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RESEARCH MEMORANDUM

RESULTS OBTAINED FROM THIRD FLIGHT OF NORTHROP X-4 AIRPLANE (A.F. NO. 46-676)

By Walter C. Williams

Langley Aeronautical Laboratory
Langley Air Force Base, Va.

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NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS
WASHINGTON
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SUMMARY

NACA instrumentation has been installed in the Northrop X-4 airplane to obtain stability and control data during the Northrop conducted acceptance tests. The results of the third flight of the X-4 number 1 airplane are presented in this paper.

The results of this flight showed that the directional stability as measured in steadily increasing sideslips was positive and high and that the lateral stability was positive.

INTRODUCTION

As a part of the Air Force-Navy-NACA transonic flight-research program, the Northrop Company has constructed the X-4 airplane. This airplane is intended for performing research on a tailless configuration at high subsonic Mach numbers.

NACA recording instrumentation has been installed in the airplane to provide data on stability and control characteristics during the Northrop conducted acceptance tests. The present paper gives data obtained in the third flight of this airplane made May 5, 1949. Since the second flight, the contractor added strips to the trailing edge of the rudder to increase rudder forces and as a possible fix for the lateral oscillation experienced in the previous flights. Data from flights 1 and 2 were presented in references 1 and 2, respectively.

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SYMBOLS

V_i indicated airspeed, miles per hour

β sideslip angle, degrees

δ_e elevon angle, degrees

δ_r rudder angle, degrees

Subscripts:

R, L right and left elevons, respectively

AIRPLANE

The Northrop X-4 airplane is a semitailless research airplane having a vertical tail but no horizontal tail surfaces. It is powered by two Westinghouse J30-WE-7-9 engines and is designed for flight research in the high-subsonic-speed range. Photographs of the airplane are presented as figure 1 and a three-view drawing as figure 2. Table I lists the physical characteristics of the airplane.

TEST INSTRUMENTATION

Because of the small size of the X-4 airplane and the instrumentation requirements for the Northrop structure and engine temperature measurements it was possible to install only a minimum of stability and control instrumentation. Standard NACA internal instruments record altitude, airspeed, angle of sideslip, right and left elevon positions, and rudder position. In addition, the following quantities are telemetered to a ground station: normal acceleration, altitude, airspeed, right and left elevon positions, and rudder position. All of the records are correlated by a common timer.

The recording airspeed and altimeter are connected to the airspeed head on the vertical fin. A calibration of this installation has not yet been made.

RESULTS AND DISCUSSION

In this flight, the pilot was scheduled to make steady sideslips at several sideslip angles at various speeds. He had accomplished only two sideslips to small angles at approximately 175 miles per hour when the right-engine oil supply dropped to the danger point and the flight was terminated.

The pilot took records in these sideslips as he slowly increased sideslip and then attempted to maintain a steady condition. Time histories of these two runs are presented in figures 3 and 4. From these data, figure 5 was prepared which presents the variation of rudder and lateral-control position with sideslip angle. There is scatter in these data, particularly those pertaining to the lateral control, but as can be seen in figures 3 and 4, the control was not moved smoothly, which resulted in some oscillation in sideslip. It can be seen from figure 5, however, that the directional stability as measured by the variation of rudder position with sideslip angle is high, approximately 1.7° of rudder per degree sideslip. The effective dihedral as shown by the variation of lateral control with sideslip angle is positive.

A time history of the landing approach and landing is given in figure 6. The landing was quite similar to that made in flight 2 (reference 2) with touchdown at about the same speed, 150 miles per hour. The landing was made with flaps up. The poor damping of the lateral oscillation reported in the previous flight (reference 2) was still present, as can be seen by examination of the sideslip record. The pilot reported that the rudder forces were higher with the trailing-edge strip but could not comment on the lateral oscillation, since it was most objectionable on the previous flight above 250 miles per hour, and he did not go to such speeds in this flight.

CONCLUSIONS

Measured results obtained from the third flight of the Northrop X-4 airplane showed the following conclusions:

1. The directional stability as measured in steadily increasing sideslips at 175 miles per hour is positive and high.

2. The lateral stability as measured in these sideslips is positive.

Langley Aeronautical Laboratory
National Advisory Committee for Aeronautics
Langley Air Force Base, Va.

