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20896

Aerodynamics (2)
Stability and Control (1)

NR 15126

Airplanes, - Control characteristics
(08395); Airplanes - Stability (08487); Airplanes,
Bomber - Performance charts (08517)

Charts showing stability and control characteristics of airplanes in flight

National Advisory Committee for Aeronautics, Washington, D. C.

U.S.

Eng.

Unclass. Dec 4, 32

graphs

A collection of charts is presented which indicates the satisfactory and unsatisfactory stability and control characteristics of fighters, Navy scout and patrol bombers and of trainees. Elevator, aileron and rudder control characteristics and dihedral characteristics are also evaluated. These charts were used during a conference to portray good and undesirable airplane flight characteristics.

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D52.32 / 268
MR No. L4126

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WARTIME REPORT

ORIGINALLY ISSUED
December 1944 as
Memorandum Report L4126

CHARTS SHOWING STABILITY AND CONTROL CHARACTERISTICS

OF AIRPLANES IN FLIGHT

By Stability and Control Section
of Flight Research Division

Langley Memorial Aeronautical Laboratory
Langley Field, Va.

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I - 706

MR No. 14126

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Army Air Forces, Air Technical Service Command

and the

Bureau of Aeronautics, Navy Department

CHARTS SHOWING STABILITY AND CONTROL CHARACTERISTICS

OF AIRPLANES IN FLIGHT

By Stability and Control Section
of Flight Research Division

INTRODUCTION

During October 1944, the National Advisory Committee conducted a series of conferences with the Army, Navy, and representatives of the aircraft industry for the purpose of discussing the flight-test procedures used in measuring the stability and control characteristics of airplanes. The conferences were initiated by the Army Air Forces, Air Technical Service Command, to acquaint the flight organizations of the industry with the flight test methods employed by the NACA and to standardize the techniques insofar as possible as they are employed by the various manufacturers and agencies engaged in determining the flying qualities of airplanes.

To facilitate the discussion during the conferences a series of charts was presented which portrayed typical good and undesirable airplane characteristics as determined in flight. The discussion centered around the characteristics portrayed and their relation to the Army Air Forces specifications for the stability and control of airplanes (reference 1). In general the following points were covered in connection with each chart:

- (a) The purpose of the test
- (b) The flight technique used

(c) Items recorded

(d) Evaluation and interpretation of data obtained

There were many requests from the conferees for copies of the charts presented for their further study and for reference with their notes taken during the discussion. Accordingly, the charts have been reproduced and are presented herein.

During the discussion there were many additional explanatory figures drawn on the blackboard so that the more formal charts do not give a complete picture of the material presented and discussed.

The conferences were held at both the Langley and Ames Laboratories of the NACA and a separate series of charts was presented by each group. Because of the similarity of the charts, however, only the charts presented at the Langley conference are given herein.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 26, 1944.

REFERENCE

1. Anon.: Stability and Control Requirements for Airplanes. AAF Specification No. C-1815, Aug. 31, 1943.

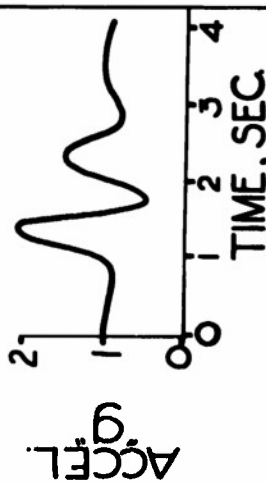
UNSATISFACTORY UNCONTROLLED LONGITUDINAL

MOTION

FIGHTER AIRPLANE

$V_i = 250$ MPH

ELEV. ANGLE
DOWN
UP
CONTROL
RELEASED



SATISFACTORY UNCONTROLLED LONGITUDINAL

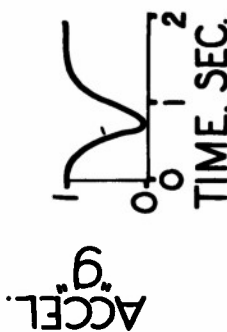
MOTION

FIGHTER AIRPLANE

$V_i = 316$ MPH

NATIONAL AERONAUTICS
COMMITTEE FOR AERONAUTICS

ELEV. ANGLE
DOWN
CONTROL
RELEASED



LMAL 4050

Figure 1.

L-706

MR No. L4L26

SATISFACTORY STICK FIXED AND STICK FREE STATIC LONGITUDINAL STABILITY

FIGHTER AIRPLANE CLIMBING CONDITION

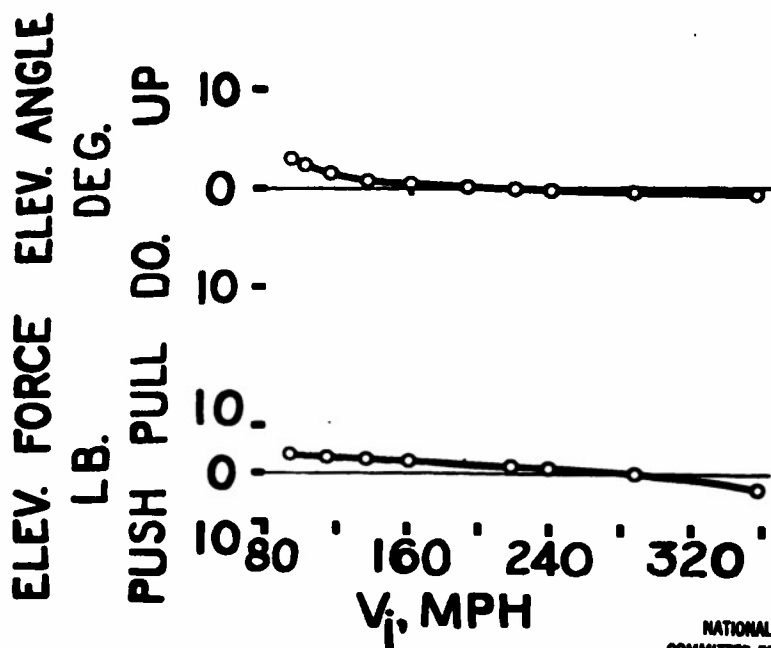


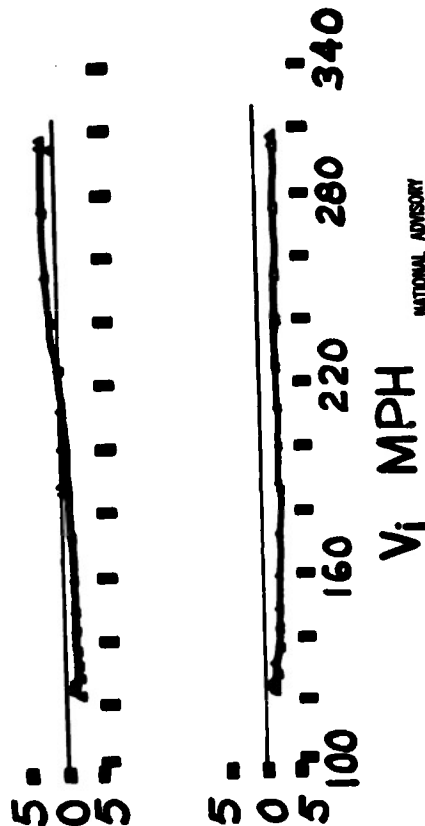
Figure 2.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LMAL 4055

UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

FIGHTER AIRPLANE GLIDING CONDITION

ELEVATOR
ANGLE DEG.
UP DOWN
FORCE LB.
PULL



LMAL 4051

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

Figure 3.

UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

FIGHTER AIRPLANE
CLIMBING CONDITION
RATED POWER, CLEAN

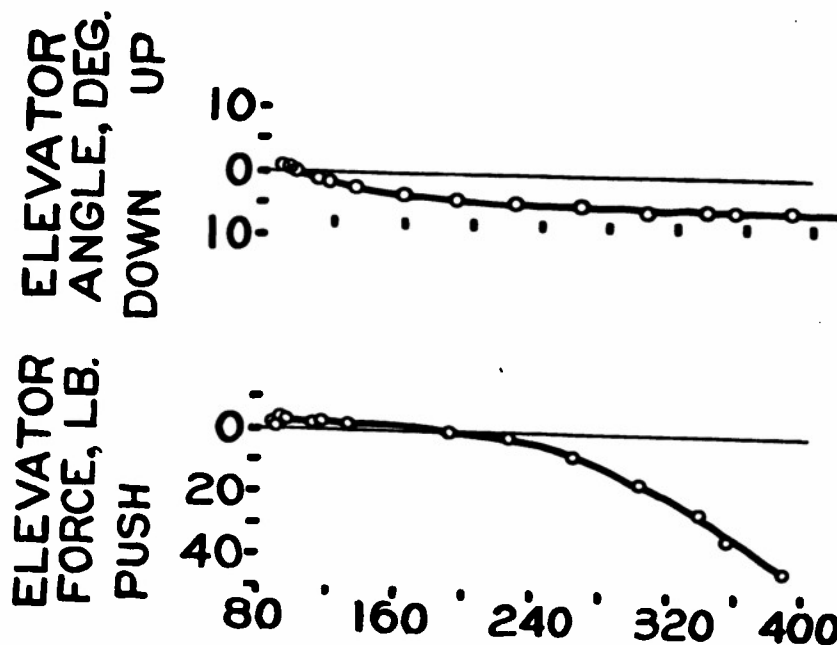


Figure 4.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

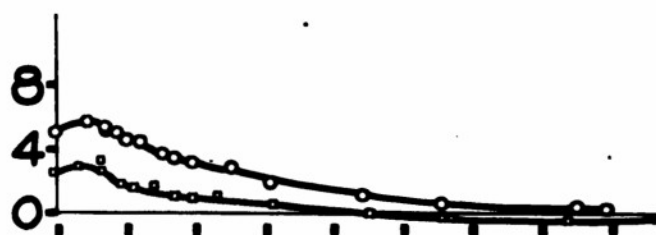
LMAI 4032

UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

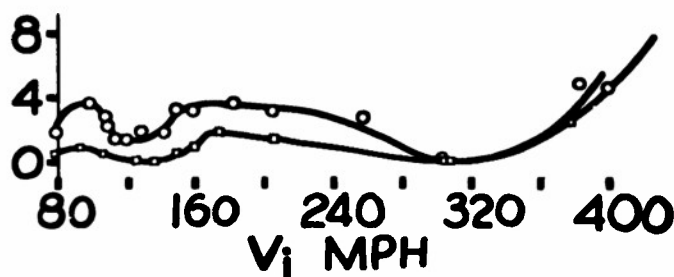
FIGHTER AIRPLANE
CLEAN CONDITION, POWER ON
C.G. POSITION IN % M.A.C.

- 22.85%
- ◻ 27.3%

ELEVATOR ANGLE
DEG.
UP



STICK FORCE, LB.
PUSH PULL



NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
L.MAL.4042

Figure 5.

L-706

UNSATISFACTORY STICK-FIXED LONGITUDINAL STABILITY

NAVY SCOUT BOMBER
CLIMBING CONDITION

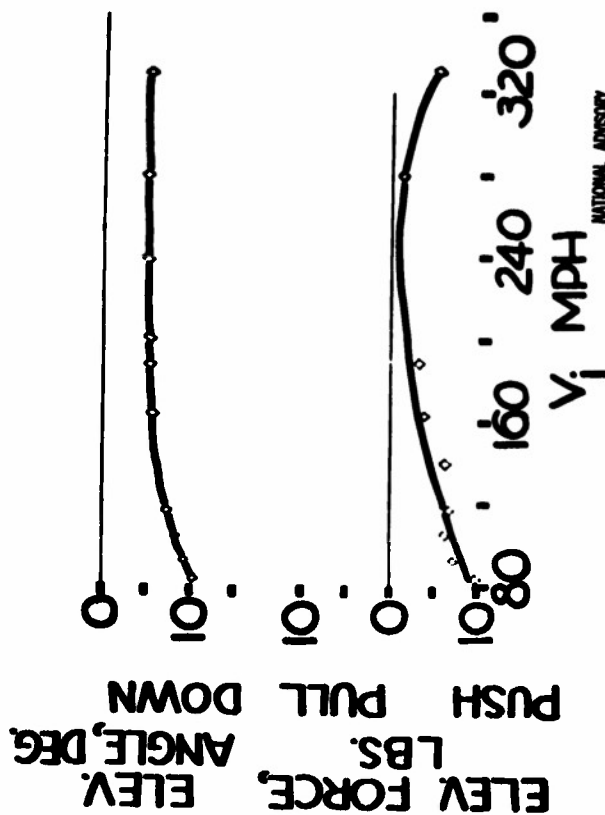


Figure 6.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LMAI 4053

MR No. L4L26

SATISFACTORY ELEVATOR FORCE CHARACTERISTICS IN ACCELERATED FLIGHT

FIGHTER AIRPLANE CRUISING CONDITION

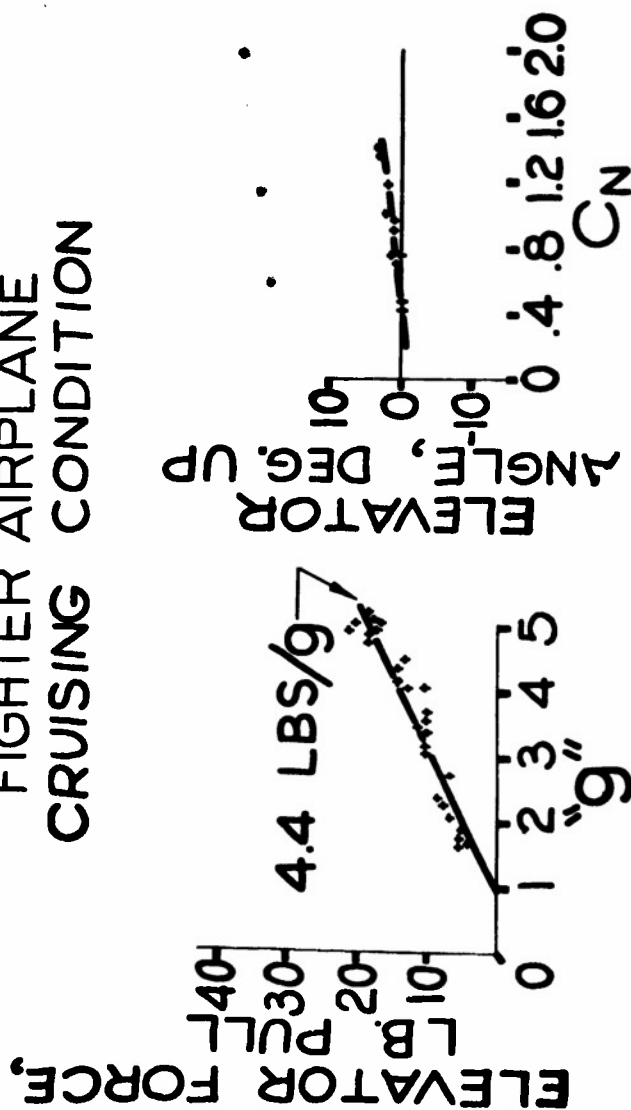


Figure 7.

