

R. N. 1436

UNCLASSIFIED

~~CONFIDENTIAL~~

FM No. L7G10

Inactive

1104  
Vought  
R70-111  
pt 2  
copy 2



# RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Navy Department

AN INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF AN 0.08-SCALE  
MODEL OF THE CHANCE VOUGHT XF7U-1 AIRPLANE IN THE  
LANGLEY HIGH-SPEED 7- BY 10-FOOT TUNNEL  
PART II - BASIC LATERAL STABILITY CHARACTERISTICS

TRD NO. NACA DE308

By

William B. Kemp, Jr., Kenneth W. Goodson, and Richard E. Kuhn  
Langley Memorial Aeronautical Laboratory  
Langley Field, Va.

CLASSIFIED DOCUMENT

This document contains classified information affecting the National Defense of the United States within the meaning of the Espionage Act, USC 50:31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law. Information so classified may be imparted only to persons in the military and naval services of the United States, appropriate civilian officers and employees of the Federal Government who have a legitimate interest therein, and to United States citizens of known loyalty and discretion who of necessity must be informed thereof.

~~CONFIDENTIAL~~

CLASSIFICATION CANCELLED

Authority: NACA 2946 Date 2/25/53

By: DADA 3/24/53 See

## NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WASHINGTON

JUL 18 1947

~~CONFIDENTIAL~~

UNCLASSIFIED



UNCLASSIFIED

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

## RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Navy Department

AN INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF AN 0.08-SCALE  
MODEL OF THE CHANCE VOUGHT XF7U-1 AIRPLANE IN THE  
LANGLEY HIGH-SPEED 7- BY 10-FOOT TUNNEL  
PART II - BASIC LATERAL STABILITY CHARACTERISTICS

TED NO. NACA DE308

By William B. Kemp, Jr., Kenneth W. Goodson, and Richard E. Kuhn

## SUMMARY

Tests have been conducted in the Langley high-speed 7- by 10-foot tunnel over a Mach number range from 0.40 to 0.91 to determine the stability and control characteristics of an 0.08-scale model of the Chance Vought XF7U-1 airplane. The basic lateral stability characteristics of the complete model with undeflected control surfaces are presented in the present report with a very limited analysis of the results:

## INTRODUCTION

At the request of the Bureau of Aeronautics, Navy Department, an investigation of the stability and control characteristics of an 0.08-scale model of the Chance Vought XF7U-1 airplane was conducted in the Langley high-speed 7- by 10-foot tunnel.

The present report presents the results of the basic lateral stability tests. The results include yawing moment, rolling moment, and side force data for the model for several angles of attack and yaw at Mach numbers ranging from 0.40 to 0.91. The inlet-velocity ratios associated with the simulated jet air-intake duct are also presented.

~~CONFIDENTIAL~~

UNCLASSIFIED

The present report is published with the purpose of presenting the data available at present from high-speed tests of the 0.08-scale model of the XF7U-1 airplane. Accordingly, no detailed analysis of the data has been made. The basic longitudinal stability characteristics are presented in reference 1.

### COEFFICIENTS AND SYMBOLS

The system of axes used for the presentation of the data, together with an indication of the sense of the positive force and moments, is presented in figure 1. Pertinent symbols are defined as follows:

- $C_L$  lift coefficient  $\left(\frac{\text{Lift}}{qS}\right)$
- $C_Y$  lateral-force coefficient  $\left(\frac{Y}{qS}\right)$
- $C_N$  yawing-moment coefficient  $\left(\frac{N}{qSb}\right)$
- $C_L$  rolling-moment coefficient  $\left(\frac{L}{qSb}\right)$
- Y lateral force measured along Y-axis
- L rolling moment about X-axis
- N yawing moment about Z-axis
- q free-stream dynamic pressure, pounds per square foot  $\left(\frac{\rho V^2}{2}\right)$
- S wing area (3.174 sq ft on model)
- $c'$  wing mean geometric chord (M.G.C.) (1.046 ft on model)
- c chord, parallel to plane of symmetry
- $c_1$  chord, perpendicular to 0.25c line
- b wing span (3.093 ft on model)
- V air velocity, feet per second
- a speed of sound, feet per second

