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MEASUREMENT OF FLYING QUALITIES OF A DEHAVILLAND MOSQUITO F-8 AIRPLANE (AAF NO. 43-334960)

I - LATERAL AND DIRECTIONAL STABILITY AND CONTROL CHARACTERISTICS

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NACA

WASHINGTON

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Army Air Forces, Air Technical Service Command

MEASUREMENT OF FLYING QUALITIES OF A DEHAVILLAND

MOSQUITO F-8 AIRPLANE (AAF NO. 43-334960)

I - LATERAL AND DIRECTIONAL STABILITY

AND CONTROL CHARACTERISTICS

By H. L. Crane, D. B. Talmage, and W. E. Gray, Jr.

SUMMARY

This paper presents the results of flight tests to determine the lateral and directional stability and control characteristics of a DeHavilland Mosquito F-8 airplane. The data presented herein have no bearing on the performance characteristics of the airplane, which were not measured in these tests, but which were considered to be exceptionally good. Some of the desirable features of the lateral and directional stability and control characteristics of the F-8 were:

1. Rudder-control forces required with the spring-tab rudder were never excessive. The variation of rudder force with speed in straight flight was very small.

2. Control could be easily maintained during single-engine operation in the clean condition.

3. The control-fixed effective dihedral was always positive and was not considered excessive.

The lateral and directional stability and control characteristics of the airplane were considered to be unsatisfactory in the following respects:

1. The directional stability with rudder fixed did not sufficiently restrict the aileron yaw.

2. Rudder lock occurred near the stall in the clean condition with power for level flight at large angles of sideslip.

3. The rudder control was inadequate during take-off and landing and was insufficient to fly the airplane with one engine inoperative and the other engine delivering power for level flight with the flaps and landing gear down.

4. In the clean condition, the power of the ailerons was slightly below the minimum value specified for airplanes of this type.

5. Aileron overbalance occurred in rolls up to an indicated speed of 200 miles per hour over a large part of the deflection range. The aileron forces at indicated speeds up to 300 miles per hour were, however, desirably light.

6. In power-on conditions of flight, an undesirable pitching moment due to sideslip and due to yawing velocity existed, which made it difficult to trim the airplane in rough air.

INTRODUCTION

Flight tests have been made to determine the flying qualities of a DeHavilland Mosquito F-8 airplane. This paper presents the results of the tests to determine the lateral and directional stability and control characteristics. The results of the tests of longitudinal stability and control will be presented in part II. The complete program required 16 flights and approximately 24 hours of flying. These flights were made in October and November of 1944.

DESCRIPTION

The Mosquito is a two-place, twin-engine, midwing airplane, having slotted flaps and a retractable conventional type landing gear. The version of the Mosquito tested was a Canadian built, camera-equipped F-8 airplane which had no armament. With the exception of the control surfaces and nacelles which were constructed of and covered with metal the airplane was of plywood or balsa-plywood sandwich construction. The airplane had Frise ailerons and horn-balanced elevator and rudder. The ailerons and elevator were equipped with balancing tabs and the rudder with a spring tab. Power was supplied by two Rolls-Royce Merlin 33 engines. For this series of tests the weight of the airplane at take-off was approximately 19,000 pounds. All tests were made with the external wing tanks removed. Several photographs of an F-8 airplane are shown in figure 1. A three-view drawing of the airplane, cross sections of the wing and aileron, and of the horizontal and vertical tail are presented in figures 2 and 3. General specifications of the airplane are given in the appendix.

Figure 4 presents the characteristics of the spring-tab rudder. Rudder deflection was measured with respect to the fin which was set parallel to the thrust axis. The friction of the rudder system amounted to ±5 pounds of pedal force. Figure 5 shows the variation of aileron position with control-wheel deflection and figure 6, the variation of aileron balancing tab-position with aileron position. The friction in the aileron system was approximately ±4 pounds for small deflections and increased slightly at large deflections.

INSTRUMENTATION

The following instruments were mounted in the airplane:

Measured Quantity	NACA Instrument
1. Time	Timer (synchronizing all records)
2. Airspeed	Airspeed recorder
3. Control positions	Control-position recorders
4. Control forces	Strain-gage pedal-force and wheel-force recorders
5. Sideslip angle	Yaw-angle recorder and indicator

	Measured Quantity	NACA Instrument
6.	Angle of bank	Recording inclinometer
7.	Normal, longitudinal and transverse accelerations	Three-component recording accelerometer and indicating normal accelerometer
8.	Angular velocities	Rolling-velocity, pitching-velocity, and yawing-velocity recorders (gyroscopic)
9.	Elevator-tab position	Position recorder (connected at tab)
10.	Shutter position	Position recorder
11.	Free-air temperature	Electrical resistance-bulb-type thermometer

Service indicated airspeed as used herein corresponds to the reading of a standard A-N airspeed meter connected to a pitot-static system that is free from position error, and is defined by the formula:

$$V_i = 45.08\, f_o\sqrt{q_c}$$

where

V_i is in miles per hour,

q_c is the difference between total pressure and correct static pressure,

f_o is the compressibility correction factor at sea level.

Static pressure was measured with a swiveling static head mounted 1 chord length ahead of and slightly below the right wing tip. The static head was calibrated for position error by means of a trailing airspeed bomb. Total pressure was measured with a shielded total head mounted at the right wing tip.

Control positions were measured by both electrical and mechanical recorders. The transmitting elements of the electrical recorders were mounted at the inboard ends of the control surfaces. Mechanical position recorders were attached to the control column, one rudder pedal, and to an aileron control cable in the bomb bay. From recorded flight data it was determined that the stretch of the elevator control system was 1° of elevator deflection per 25 pounds of wheel force. The flexibility of the rudder system amounted to 1° of rudder deflection per 10 pounds of pedal force. Since the mechanical position recorder was not connected at the control wheel, the stretch of the aileron system was measured on the ground and found to be 1° per 8 pounds of wheel force with the ailerons near neutral.

To measure control forces the service wheel was replaced with one on which strain gages were mounted. Aileron-control forces presented in this report are based on a wheel diameter of 14 inches to the center of the grips while the standard wheel for the F-8 is approximately $12\frac{3}{4}$ inches in diameter at the center of the grips. The aileron forces for a service wheel may be obtained by multiplying the forces presented in this report by 1.1.

TESTS, RESULTS, AND DISCUSSION

The results of the tests are evaluated in terms of the specifications of reference 1.

A. Longitudinal Stability and Control Characteristics

The longitudinal stability and control characteristics will be discussed in a subsequent report.

B. Lateral and Directional Stability and Control Characteristics

1-B. Dynamic Lateral and Directional Stability

The control-free lateral oscillation was investigated in the clean condition at the speed for maximum L/D, approximately 180 miles per hour with the engines set at 2650 revolutions per minute and 4 pounds boost and also at 280 miles per hour with the engines set for rated power (2650 revolutions per minute and 7 pounds boost). At both speeds it was found that lateral oscillations could not be induced by releasing the controls while in a steady sideslip. This was due to the overbalanced ailerons causing the airplane to roll and turn. The oscillations were induced by kicking the rudder and releasing it while holding the elevator and the ailerons fixed. Time histories of oscillations due to a right and a left rudder kick at 180 miles per hour are presented in figure 1.

The lateral oscillations were damped to 1/2 amplitude in 2 cycles and therefore met the requirements of reference 1. The short-period oscillation of the rudder, indicated in figure 7 by a slight tendency of the rudder to overshoot its equilibrium position when suddenly released, was completely damped in less than 1 cycle. The requirement of reference 1 that there should be no short-period oscillation of the rudder was therefore satisfied. The rudder showed a marked tendency to float with the relative wind, and continued to oscillate in phase with the airplane motion during the oscillation. Rudder kicks were also made in which the rudder was kicked, returned to zero, and held as well as possible while the elevator and the ailerons were held fixed. A time history of one such rudder kick at 180 miles per hour is given in figure 8. The pilot considered that the damping of the lateral oscillation was somewhat better than if the rudder were not fixed at zero; however, the rudder blew with the relative wind and because of the flexibility of the rudder-control system could not be held in a fixed position. A time history of a rudder kick and release at 280 miles per hour is given in figure 9. The increase in speed reduced the period, but had little effect on the damping of the oscillations. In all the oscillations the pitching moment due to yawing caused alternate push and pull forces on the control wheel, a characteristic which was objectionable to the pilot.

No flight records were made with the bomb-bay doors open because most of the instrumentation was located in the bomb bay. However, the pilot noticed no appreciable difference in the damping of the lateral oscillations with the bomb-bay doors open.

2-B. Static Lateral and Directional Stability

1. Sideslip due to aileron deflection - rudder to overcome adverse aileron yaw

The sideslip due to aileron deflection and the rudder required to overcome adverse aileron yaw were measured in rolls out of turns. Typical time histories of rolls out of turns with fixed rudder and with coordinated rudder are given in figure 10. The variation of maximum angle of sideslip with total aileron deflection in rudder-fixed roll-outs at low speeds is presented for several conditions in figure 11. The directional stability as indicated by the data of figure 11 was about equal in the gliding and wave-off conditions and slightly greater in the landing condition. The maximum angle of sideslip due to aileron deflection reached in the gliding condition was over 20° and therefore the requirements of reference 1 were not met. It was not always possible for the pilot to continue the maneuver until a maximum angle of sideslip was reached because of the pitching moment due to yawing. In figure 10(c) two rudder-fixed roll-outs are presented for the wave-off condition at 115 miles per hour during which the airplane pitched down abruptly as indicated by the pitching velocity and normal acceleration and in the right roll caused both engines to cut out. This figure also shows aileron shaking which was often noticed when the ailerons were fully deflected.

Analysis of the data in figure 10 and other similar data indicates that nearly all of the available change of rudder deflection, approximately 15° right or 20° left, and approximately a 50-pound increment of rudder force were necessary to overcome the yaw due to full aileron deflection at 125 miles per hour with flaps and gear down, power for level flight. The requirement of reference 1 that the rudder be able to overcome the adverse yaw due to full aileron deflection with a rudder force of less than 180 pounds was satisfied, but the pilot commented that a considerable amount of pedal motion was required for the amount of aileron control applied.

2. Sideslip characteristics

One set of data which illustrates the occurrence of rudder lock was obtained from a preliminary flight during which gradually increasing sideslips were made by slowly deflecting the rudder while using the ailerons and elevator to maintain straight and level flight. Otherwise the sideslip characteristics were investigated in steady sideslips. The data from these sideslips are given in figures 12 through 16 and show measurements of directional stability (variation of rudder angle and force with sideslip angle), dihedral effect (variation of aileron angle and force with sideslip angle), pitching moment due to sideslip (variation of elevator angle and force with sideslip angle) and the side-force characteristics (variation of angle of bank with sideslip angle). The angles of sideslip reached were restricted at low speeds to avoid rudder lock and at high speeds in order not to overload the vertical tail. It was thought that with the closely balanced rudder there was some possibility of overloading the vertical tail. The test conditions and speeds were as follows:

Condition	Power setting	Position of			Speed (mph)	Method of test	Figure
		Flaps	Landing gear	Shutters			
Clean power for level flight	2650 rpm $3\frac{1}{2}$ psi boost	Up	Up	Open	115	Gradual increase of sideslip angle	12
Clean rated power	2650 rpm 7 psi boost	Up	Up	Open Closed Closed	120 130 240	Steady sideslip	13(a) 13(b) 13(c)
Clean power off	Engines idling	Up	Up	Closed Closed Closed	120 180 240	Steady sideslip	14(a) 14(b) 14(c)
Landing	Engines idling	Down	Down	Open Open	115 140	Steady sideslip	15(a) 15(b)
Wave-off	2650 rpm 7 psi boost	Down	Down	Open Open	110 140	Steady sideslip	16(a) 16(b)

a. Directional stability

The control-fixed directional stability was positive in all conditions and therefore satisfied the requirements of reference 1. The variation of rudder angle with sideslip angle was nearly linear in all conditions. The data indicate that there was about 2° of right sideslip at 240 miles per hour with zero bank. It is believed that at this speed there would have been very nearly 0° sideslip and that the 2° indication was due either to sidewash or to an unsymmetrical yaw vane which was in error by a constant amount.

The rudder-free directional stability was positive in all conditions except at low speeds with power on, flaps and gear retracted, where the rudder-force variation with sideslip angle became negative at large angles of sideslip, and therefore did not satisfy the requirements of reference 1. A time history of a gradually increasing sideslip in which rudder lock occurred is given in figure 17. In the recovery from this maneuver, the engines were cut. Even with the large degree balance provided by the spring tab which made the rudder very light under normal conditions a force of nearly 200 pounds was required to return the rudder to neutral.

b. Dihedral effect

The stick-fixed dihedral effect as shown by the variation of aileron angle with sideslip angle in figures 12 to 16 was positive in all conditions and met the requirements of reference 1. In the gliding condition the effective dihedral was 4.0° compared with 1.4° geometric dihedral at the top surface of the wing. The stick-free dihedral effect as shown by the variation of the aileron force with sideslip angle was marginal to slightly negative in all conditions; the stick forces were very light and hardly out of the range of the friction force in the aileron system which was approximately ±4 pounds.

c. Pitching moment due to sideslip

The changes in elevator force and position due to sideslip were small at high speeds but at lower speeds where large angles of sideslip were reached there was a considerable increase in elevator force at large angles of sideslip. There was an objectionable variation of elevator force with sideslip angle near zero yaw in steady sideslips in the power-on conditions, as shown by figures 12 and 13. An appreciable pitching tendency due to yawing velocity also was observed, which was attributed to the gyroscopic effects of the propellers. It should be noted that these effects combine to cause the airplane to tend to pitch down in right rudder kicks and up in left rudder kicks. The elevator force required to offset these pitching moments was small but the yawing encountered in even slightly rough air was sufficient to cause small pitch changes and require continuous elevator motion which made it impossible to trim the airplane.

d. Side-force characteristics

The side-force characteristics (variation of bank angle with angle of sideslip) satisfied the requirements of reference 1 which stated that the variation should be such that right bank accompanies right sideslip and vice versa.

