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RESEARCH MEMORANDUM

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Air Materiel Command, Army Air Forces

FLIGHT MEASUREMENTS OF THE FLYING QUALITIES OF A

LOCKHEED P-80A AIRPLANE (ARMY NO. 44-85099) -

STALLING CHARACTERISTICS

By Seth B. Anderson and George E. Cooper

Ames Aeronautical Laboratory
Moffett Field, Calif.

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FLIGHT MEASUREMENTS OF THE FLYING QUALITIES OF A

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STALLING CHARACTERISTICS

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SUMMARY

This report contains the flight-test results of the stalling characteristics measured during the flying-qualities investigation of the Lockheed P-80A airplane (Army No. 44-85099). The tests were conducted in straight and turning flight with and without wing-tip tanks.

These tests showed satisfactory stalling characteristics and adequate stall warning for all configurations and conditions tested.

INTRODUCTION

Flight tests were conducted on a Lockheed P-80A airplane (Army No. 44-85099) at the request of the Air Materiel Command, Army Air Forces, to obtain quantitative measurements of the flying qualities. This report presents the data obtained during the stall tests. The longitudinal and the lateral and directional tests have been reported in references 1 and 2, respectively.

DESCRIPTION OF THE AIRPLANE

A three-view drawing of the airplane is presented in figure 1 and photographs of the airplane as instrumented for

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flight tests are given in figures 2 and 3. The basic dimensions of the airplane are given in tables I and II. The normal gross weight of the airplane is 12,000 pounds and the center-of-gravity range possible in flight under various loading conditions is 0.196 to 0.317 M.A.C.

INSTRUMENT INSTALLATION

The flight-test data were obtained by the use of standard NACA photographically recording instruments synchronized by an NACA timer. The elevator recorder was of the wire-wound resistor type mounted on the inboard edge of the fixed surface.

Indicated airspeed V_1 was measured by means of a standard NACA free-swiveling airspeed head mounted approximately two chord lengths ahead of the wing leading edge on the right wing tip (fig. 2). The airspeed values were corrected for position error due to the presence of the wing. Values of indicated airspeed were computed from the airspeed formula (corrected for compressibility) commonly used in the calibration of standard airspeed indicators.

TESTS, RESULTS, AND DISCUSSION

The tests were conducted at an average gross weight W of 11,400 pounds (take-off) and a center-of-gravity location at 0.24 M.A.C. Records were taken at a pressure altitude (h_p) range of 6,000 feet to 10,000 feet both with and without empty wing-tip tanks installed. Tests were made in straight and turning flight in the power-on, clean (flaps and gear up, 90-percent rpm), glide (flap and gear up, engine throttled), approach (flap and gear down, 50-percent rpm), and landing condition (flap and gear down, engine throttled).

Stalling Characteristics with Wing-Tip Tanks Off

Time histories of stalls for the various conditions in straight and turning flight are presented in figure 4. In most cases the stall was approached gradually and the recovery was started as soon as the first indication of the complete stall had been reached.

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For all tests the approach to the stall was accompanied by a definite stall warning in the form of buffeting and shaking of the airplane and controls. This stall warning occurred at speeds between 1.05 and 1.10 times the stalling speed for the various test configurations in straight flight. In turning flight the stall warning was considered adequate in that a definite buffeting occurred in advance of the complete stall.

The stalls were considered mild in nature consisting of a slowly developing pitching motion with very little tendency to roll. It was possible to promptly recover from the complete stall by normal use of the controls after the stall warning had occurred.

Stalling Characteristics with Wing-Tip Tanks On

Since the airplane was reported to have had ^{unsatisfactory} stalling characteristics with the wing-tip tanks on, stalls were made in straight and turning flight for the glide and approach conditions. Although records were taken of these stalls, no time histories are presented in this report since the data were similar in nature to that presented in figure 4.

In all cases adequate stall warning was present in the form of buffeting of the airplane and controls. This stall warning occurred at 1.05 to 1.10 times the stalling speed in straight flight for the various configurations tested. In turning flight a smaller amount of buffeting preceded the complete stall; however, the stall warning was considered adequate.

In general, for the tests conducted the motions of the airplane during the stall were more violent with the tip tanks on. This was due in part to the fact that recovery from the stall was not started immediately after the first warning of the complete stall had occurred. With continued rearward movement of the control stick the airplane had a tendency to roll either to the right or left before the final pitch-down. In turning flight the roll-off was more abrupt and violent. In all cases, however, the rolling motion was controllable by use of the ailerons. It should be noted that these tests were conducted with the wing-tip

tanks empty to determine aerodynamic effects. If the tanks had been filled, it probably would have been more difficult to stop any rolling motion due to the increased moment of inertia.

CONCLUDING REMARKS

In all cases tested adequate stall warning existed in the form of buffeting of the airplane and controls. This warning occurred at 1.05 to 1.10 times the stalling speed in the various configurations in straight flight.

The motions of the airplane in the complete stall consisted of a slowly developing pitching motion with very little rolling tendency for the wing-tip tanks-off condition. With the tanks on but empty the rolling tendency was more pronounced.

Ames Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Moffett Field, Calif.

REFERENCES

1. Anderson, Seth B., Christofferson, Frank E., and Clousing, Lawrence A.: Flight Measurements of the Flying Qualities of a Lockheed P-80A Airplane (Army No. 44-85099).- Longitudinal-Stability and -Control Characteristics. NACA CRM No. A7G01, 1947.
2. Anderson, Seth B., and Cooper, George E.: Flight Measurements of the Flying Qualities of a Lockheed P-80A Airplane (Army No. 44-85099).- Lateral- and Directional-Stability and Control Characteristics. NACA CRM No. A7J24, 1947.