MR No. L4L26

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COMMITTEE FOR AERONAUTICS
LWAL-4043

L-706

UNSATISFACTORY STICK FORCE CHARACTERISTICS IN ACCELERATED FLIGHT

NAVY SCOUT BOMBER WITH EXP.
BALANCE TAB
 $V_i = 170$ MPH

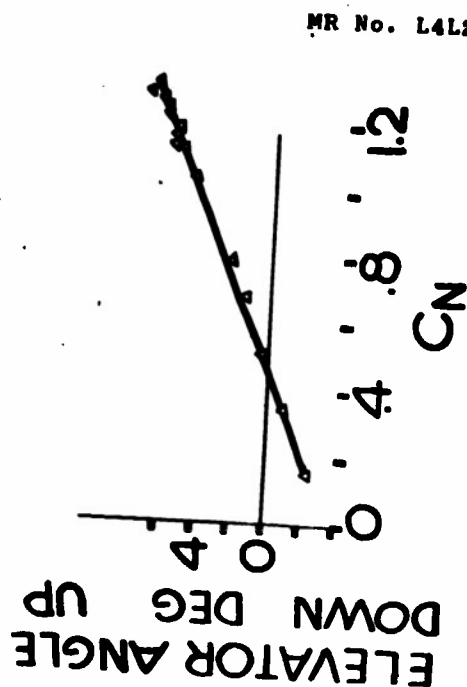
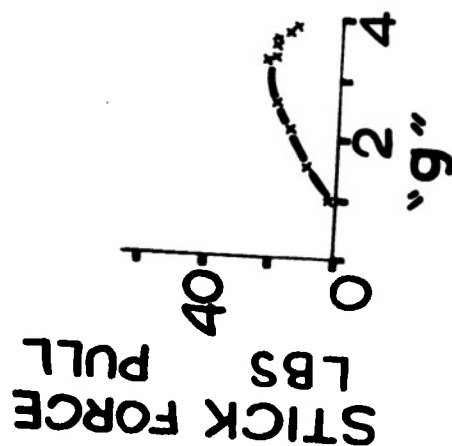
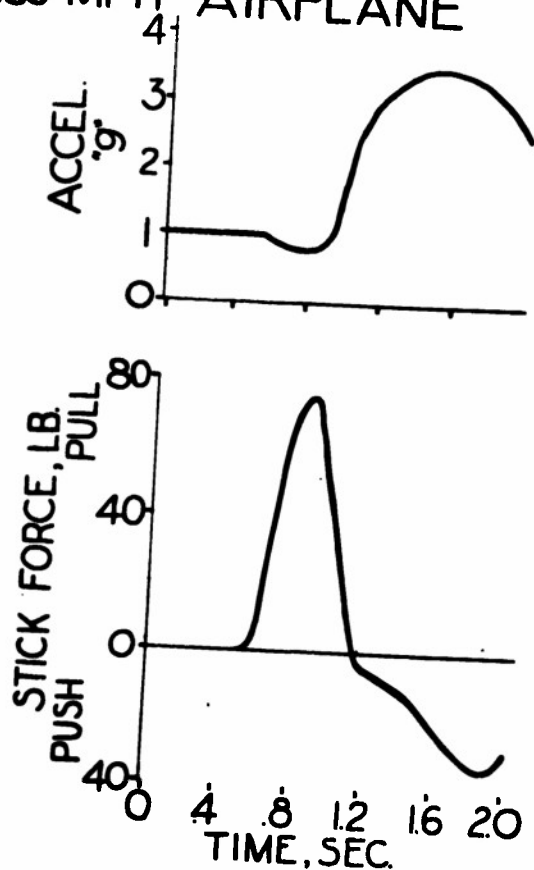


Figure 8.

MR No. L4L26

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LINAL 4034

SATISFACTORY ELEVATOR CONTROL IN ABRUPT PULL-UPS-FIGHTER $V_i = 188$ MPH AIRPLANE



NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

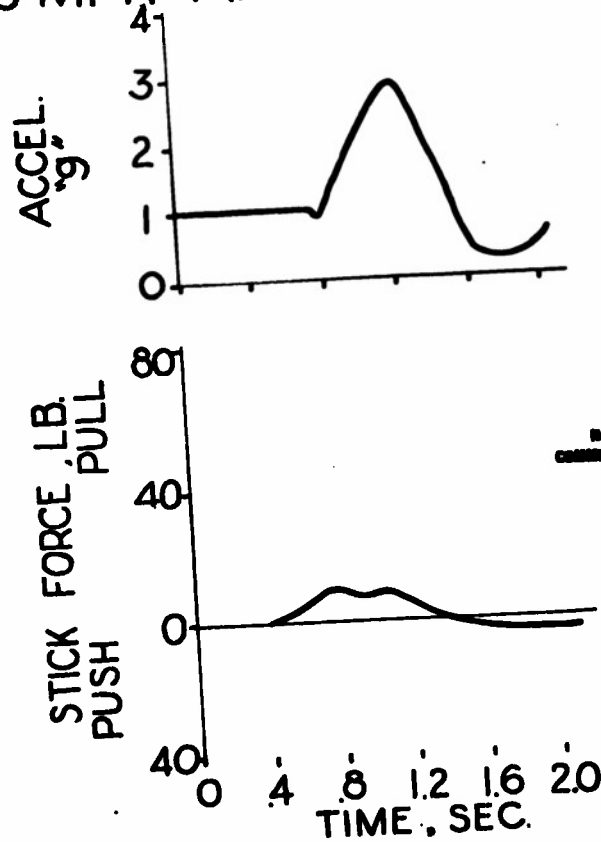
LMAL 4044

Figure 9.

MR No. L4L26

UNSATISFACTORY ELEVATOR CONTROL
IN ABRUPT P. - FIGHTER
 $V_i = 205$ MPH AIR

L-706



NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

Figure 10.

