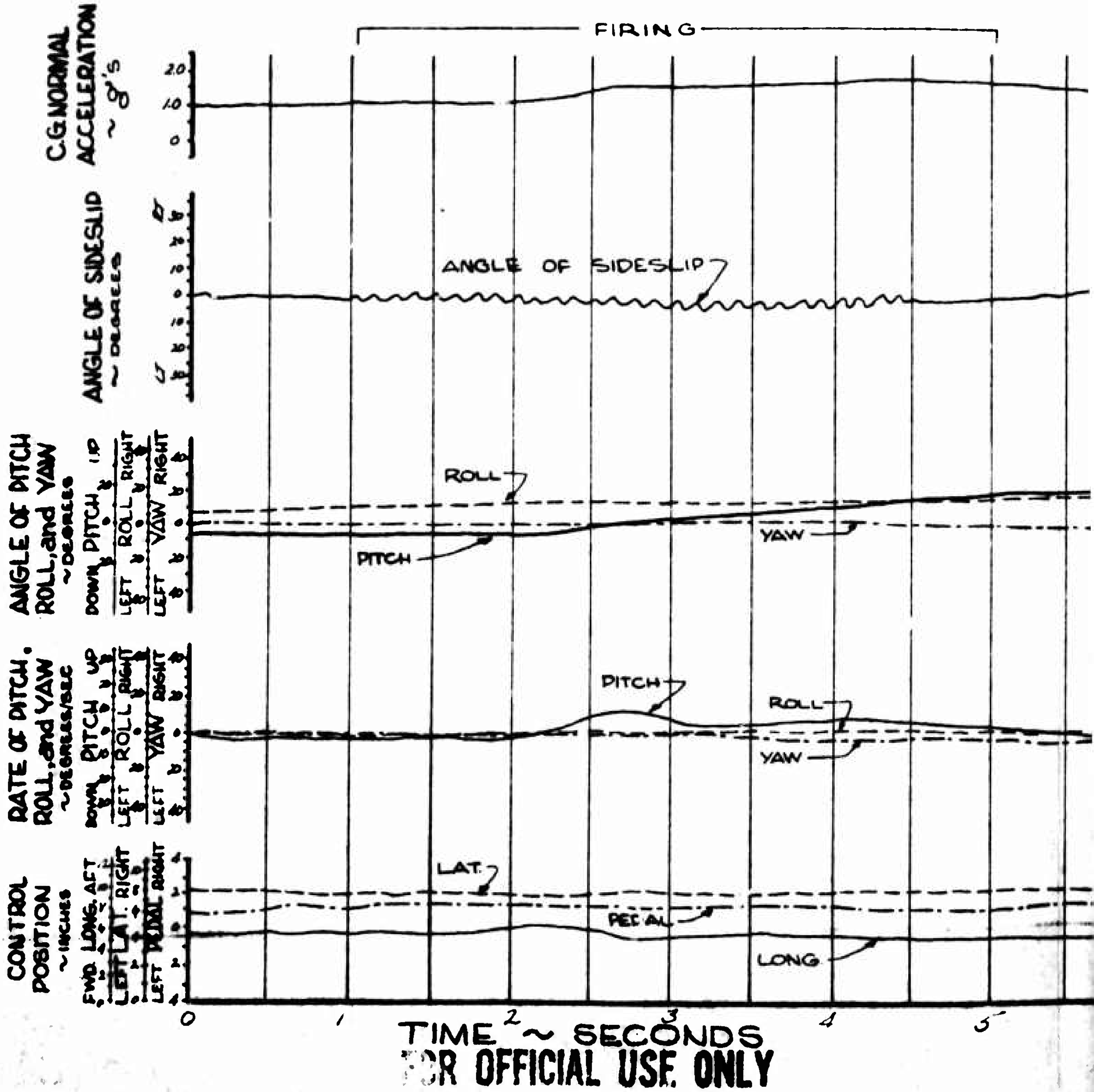


FIGURE NO. 237

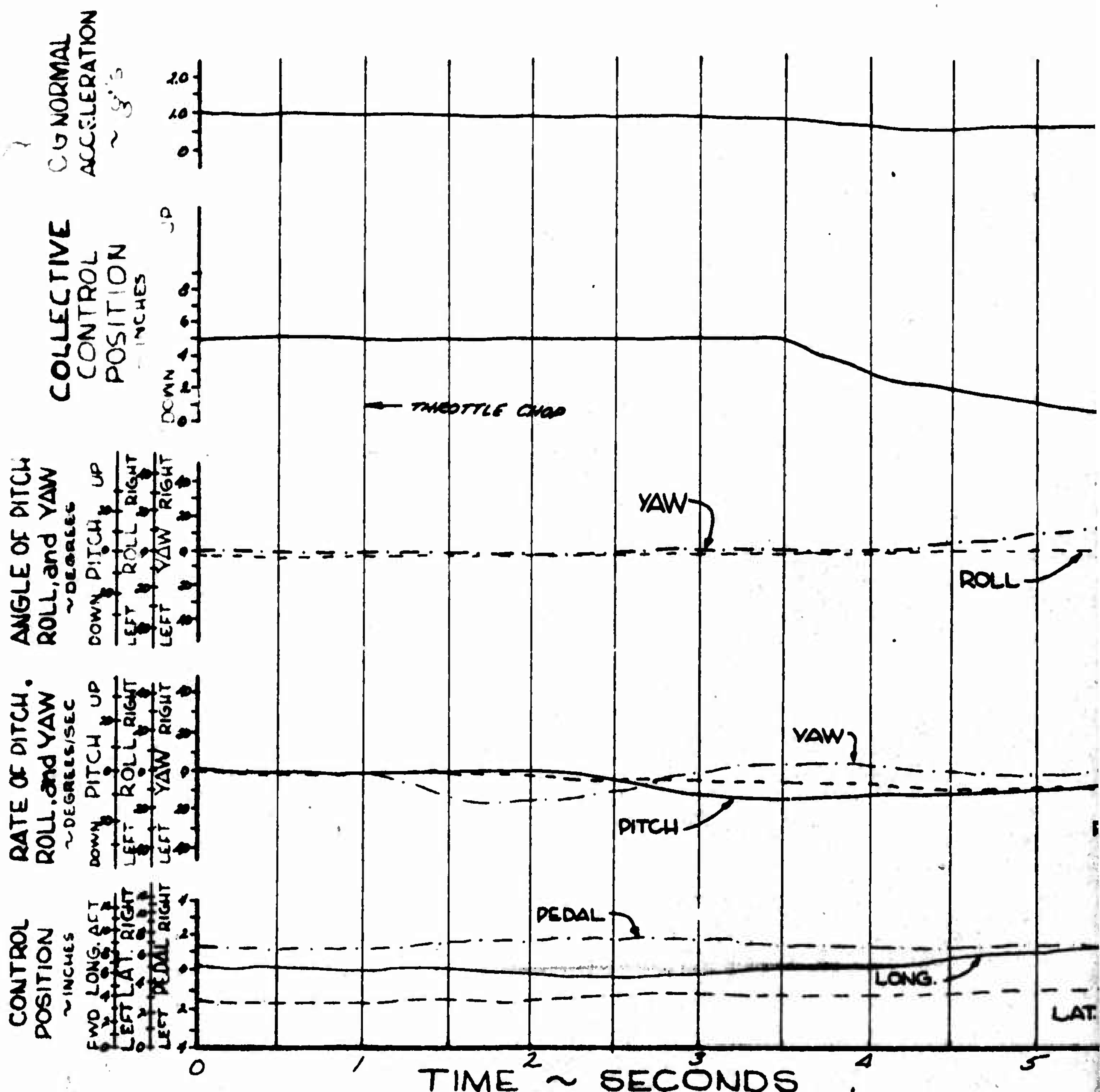
TIME HISTORY OF A THROTTLE CHOP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION: CLEAN
AVERAGE GROSS WEIGHT: 2150 LBS.
LONG C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 30 KNOTS
DENSITY ALTITUDE: 5000 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK
ROLL - - - - and LAT. STICK
YAW — - — - and PEDAL