- M Mach number  $\left(\frac{V}{a}\right)$
- R Reynolds number  $\left(\frac{\rho V c}{\mu}\right)$
- $\mu$  absolute viscosity, lb. sec/ft<sup>2</sup>
- $\rho$  mass density of air, slugs per cubic foot
- $\alpha$  angle of attack, measured from the X-axis to the fuselage center line, degrees
- $\psi$  angle of yaw, degrees
- $G_{n\psi} = \frac{\partial C_n}{\partial \psi}$
- $C_{z\psi} = \frac{\partial C_z}{\partial \psi}$
- $C_{Y\psi} = \frac{\partial C_Y}{\partial \psi}$
- $\alpha_{static}$  angle of attack under no load conditions, degrees

## APPARATUS AND METHODS

### Model

The 0.08-scale steel model of the XF7U-1 airplane was constructed by Chance Vought Aircraft. Pertinent dimensions of the model are presented in figure 2. The right air-intake duct contained a cluster of small, pitot pressure tubes which were used to determine the inlet-velocity ratios.

### Tests

The model was tested through the Mach number range at various angles of attack and yaw. The model was tested on a sting support as shown in figure 3. In order to obtain tares the model was also tested on wing-tip stings (fig. 4) with and without the center sting. A more complete description of the testing technique employed is given in reference 1.

The variation of test Reynolds number with Mach number for average test conditions is presented in figure 5. The Reynolds number was computed using a turbulence factor of unity. The degree of turbulence of the tunnel is not known but is believed to be small because of the high contraction ratio of the tunnel. The size of the model used in the present investigation leads to an estimated choking Mach number of 0.93 based on one-dimensional-flow theory. Experience has indicated that with this value of the choking Mach number, the tunnel constriction effects should not invalidate the test results at tunnel Mach numbers below 0.90. Application of the blocking correction increases this limit to over 0.91.

#### Corrections

The test results have been corrected for the tare forces and moments produced by the support system and for deflections of the system under load.

The jet-boundary correction to the angle of attack was computed from the following equation by the method of reference 2:

$$\alpha = \alpha_M + 0.331C_{LM}$$

where the subscript M indicates measured value.

All coefficients and Mach numbers were corrected for blocking by the model and its wake.

#### RESULTS AND DISCUSSION

The test results presented are for the complete model configuration; wing, fuselage, canopy, and vertical tails. (See fig. 3.)

The variation of lateral stability characteristics with Mach number (for  $\alpha_{\text{static}} = 0^\circ$  and  $6^\circ$ ) is presented in figure 6. During the test runs in which these data were obtained, the lift coefficient varied as indicated by the curves of figure 7. The angle-of-attack change from the wind-off static values ( $\alpha_{\text{static}} = 0^\circ$  and  $6^\circ$ ) was caused by deflection of the support system under aerodynamic load and is indicated by the values of actual angle of attack shown on figure 7. The lateral stability derivatives of figure 8 were obtained by measuring the slopes of cross plots of the data of figure 6.

The results of the duct inlet-velocity measurements are presented in figure 9. The measured inlet-velocity ratios are about half the magnitude of those expected in high-speed, full-power flight.

Langley Memorial Aeronautical Laboratory  
National Advisory Committee for Aeronautics  
Langley Field, Va.

*Charles J. Doolan*  
for William B. Kemp, Jr.  
Aeronautical Engineer

*Charles J. Doolan*  
for Kenneth W. Goodson  
Aeronautical Engineer

*Richard E. Kuhn*  
Richard E. Kuhn  
Aeronautical Engineer

Approved:

*Thomas P. Higgins*  
for Hartley A. Soule  
Chief of Stability Research Division

CJB

## REFERENCES

1. Kemp, W. B., Jr., Kuhn, R. E., and Goodson, K. W.: An Investigation of the Aerodynamic Characteristics of an 0.08-Scale Model of the Chance Vought XF7U-1 Airplane in the Langley High-Speed 7- by 10-Foot Tunnel. Part I - Basic Longitudinal Stability Characteristics. NACA RM No. L7G08, Bur. Aero., 1947.
2. Gillis, Clarence L., Polhamus, Edward C., and Gray, Joseph L., Jr.: Charts for Determining Jet-Boundary Corrections for Complete Models in 7- by 10-Foot Closed Rectangular Wind Tunnels, NACA ARR No. L5G31, 1945.