3-B. Lateral and Directional Control

1. Rudder to overcome adverse aileron yaw

The ability of the rudder to overcome the yawing moment due to full aileron deflection has been discussed in the section on sideslip due to aileron deflection (2-B, 1).

2. Rudder control in take-off and landing

The F-8 is a twin-engine airplane with a single vertical tail not located in the slipstream. It was very difficult to perform the maneuver specified in reference 1 for determination of the minimum speed at which it was possible to raise the tail during take-off for the following reasons. First, full power could not be applied because it was necessary to apply power asymmetrically to maintain directional control at very low speeds. Second, if the tail was brought up at the minimum speed with the rudder deflected full right, an uncontrollable yawing motion to the left resulted due to the gyroscopic effect of the propellers. Lack of directional control during landing several times nearly resulted in a ground loop. The directional control of the F-8 airplane was considered to be unsatisfactory for both take-off and landing. No take-offs or landings were made in a 90° cross wind. Time histories of a take-off and landing are presented in figures 18 and 19.

3. Single-engine operation

a. Rudder control with one engine inoperative

Attempts were made to simulate the flight condition following failure of the left engine in the wave-off condition with flaps and landing gear down, and rated power. At 120 miles per hour the power of the rudder was not sufficient to maintain straight flight with the wings level. When the airplane was banked to the right in order to maintain straight flight, buffeting of the rudder occurred and the maneuver was discontinued because of the danger of rudder lock. Control could be maintained if the right engine was throttled back somewhat, but the power would then not be sufficient for level flight.

b. Directional trim characteristics

Figure 20 presents the directional trim characteristics for single-engine operation in the rated-power, clean condition in straight flight with the wings level. Data were obtained with the left propeller windmilling with the governor set at 2650 rpm and also with the left propeller feathered. Figure 20 shows that full tab deflection, left from the rudder, was required to trim the rudder force to zero at 190 miles per hour with the left propeller windmilling, and about 1/3 less, with the left propeller feathered. The rudder control was sufficient to maintain straight flight in either case with the wings level at 150 miles per hour. By holding a slight degree of bank it was possible to maintain directional control to the stall in the clean condition. During single-engine flight with the wings level the rudder force increased rapidly with decreasing speed from 0 at 190 miles per hour to 120 pounds with the left propeller feathered, or 135 pounds with the left propeller windmilling at 150 miles per hour. Due to the deflection of the spring and the flexibility of the rest of the rudder system the available rudder deflection was reduced 1° per 10 pounds of control force. Over half of the available no-load deflection was lost at 150 miles per hour in the case illustrated in figure 20. Placing stops only on the rudder itself would remedy this situation. The rudder trimming tab was powerful enough to trim out the rudder-control forces with the wings level at 190 miles per hour with one propeller windmilling or at 170 miles per hour with one propeller feathered. No records were obtained of banked single-engine flight, but less rudder deflection would be required so that the minimum speed at which full tab deflection would produce zero rudder-control force would be reduced. The aileron-control forces were negligible and could easily have been trimmed out.

4. Directional trim characteristics including rudder control in dives (symmetric power)

From trim at maximum level-flight speed with power on or trim at the same speed with the engines idling the rudder-control force changed only 10 pounds in going to 360 miles per hour, the maximum speed attained in these tests. This is shown in the directional-trim curves of figure 21, which indicate small variation of rudder force with speed in all conditions.

5. Power of rudder and aileron trimming tabs

The power of the rudder trimming tab to trim the rudder forces to zero at any speed in any of the test conditions is also indicated by figure 21. The variation of aileron-control force with speed was small except in high-speed dives as shown in figure 22 and was easily trimmed out. The power of the trimming tabs during single-engine operation has been discussed in 3-B, 3.

6. Rolling moment due to yawing

Rudder kicks were made at 140 and 200 miles per hour in the clean condition with power for level flight to determine the amount of rolling due to yawing. In these maneuvers the rudder was abruptly deflected and held fixed as well as possible at the deflected position and the aileron and elevator were held fixed throughout the maneuver. Time histories of rudder kicks at 200 miles per hour are shown in figure 23. The maximum change in sideslip angle, rolling and yawing velocity, and rudder force are presented as a function of rudder deflection in figure 24. Because of the very light rudder forces the rolling velocity produced with a given rudder force was large but was not considered objectionable by the pilot.

7. Aileron control characteristics

The aileron control characteristics were measured in abrupt rudder-fixed aileron rolls at various speeds in the following flight conditions:

Power	Flaps	Landing gear	Speed	Figure
Level flight or rated	Up	Up	140	25, 26
			170	26
			200	26
			250	26
			300	26
Engines idling	Down	Down	120	27
			140	
Level flight	Down	Down	120	28
			140	

Time histories of typical left and right rolls at 140 miles per hour with level-flight power in the clean condition are presented in figure 25. The values of rolling effectiveness obtained and wheel forces required are plotted as a function aileron deflection in figures 26, 27, and 28. No information was available on permissible aileron deflections at high speed so aileron deflection was arbitrarily limited above 200 miles per hour.

The aileron control characteristics of the F-8 airplane may be summarized as follows:

a. The maximum rolling velocity obtained in abrupt aileron rolls varied smoothly with aileron deflection throughout the speed range.

b. The ailerons exhibited no undesirable lag characteristics and the rolling acceleration was always in the correct direction.

c. No reversal of rolling velocity due to aileron yaw ever occurred.

d. With flaps down, and power on or off, satisfactory rolling performance was indicated. Maximum values of helix angle pb/2V of approximately 0.075 for right rolls and 0.09 for left rolls were obtained. The difference was due to the aileron deflection required for trim in level flight.

e. The requirement of reference 1 that it be possible to obtain a helix angle pb/2V of at least 0.07 up to 70 percent of the maximum level-flight speed was satisfied in left rolls where a pb/2V of 0.074 at an indicated airspeed of 200 miles per hour was obtained. The aileron deflection available for right rolls was restricted due to the necessity of using considerable right aileron deflection for trim as shown in figure 22. The maximum pb/2V obtained in right rolls at 200 miles per hour was approximately 0.06 and the average value of pb/2V available at this speed was therefore approximately 0.067 which was below the value specified in reference 1.

The proposed requirement that it be possible to obtain a helix angle pb/2V of 0.05 with 100° of wheel deflection up to 70 percent of the maximum level-flight speed was satisfied by the F-8.

f. The aileron-control forces were usually in the range of the friction force and never exceeded 20 pounds in the rolls made with the aileron deflection arbitrarily limited for the purpose of the tests. The ailerons were designed with the intent of making the forces very light. Information obtained from the DeHavilland Company indicated that the adjustable balancing-tab ratio was set to give approximately neutral balance on each airplane. The data of figures 25 through 28 indicate that on this particular Mosquito aileron overbalance occurred in rolls in all conditions below 200 miles per hour over a considerable range of aileron deflections. It has been stated previously that the ailerons tended to shake when fully deflected and that an example of aileron shaking is presented in figure 10(c).

g. The variation with airspeed of aileron deflection and control force required to hold the wings level in the rated-power, clean condition is shown in figure 22. The amount of aileron deflection would vary with any variation of lateral loading, but fuel was always used symmetrically so that little variation of lateral loading occurred in the tests. The large amount of aileron deflection required for trim indicated that an effective twist was present in the wing structure. An effective twist of approximately 1° on each tip would be required to account for the amount of aileron deflection that was used for trim. A tendency for the force to increase rapidly to the right at high speeds would become objectionable before the maximum diving speed, 450 miles per hour, was reached.

h. Another F-8 airplane (AAF No. 43-334928) that was flown by the NACA pilots was observed to have somewhat different aileron control characteristics from those presented herein. No quantitative measurements were made on the second airplane.

CONCLUSIONS

The results of the tests to determine the lateral and directional stability and control characteristics of an F-8 airplane (AAF No. 43-334960) may be summarized as follows:

1. A divergence occurred due to aileron overbalance if the controls were released in a sideslip. Oscillations of the airplane in the clean condition induced by kicking and releasing the rudder with ailerons fixed did damp to 1/2 amplitude in 2 cycles. There was no short-period oscillation of the rudder itself.

2. The directional stability of the airplane with the rudder fixed was not sufficient to restrict the yaw due to full aileron deflection at 120 miles per hour to less than 20°.

3. Control-fixed and control-free directional stability was positive except near the stall with power for level flight in the clean condition at large angles of sideslip where rudder lock occurred.

4. The stick-fixed effective dihedral was positive in all conditions. Due to the closely balanced or slightly overbalanced ailerons the stick-free dihedral was neutral or slightly negative in all conditions.

5. In power-on conditions of flight an undesirable pitching moment due to sideslip and due to yawing velocity existed which made it difficult to trim the airplane in rough air.

6. The side force due to sideslip was always in the correct direction.

7. The rudder control on the ground was weak, and in flight was barely sufficient to overcome adverse aileron yaw. The rudder control was sufficient to maintain a straight path with the wings level in all normal flight conditions at any speed or down to 150 miles per hour with one propeller windmilling or feathered and the other engine delivering rated power in the clean condition. There was insufficient rudder deflection available to fly the airplane with the wings level on one engine with the flaps and landing gear down. When a banked sideslip was attempted in order to maintain straight flight in this condition rudder lock seemed to be imminent.

8. The variation of rudder and aileron force with speed was small except in dives at high speed and the force could be easily reduced to zero by use of the trimming tabs. Above 300 miles per hour indicated airspeed there was an objectionable increase in aileron forces required for trim.

9. The power of the ailerons to roll the airplane was satisfactory in the landing and wave-off conditions and in left rolls in the power-on, clean condition. Because considerable right aileron was required for trim in level flight, a maximum $pb/2V$ of only about 0.06 was obtained in right rolls in the clean condition at 200 miles per hour. For an F-8 with an untwisted wing the maximum $pb/2V$ available would still fall slightly short of the 0.07 required at 200 miles per hour in the clean condition. The aileron forces were always small

but were unsatisfactory according to the standards of reference 1 because of the aileron overbalance which occurred up to 200 miles per hour over a large part of the deflection range.

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APPENDIX

GENERAL SPECIFICATIONS OF THE AIRPLANE

Name and type . . . . DeHavilland "Mosquito" F-8, (AAF No. 43-334960)

Engines (2) . . . . Packard Rolls-Royce Merlin 33
Rating
Take-off (5 minutes) . . . . 3000 rpm - 58 in. Hg or 14 psi boost, low blower
Military (30 minutes) . . . . 2850 rpm - 48 in. Hg or 9 psi boost, auto blower
Maximum continuous . . . . . 2650 rpm - 44 in. Hg or 7 psi boost, auto blower

Propellers (2). Type 23EX-493-6519A-12 Hamilton Standard
Diameter, ft 12.5
Number of blades 3
Gear ratio 0.42:1

Fuel capacity, U. S. gal.
Normal, 10 tanks . . . . total 647
Long range, 2 tanks, bomb bay . . . . total 145
Droppable, 2 tanks wing . . . . total 96

Oil capacity, U. S. gal.
Normal, 2 tanks, nacelle . . . . total 18
Long range, 1 tank, fuselage . . . . total 11.7

Rearward permissible c.g. position, percent M.A.C. 36.0
Weight for tests, lb 19,000

Wing
Span, ft 54.16
Area, sq ft 450
Airfoil section, Piercy Modified . . . . RAF 34
Chord at fuselage juncture (25 in. from centerline), ft 12.25
Chord at tip (25 ft from centerline), ft 3.83
Mean aerodynamic chord, in. 101.52
Leading edge of M.A.C. forward of jig point, in. 17.52
Aspect ratio 6.5
Taper ratio 0.31

Dihedral (top face of front spar), deg	1.4 ±0.2
Incidence, deg	1.5
Sweepback (at rib number 4), deg	2.5
Wing flaps (slotted)	
Area (bottom surface) total, sq ft	50.8
Length, from fuselage centerline, ft	13.7
Travel (no air load), deg	45 ±2
Ailerons	
Area (aft of hinge line, total of 2 including tabs) sq ft	34.4
Length, ft	12.4
Deflection range, deg	26.5 up, 11.5 down, ±0.5
Balancing-tab area, total, sq ft	2.2
Balancing-tab gear ratio, see figure 6	
Trimming-tab area, sq ft	1.1
Trimming-tab-deflection range, from aileron, deg	±12.5 ±0.5
Horizontal tail	
Span, ft	20.75
Chord at root, ft	5.5
Area, excluding fuselage, sq ft	78.4
Incidence, deg	1.25 ±0.25
Elevator area, aft of hinge line, sq ft	33.4
Horn balance, percent of elevator area	6.9
Tail length from elevator hinge line to 25 percent M.A.C., approximate, ft	28.3
Balancing-tab area, total, sq ft	3.06
Balancing-tab gear ratio	0.31
Trimming-tab area, total, sq ft	3.06
Trimming-tab-deflection range, deg	±7 ±0.5
Vertical tail	
Area, sq ft	29.3
Height, above top of fuselage, ft	7.1
Offset from thrust axis, deg	0
Rudder area (aft of hinge line), sq ft	15.25
Rudder-deflection range, deg	26, -1 or 2
Horn balance, percent of rudder area	4.9
Trim and balance-tab area, sq ft	1.15
Trimming-tab-deflection range, deg	16 ±2.5