TABLE I.- BASIC DIMENSIONAL DATA OF THE TEST AIRPLANE, LOCKHEED P-80A AIRPLANE

Item	Wing	Horizontal tail	Vertical tail
Area, sq ft	237	34.7	22.4
Span, ft	38.9	15.6	6.5
Aspect ratio	6.39	7.01	1.89
Taper ratio	.364	.366	.40
Mean aerodynamic chord, in.	80.6	---	---
Dihedral of trailing edge of wing, deg	3.83	0	---
Incidence of root chord (with respect to thrust line), deg	1.0	1.30	---
Geometric twist, deg	1.5 washout from root to tip	0	0
Root section	NACA 65 ₁ -213 (a=0.5)	NACA 65-010	NACA 65-010
Tip section	NACA 65 ₁ -213 (a=0.5)	NACA 65-010	NACA 65-010

TABLE II.- DIMENSIONAL CHARACTERISTICS OF THE SURFACES OF THE TEST AIRPLANE, LOCKHEED P-80A AIRPLANE

Item	Elevators	Rudder	Flaps	Ailerons
Area aft of hinge line (both sides), sq ft	8.5	5.6	30.7	17.5
Hinge-line location, percent chord of fixed surface	75	75	75	75
Type of flap and balance.	Boost tab plus spring tab; radius nose on elevator. Static and dynamic mass balance.	No balance; radius nose on rudder. Rudder has centering spring. Static and dynamic mass balance.	Split, no balance.	None; piano hinge on upper wing surface. Aileron control system has power boost. Static and dynamic mass balance.
Travel	37° up, 16° down	15.5° left and 15.5° right	Down 45°	41.5° total
Tabs	Trim and boost-tab area, 0.55 sq ft (total). Boost-tab ratio, 0.33. Spring tab (on inboard and of elevator) area, 0.51 sq ft (total).	Bent tab on trailing edge of rudder,	- - - -	Trim tab on left aileron

Note: All movable surfaces are metal covered.

FIGURE LEGENDS

Figure 1.- Three-view drawing of test airplane.

Figure 2.- Three-quarter front view of the test airplane as instrumented for flight tests.

Figure 3.- Three-quarter rear view of the test airplane.

Figure 4.- Time history of stall. (a) Power-on, clean. Straight flight.

Figure 4.- Continued. (b) Power-on, clean. Turning flight.

Figure 4.- Continued. (c) Glide. Straight flight.

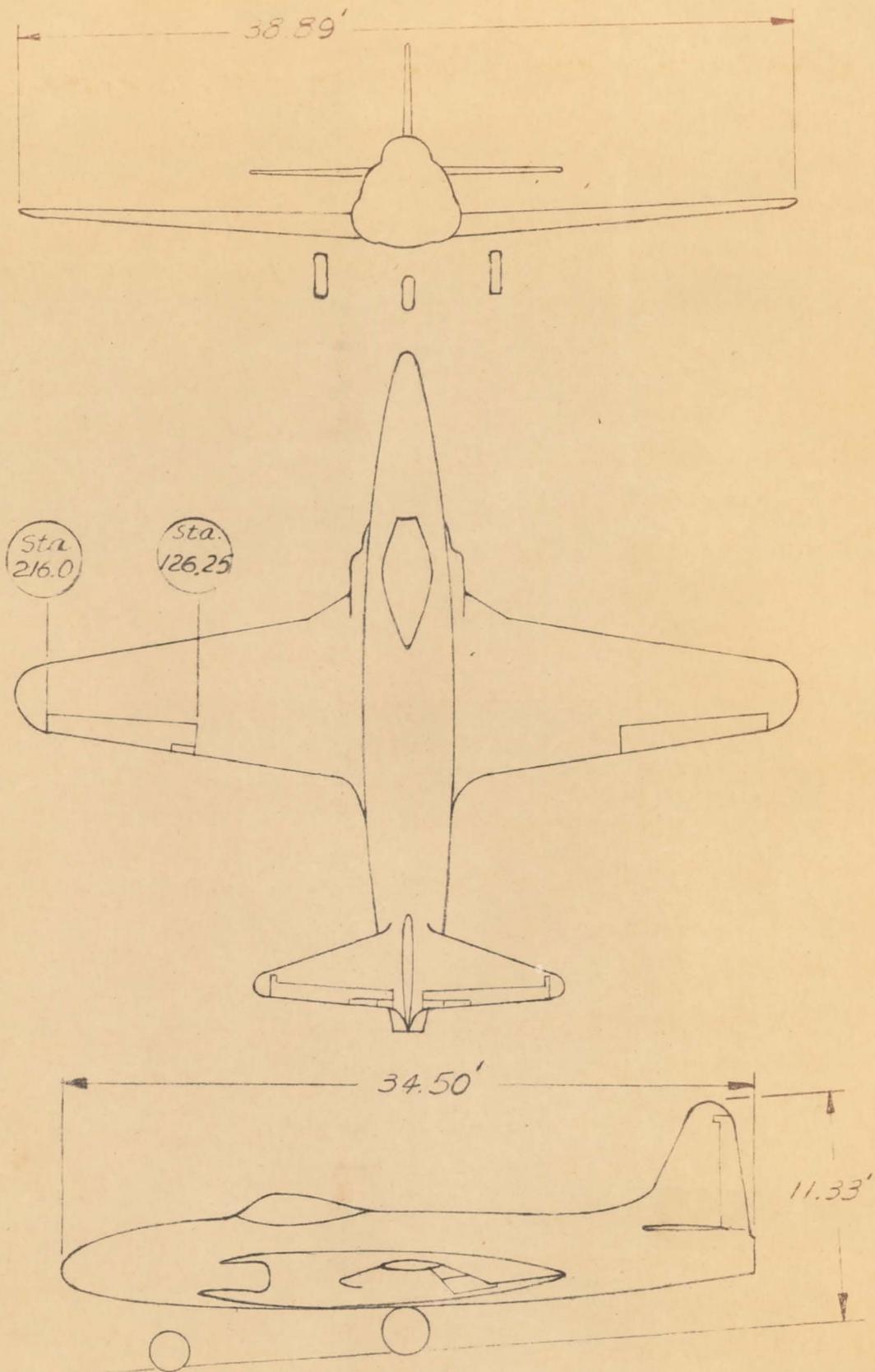
Figure 4.- Continued. (d) Glide. Turning flight.