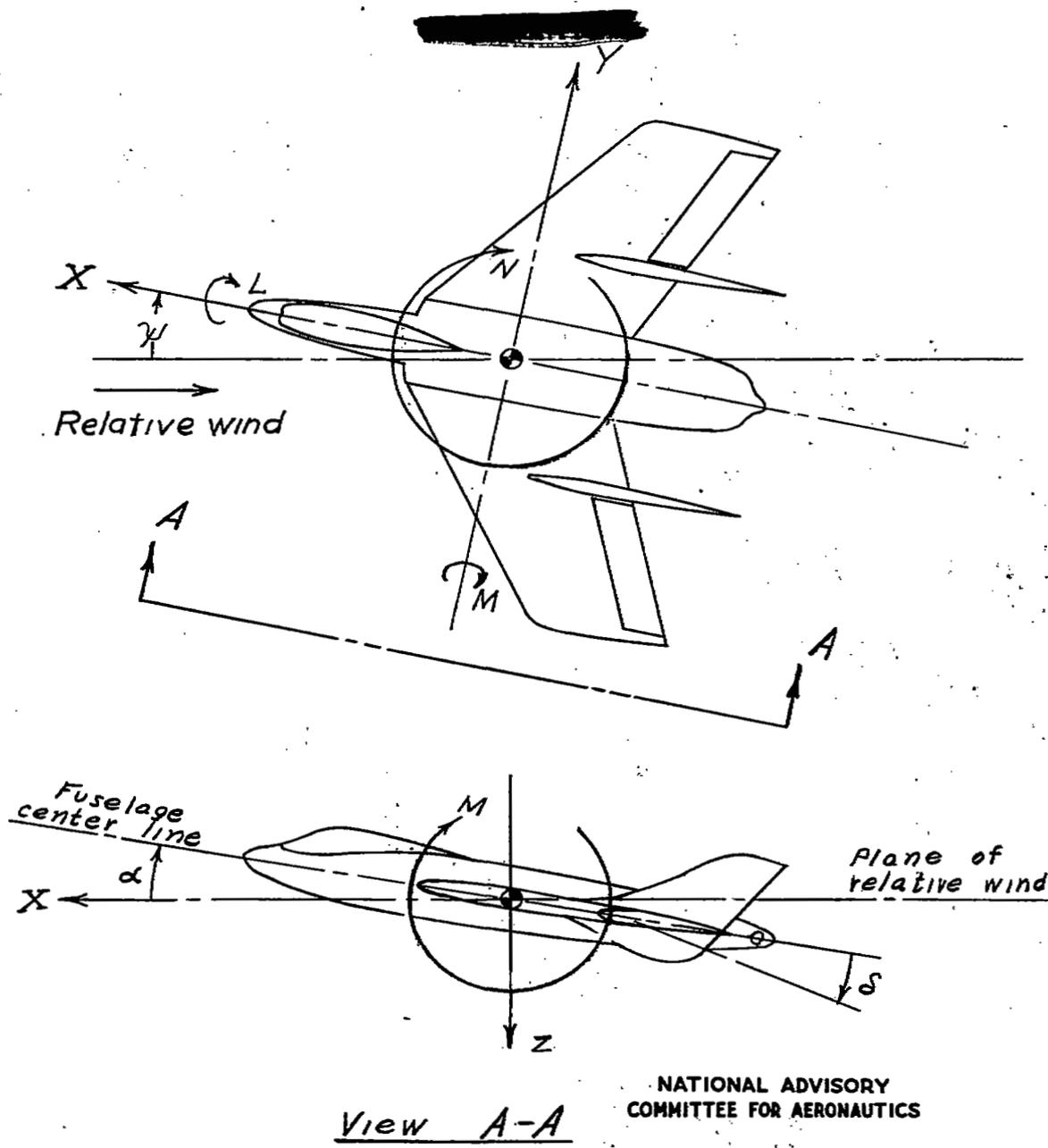
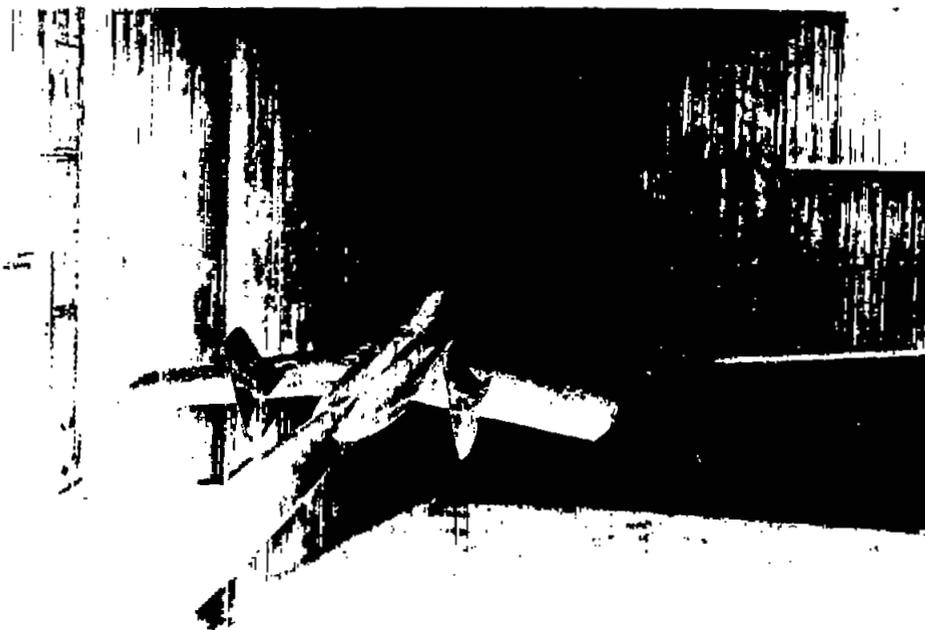