LMAL 4045

L-706

MR No. L4L2f

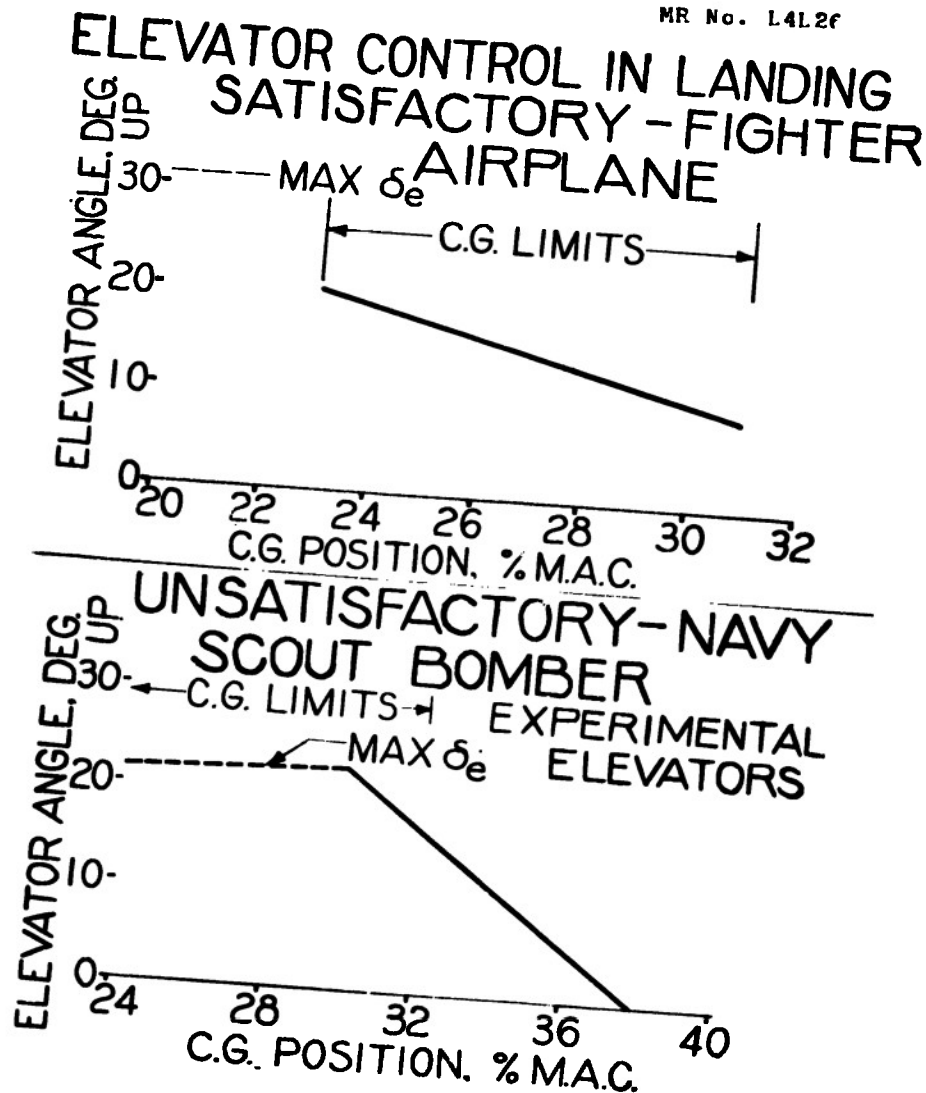


Figure 11.

NATIONAL ADVISORY
 COMMITTEE FOR AERONAUTICS

LMAL 4046

CHANGE IN ELEVATOR FORCE FROM CLIMBING CONDITION AT $V_i=120$ MPH

CONDITION	FIGHTER AIRPLANE	NAVY SCOUT BOMBER
CLIMBING	0	0
GLIDING	.4 PULL	14 PULL
LANDING	5.1 "	14 "
WAVE-OFF	2.9 "	3.5 "
APPROACH	5.4 "	10.7 "

Figure 12.

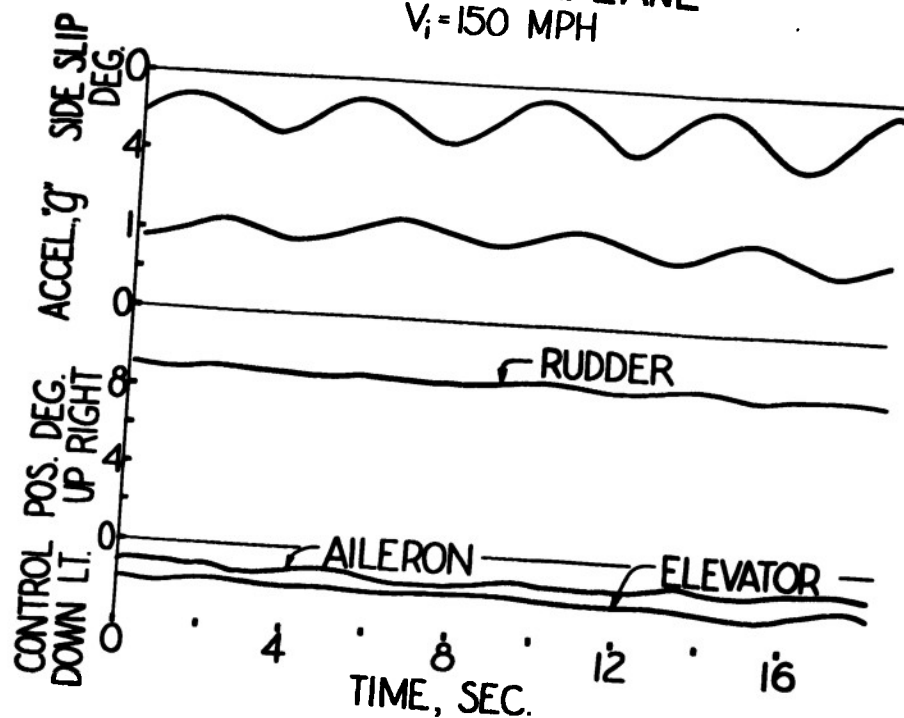
NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LMAL 4041

L-706

MR No. L4L26

UNSATISFACTORY CONTROL FIXED OSCILLATION

FIGHTER AIRPLANE
 $V_i = 150$ MPH



NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

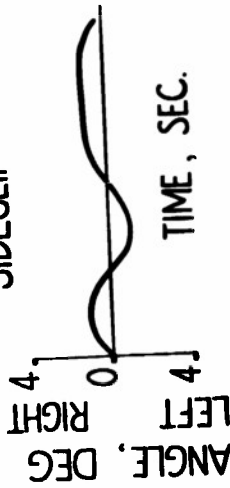
LMAL 4047

Figure 13.

UNSATISFACTORY UN-
CONTROLLED LATERAL
AND DIRECTIONAL MOTION
TRAINER AIRPLANE
 $V_i = 86$ MPH
SIDESLIP

ALL MOVABLE VERTICAL TAIL

$V_i = 86$ MPH
SIDESLIP



RUDDER

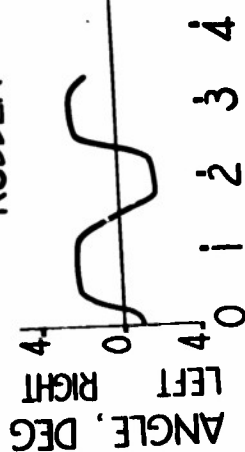


Figure 14.