Figure 4.- Continued. (e) Approach. Straight flight.

Figure 4.- Continued. (f) Approach. Turning flight.

Figure 4.- Continued. (g) Landing. Straight flight.

Figure 4.- Concluded. (h) Landing. Turning flight.



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Figure 1. - Three-view drawing of test airplane.



Figure 2.- Three-quarter front view of the test airplane as instrumented for flight tests.

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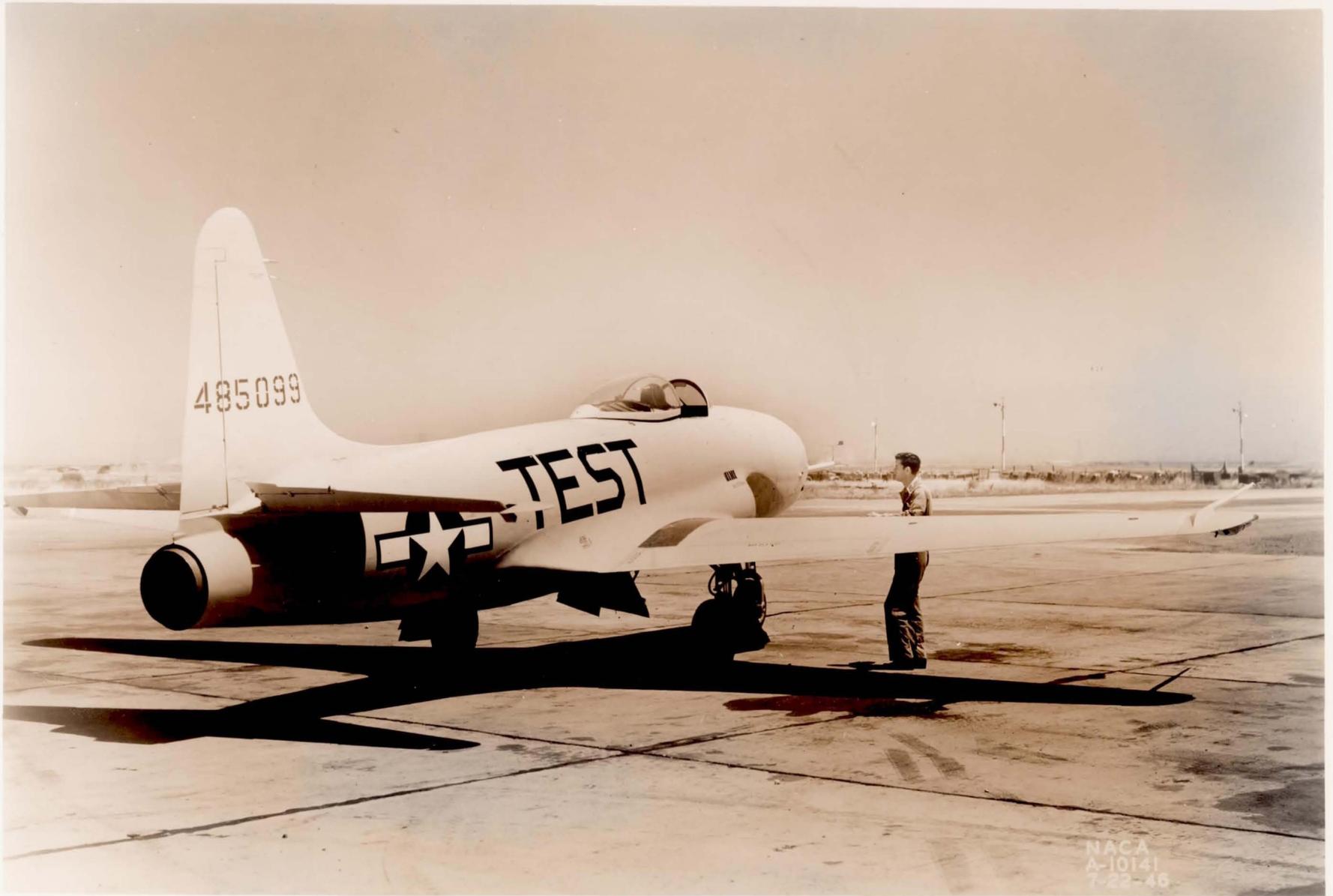
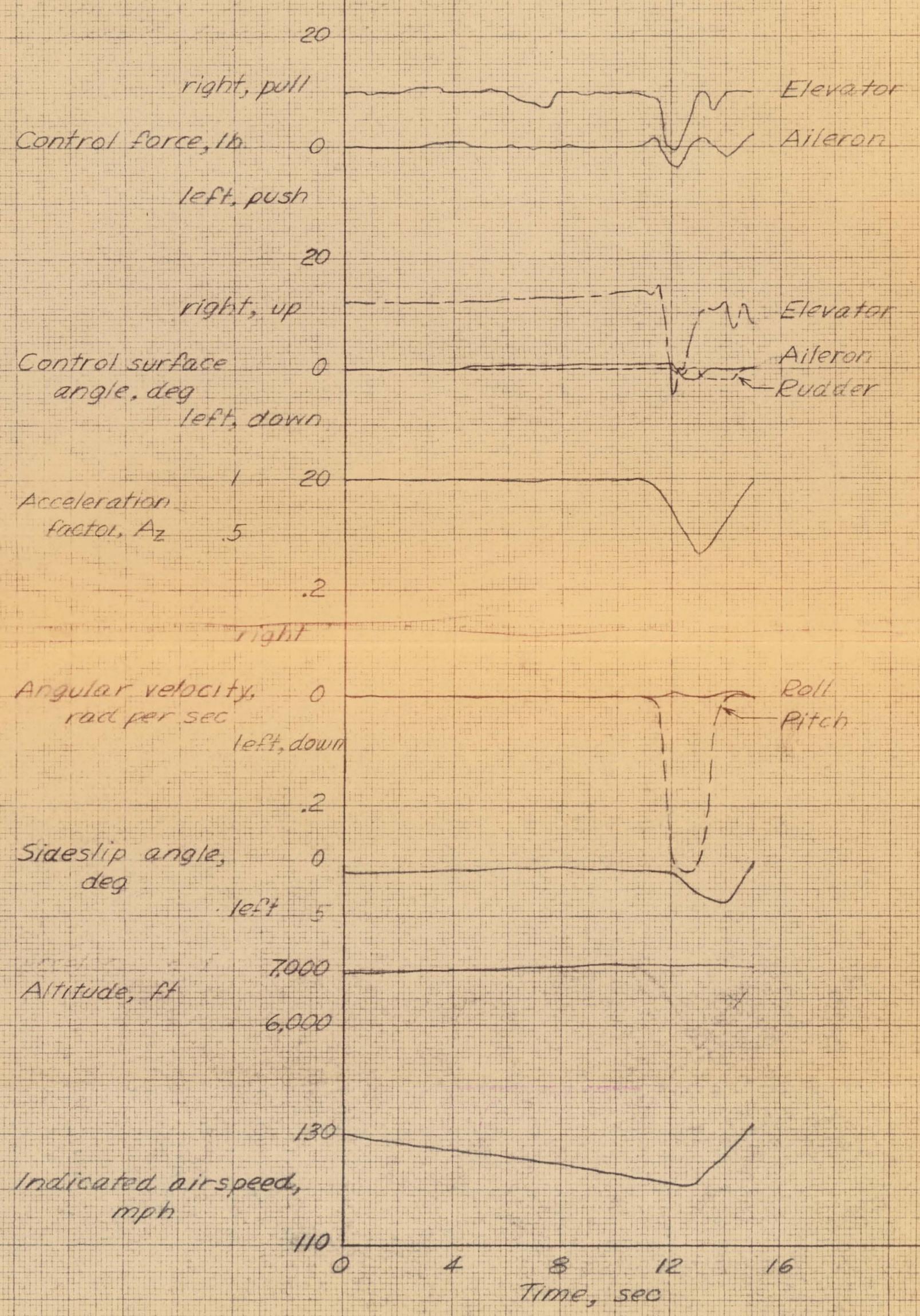