Figure 1 .- System of axes and control-surface deflections. Positive values of forces, moments, and angles are indicated by arrows.





NACA LMAL 52863

Figure 3.- Photograph of the 0.08-scale model of the XF7U-1 airplane mounted on the center sting at a positive angle of attack.

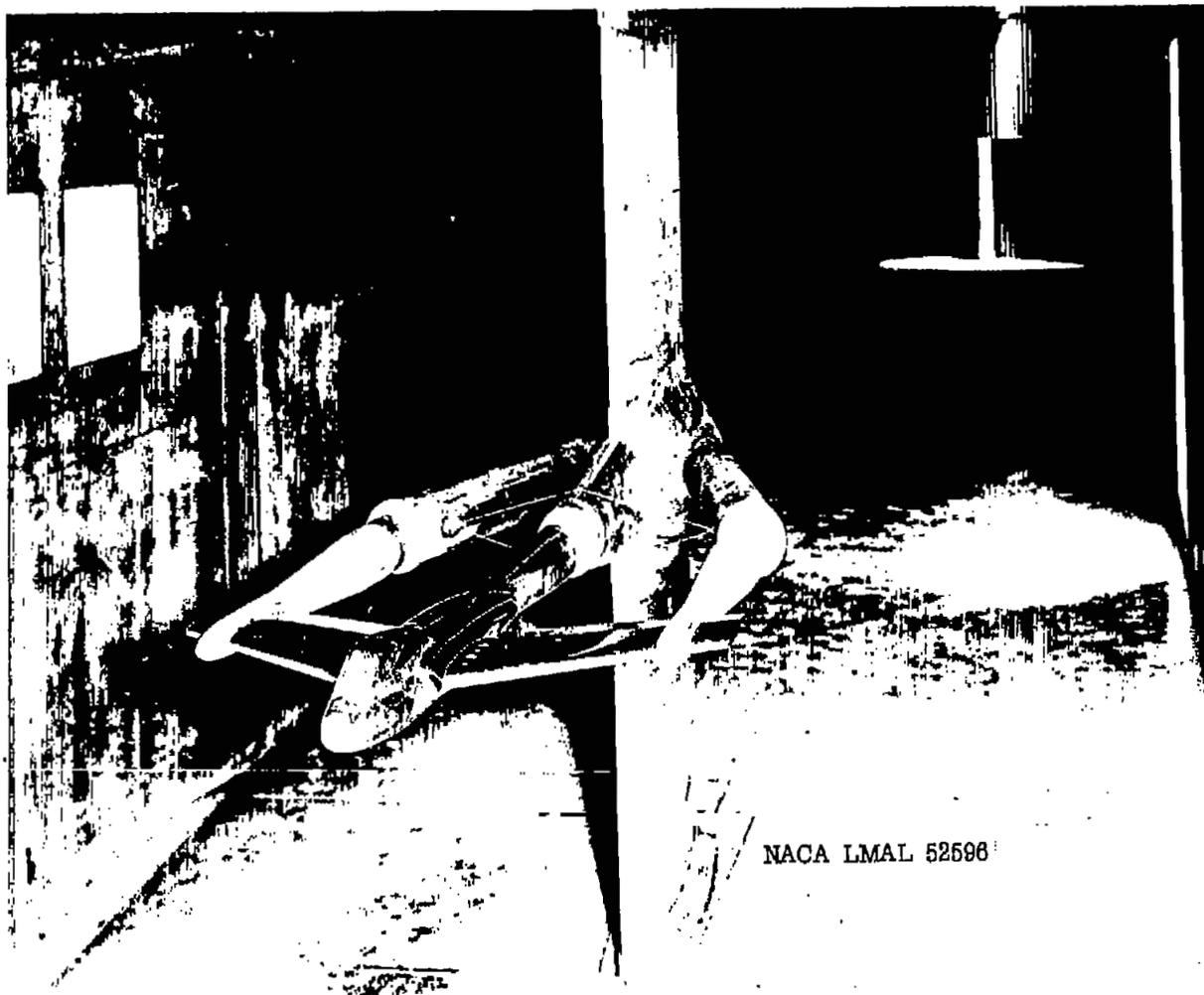


Figure 4.- Photograph of the 0.08-scale model of the XF7U-1 airplane with vertical tails removed mounted on the wing supports with center sting in place.