REFERENCES

1. Drake, Hubert M.: Stability and Control Data Obtained from First Flight of X-4 Airplane. NACA RM L9A31, 1949.

2. Williams, Walter C.: Results Obtained from Second Flight of X-4 Airplane (A.F. No. 46-676). NACA RM L9F21, 1949.

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TABLE I.– PHYSICAL CHARACTERISTICS OF X-4 AIRPLANE

Engine	Two Westinghouse J-30-WE-8-9
Rating (each), lb static thrust at sea level	1600
Weight for acceptance tests, lb:	
Maximum (240 gal fuel)	7050
Minimum (10 gal fuel trapped)	5670
Wing loading, lb/sq ft:	
Maximum	35.2
Minimum	28.3
Center-of-gravity travel (first flight), percent M.A.C.:	
Gear down, full load	22.5
Gear down, empty	20.2
Gear up, full load	22
Gear up, empty	19.7
Height, over all, ft	14.83
Length, over all, ft	23.25
Wing:	
Area, sq ft	200
Span, ft	26.83
Airfoil section	0010.64
Mean aerodynamic chord, ft	7.81
Aspect ratio	3.6
Root chord, ft	10.25
Tip chord, ft	4.67
Taper ratio	2.2:1
Sweepback (leading edge), deg	41.57
Dihedral (chord plane), deg	0
Wing flaps (split):	
Area, sq ft	16.7
Span, ft	8.92
Chord, percent wing chord	25
Travel, deg	30
Dive-brake dimensions as flaps:	
Travel, deg	±60

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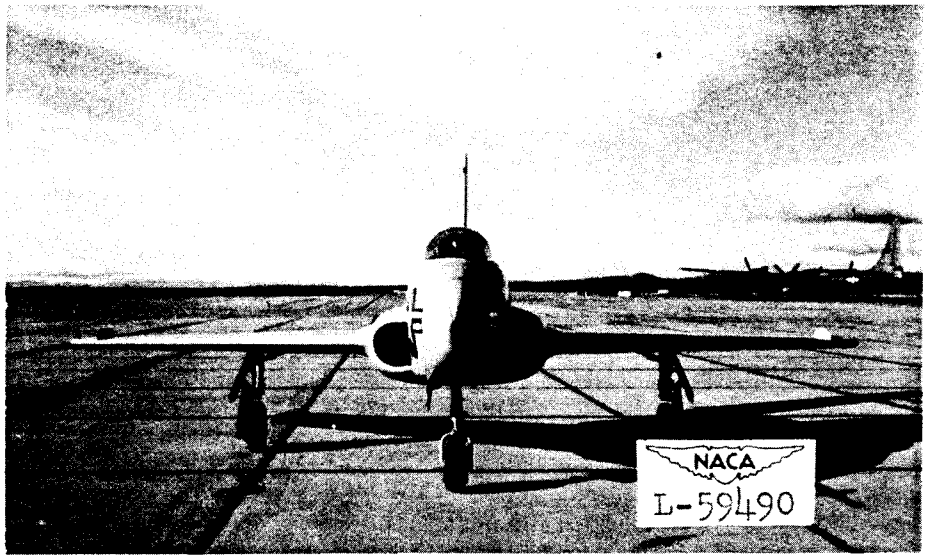