Figure 3.- Three-quarter rear view of the test airplane.

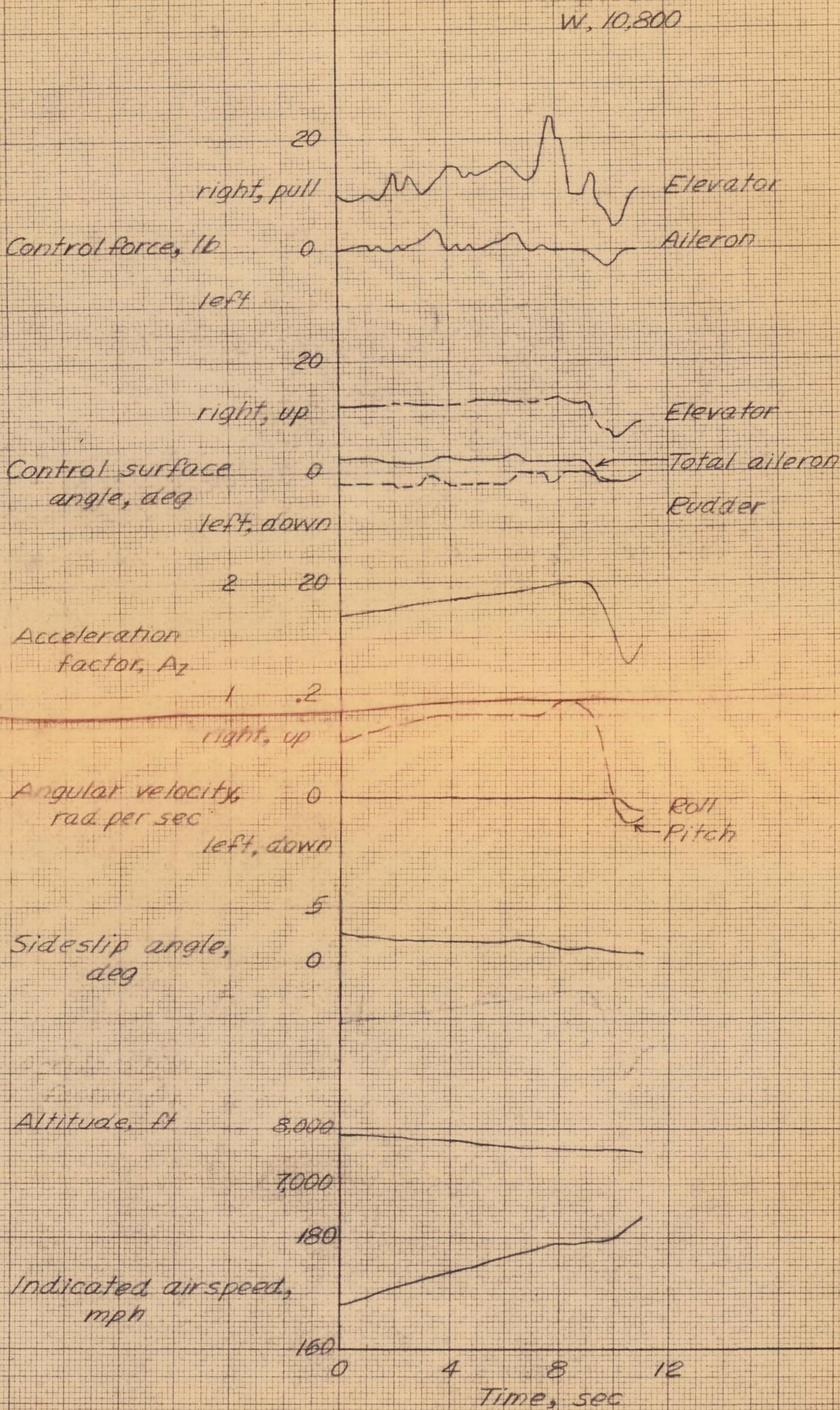
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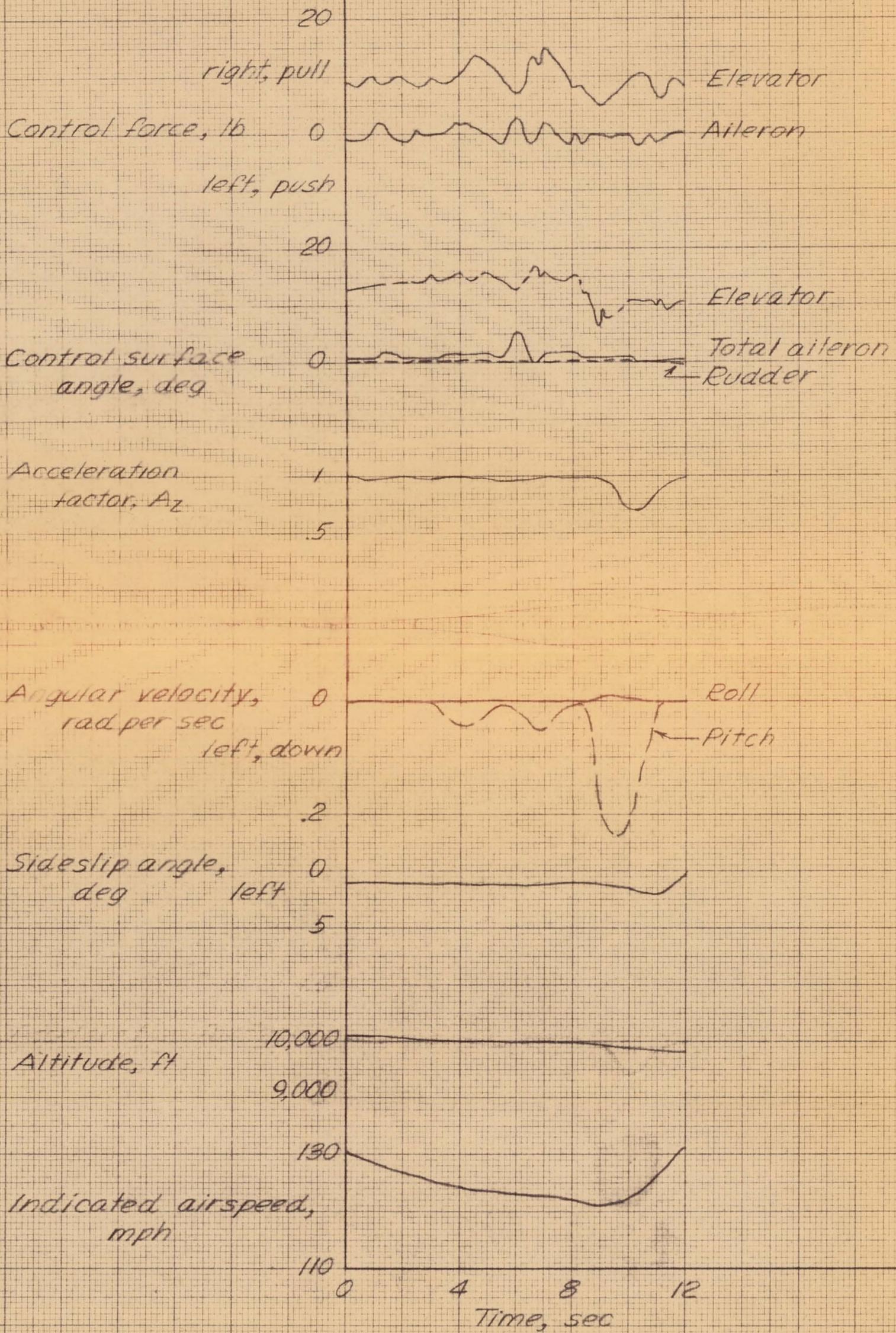