SATISFACTORY UNCON-
TROLLED LATERAL AND
DIRECTIONAL MOTION
FIGHTER AIRPLANE
 $V_i = 243$

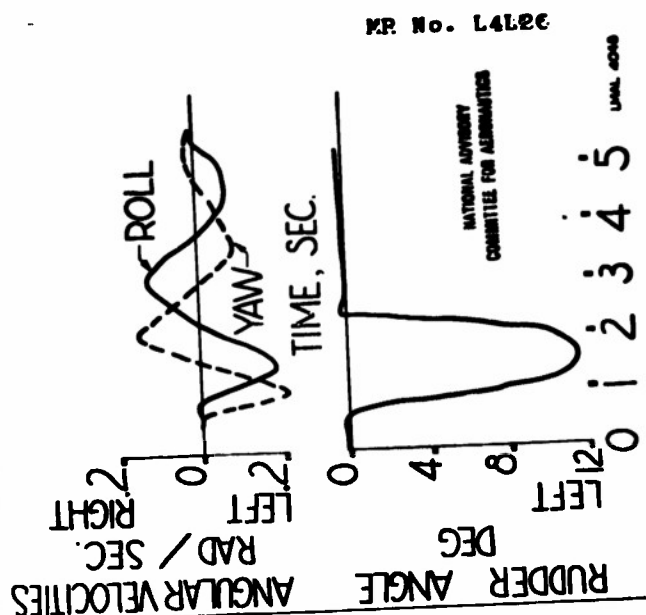


Figure 15.

UNSATISFACTORY
UNCONTROLLED
LATERAL MOTION
FIGHTER AIRPLANE
(EXPERIMENTAL AILERONS)

$V_i = 320$ MPH

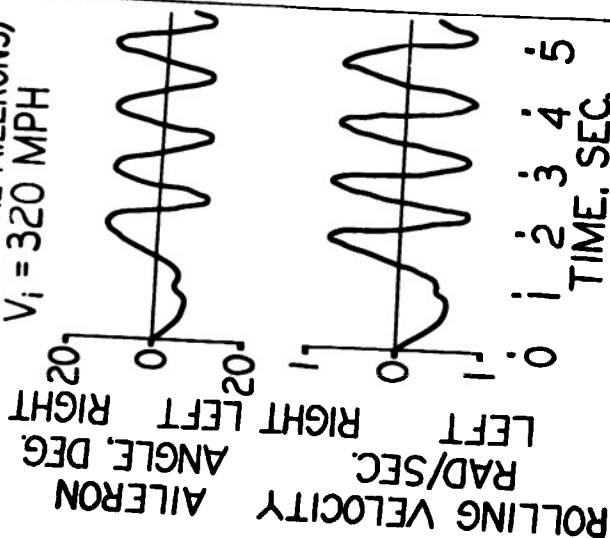


Figure 16.

SATISFACTORY
UNCONTROLLED
LATERAL MOTION
NAVY SCOUT BOMBER

$V_i = 298$ MPH

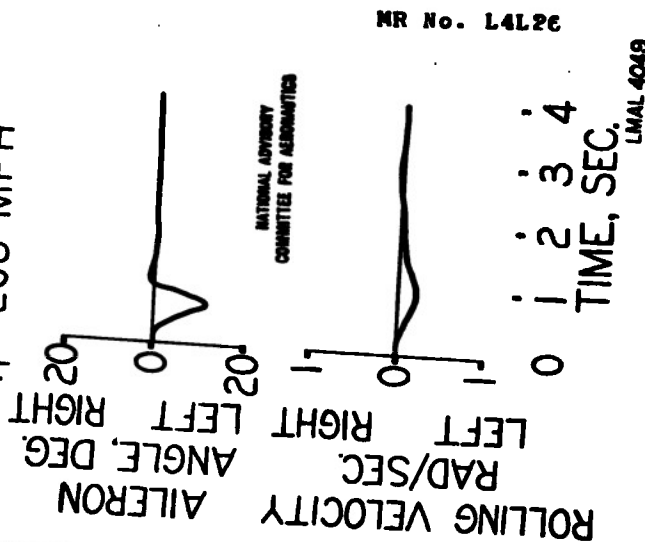


Figure 17.