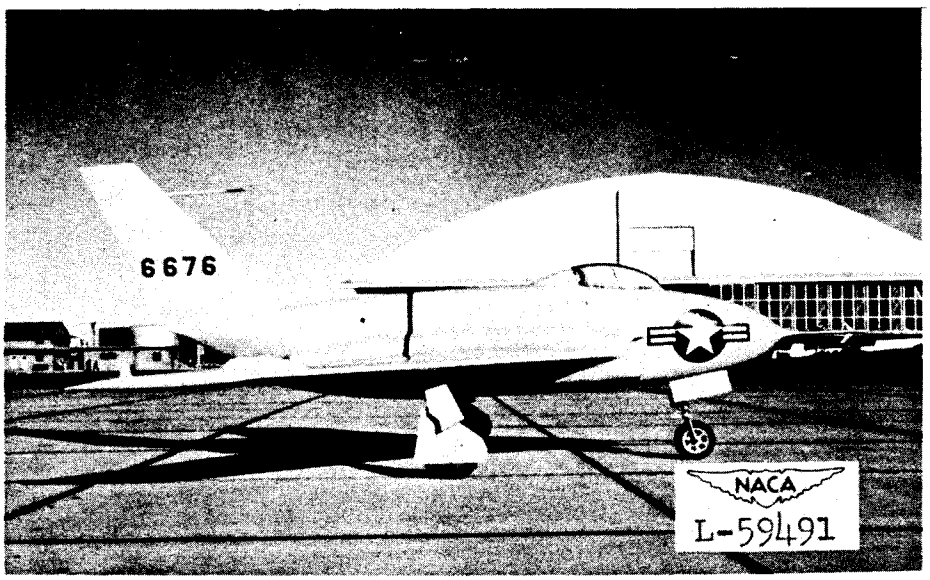
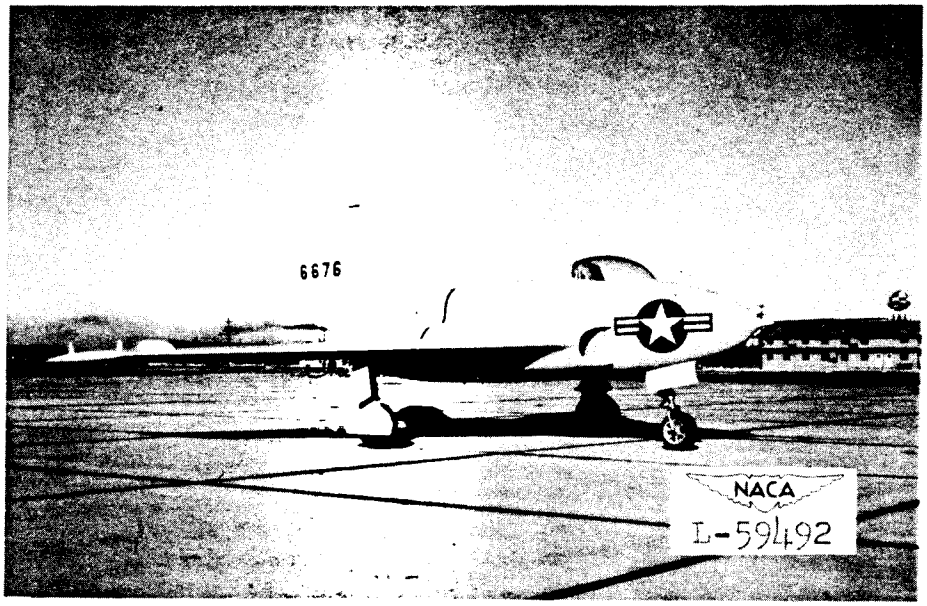


Figure 1.- Photograph of Northrop X-4 airplane.



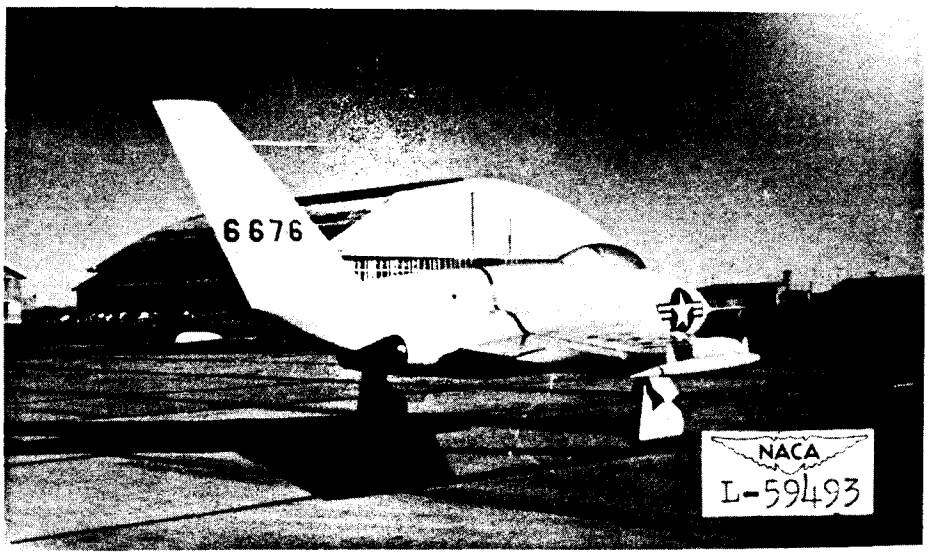


Figure 1.– Concluded.