FIG. 4

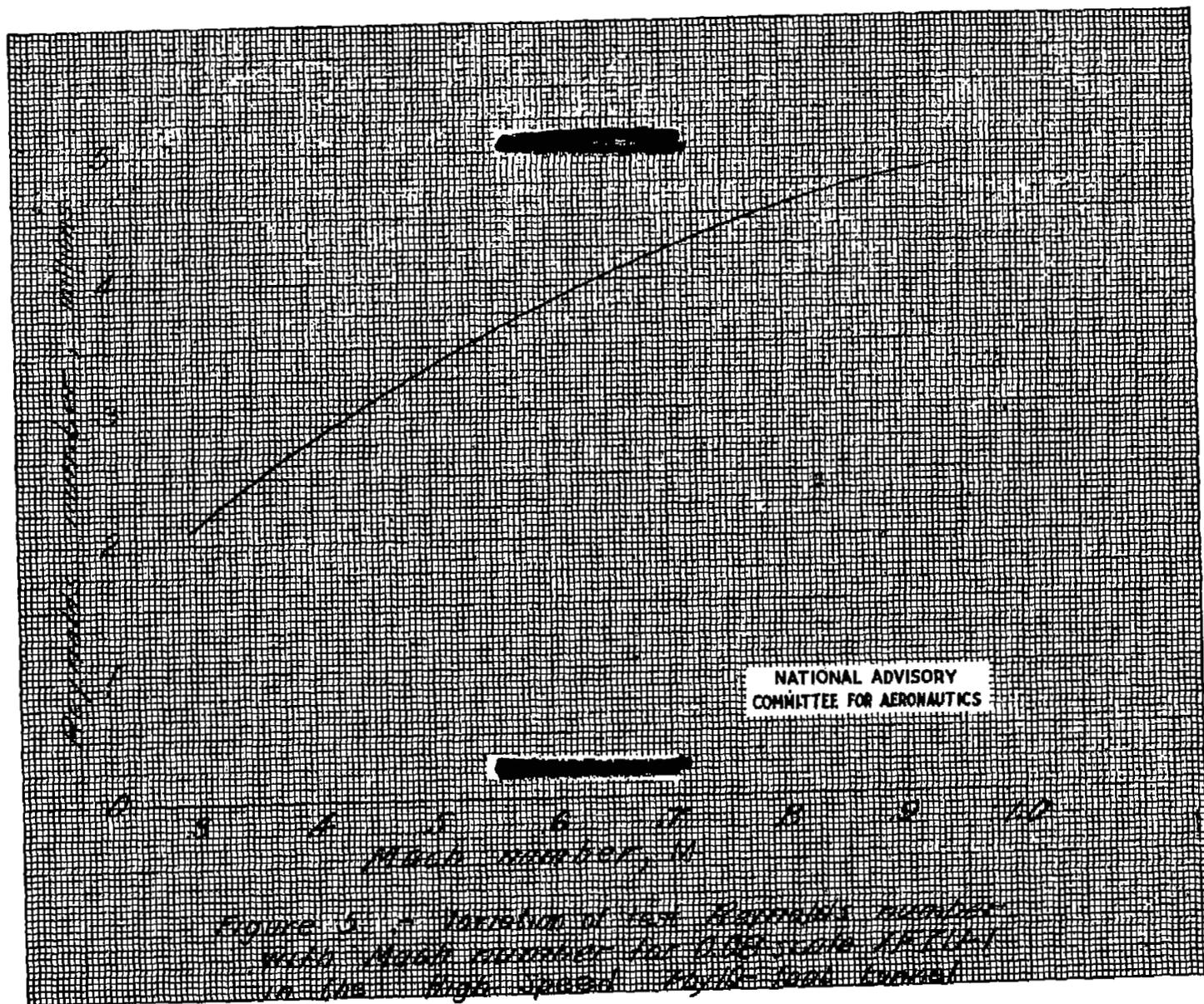