LMAL 4049

NR No. L4L26

**SATISFACTORY AILERON
FORCE CHARACTERISTICS
FIGHTER AIRPLANE
(EXPERIMENTAL AILERON)
CLEAN CONDITION
 $V_i = 201$ MPH**

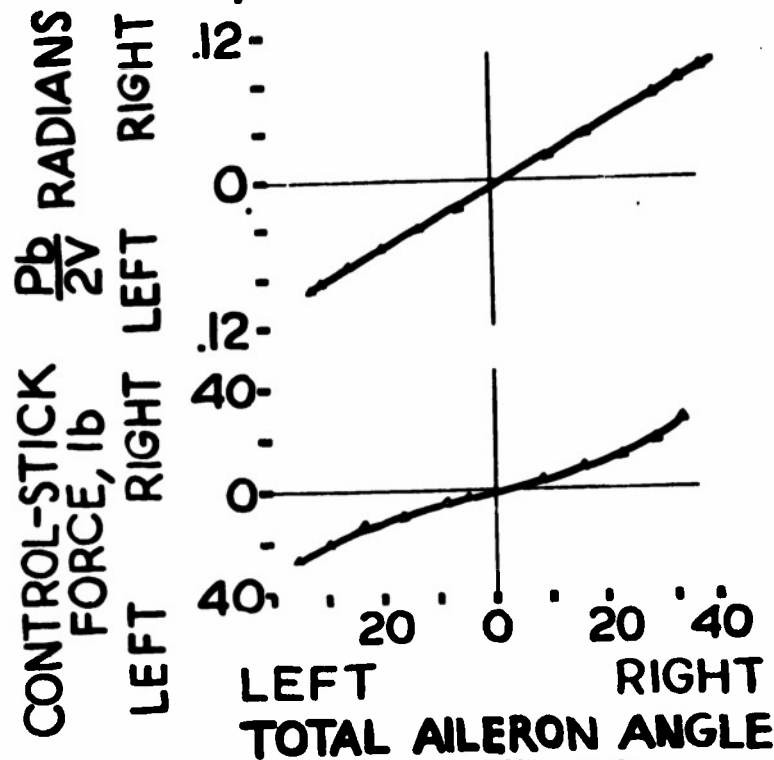


Figure 18.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

LMAL 4040

UNSATISFACTORY AILERON FORCE CHARACTERISTICS FIGHTER AIRPLANE (CLEAN CONDITION) $V_i = 210$ MPH

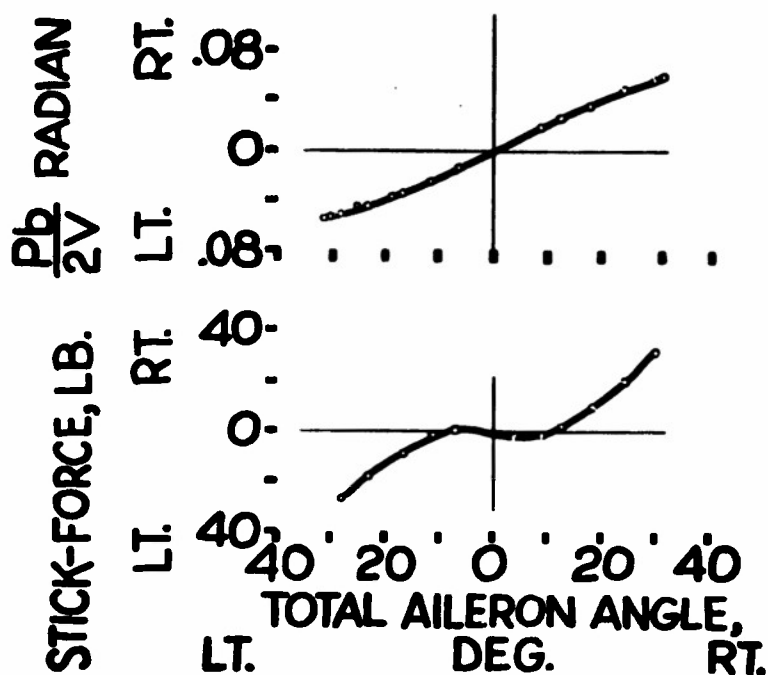


Figure 19. NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS LMAL 4035

L-706

AILERON EFFECTIVENESS OF VARIOUS FIGHTER AIRPLANES WITH 50 LB. STICK FORCE

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

MR No. L4L26



LNAL 4058

Figure 20

UNSATISFACTORY DIRECTIONAL TRIM CHARACTERISTICS

FIGHTER AIRPLANE
RATED POWER, CLEAN CONDITION

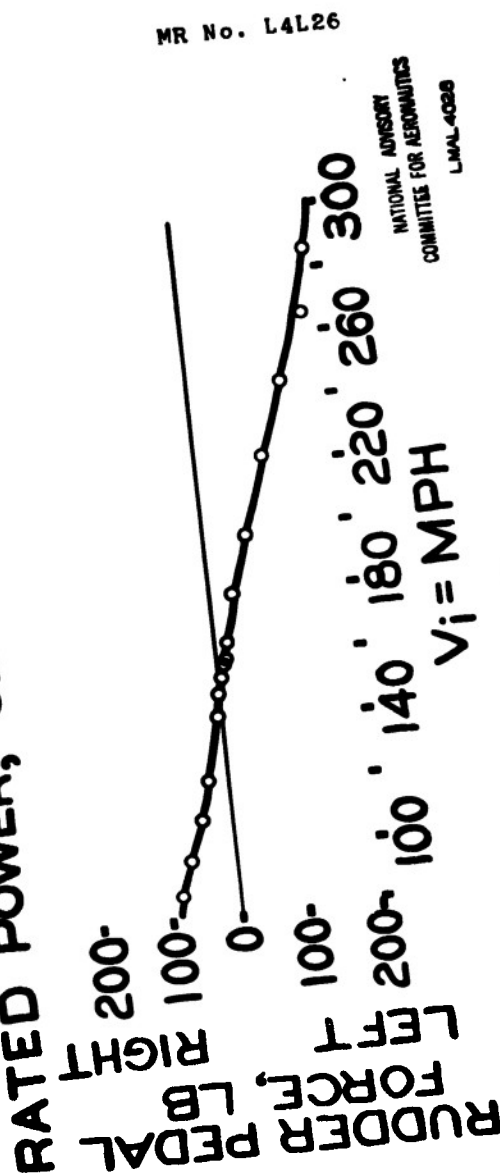
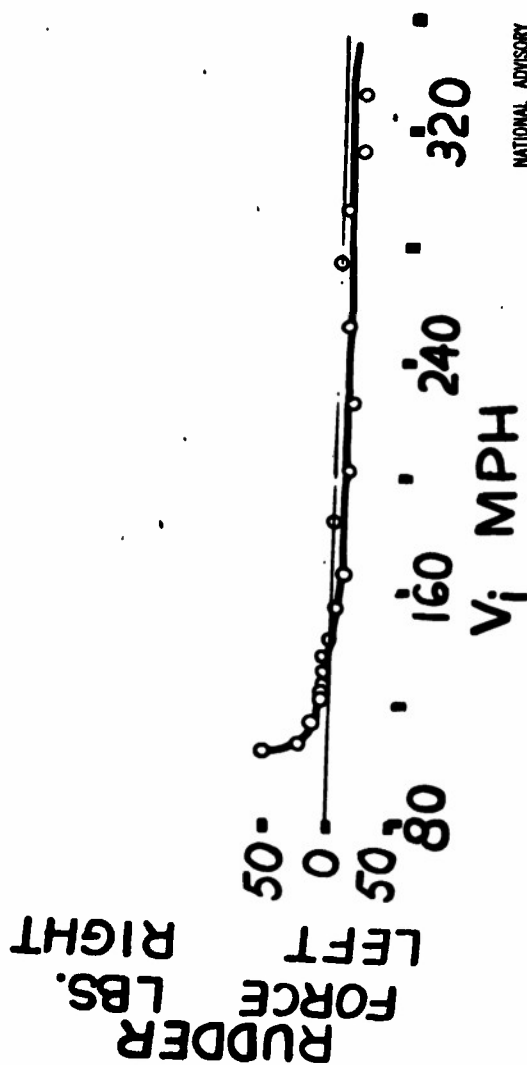


Figure 21.

L-706

SATISFACTORY DIRECTIONAL TRIM CHARACTERISTICS

ATTACK BOMBER
RATED POWER, CLEAN CONDITION



NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

LMAL 4039

Figure 22.

MR No. L4L26

EFFECT OF LATERAL C.G. SHIFT ON RUDDER DEFLECTION REQUIRED FOR TRIM

NAVY SCOUT BOMBER

- C.G. 4.16 IN. TO LEFT OF Φ
- C.G. 4.16 IN. TO RIGHT OF Φ

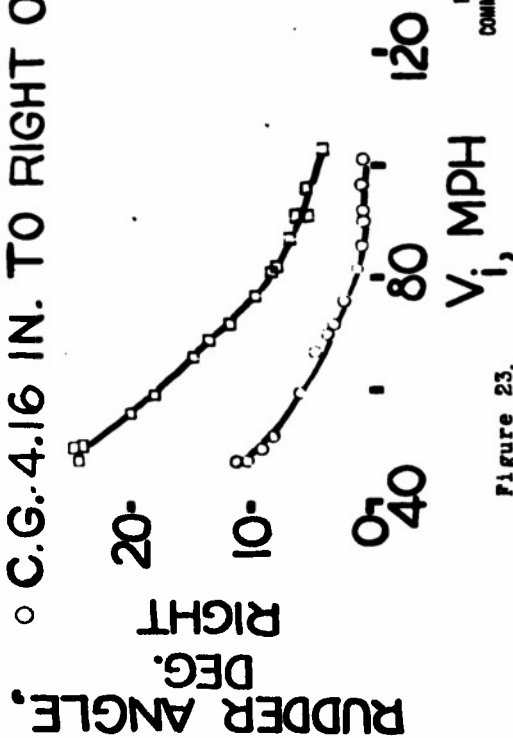


Figure 23.