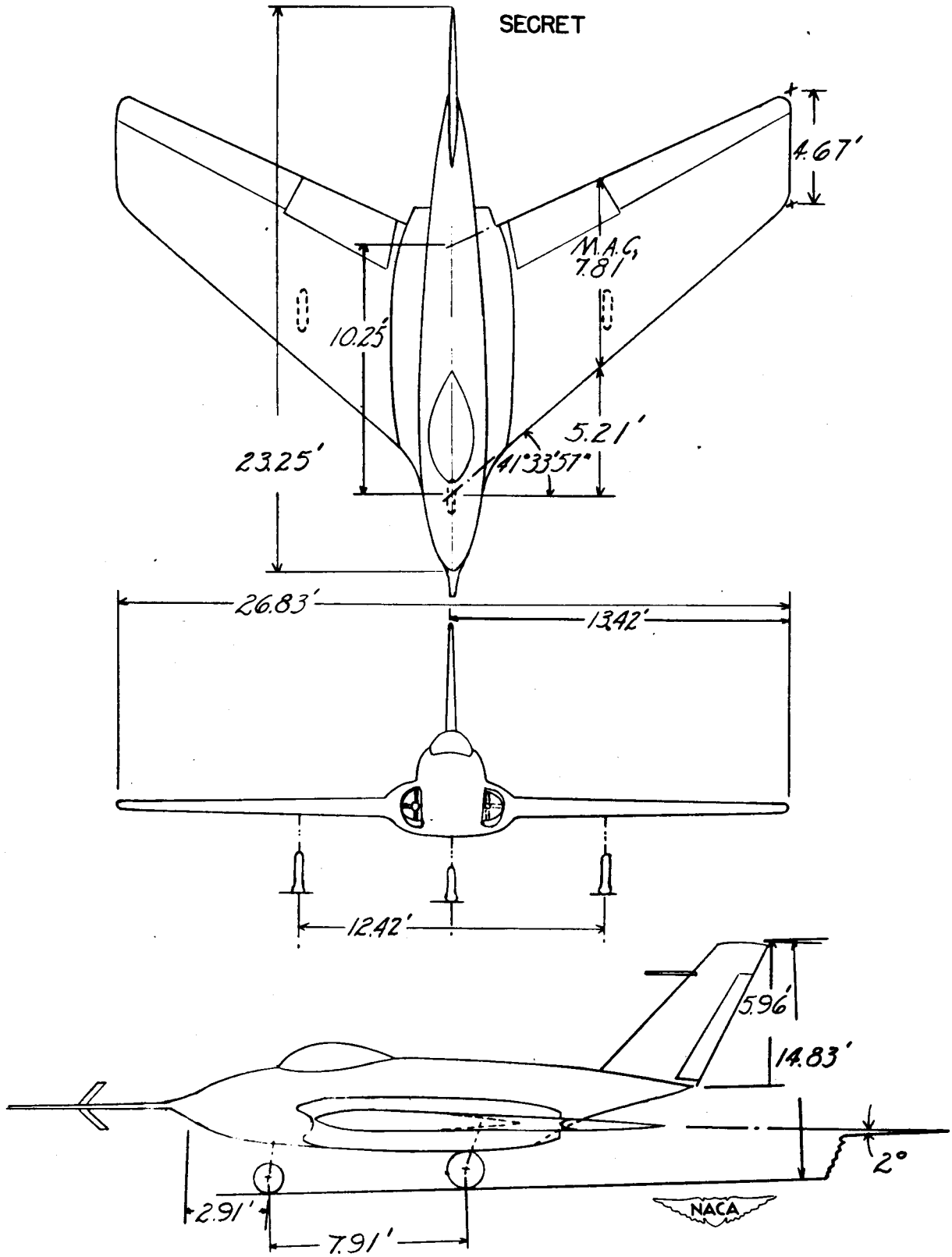


Figure 2.- Three-view drawing of Northrop X-4 airplane.