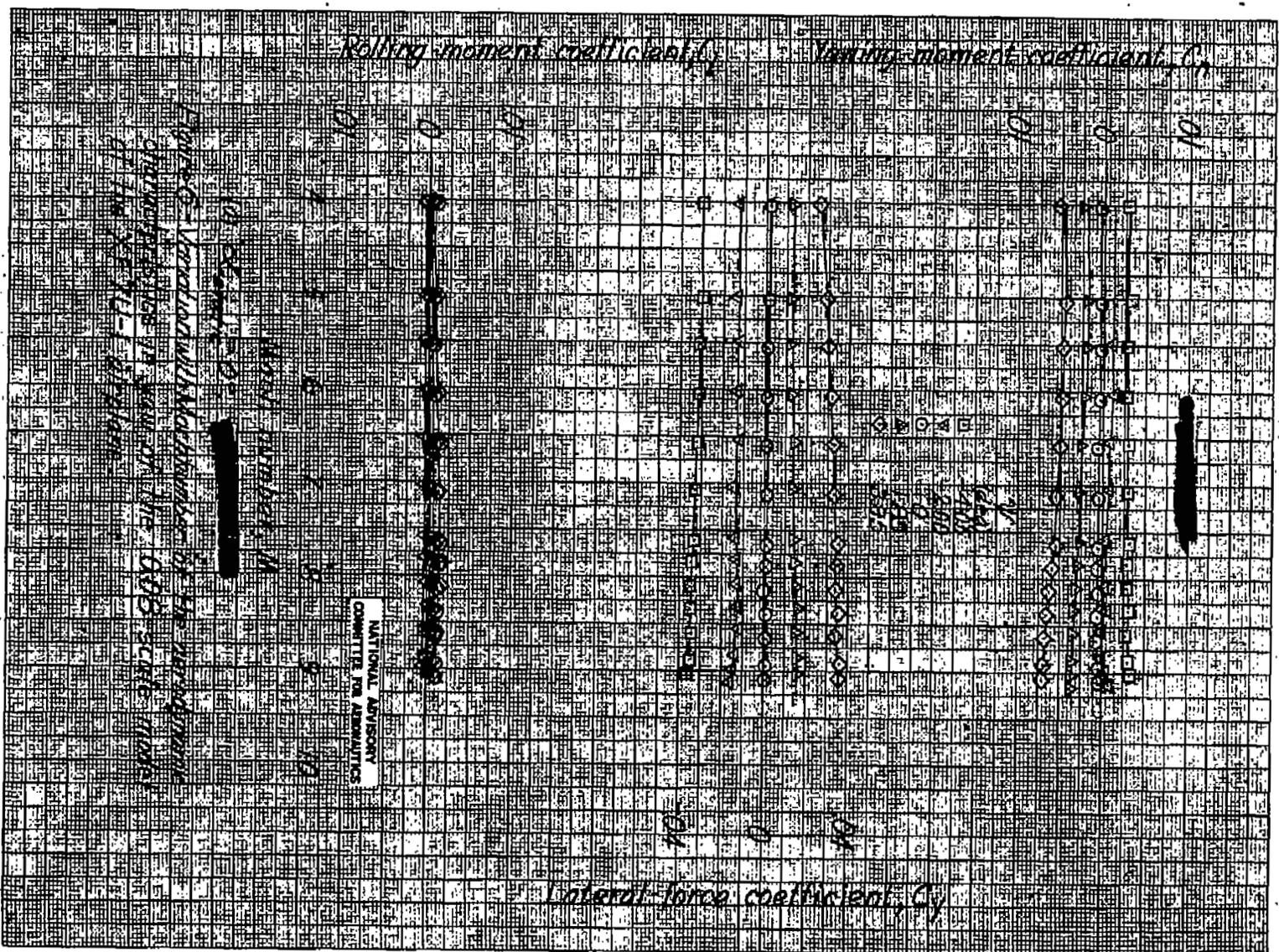