(a.) Power-on, clean. Straight flight
Figure 4.- Time history of stall

H1



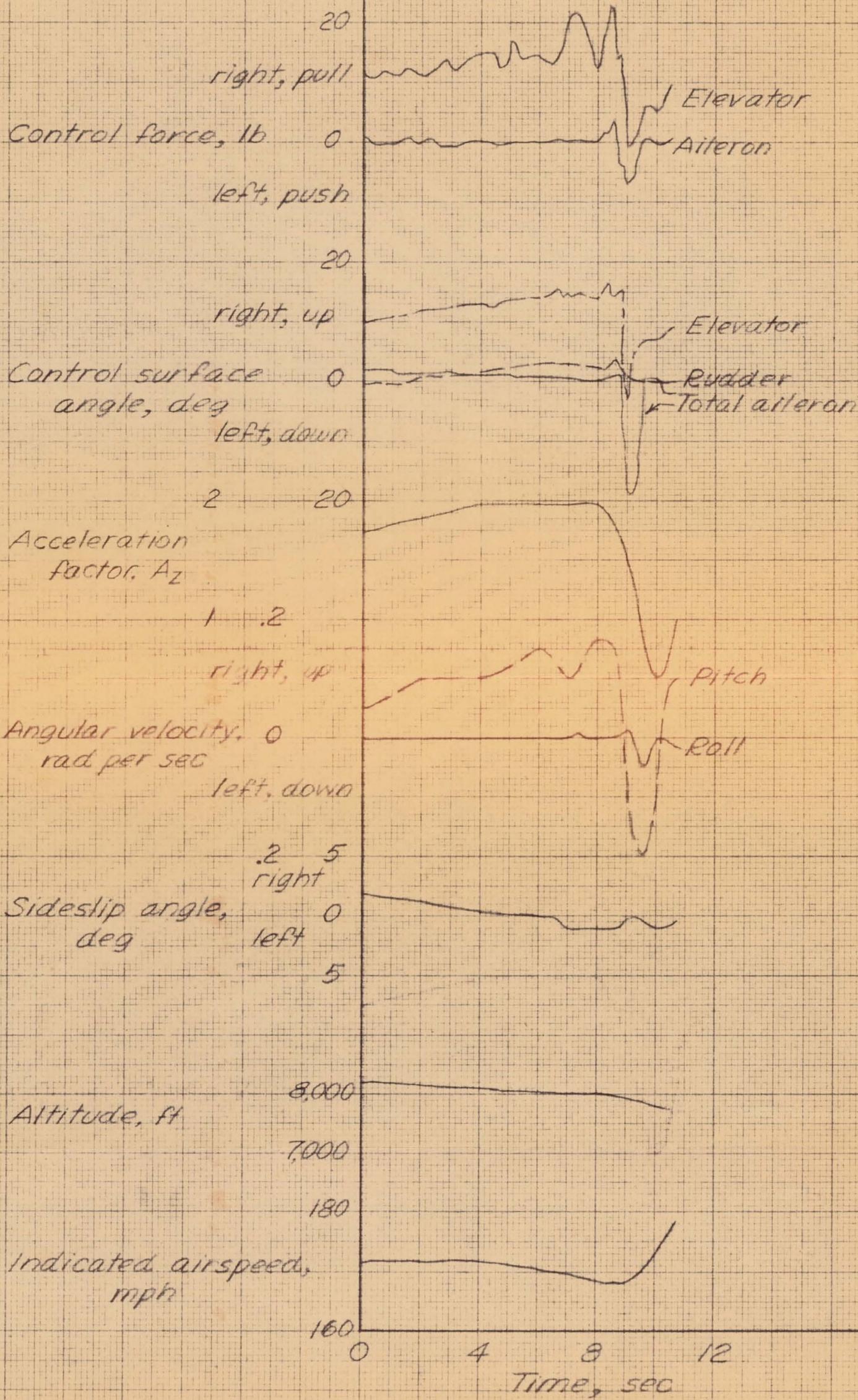
(b) Power-on, clean. Turning flight.
Figure 4. Continued