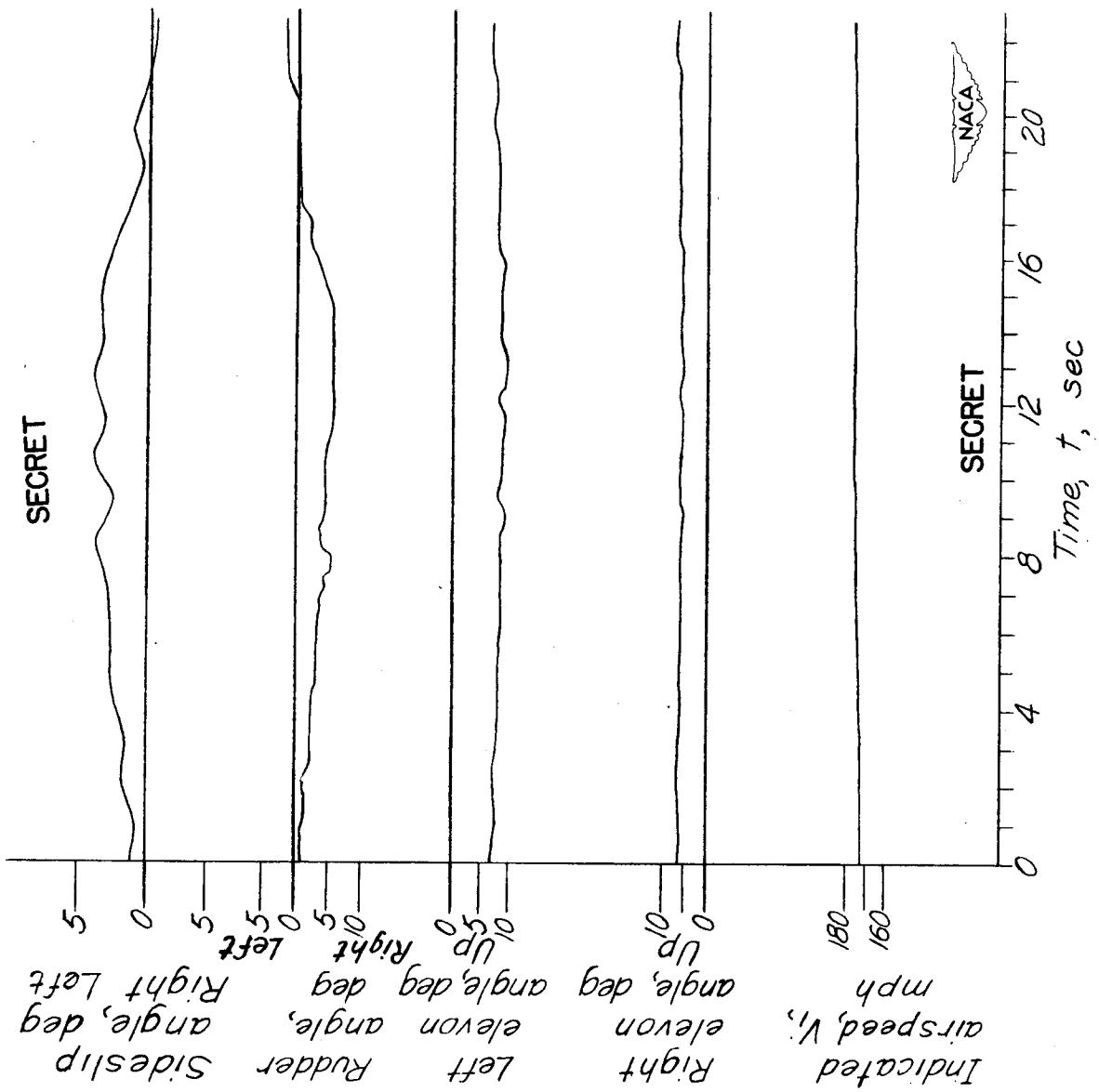


Figure 3.- Time history of a left sideslip. Northrop X-4 airplane.