Over-all dimensions

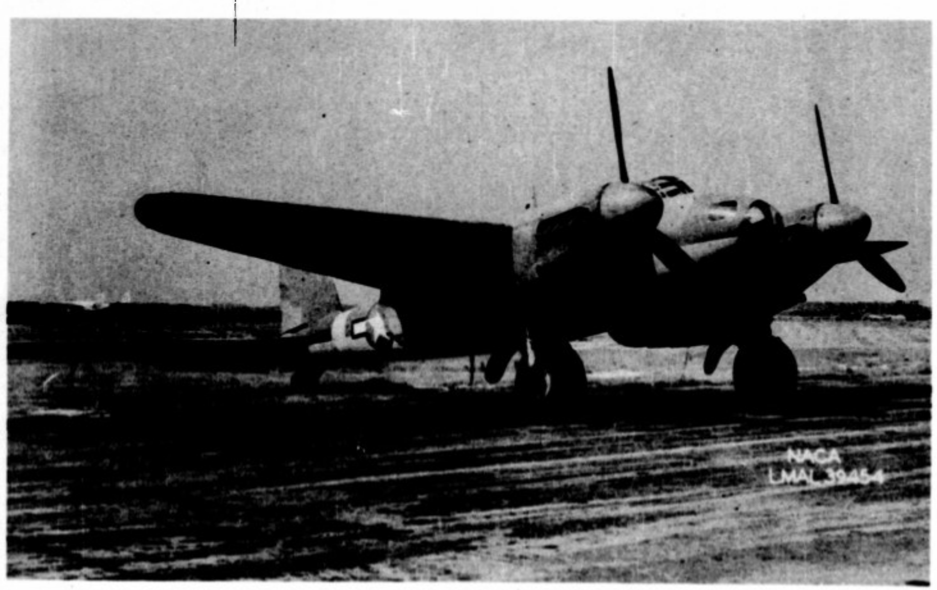
Length,	along thrust axis, ft.	40.8
	tail wheel on the ground, ft	40.33
Height,	tail wheel on ground, one blade vertically upward, ft	15.25
	tail wheel on ground, one blade vertically downward, ft	12.3
	over fin and rudder with thrust-axis level, ft	17.4

REFERENCE

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

(a) Front view.

Figure 1.- Photographs of a DeHavilland Mosquito F-8 airplane.



(b) Three-quarter front view.

Figure 1.- Continued.

(c) Side view.

Figure 1.- Continued.

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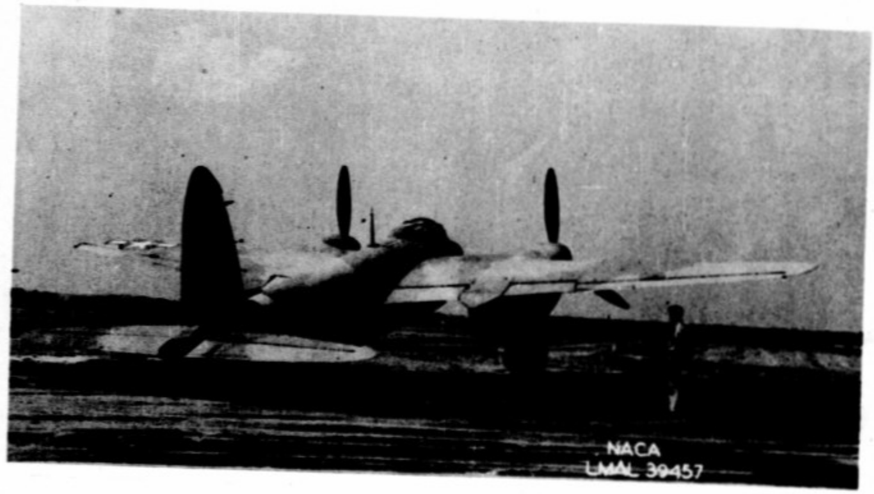

(d) Three-quarter rear view.

Figure 1.- Concluded.

L-593

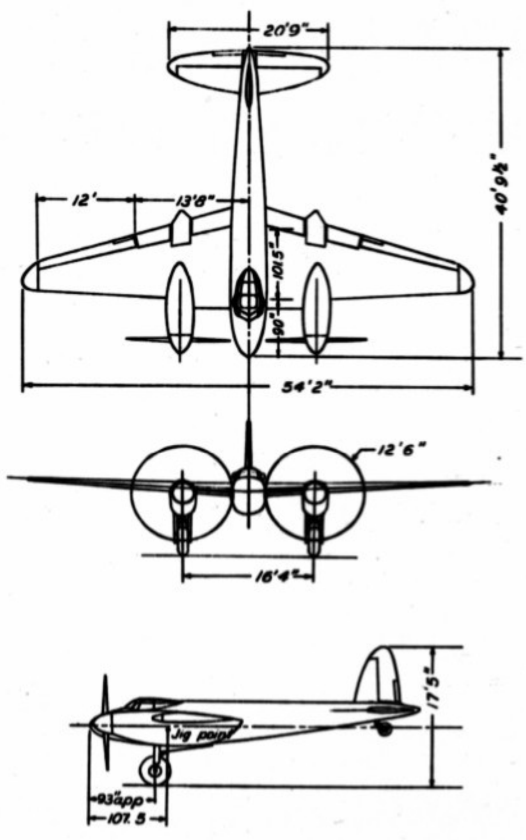

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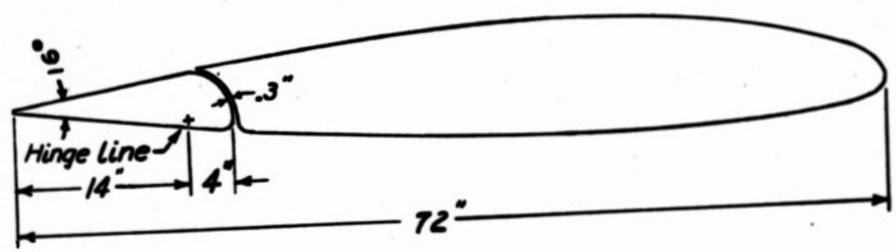
Figure 2. - Three-view drawing of DeHavilland
Mosquito F-8 airplane.



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a. Wing and aileron
Figure 3. - Section views of control surfaces, De-
Havilland Mosquito F-8 airplane.

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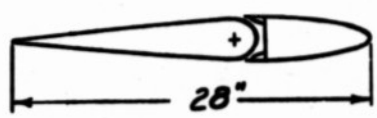
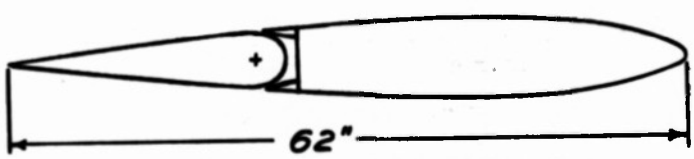


Vertical tail at tip of fin



Horizontal tail 26" from centerline

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b. Horizontal and vertical surfaces
Figure 3. - Concluded.

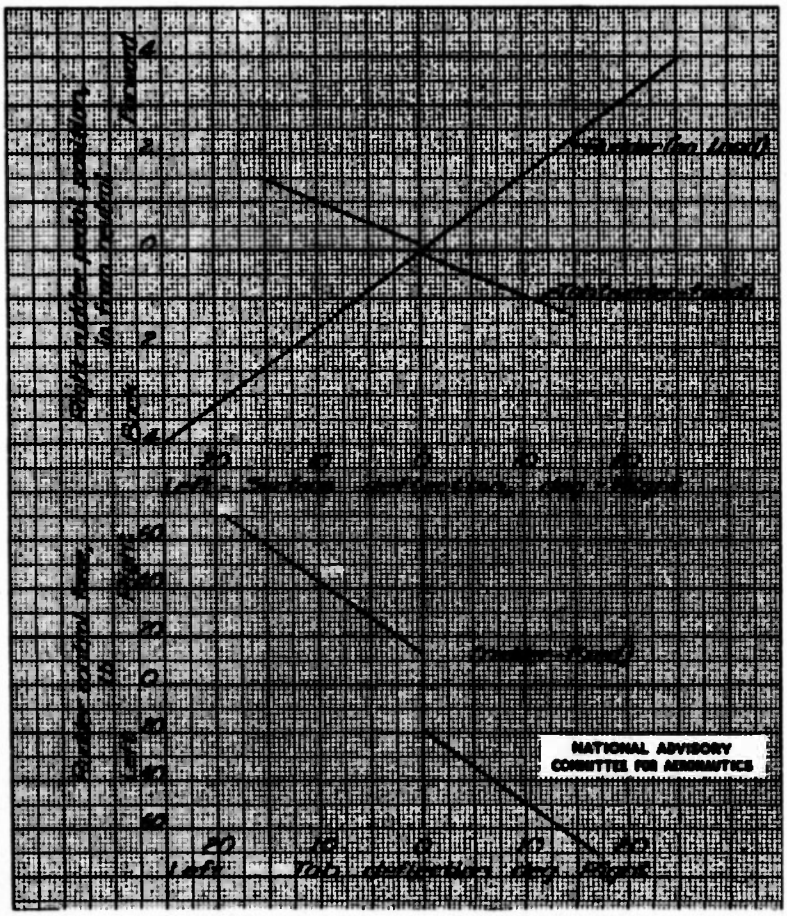

Figure 4. - Spring-tab rudder characteristics, DeHavilland Mosquito F-8 airplane.

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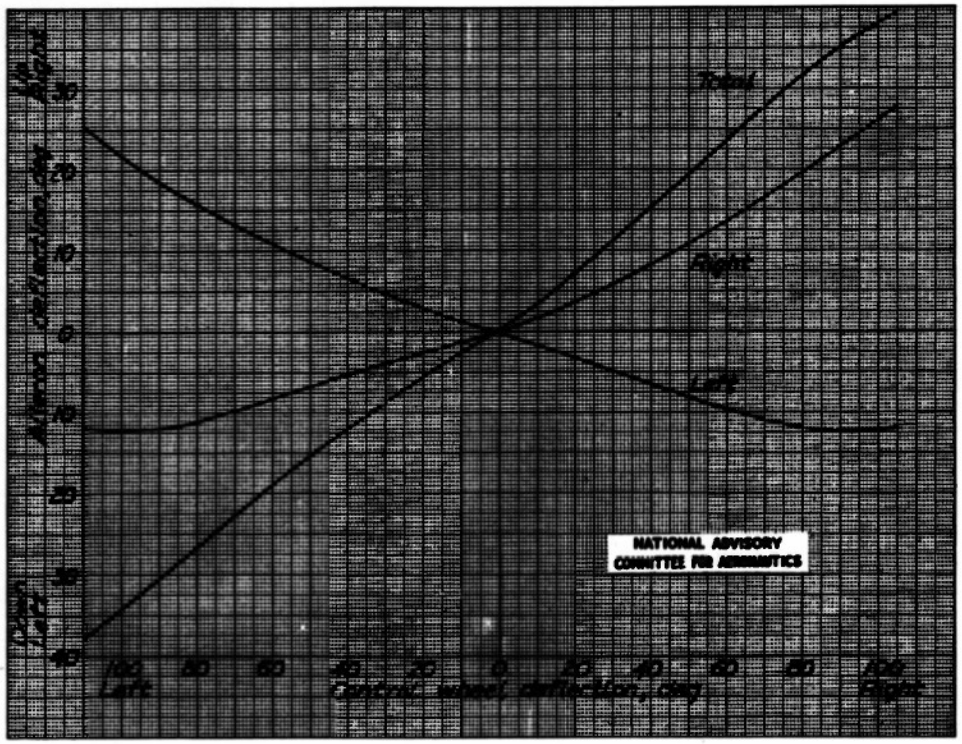

Figure 5. - Linkage between aileronsand control wheel, DeHavilland Mosquito F-8 airplane.