W, 10,700

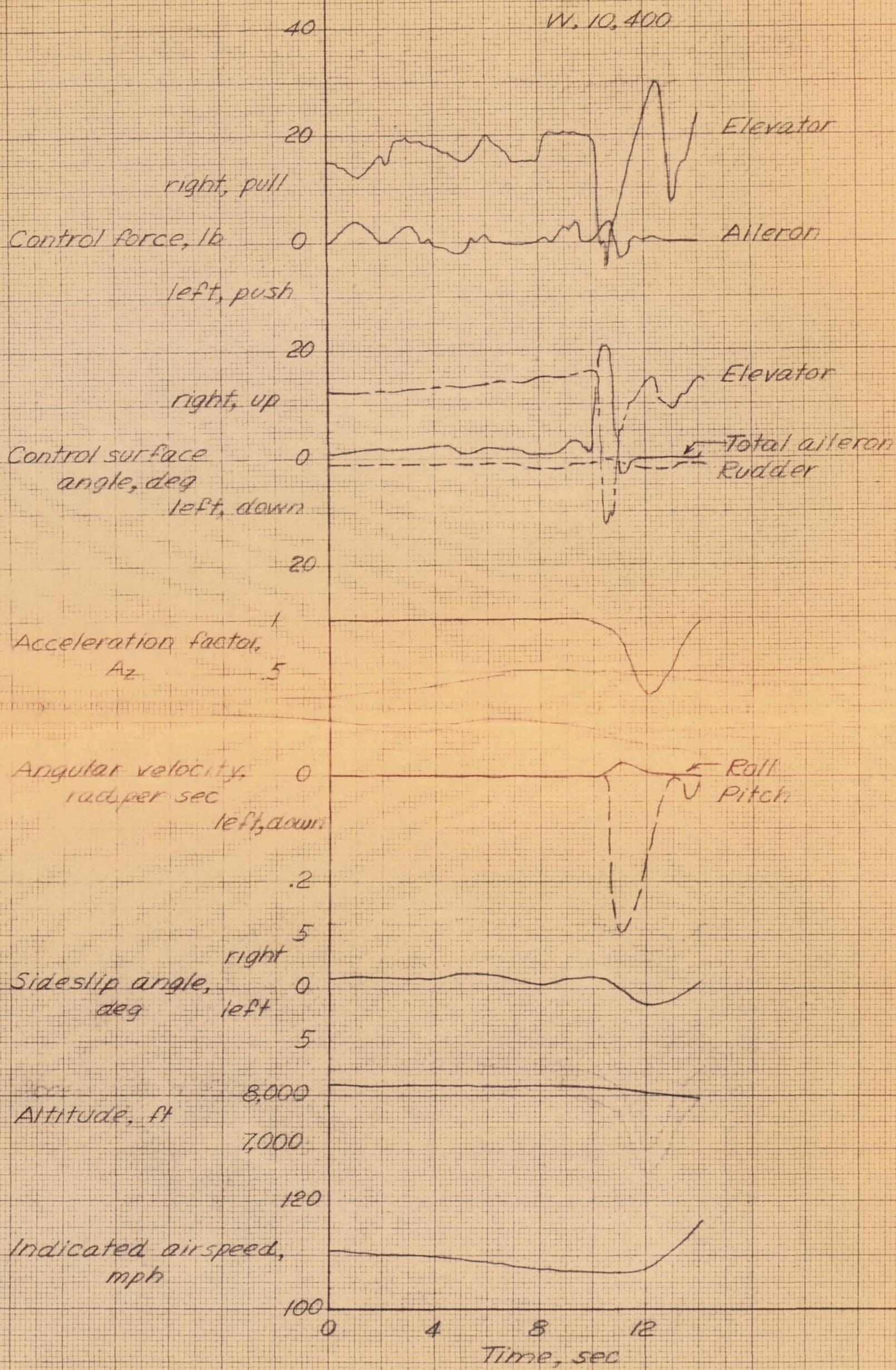


(c) Glide. Straight flight
Figure 4.- Continued.