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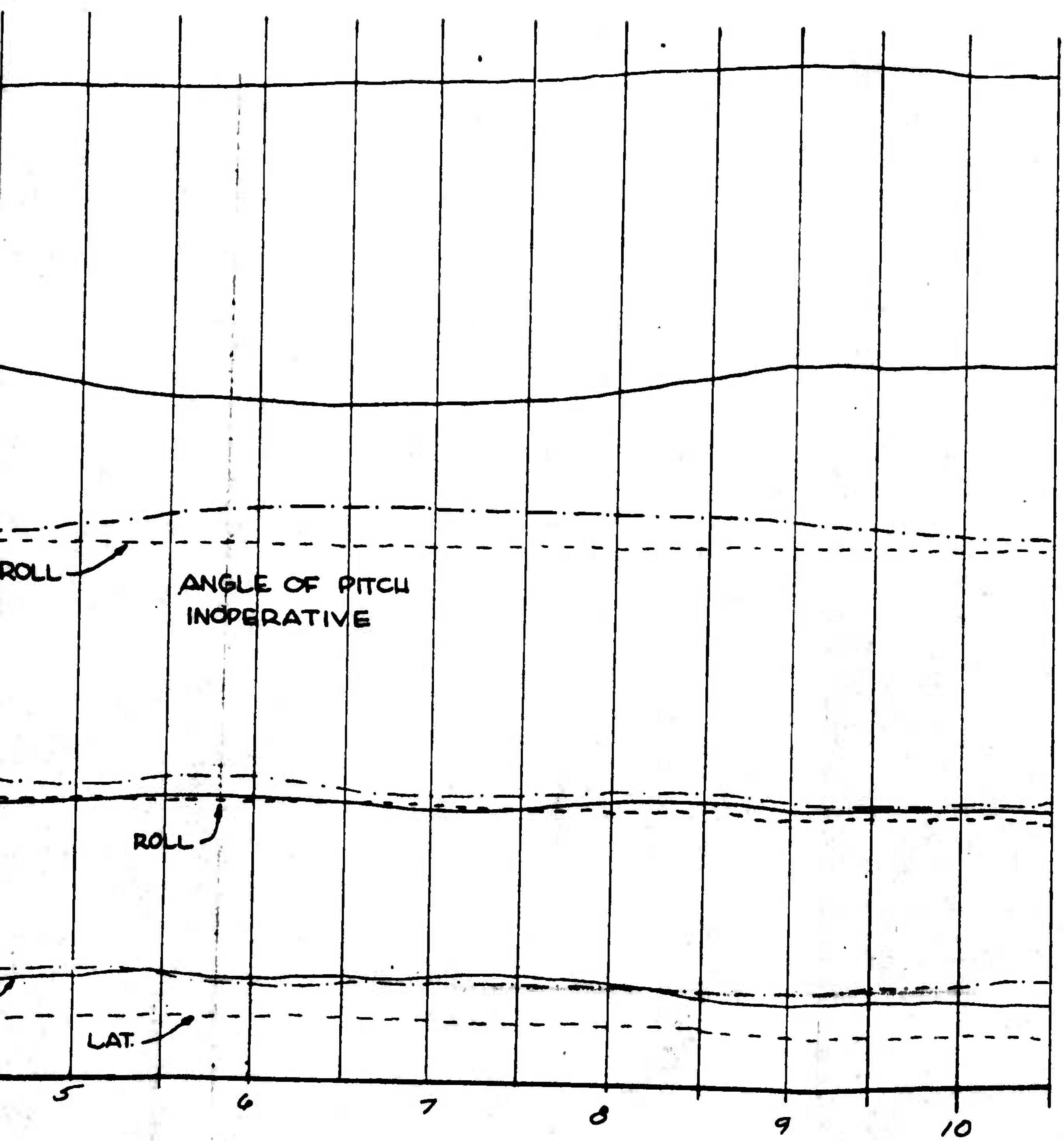
P