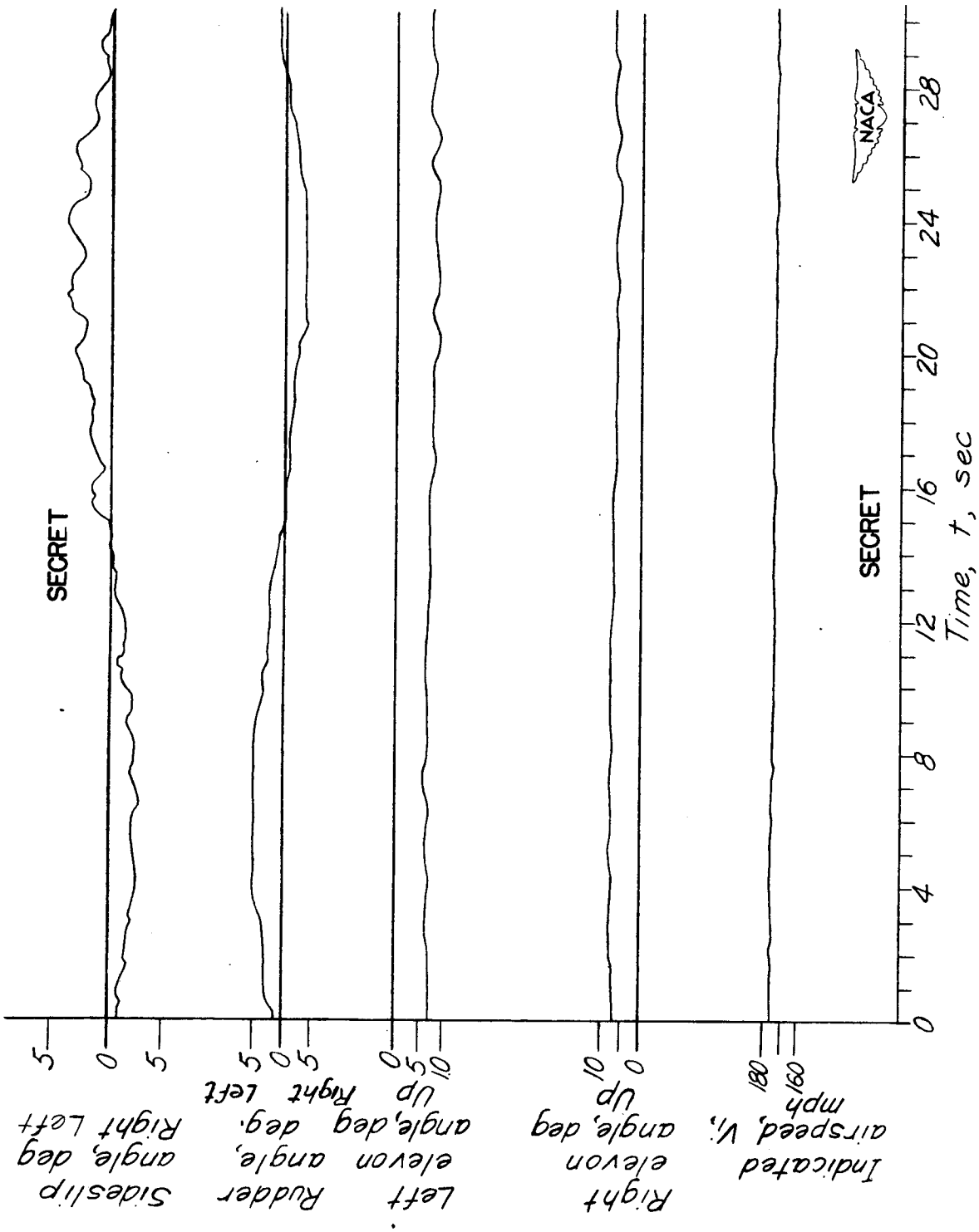


Figure 4.- Time history of steadily changing sideslip. Northrop X-4 airplane.