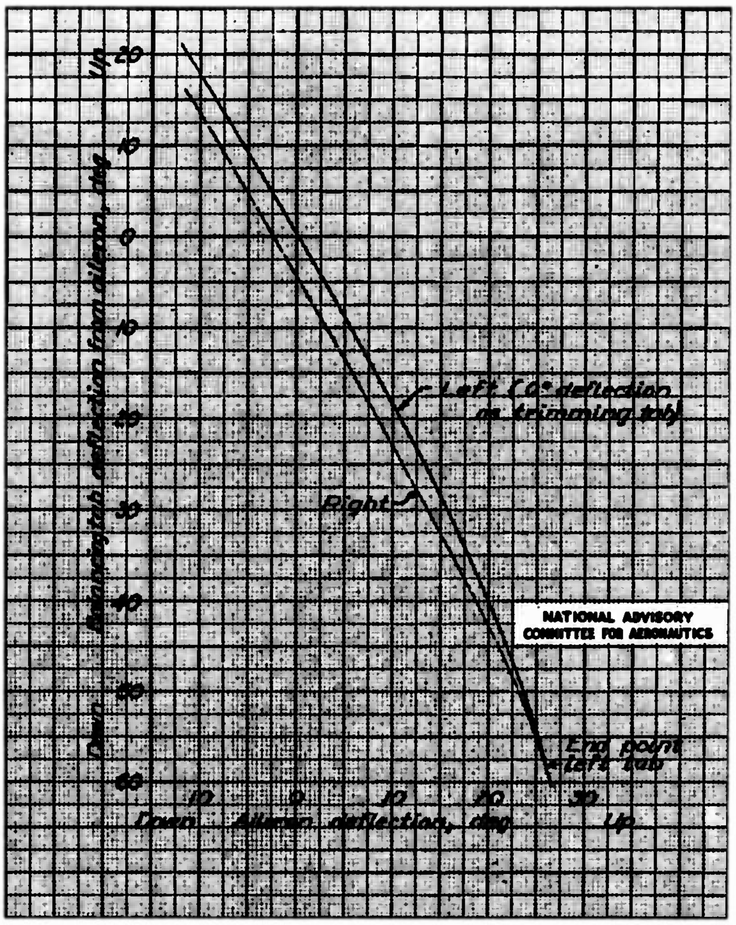

Figure 6. - Variation of balancing tab deflection with aileron deflection, DeHavilland Mosquito F-8 airplane.

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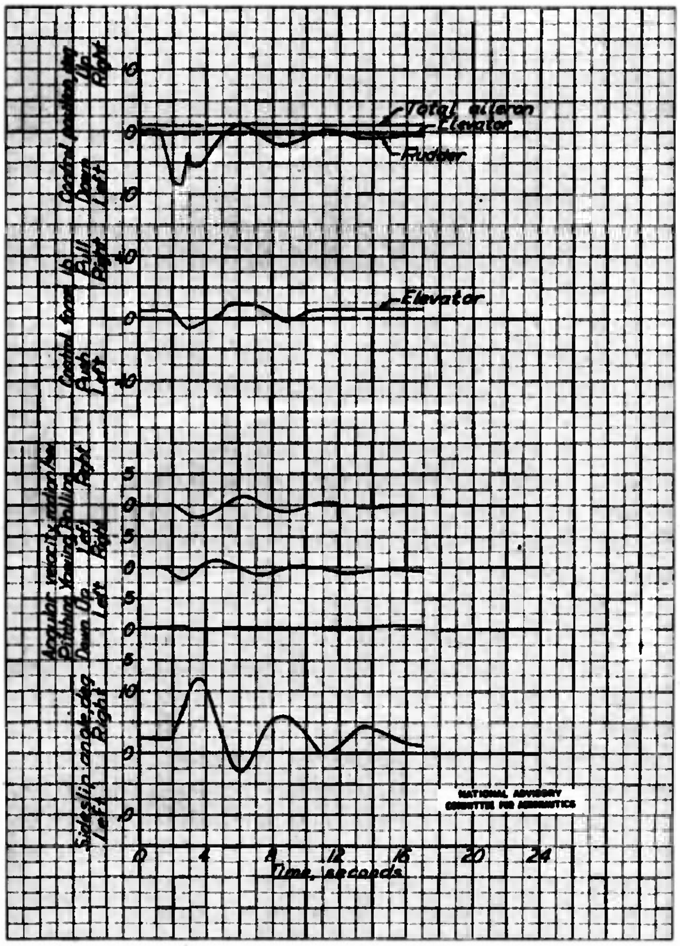

a. Left kick and release.
Figure 7. - Lateral oscillations in the clean condition at 180 miles per hour with power for level flight (2850 rpm, 4 pounds boost), shutters closed, DeHavilland Mosquito F-8 airplane.

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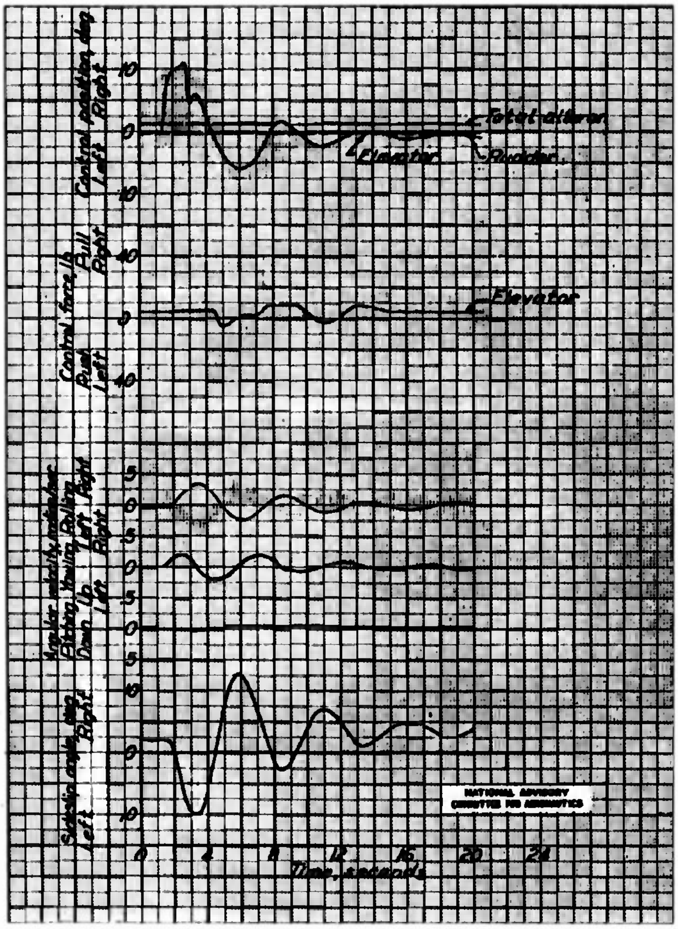

b. Right kick and release.
Figure 7. - Concluded.

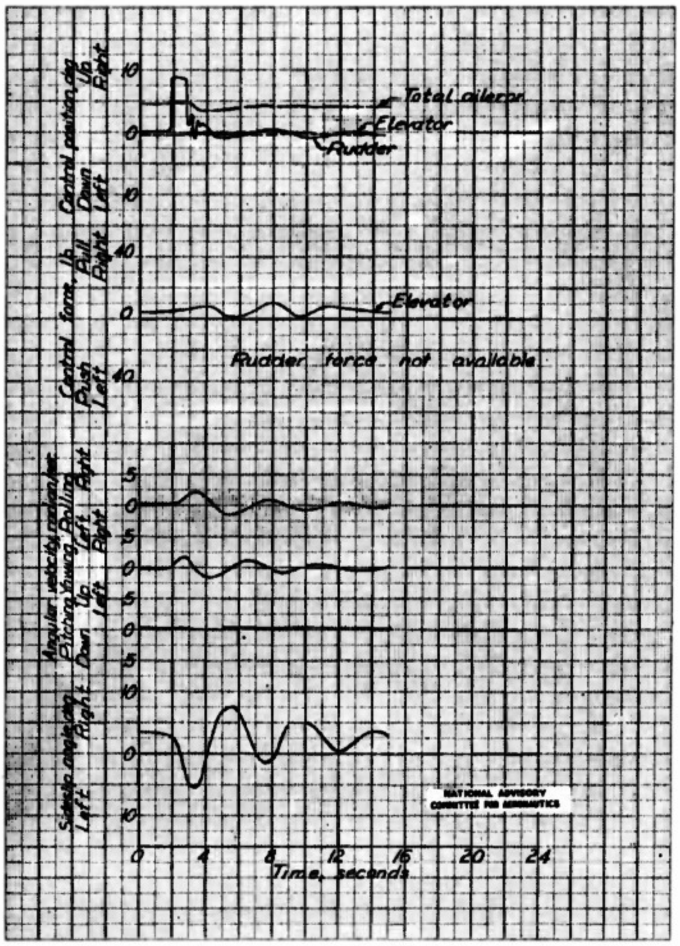

Figure 8. - Lateral oscillations in the clean condition at 180 miles per hour with power for level flight (2650 rpm, +4 pounds boost), shutters closed, caused by kicking the rudder and then fixing it in neutral, DeHavilland Mosquito, F-8 airplane.

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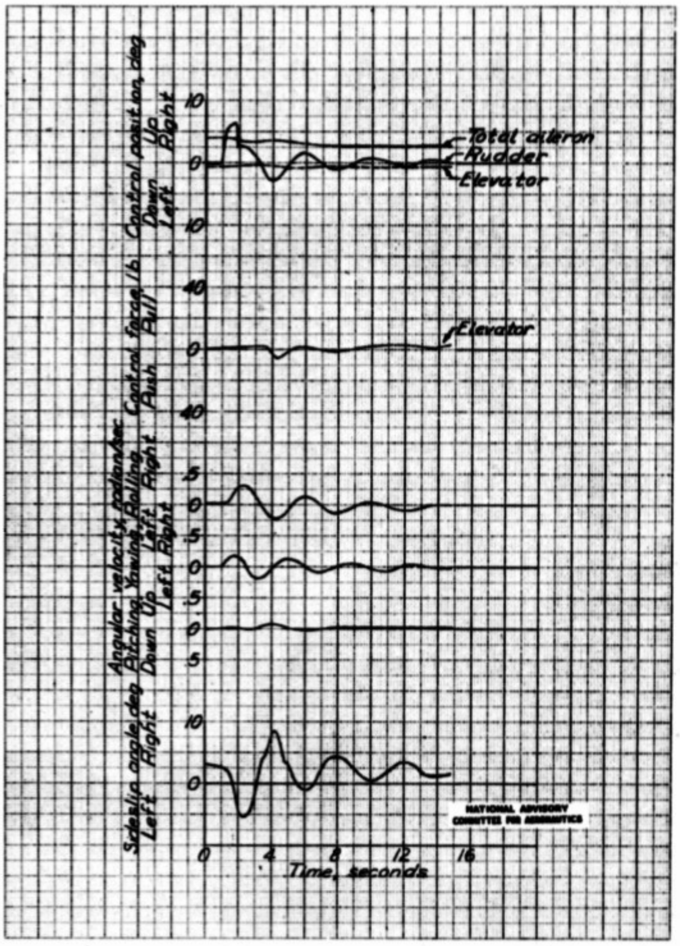
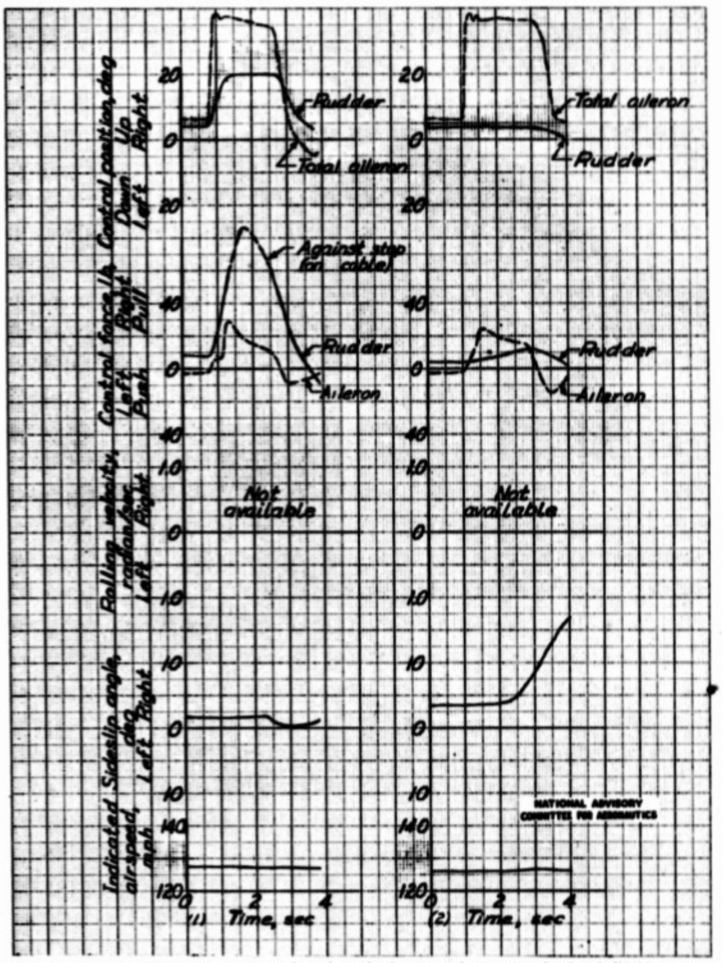


Figure 9. - Lateral oscillations in the clean condition at 280 miles per hour with rated power (2650 rpm, +7 pounds boost), shutters closed, caused by right rudder kick and release, DeHavilland Mosquito F-8 airplane.



e. Right rollouts with flaps down, landing gear down, power for level flight, shutters open, at 125 miles per hour.
(1) Using rudder to overcome aileron yaw.
(2) Rudder-fixed.

Figure 10 - Time histories of rolls out of turns, DeHavilland Mosquito F-8 airplane.