EL FLIGHT

O FEET
OM



2

FIGURE NO. 238

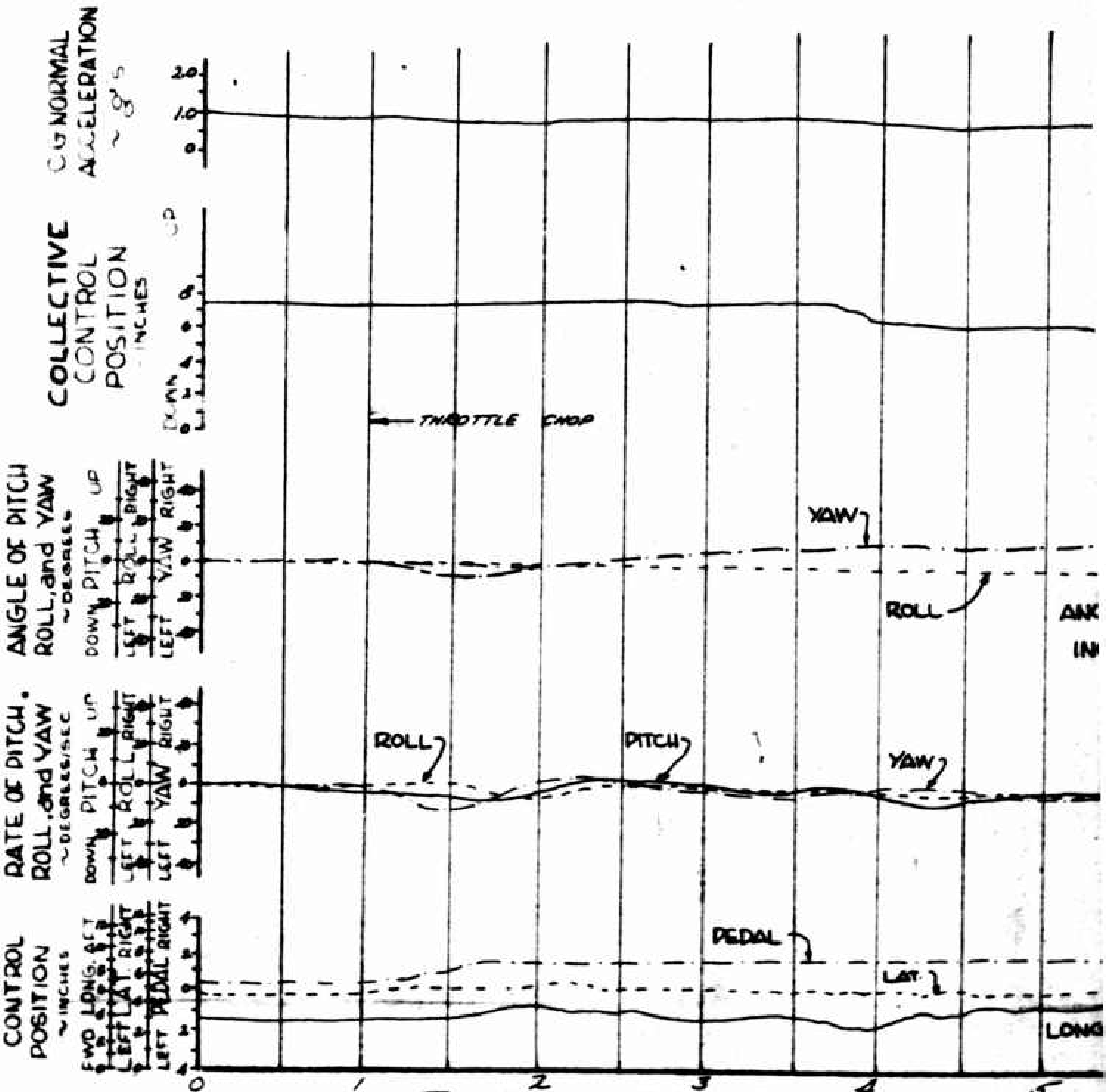
TIME HISTORY OF A THROTTLE CHOP

OH-6A, U.S.A., S/N 62-4214

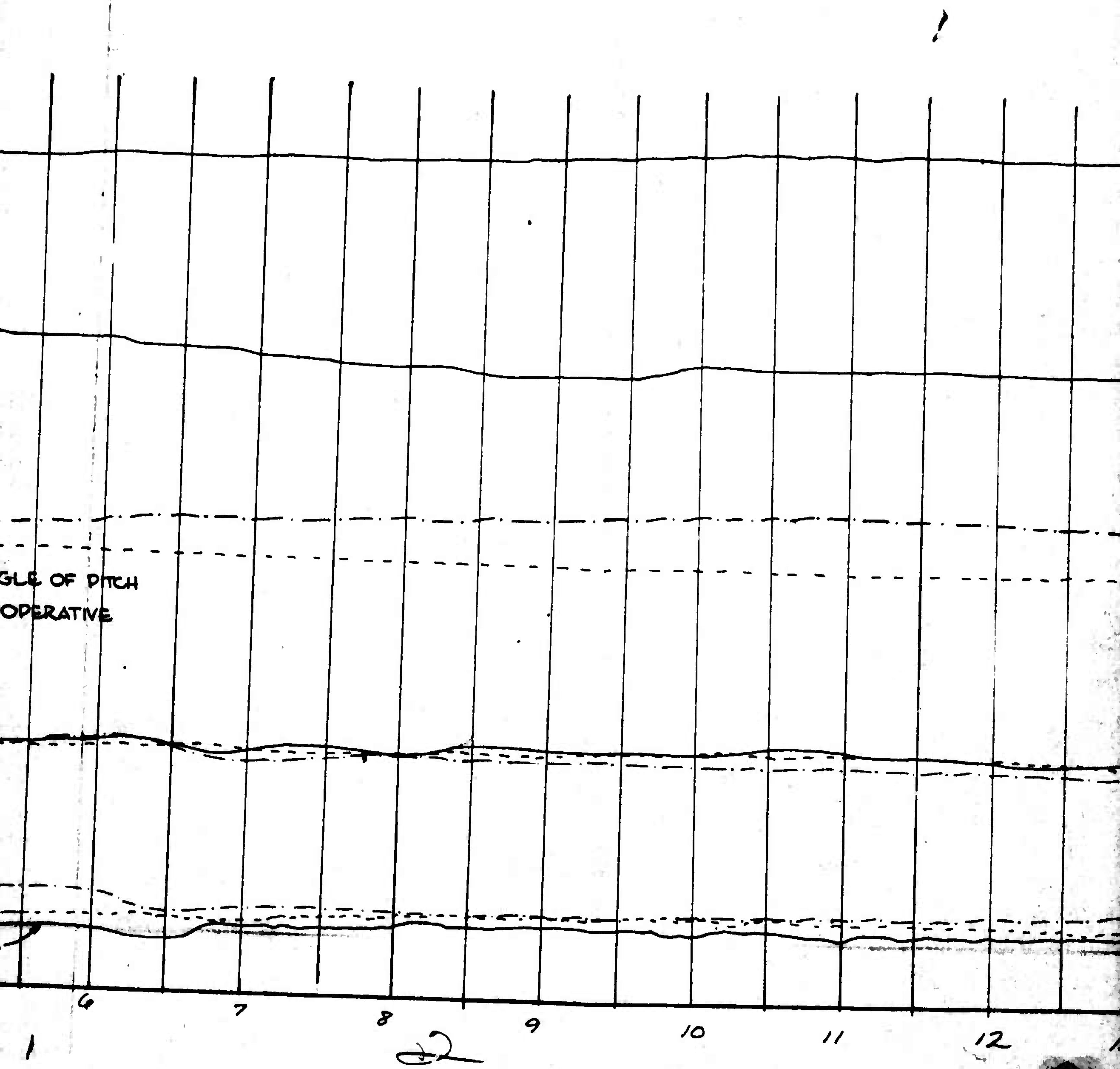
CONFIGURATION: CLEAN
AVERAGE GROSS WEIGHT: 2120 LBS.
LONG. C.G. LOCATION: 103.5 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT.)

FLIGHT CONDITION: LEVEL FLIGHT
TRIM CAS: 98 KNOTS
DENSITY ALTITUDE: 10000 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG STICK
ROLL - - - - and LAT. STICK
YAW — - — - and PEDAL