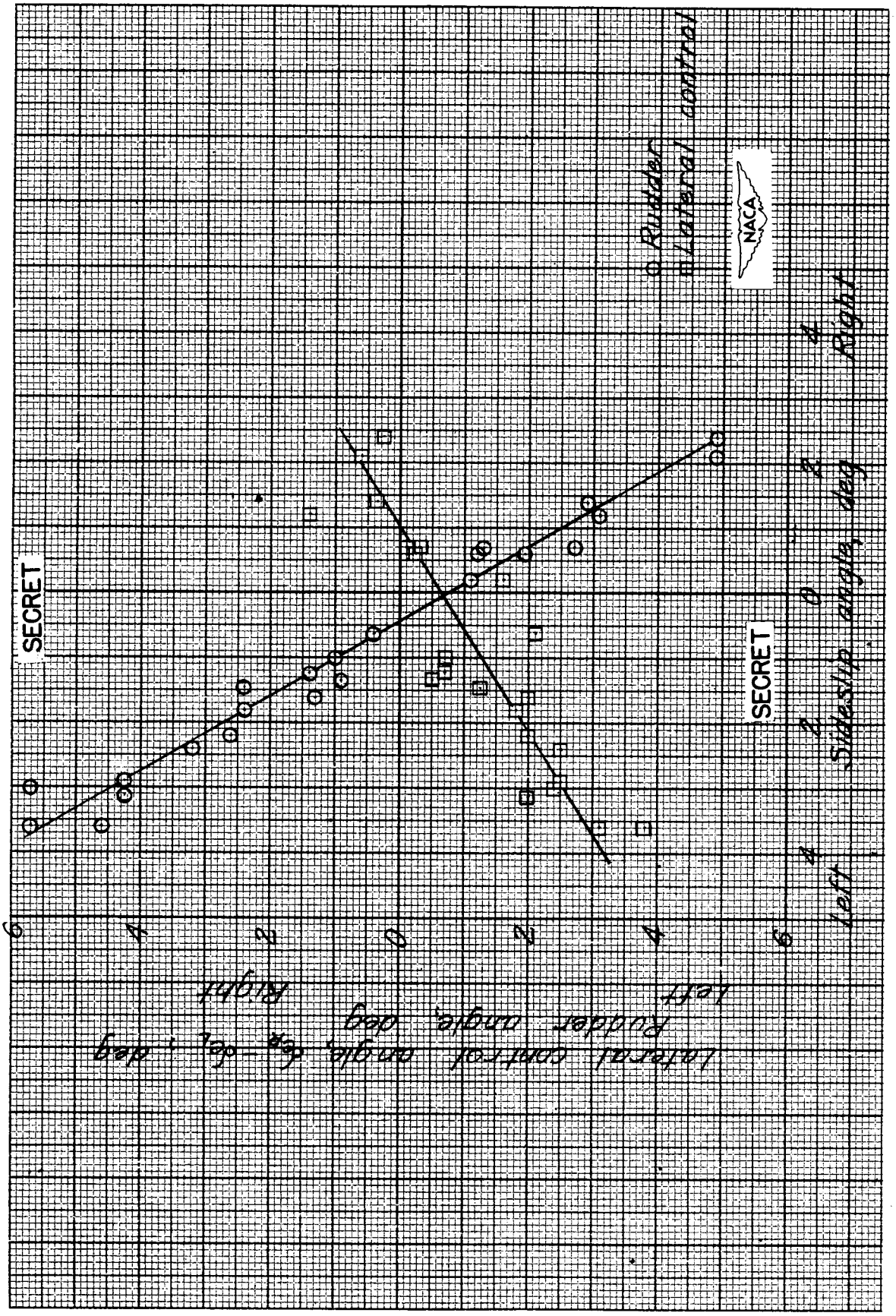


Figure 5.- Steady sideslip characteristics. Northrop X-4 airplane.

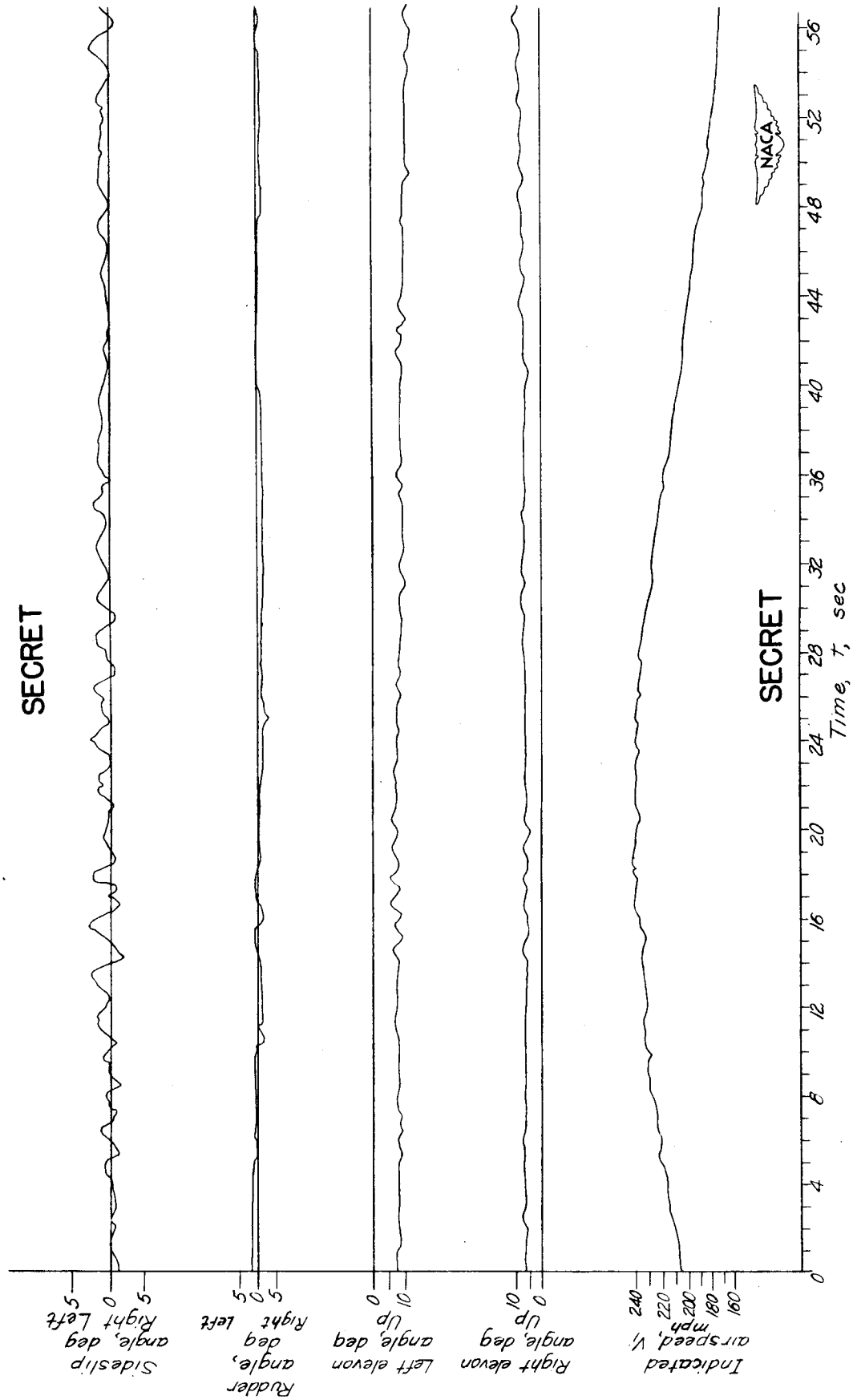


Figure 6.- Time history of landing approach and landing. Northrop X-4 airplane.