Figure 5 - Variation of Reynolds number with Mach number for 0.05 scale XFL5-1 in the high speed Mach test tunnel



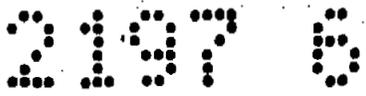


FIG. 6 cont.

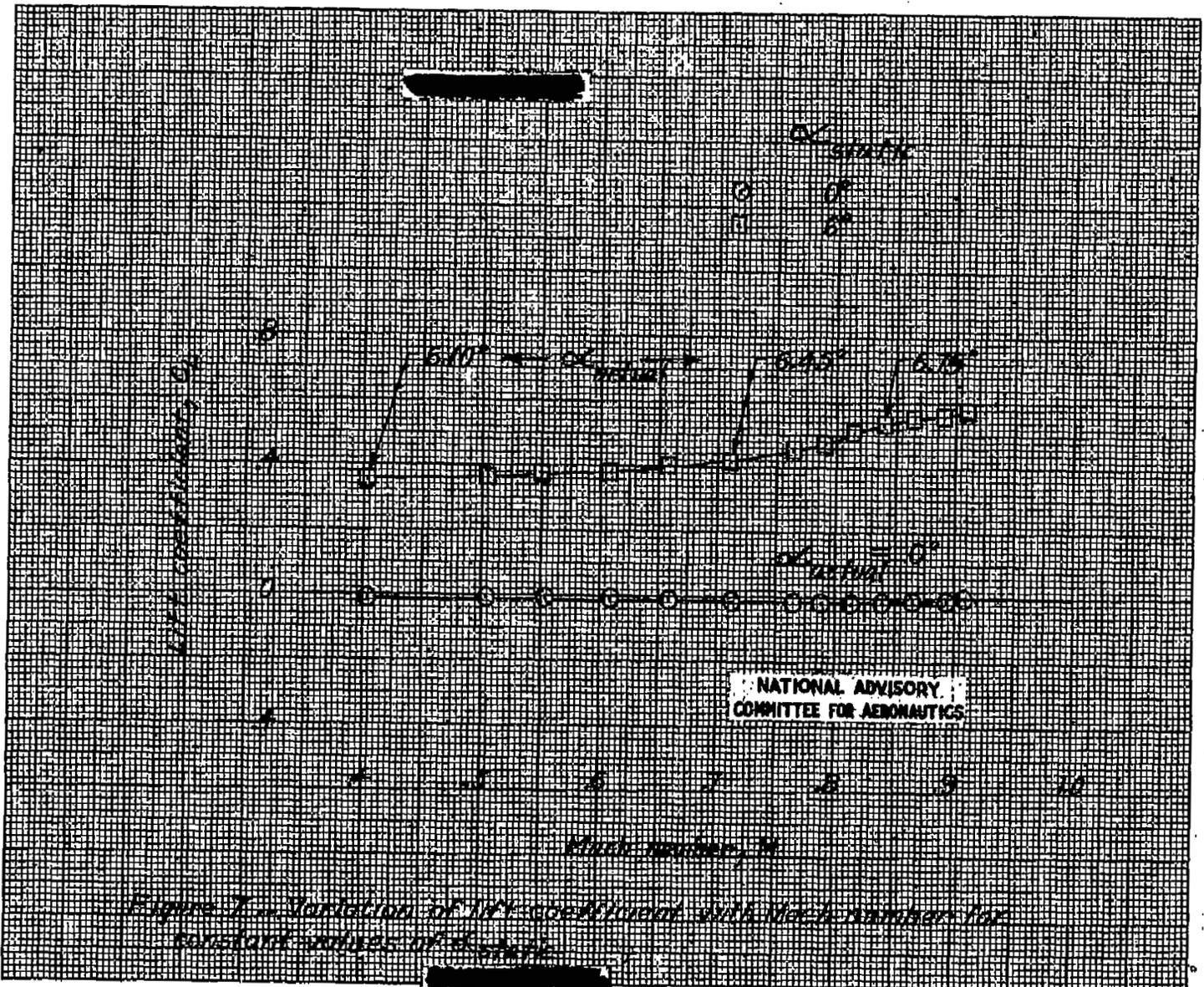


Figure 7. Variation of lift coefficient with Mach number for constant values of angle of attack.