FOR OFFICIAL USE ONLY



GLE OF PITCH
OPERATIVE
6
7
8
9
10
11
12

FIGURE NO 239

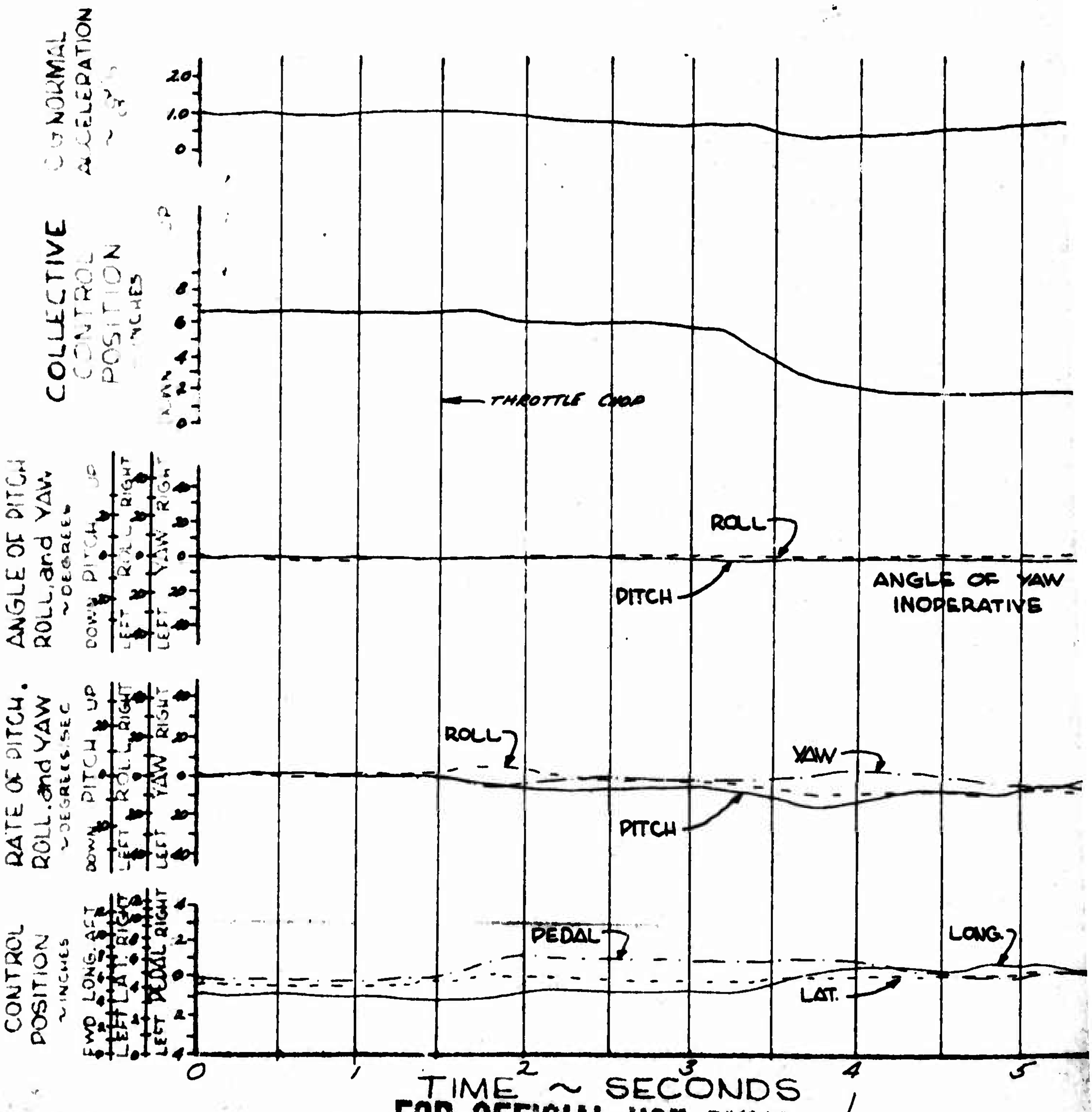
TIME HISTORY OF A THROTTLE CHOP

OH-6A, U.S.A., S/N 62-4214

CONFIGURATION : CLEAN
AVERAGE GROSS WEIGHT : 2550 LBS.
LONG CG LOCATION : 103.5 INCHES
LATERAL CG LOCATION : .5 IN. (RT.)