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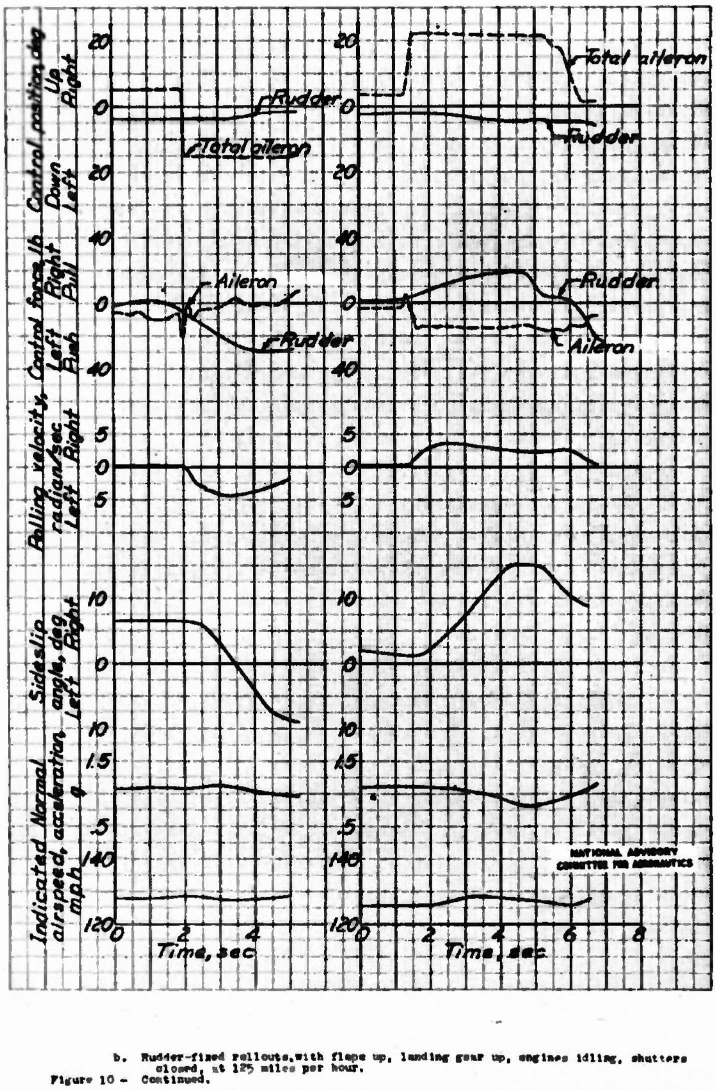
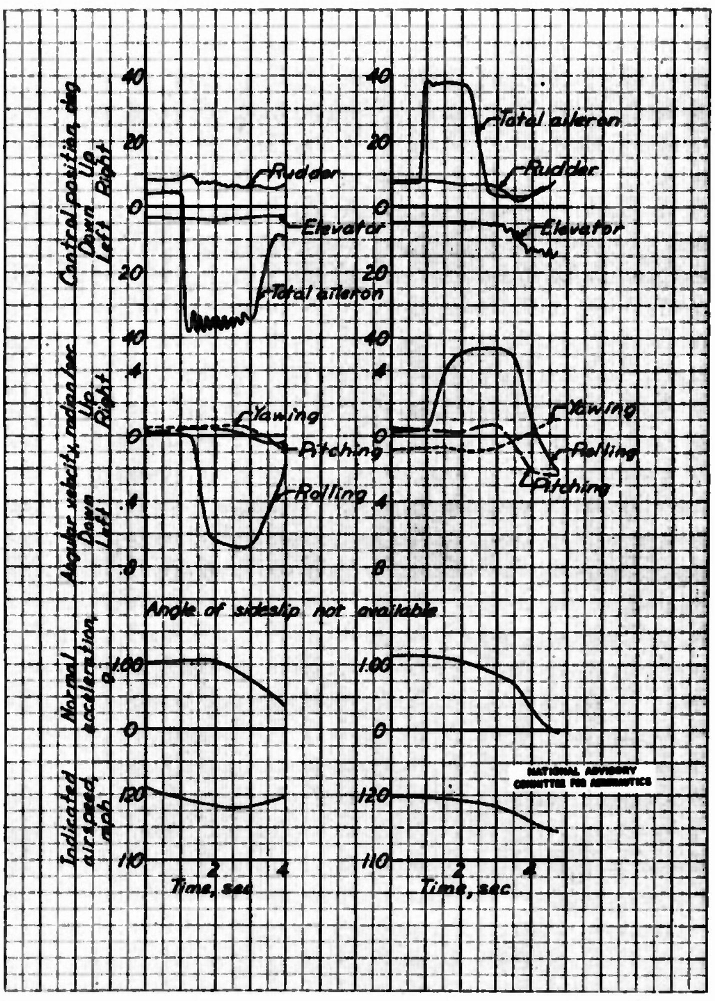


b. Rudder-fixed rollouts, with flaps up, landing gear up, engines idling, shutters closed, at 125 miles per hour.

Figure 10 - Continued.



e. Rudder-fixed left and right rollouts with flaps down, landing gear down, rated power, shutters open, at 115 miles per hour. Engines cut out during right roll when airplane pitched down.

Figure 10 - Concluded.

L-593

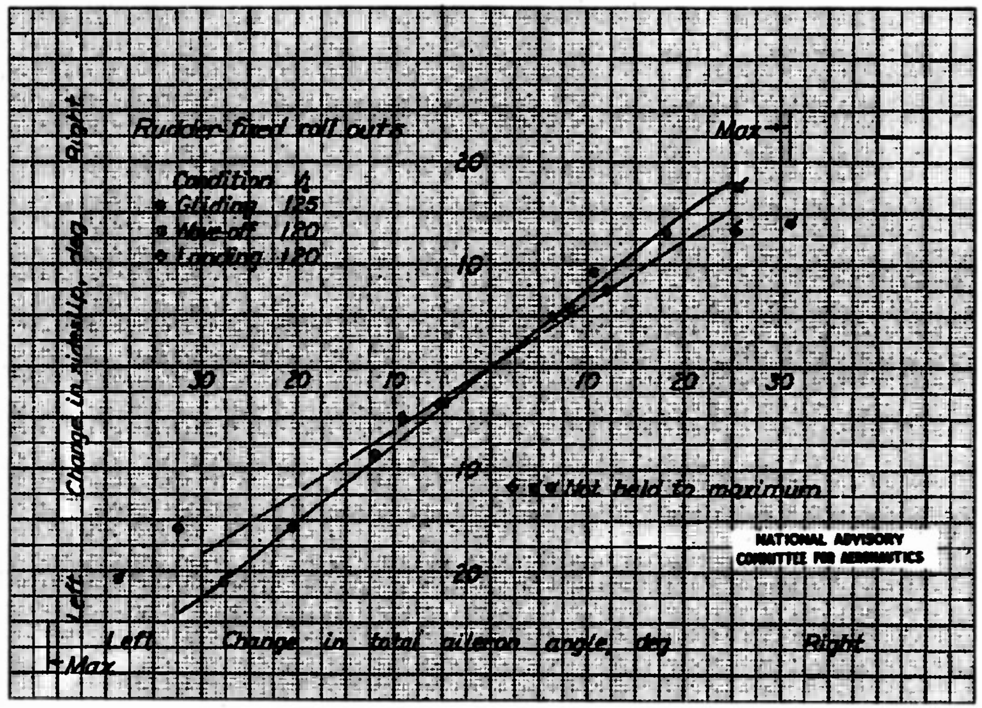


Figure 11. - Variation of maximum change in sideslip angle with change in total aileron angle for several flight conditions, DeHavilland Mosquito F-8 airplane.

L-593

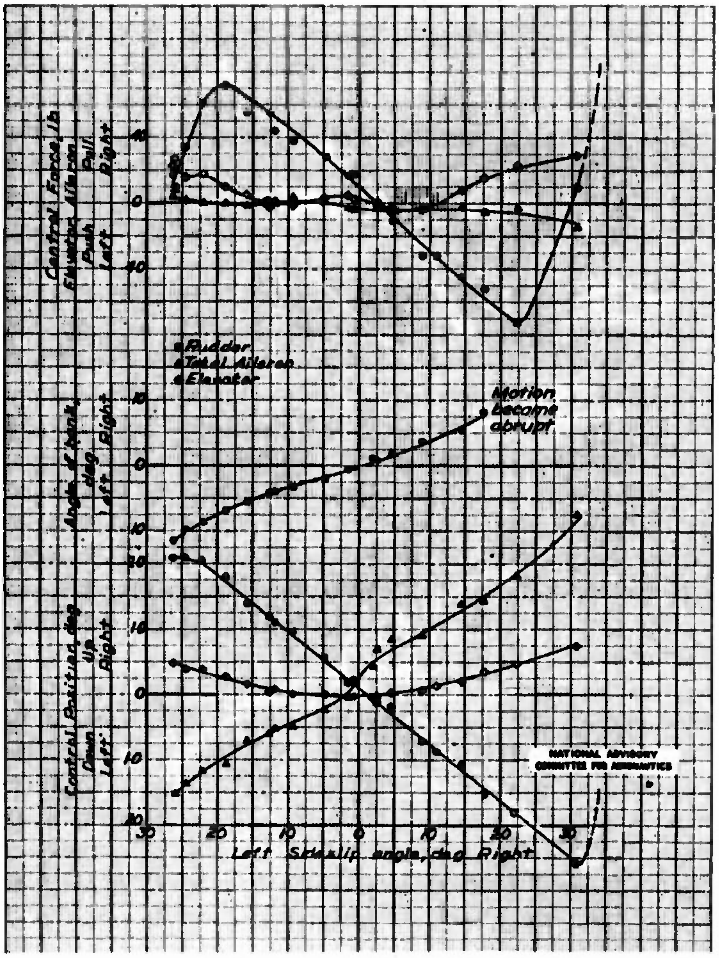
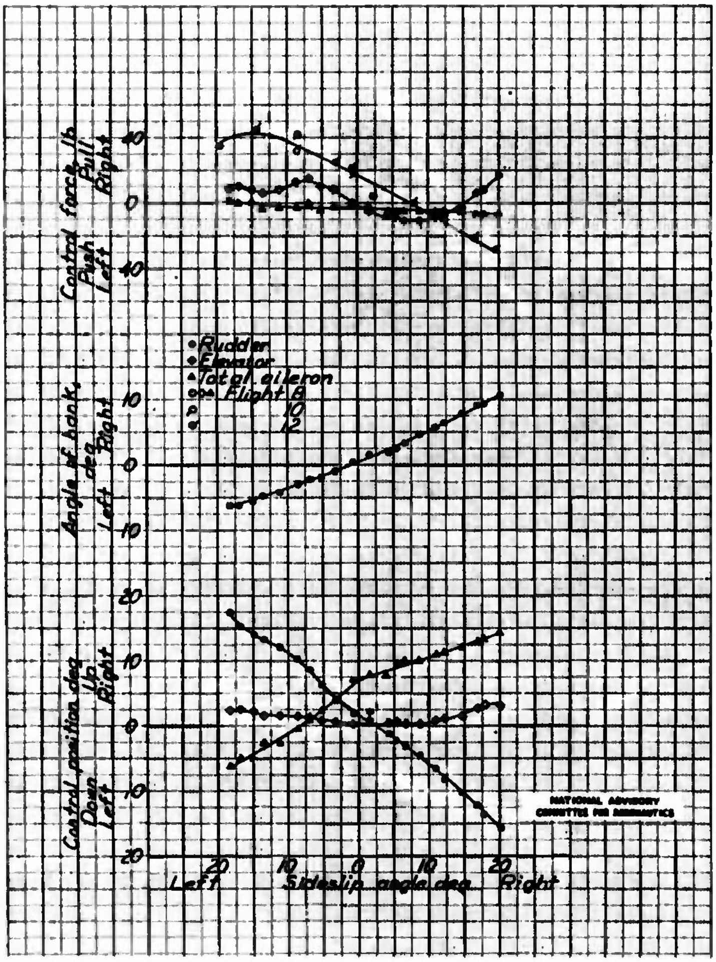


Figure 12. - Sideslip characteristics from continuous records in the clean condition at 115 miles per hour with power for level flight (2650 rpm, -3½ pounds boost) shutters open, DeHavilland Mosquito F-8 airplane.



e. 120 miles per hour, shutters open.

Figure 13. - Sideslip characteristics in the glide condition with rated power, DeHavilland Mosquito F-8 airplane.