W, 10.500

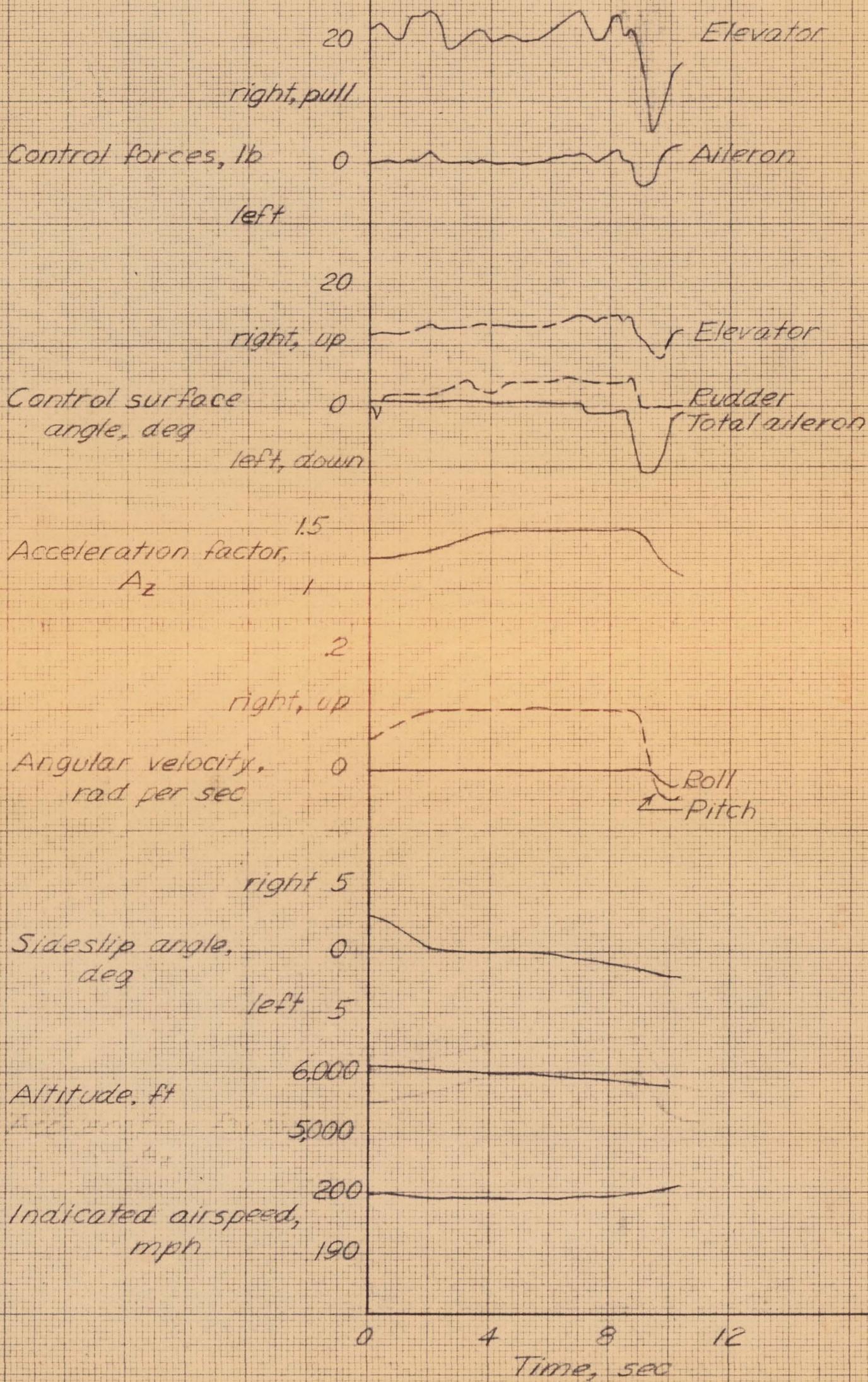


(d) Glide. Turning flight.
Figure 4.- Continued.



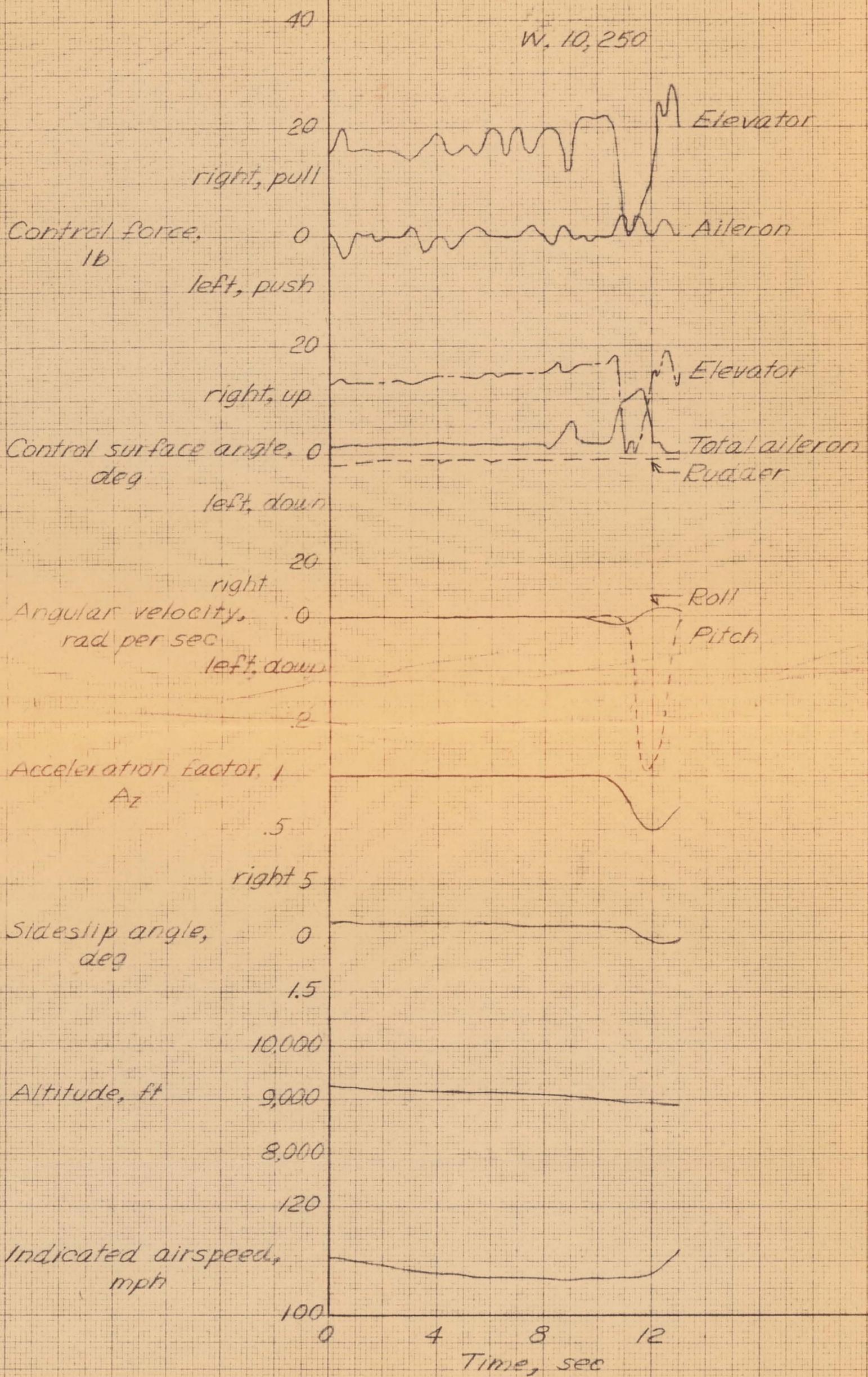
(e) Approach. Straight Flight
Figure 4.- Continued.