FLIGHT CONDITION : LEVEL FLIGHT
TRIM CAS : 100 KNOTS
DENSITY ALTITUDE : 5000 FEET
ROTOR SPEED : 465 RPM

PITCH ——— and LONG STICK
ROLL - - - - and LAT STICK
YAW — - — - — and PEDAL



FOR OFFICIAL USE ONLY

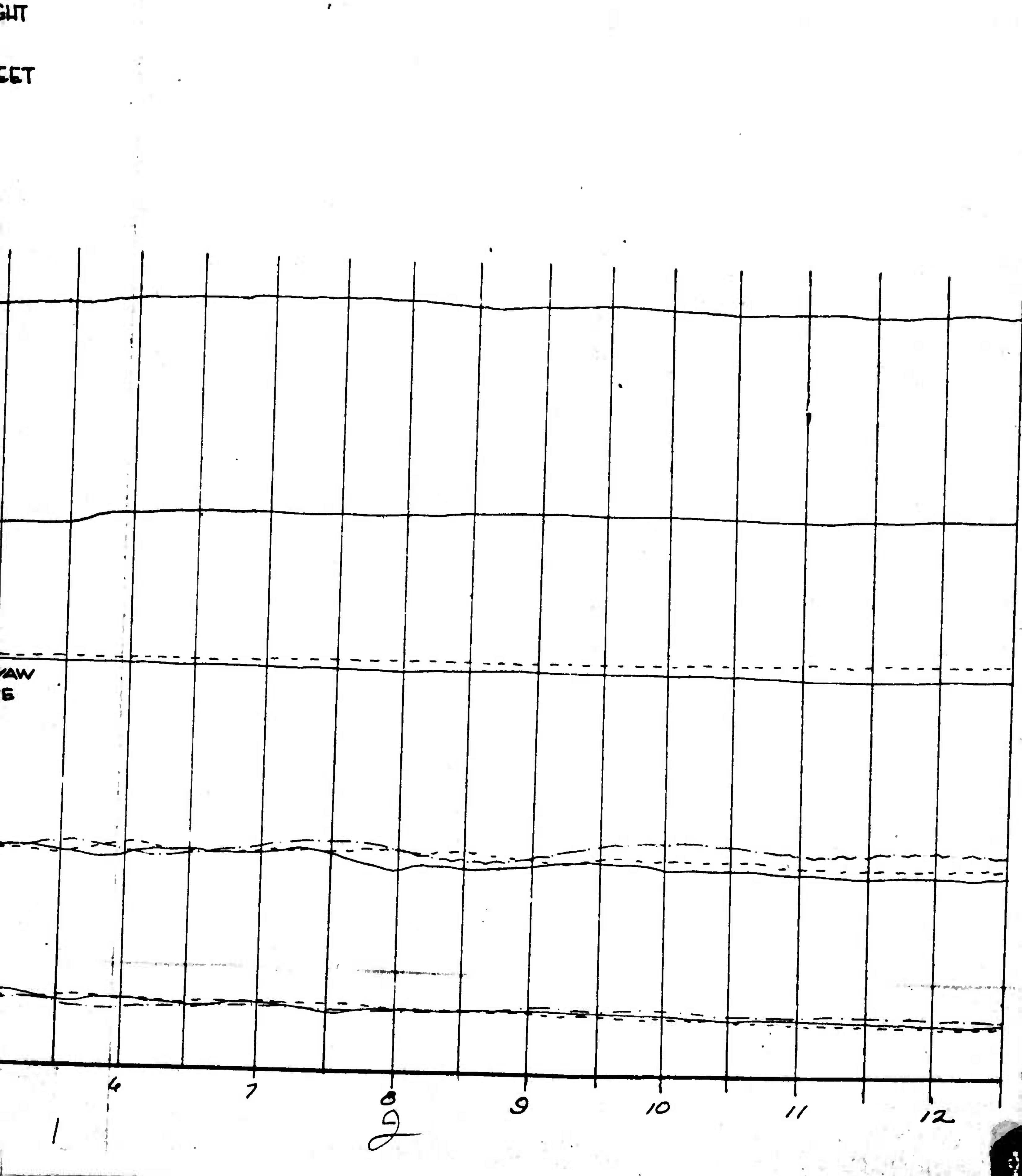

GHT
EET
YAW
E
4
7
8
9
10
11
12
1
2

FIGURE NO. 240

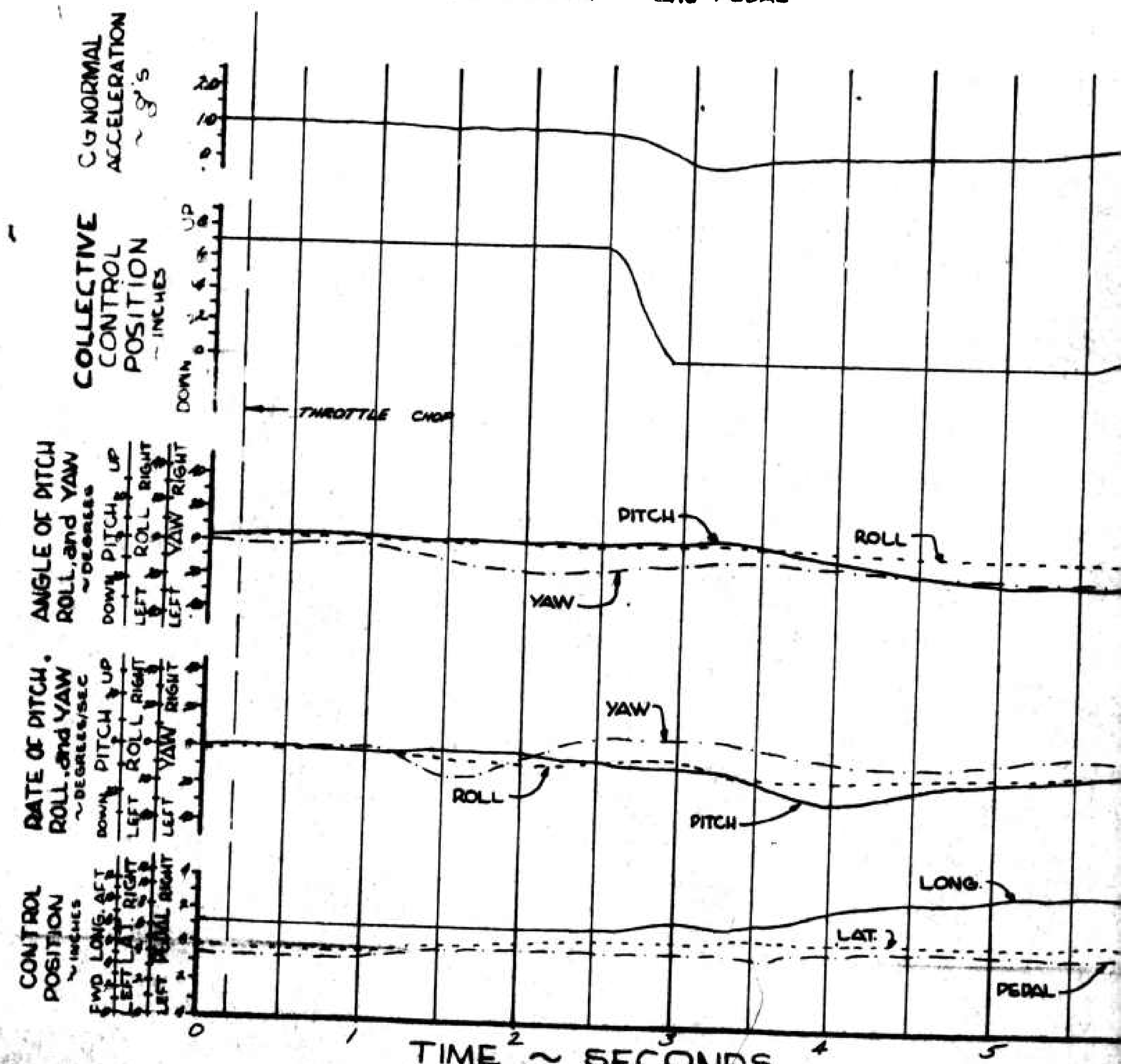
TIME HISTORY OF A THROTTLE CHOP

OH-6A, U.S.A., S/N 62-4214

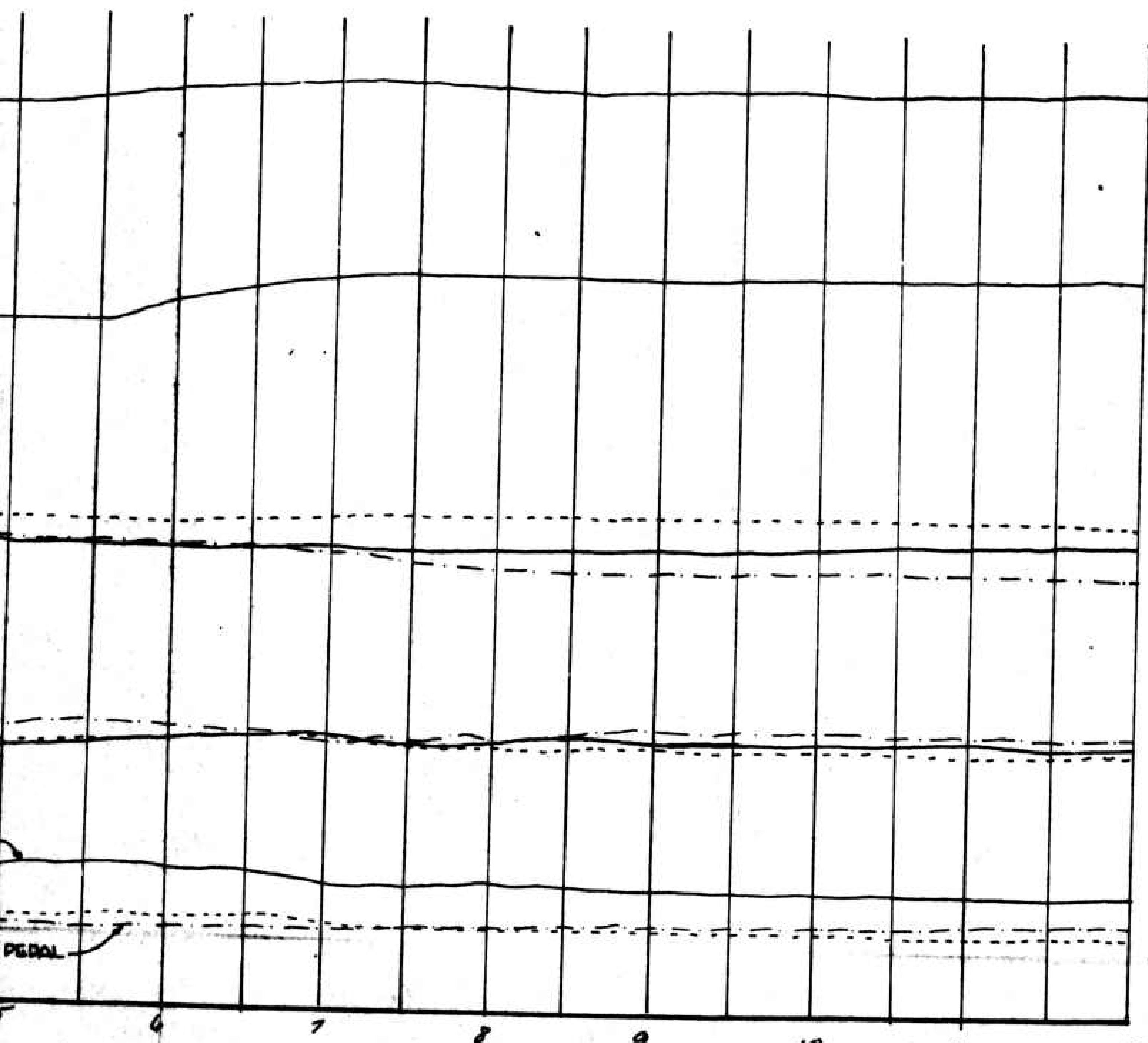
CONFIGURATION: CLEAN
AVERAGE GROSS WEIGHT: 2100 LBS.
LONG. C.G. LOCATION: 97 INCHES
LATERAL C.G. LOCATION: .5 IN. (RT)