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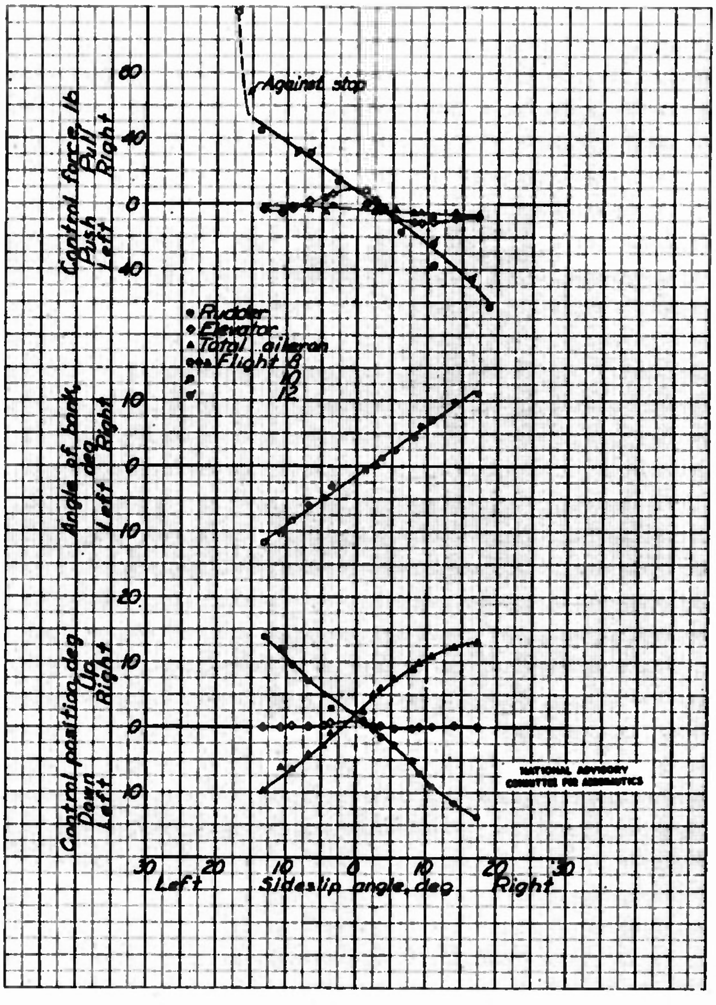
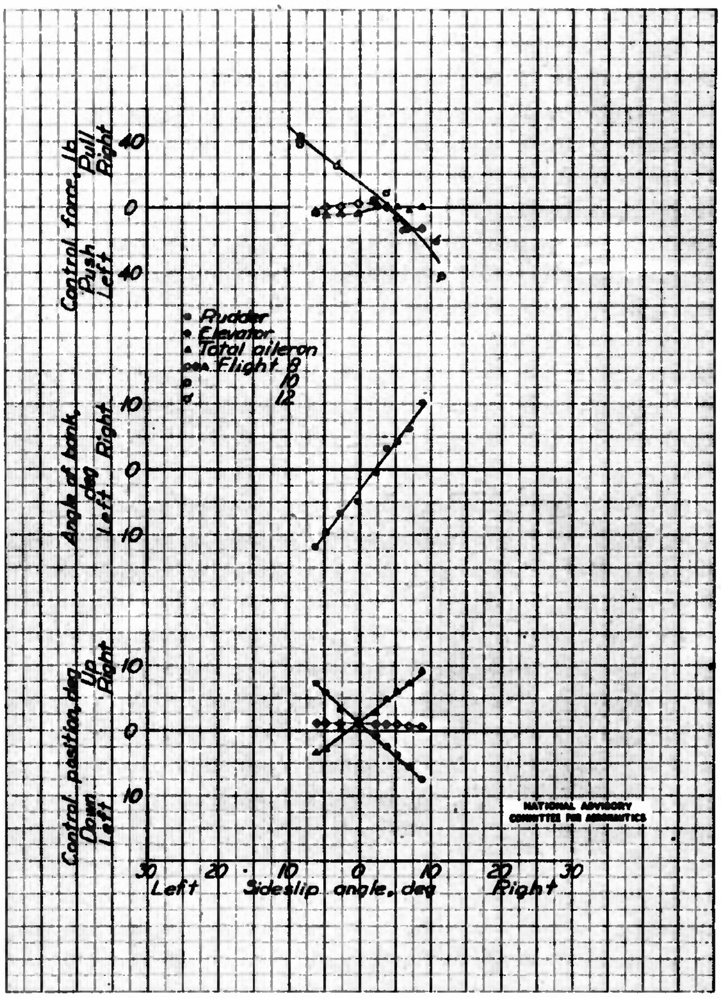


b. 180 miles per hour shutters closed.
Figure 13. - Continued.

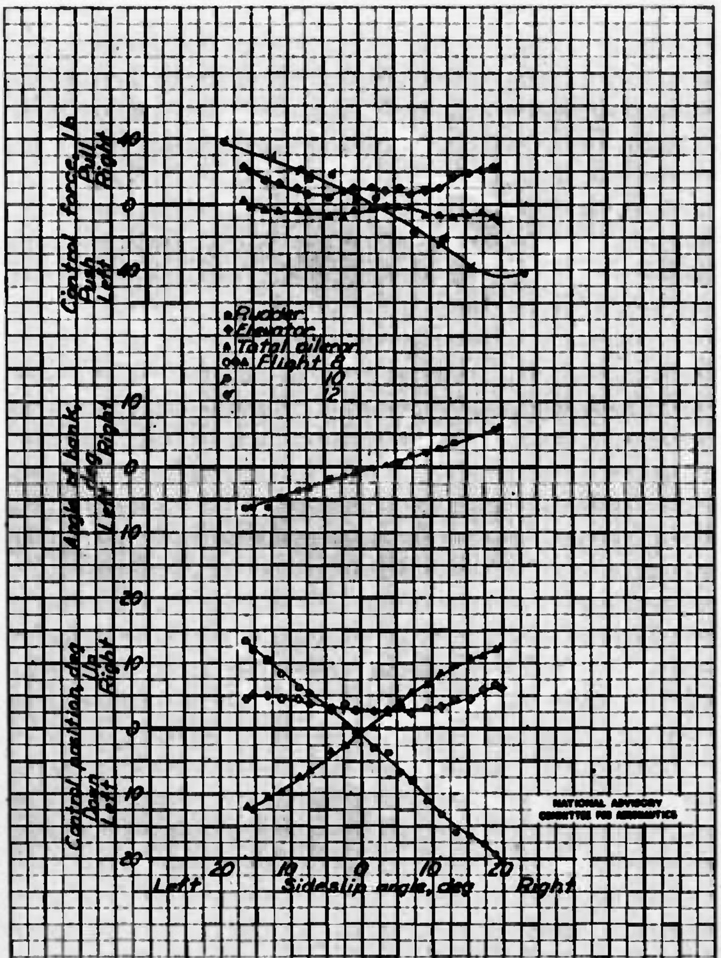
L-593



e. 240 miles per hour, shutters closed.

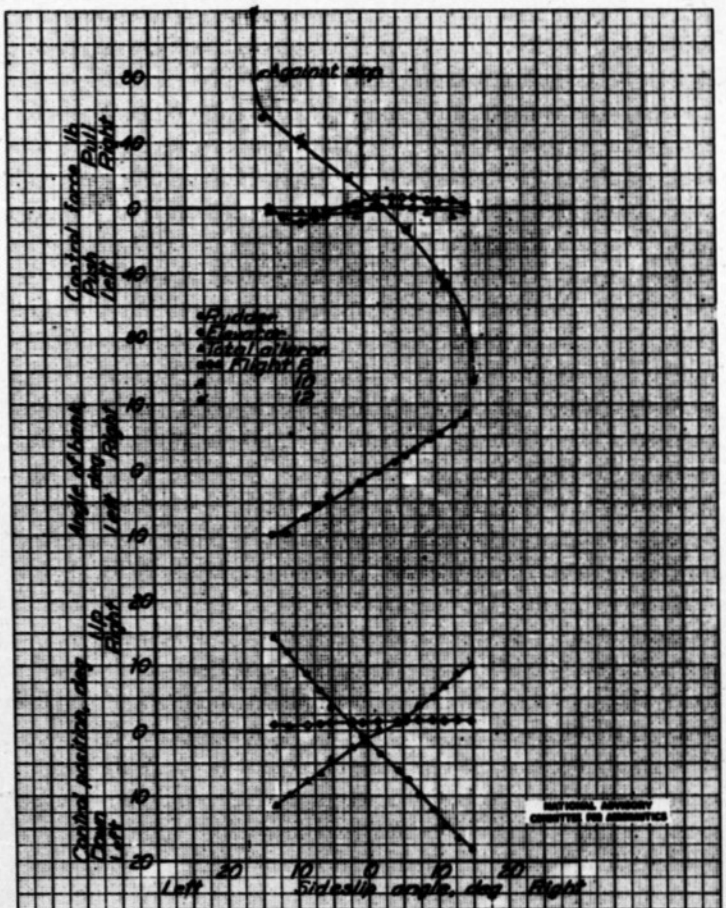
Figure 13. - Concluded.

L-593



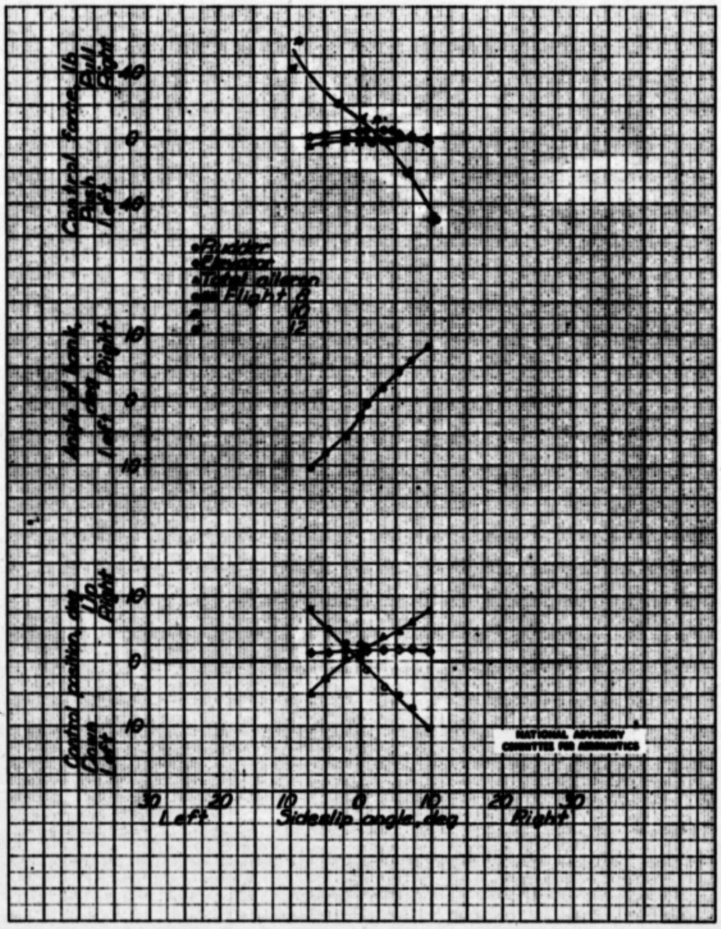
c. 120 miles per hour

Figure 14. - Sideslip characteristics in the clean condition with engines idling, shutters closed, DeHavilland Mosquito F-8 airplane.



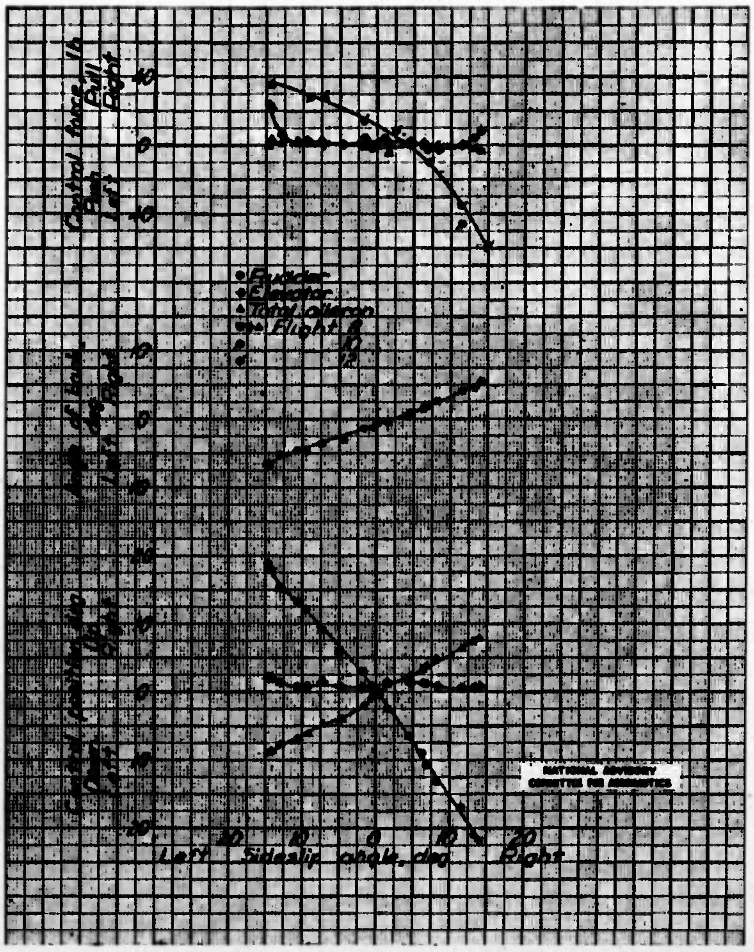
b. 180 miles per hour
Figure 14. - Continued.