MP No. L4L26

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LWAL 4034

1-706

MR No. L4L26

SATISFACTORY DIRECTIONAL STABILITY CHARACTERISTICS

FIGHTER AIRPLANE
CLIMBING CONDITION
 $V_i = 90$ MPH

RUDDER ANGLE, DEG.
RIGHT
LEFT
RUDDER FORCE, LB.
RIGHT
LEFT

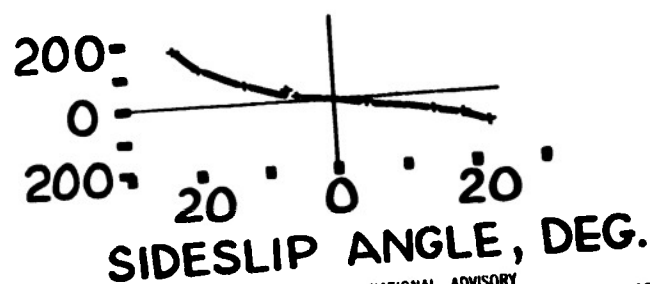
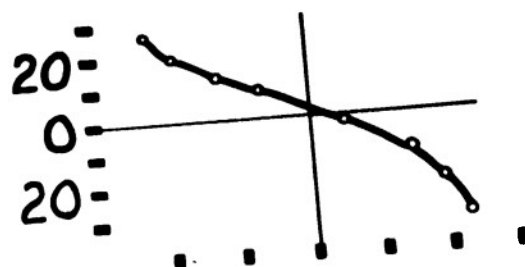


Figure 24.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS LMAL 4039

UNSATISFACTORY RUDDER
FREE STABILITY
NAVY SCOUT BOMBER,
CLIMBING CONDITION,
 $V_i = 120$ MPH

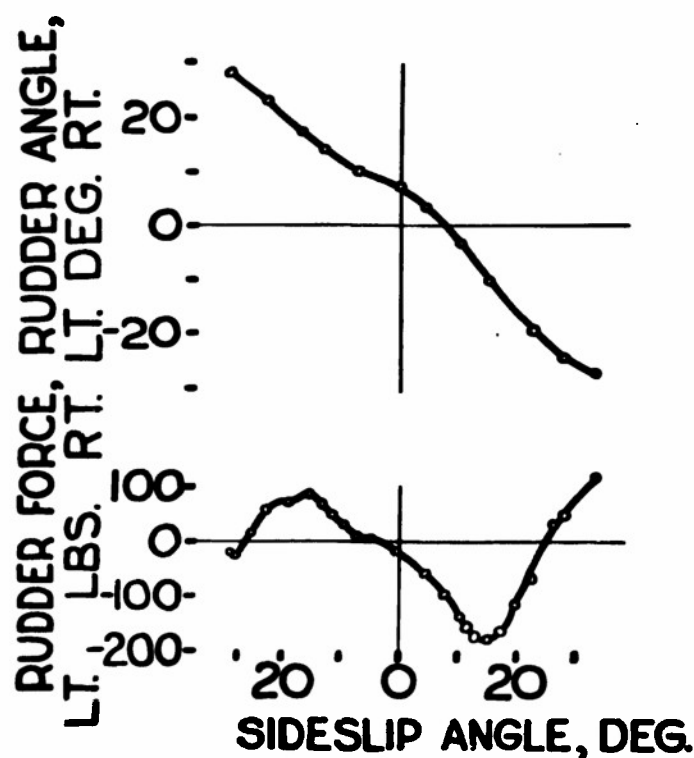


Figure 25. NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS LMAL 4037

UNSATISFACTORY RUDDER FIXED STABILITY

NAVY TORPEDO BOMBER,
GLIDING CONDITION
 $V_i = 92$ MPH

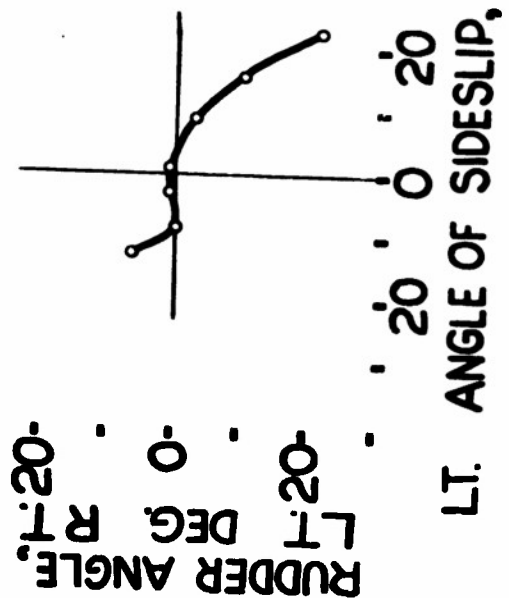


Figure 26.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS LINAL 4036

SATISFACTORY STICK FIXED AND STICK FREE DIHEDRAL EFFECT

FIGHTER AIRPLANE
CLIMBING CONDITION, 252 MPH

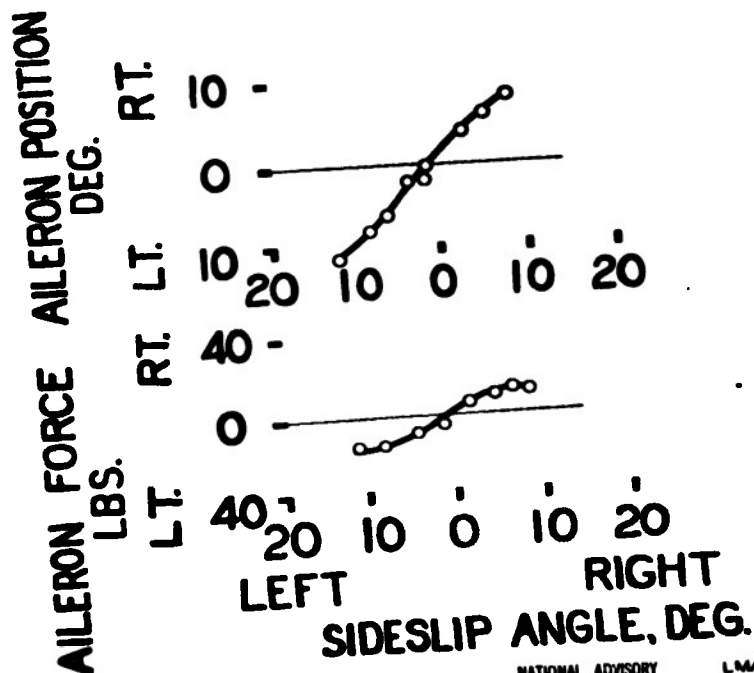


Figure 27.