FLIGHT CONDITION: CLIMB
TRIM CAS: 55 KNOTS
DENSITY ALTITUDE: 4000 FEET
ROTOR SPEED: 465 RPM

PITCH ——— and LONG. STICK
ROLL - - - - and LAT. STICK
YAW —-—-— and PEDAL



FEET



2

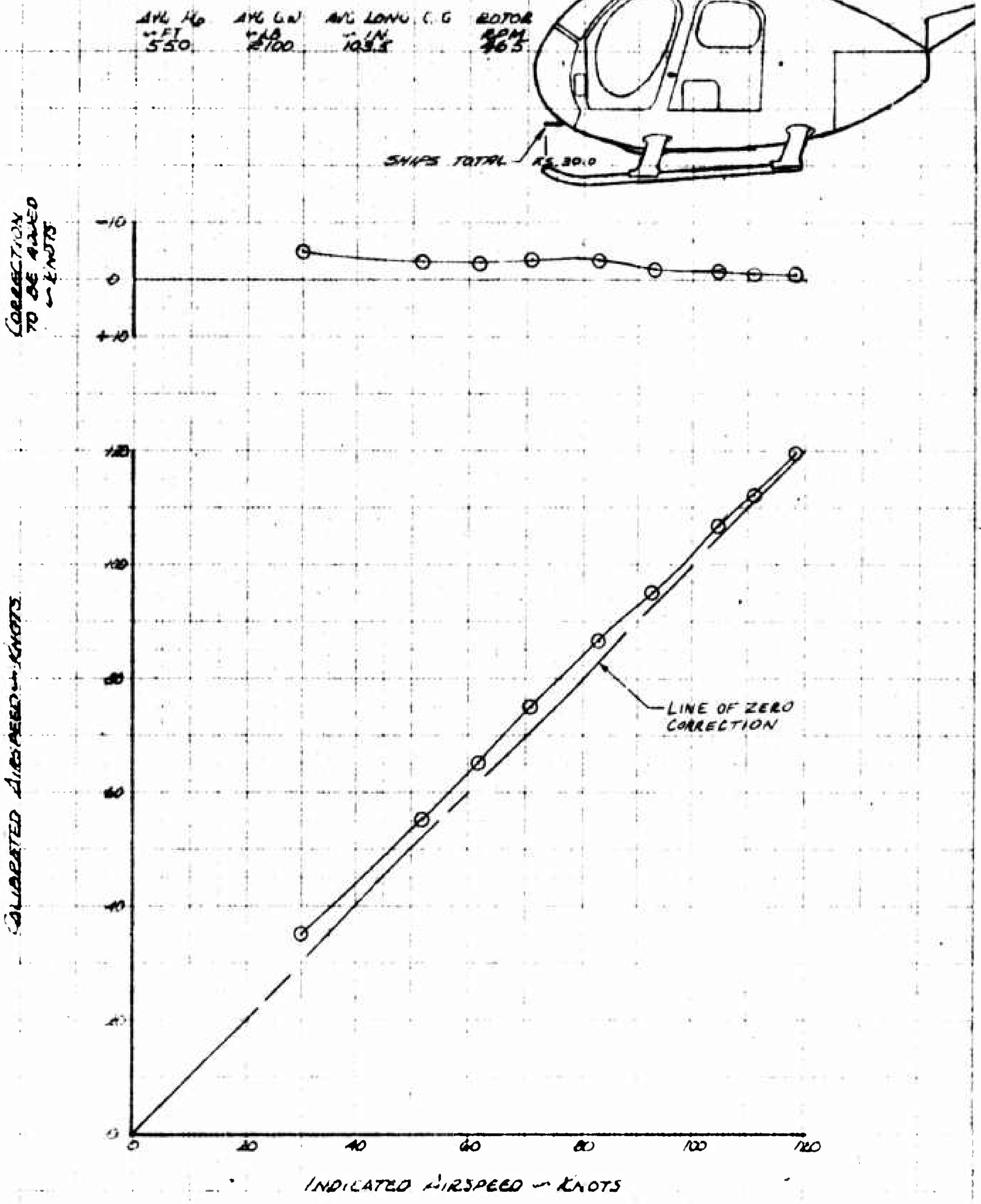
FIGURE NO. 241

AIRSPEED CALIBRATION

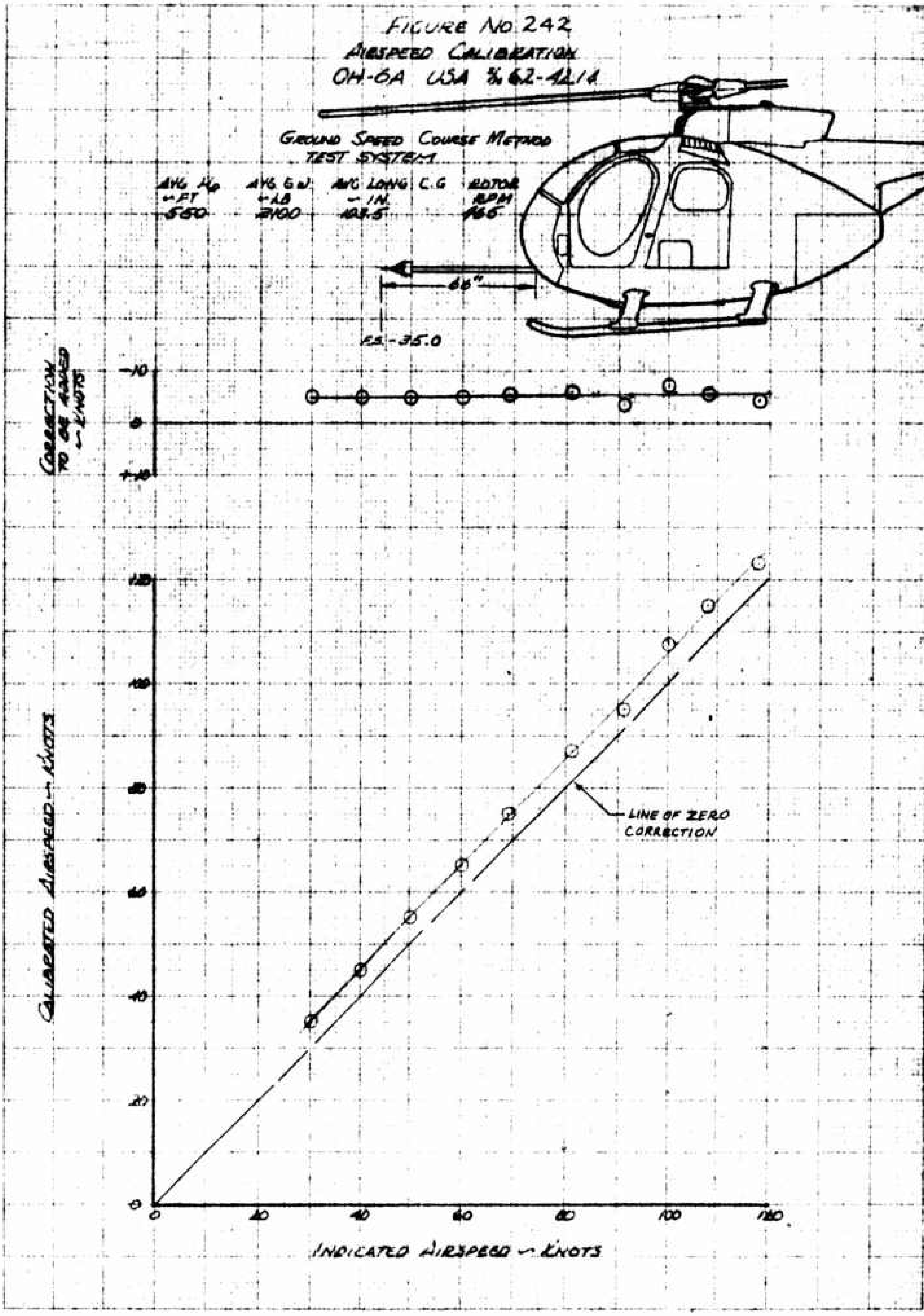
OH-6A USA S/N 62-4214

GROUND SPEED COURSE METHOD

STANDARD SYSTEM



FOR OFFICIAL USE ONLY



FOR OFFICIAL USE ONLY

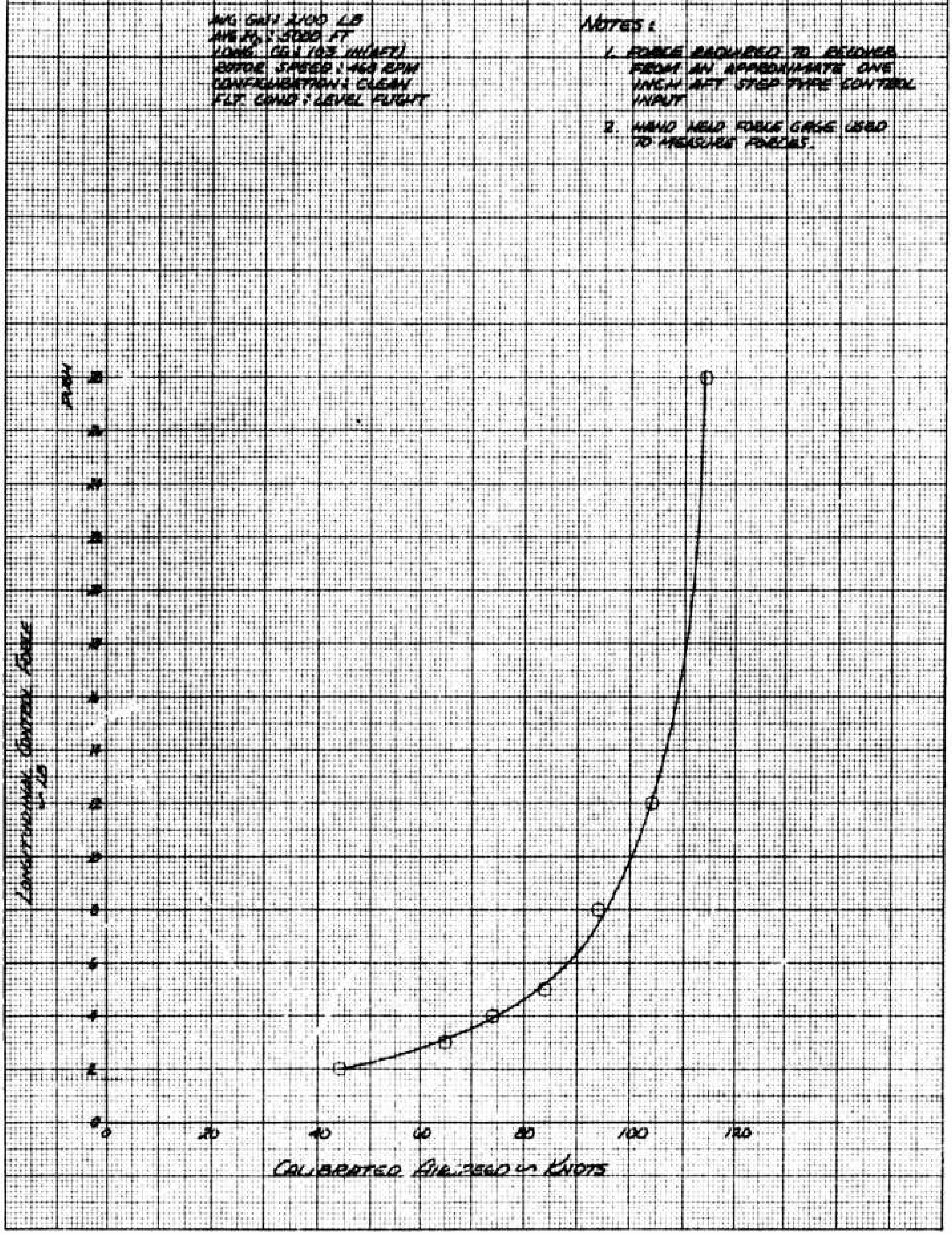


FIGURE NO. 243
LONGITUDINAL CONTROL FORCES
OH-6A USA S/N 62-4214

APPENDIX II

GENERAL AIRCRAFT INFORMATION

Aircraft Dimensions, Design Data and FAA Type Inspection Authorization Limitations, Weight and Balance and Test Instrumentation

1. Sources of Information

The following descriptive and design information was obtained from the FAA approved Flight Manual and the limitations were obtained from the FAA Type Inspection Authorization applicable at the time of the tests. The aircraft was flown to these limitations unless otherwise stated in the body of the report.

2. Description of Aircraft and Systems

2.1 Aircraft Design Data

a. Aircraft Dimensions and Certified Weights

Length (over-all)	30ft. 3 3/4 in.
Length (blades folded)	22ft. 9 1/2 in.
Height (over-all)	8ft. 1 1/2 in.
Width (fuselage)	4ft. 6 3/4 in.
Width (tread)	6ft. 9 1/4 in.
Rotor Diameter	26ft. 4 in.
Empty weight	1070 lb.
Design gross weight	2100 lb.