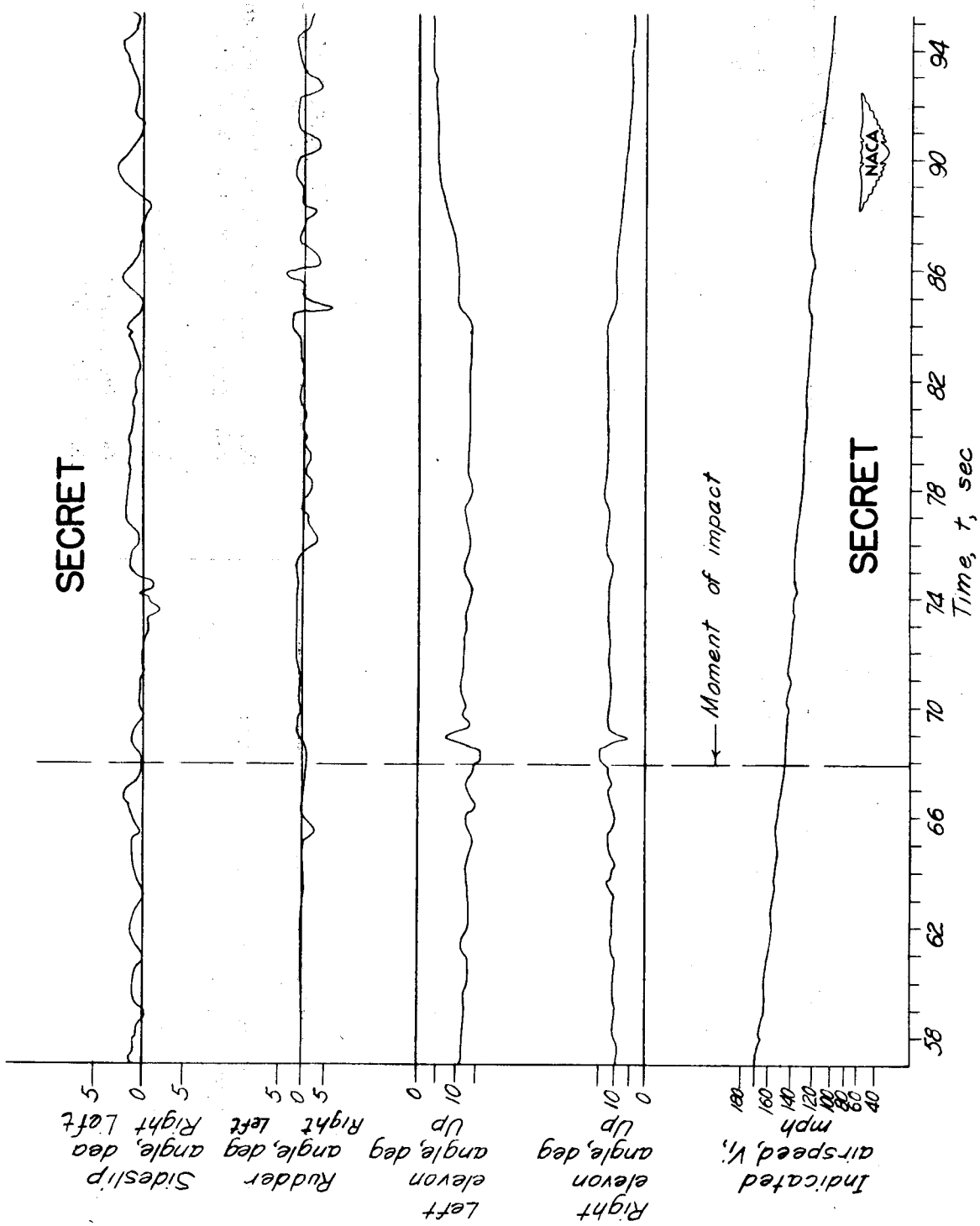


Figure 6.- Concluded.