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

L.MAL.4029

UNSATISFACTORY STICK FIXED DIHEDRAL EFFECT

FIGHTER AIRPLANE
LANDING CONDITION
 $V_i = 120$ MPH

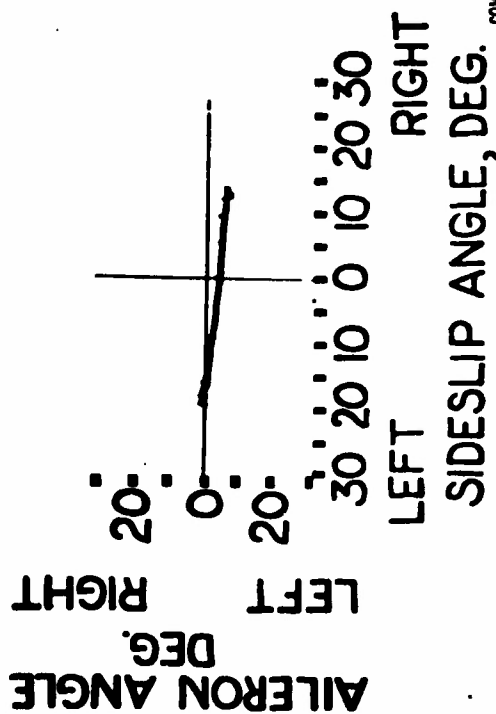


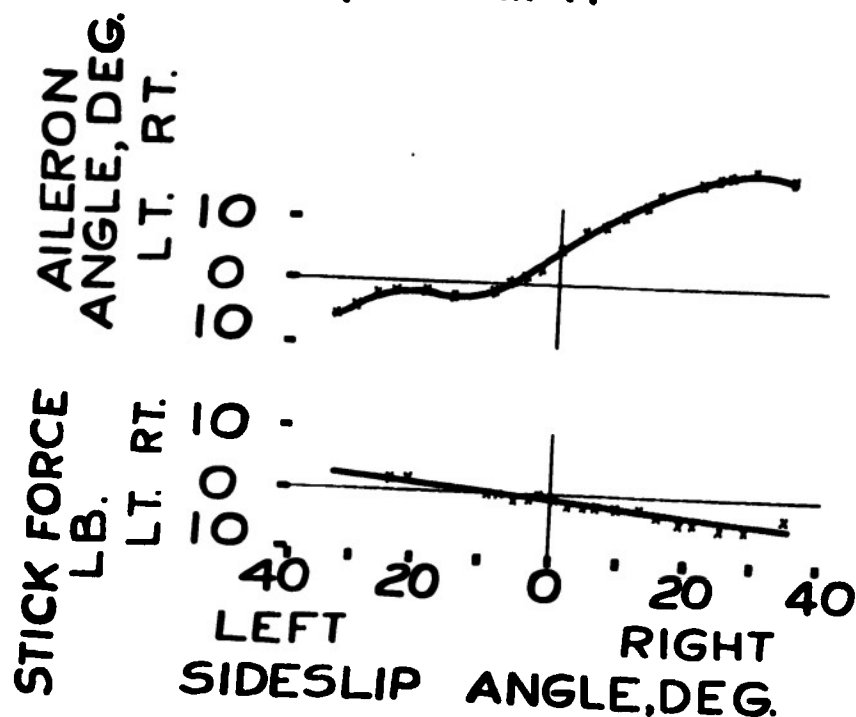
Figure 28.

MR No. L4L26

NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
LMAAL 4030

UNSATISFACTORY STICK FREE DIHEDRAL EFFECT

FIGHTER AIRPLANE
CLEAN CONDITION, RATED POWER
 $V_i = 110$ MPH



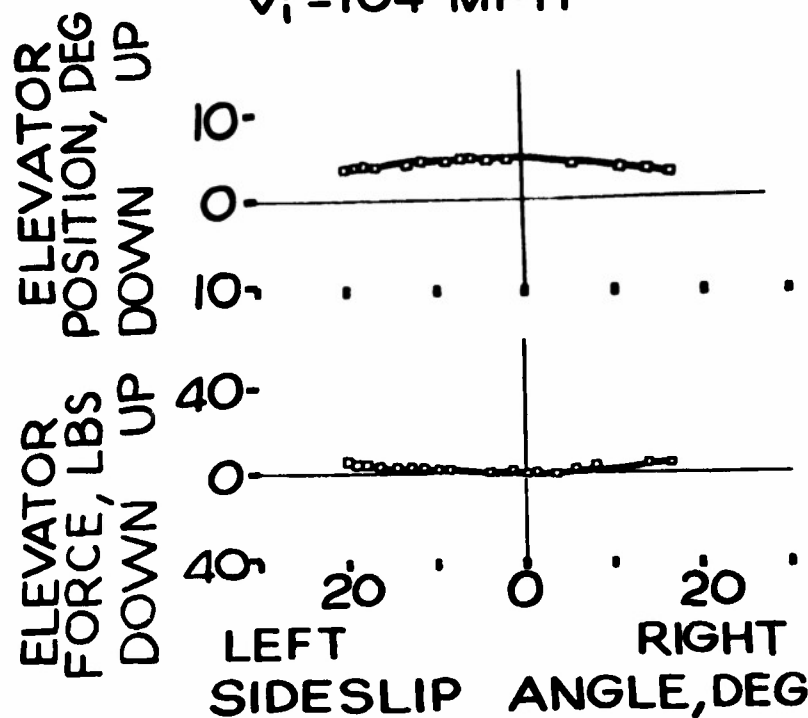
NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

LMAL 4031

Figure 29.

SATISFACTORY PITCHING MOMENT DUE TO SIDESLIP

FIGHTER AIRPLANE
LANDING CONDITION
 $V_i = 104$ MPH



NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS

LMAL 4032

Figure 30.

UNSATISFACTORY PITCHING MOMENT DUE TO SIDESLIP

NAVY TORPEDO BOMBER
CLEAN, RATED POWER
 $V_i = 95$ MPH

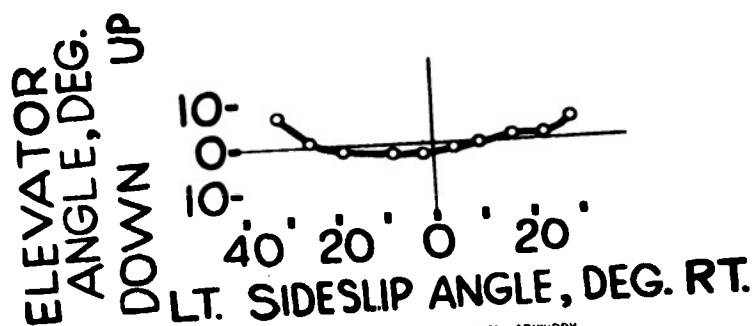
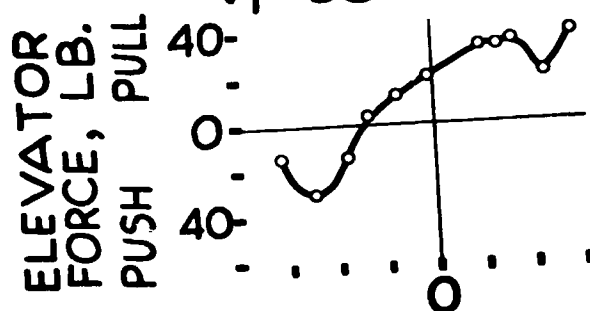


Figure 31.

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FORM 100 (10-1-57)

DIVISION: Aerodynamics (2)
 SECTION: Stability and Control (12.6.1)
 CROSS REFERENCES: Airplanes - Control characteristics
 (08393); Airplanes - Stability (08487); Airplanes,
 Bomber - Performance charts (08517)

AUTHOR(S)

ATI- 20896
 ORIG. AGENCY NUMBER
 MR 14126
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AMER. TITLE: Charts showing stability and control characteristics of airplanes in flight
 FOREIGN TITLE: OVER

ORIGINATING AGENCY: National Advisory Committee for Aeronautics, Washington, D. C.

TRANSLATION:

COUNTRY	LANGUAGE	FORG'N CLASS	U. S. CLASS	DATE	PAGES	ILLUS.	FEATURES
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NOTE: Requests for copies of this report must be addressed to: N.A.C.A.,
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T-2 HQ, AIR MATERIEL COMMAND

AERO INDEX

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EDIC FORM 13 (13 MAR 47)

DIVISION: Aerodynamics (2)
 SECTION: Stability and Control (1)
 CROSS REFERENCES: Airplanes - Control characteristics (08393); Airplanes - Stability (08487); Airplanes, Bomber - Performance charts (08517)

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JUNE 1945

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DATED 31 DECEMBER 1947.

② p1/1, p1/3/3, p1/3/4

②③ Inflight

* Aerodynamic stability

* Fighter aircraft

* Patrol aircraft