Overload gross weight	2700 lb.

b. Rotor Blade Control Travel

(1) Main Blade Movement Relative to Centerline of Mast

(a) Collective Pitch Travel at .75R — 6 - 7 deg up; 6 - 7 deg down

(b) Cyclic Pitch - Longitudinal Forward — 16 deg; Aft — 8 deg

Lateral Left	7.25 deg
Right	6.25 deg

(2) Tail Rotor Control Travel Blade Movements

(a) Collective	+27 deg (thrust to the right)
	-12 deg (thrust to the left)
(b) Swashplate	±0.63 in.

c. Rotor Dimensions and Design Data

Number of Blades	4
Main Rotor Diameter	26ft. 4 in.
Main Rotor Chord (Constant)	6.75 in.
Main Rotor Airfoil	NACA 0015
Main Rotor Twist	8 1/2
Tail Rotor Diameter	4ft. 3 in.
Tail Rotor Airfoil	NACA 0014 Modified
Tail Rotor Chord	4.81 in.

2.2 Aircraft Systems

2.2.1 Electrical System

A 28 volt, 65 ampere-hour nickel-cadmium battery provided D.C. power for all electrical services, including engine starting, which were protected by circuit breakers on the center console. Generator power was controlled by a master electrical selector switch and provision was made, under the left seat and inside the aircraft, for an external power receptical. In-flight electrical power was provided by a 28 volt, 100 ampere generator driven by the engine and controlled by a voltage regulator. A load-meter was provided in the cockpit and the battery could be isolated by moving the master control switch from "NORMAL" to "Generator."