L-593



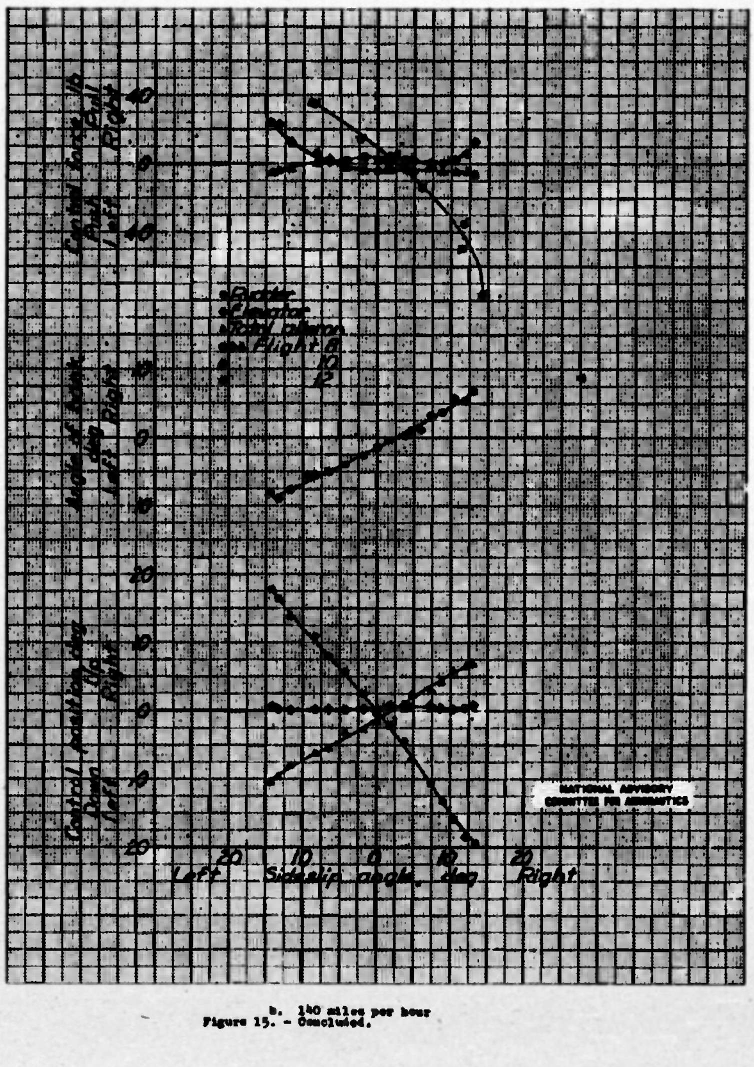
c. 240 miles per hour
Figure 14. - Concluded.

L-593



a. 115 miles per hour

Figure 15. - Sideslip characteristics with flaps and landing gear down, engines idling, shutters open, DeHavilland Mosquito F-8 airplane.



b. 140 miles per hour
Figure 15. - Concluded.

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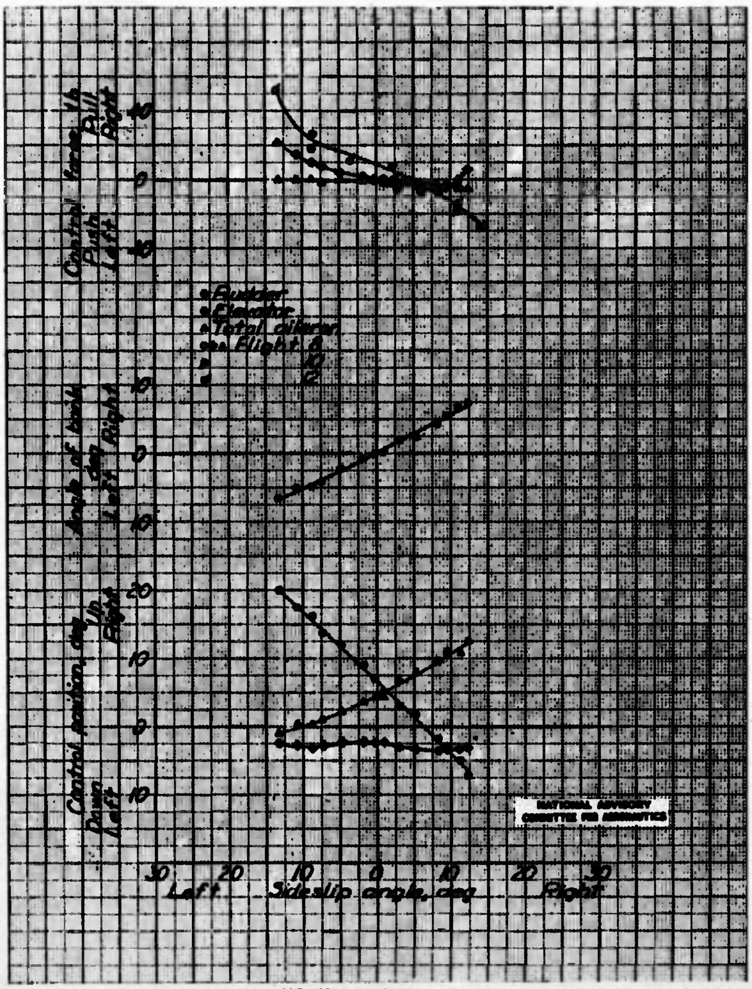
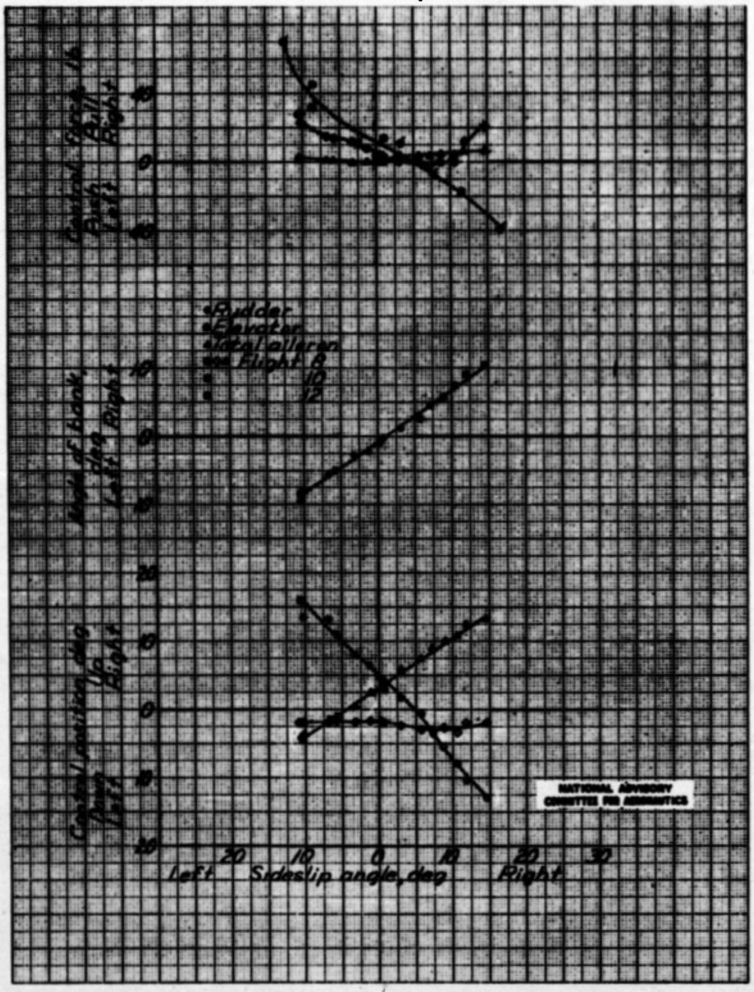


e. 110 miles per hour

Figure 16. - Sideslip characteristics with the flaps and landing gear down, rated power, shutters open, DeHavilland Mosquito F-8 airplane.



h. 140 miles per hour
Figure 16. - Concluded.

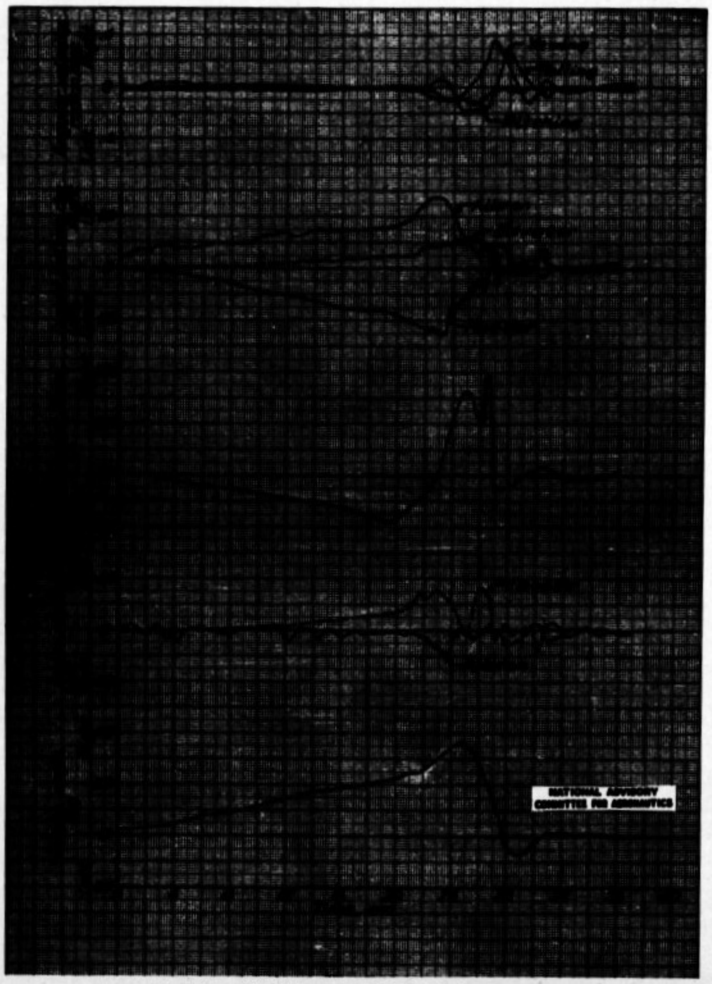


Figure 17. - Time history of right sideslip in the clean condition with power for level flight at 115 miles per hour, shutters open, in which rudder lock occurred, DeHavilland Mosquito F-8 airplane. Engines were cut to regain control.

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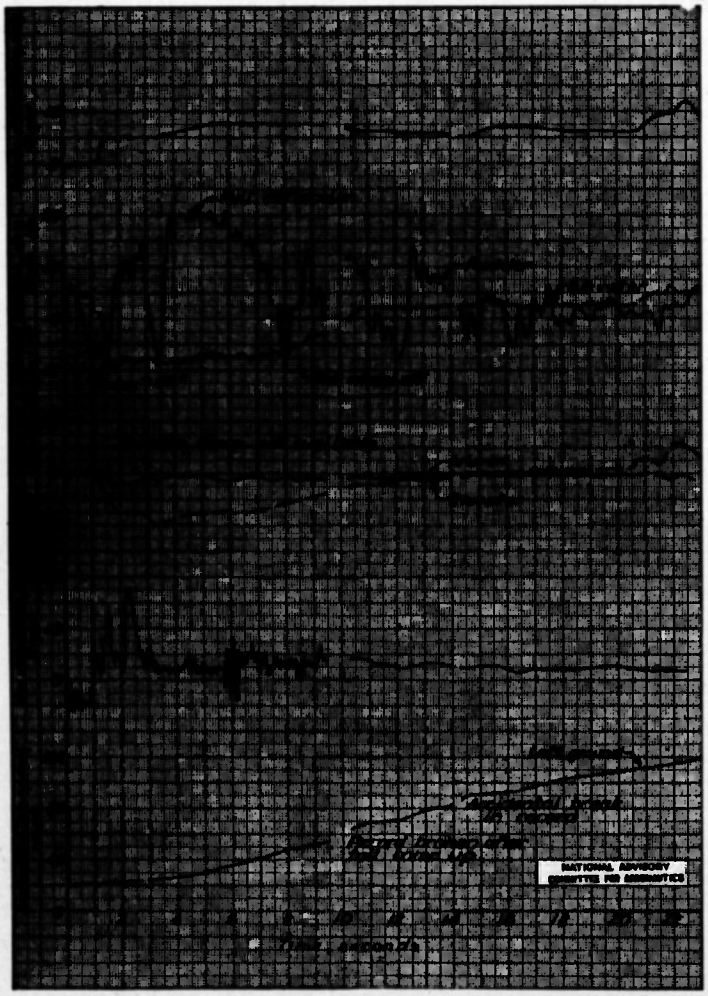

Figure 18. - Time history of a take-off using 10 pounds boost at 3000 rpm, shutters open, flaps up, center of gravity at 35 percent M.A.C., DeHavilland Mosquito F-8 airplane.