W, 10,300

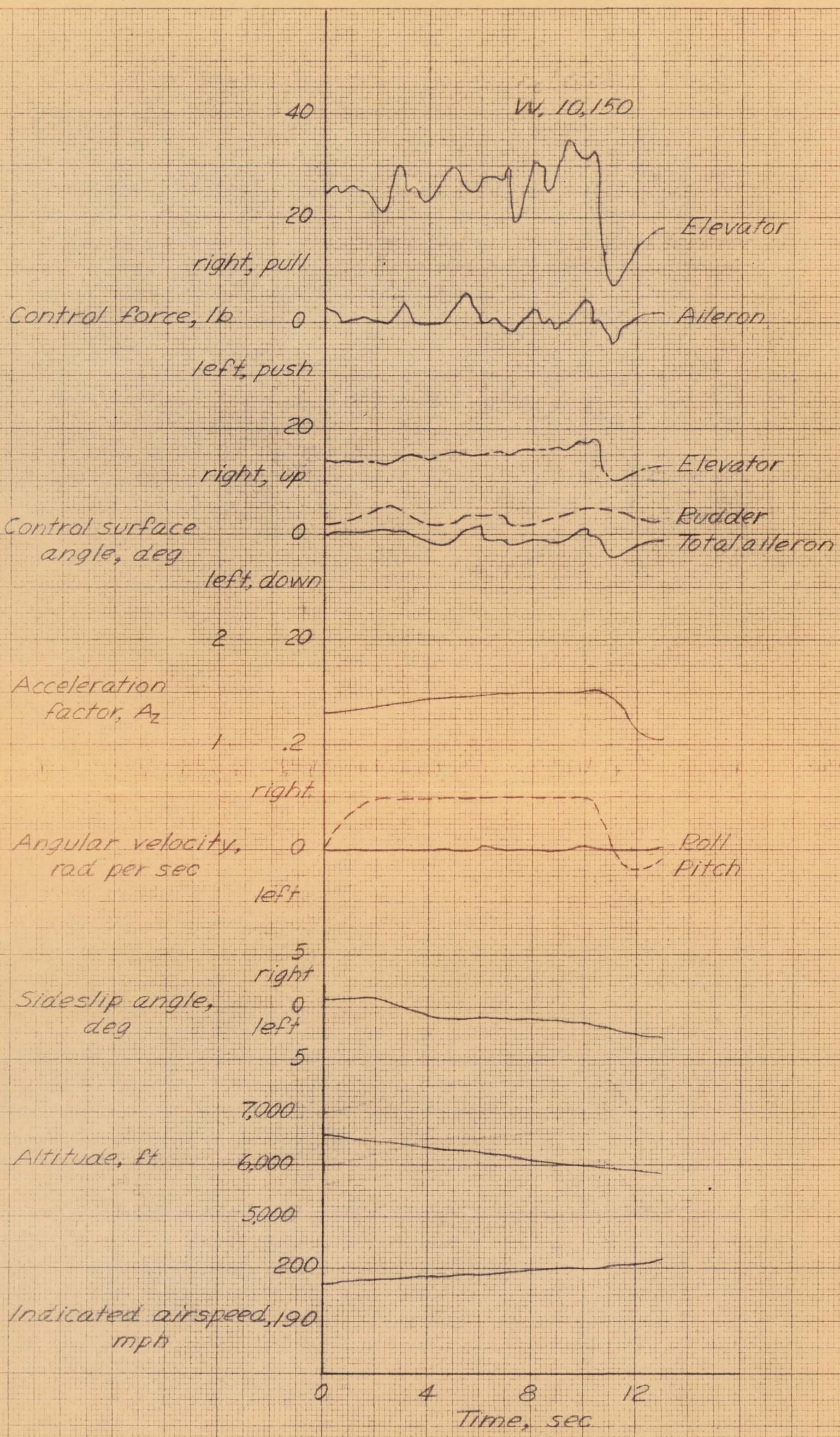


(f) Approach Turning flight
Figure 4.-Continued.

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(g) Landing. Straight flight.
Figure 4.- Continued.



(h) Landing. Turning flight
 Figure 4.- Concluded.