2.2.2 Power Plant

The OH-6A is powered by an Allison T-63A free turbine engine rated at 275 SHP and utilizing a Bendix pneumatic fuel control system which provides automatic speed governing, acceleration control, altitude compensation and temperature compensation. The drive to the rotor is through a single gearbox which is rated at 250 SHP at 100 percent N_2 (6000 rpm). The tail rotor drive is taken off the same gearbox.

2.2.3 Landing Gear

A skid landing gear is fitted with four air/oil damped shock struts. Ground handling wheels permit one-man ground handling.

2.2.4 Fuel System

Two fabric-reinforced rubber bladder fuel cells are located under the flooring in the passenger-cargo compartment and have a useable capacity of 382 pounds. The fuel system is pressurized and consists of a booster pump, electrically actuated low pressure cut-off valve, fuel filter and engine-driven fuel pump. Range extension torso tanks can be fitted.

2.2.5 Control System

The flight control system used on the OH-6A helicopter is the convential stick and rudder type. The control system is manually operated and completely unboosted. The flight control system consists of the collective stick, the cyclic stick and the rudder pedals. Movement of the collective pitch control changes the angle of attack on all four blades by means of the collective control push rod. Forward and aft movement of the cyclic stick provides longitudinal control by the swashplate tilting forward or backward which in turn causes one complete cyclic pitch change per rotor rpm. Control of the tail rotor thrust is accomplished by means of control rods and bellcranks that are connected to the rudder pedals.

A uni-loc anti-feedback device is incorporated in the longitudinal control system. This device eliminates feedback of the aft longitudinal control forces from the rotor system to the pilot. Hydraulic oil is supplied to the uni-loc by a remotely located reservoir.

3. TIA Limitations

The following limitations were adhered to during the tests.

3.1 Engine and Transmission Limitations

a. Rating	Takeoff (5 min.)	Maximum Continuous
SHP	250	212
Gas Producer rpm	48,950	47,350
Output Shaft rpm	6000	6000
Measured TOT	1240 deg F (671 deg C)	1165 deg F (630 deg C)

NOTE: The above engine ratings are based on static sea-level conditions. The maximum allowable torque as measured by the torque meter is 219 foot-pounds (250 SHP @ 100 percent N_2) for takeoff (5 minute limit), and 180 foot-pounds (212 SHP @ 100 percent N_2) for maximum continuous operation; equivalent to 91 percent and 77 percent torque, respectively.

b. Temperature Limits

Takeoff (5 minutes)	1360 deg F (738 deg C)
Continuous	1280 deg F (693 deg C)
Maximum Transient (6 seconds)	1550 deg F (843 deg C)
Oil Inlet Temperature	-65 deg F to 200 deg F

c. Engine Speed Limitations

	Minimum	Normal	Maximum
N_1	55%	-	102%
N_2 Power-On	99%	100%	103%
N_2 Power-On Transient (15 second)	-	-	105% at T/O Power 110% at Flight Idle
N_2 Power-Off	-	97%	-

3.2 Airframe and Rotor Limitations

a. Rotor Speed

	Maximum	Minimum
Power-On	484 rpm	465 rpm
Power-Off	540 rpm	380 rpm

b. Load Factor

Power-On	+ 2.58 g's
Power-Off	+ 2.91 g's

c. Weight and Center of Gravity

Design Weight	2100 lb
Overload Weight	2700 lb
Maximum Fwd C.G.	Sta. 97 (3 in. fwd)
Maximum Aft C.G.	Sta. 104 (4 in. aft)
Maximum Lateral C.G.	± 3 in. 2100 lb

d. Maximum Cargo Loading

130 lb/ft^2
Station 78.5 to 125

3.3 Airspeed Limitations

a. Forward Flight (Speeds in Knots Calibrated Airspeed [KCAS])

Altitude (feet) →		S/L	2000	4000	6000	8000	10000	12,000
2700 lb	V_{NE} (kt)	111	100	90	82	74	67	60
	V_{Dive} (kt)	123	111	100	91	82	74	66
2100 lb	V_{NE} (kt)	128	125	117	109	99	89	79
	V_{Dive} (kt)	142	138	130	121	110	99	88

b. Sideward and Rearward Flight (KCAS)

	Sideward	Rearward
2100 lb	35 kt	35 kt
2700 lb	10 kt	10 kt

3.4 Sideslip Limitation

Airspeed (kt)	30	40	60	80	100	110	120
Sideslip Angle (deg)	90	73	46	38	16	12	9

4.0 Weight and Balance

Aircraft S/N 62-4214 was weighed and its balance ascertained, in an uninstrumented condition in a closed hangar with an electric weighing kit. The aircraft contained trapped fuel and full oil. The results of this weighing were as follows:

Gross Weight	1077 lb
Center-of-Gravity	Station 109.5

A typical loading to bring the OH-6A up to the design gross weight of 2100 pounds would include:

Basic Weight	1077 lb
60 Gallons Fuel @ 6.5 lb/gal	390 lb
Crew of Two	400 lb
Cargo	233 lb
	2100 lb

Armament installations (including ammunition) that can be installed on the OH-6A and their weights are as follows:

XM-7 (left side	226 lb
XM-8 (left side)	257 lb

Prior to initiating the test program, aircraft S/N 62-4214 was weighed and the center-of-gravity determined with instrumentation installed. Ballast was added to achieve the following engine-start conditions:

Aircraft 62-4214 Configuration	Gross Weight lb	Longitudinal Center-of-Gravity in.	Lateral Center-of-Gravity in.
Design GW, aft C.G.	2200	103.5	0.5 right
Design GW, fwd C.G.	2200	97.0	0.5 right
Overload GW, aft C.G.	2700	103.5	0.4 right

5.0 Test Instrumentation

Test instrumentation was installed by personnel from the Logistics Division, U. S. Army Aviation Test Activity.

The following sensitive calibrated instruments were installed in the cockpit and hand-recorded by an engineer observer:

1. boom system airspeed
2. boom system altitude
3. rotor rpm
4. angle of attack
5. fuel consumed counter
6. outside air temperature
7. angle of sideslip indicator

The following parameters were recorded on an oscillograph:

1. longitudinal cyclic stick position
2. lateral control position
3. pedal position
4. collective pitch position
5. pitch angle
6. roll angle
7. yaw angle
8. angle of sideslip
9. angle of attack
10. pitch rate
11. roll rate
12. yaw rate
13. C.G. normal acceleration
14. voltage monitor

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APPENDIX III

SYMBOLS AND ABBREVIATIONS

Symbol	Definition	Units
KIAS	knots indicated airspeed	kts
KTAS	knots true airspeed	kts
Vmax	maximum attainable airspeed	kts
Vne	never exceed airspeed	kts
Vmin R/D	airspeed for minimum rate of descent	kts
Vmax R/C	airspeed for maximum rate of climb	kts
Vmin Angle/Descent	speed for minimum angle of descent	kts
Vdive	maximum permissible diving airspeed NOTE: normally demonstrated by contractor	kts
R/D	rate of descent	ft/min
R/C	rate of climb	ft/min
RPM	revolutions per minute	rpm
IGE	in-ground effect	-
OGE	out-of-ground effect	-
C.G.	center of gravity	in.
N_1	compressor speed	rpm
N_2	power turbine speed	rpm
H_D	density altitude	ft
°F	degrees Fahrenheit	deg
°C	degrees centigrade	deg

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