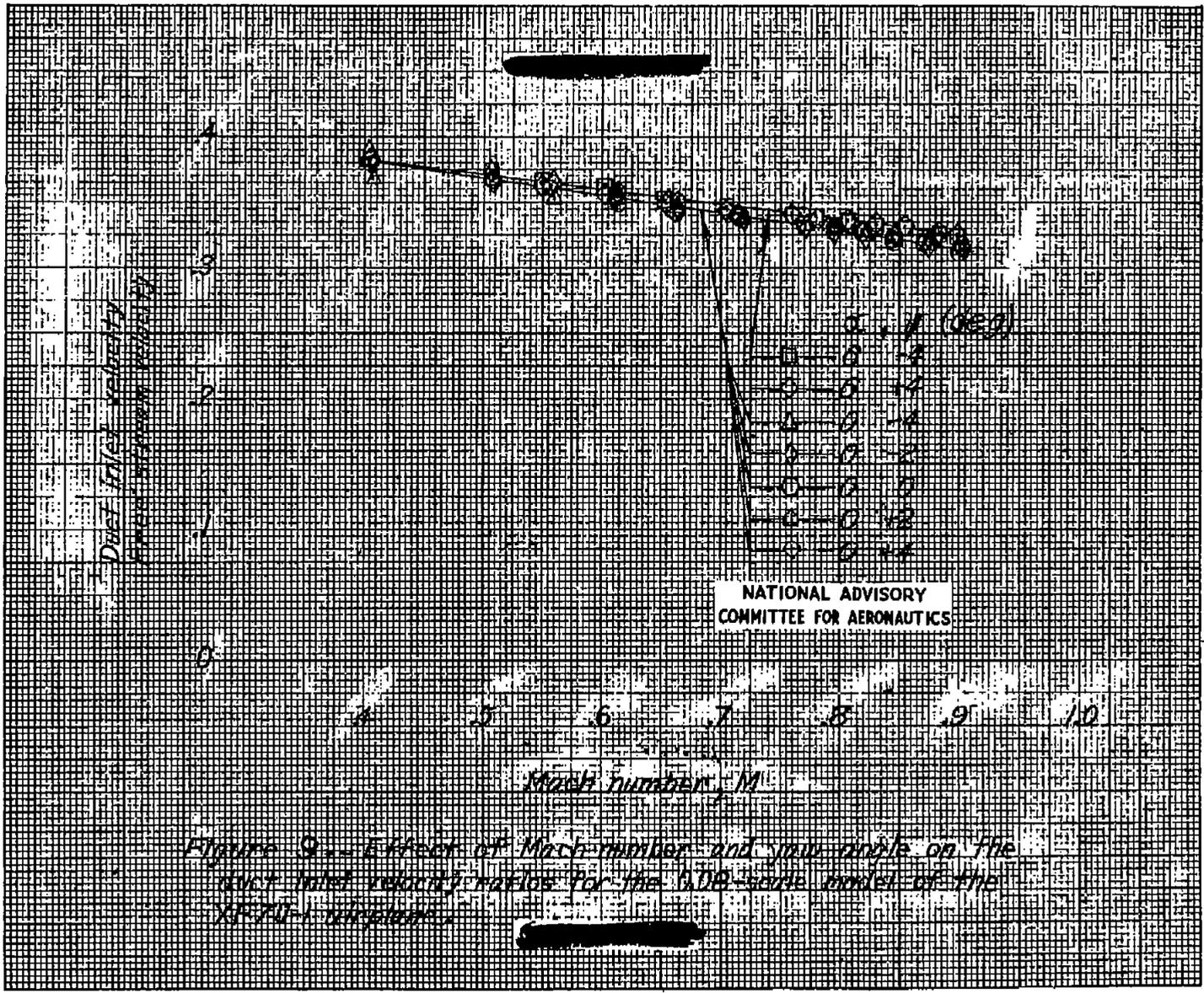


Figure 9. Effect of Mach number and yaw angle on the duct inlet velocity ratios for the 1/8 DB-scale model of the XP-70 airplane.

NASA Technical Library



3 1176 01437 5159