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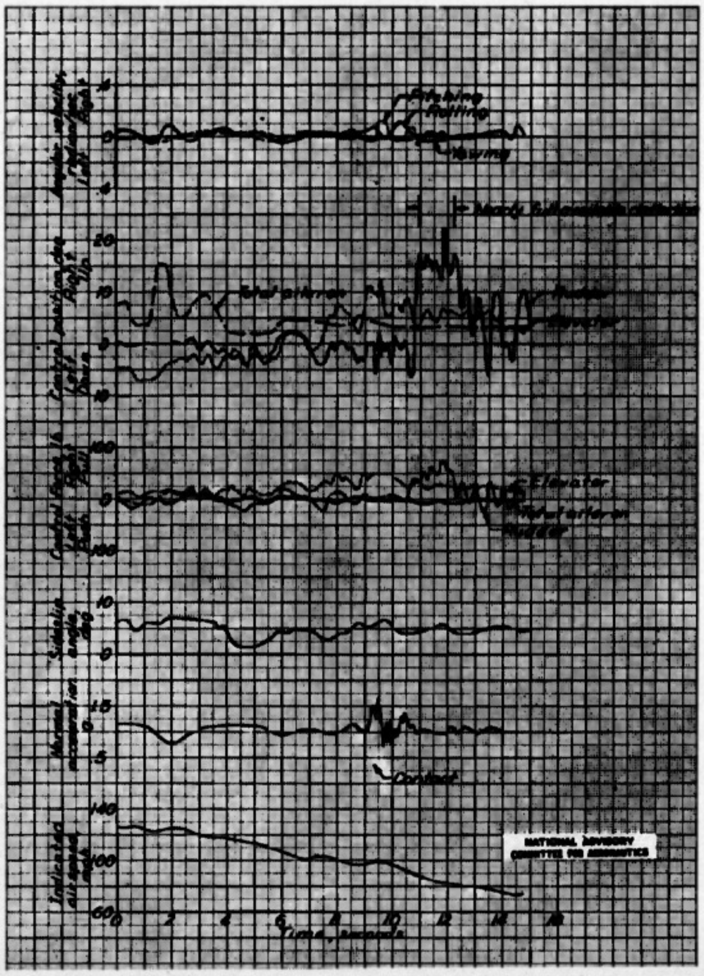
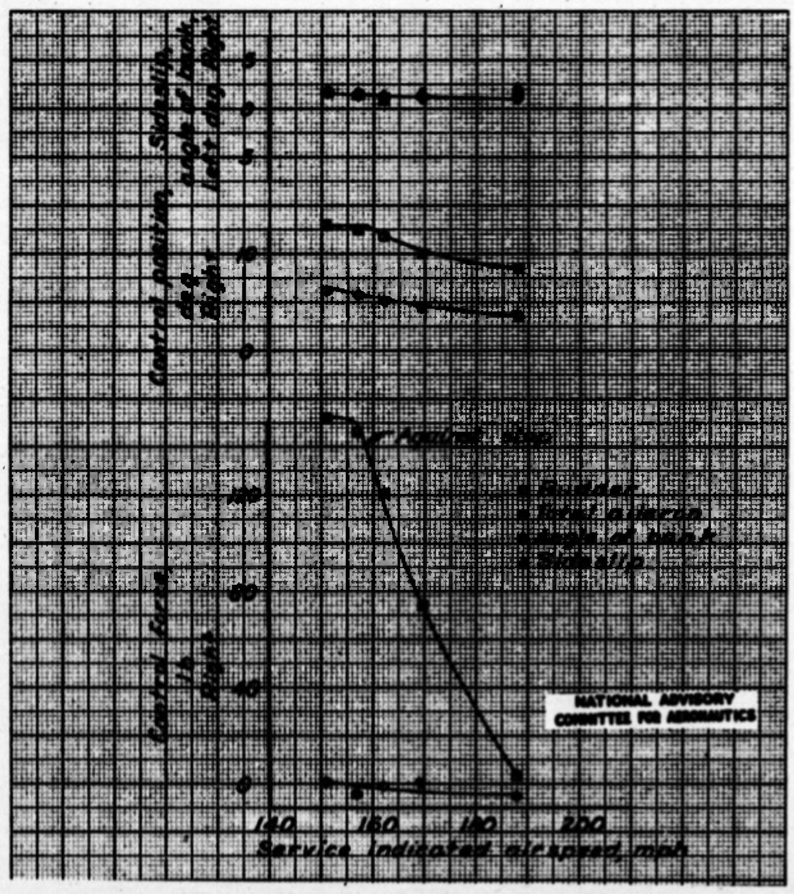
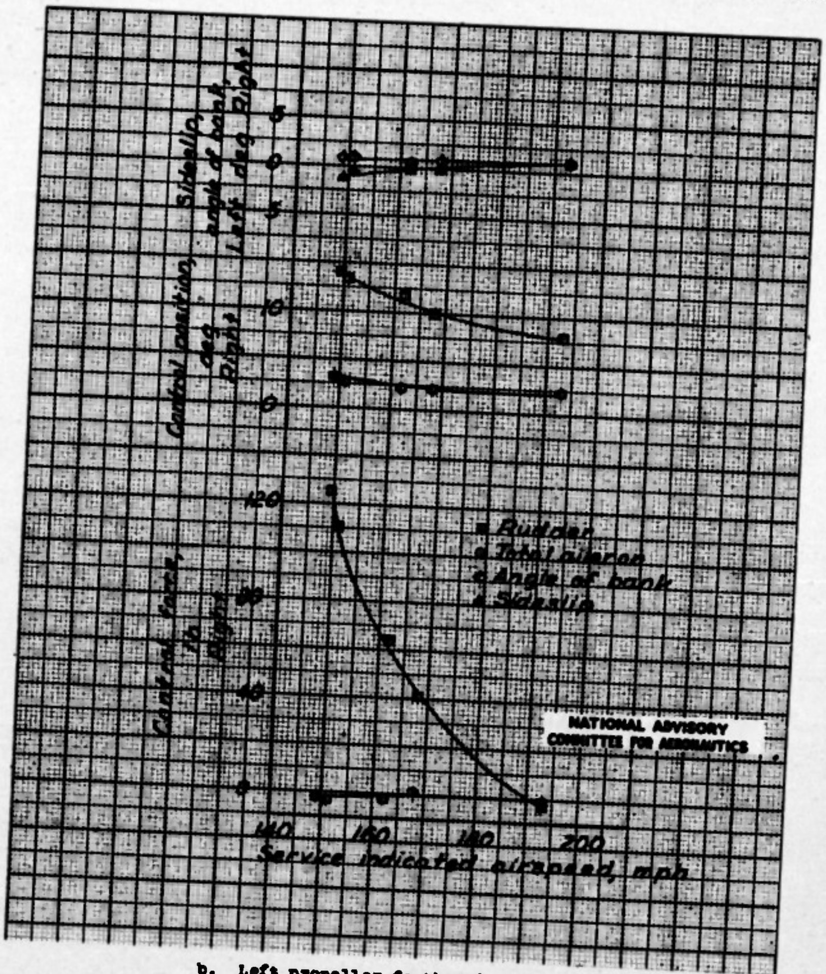


Figure 19. - Time history of a landing with the center of gravity at 30 percent M.A.C., flaps down, landing gear down, engines idling. DeHavilland Mosquito F-8 airplane.



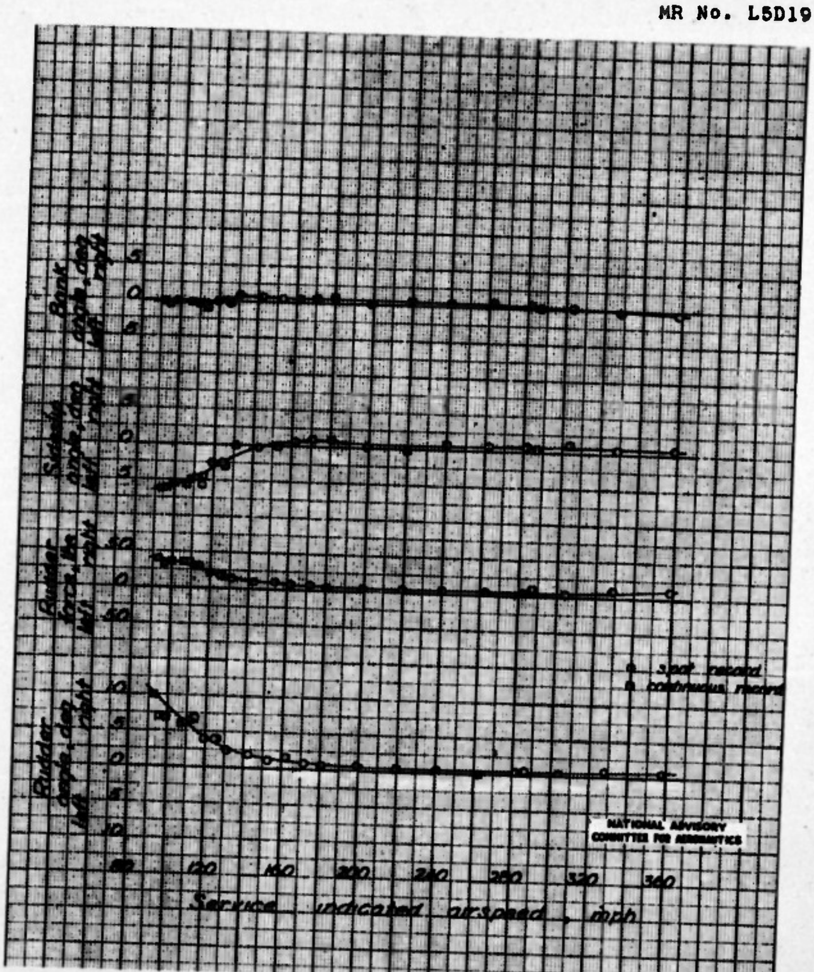
a. Left propellers windmilling with the governer set at 2650 rpm, rudder tab 15.8° full left from rudder.

Figure 20. - Directional trim characteristics for single engine operation in the rated power clean condition with left shutter closed and right shutter open, DeHavilland Mosquito F-8 airplane.



b. Left propeller feathered, rudder tab 13.5 degrees left from rudder.

Figure 20. - Concluded.



e. Rated power, clean condition, shutters closed (2650 rpm, 7 pounds boost), center of gravity at 36.3 percent M.A.C., rudder tab at 0 degrees.

Figure 21. - Directional trim characteristics in various flight conditions. DeHavilland Mosquito F-8 airplane.

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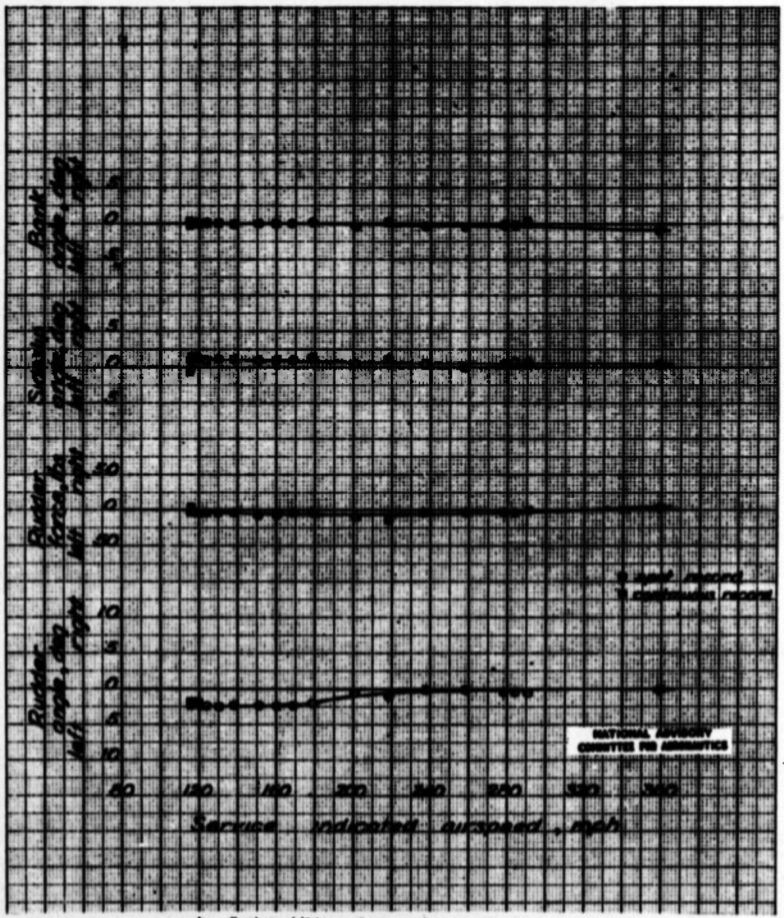
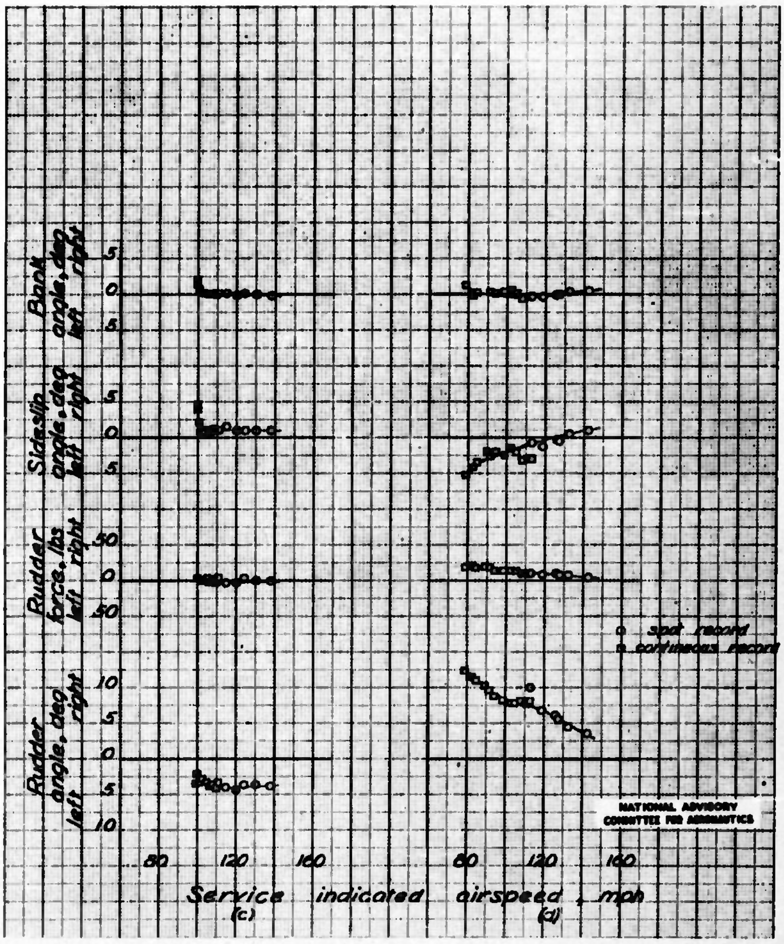


b. Engines idling, clean condition, shutters closed, center of gravity at 38.3 percent M.A.C., rudder tab 3.2 degrees right.

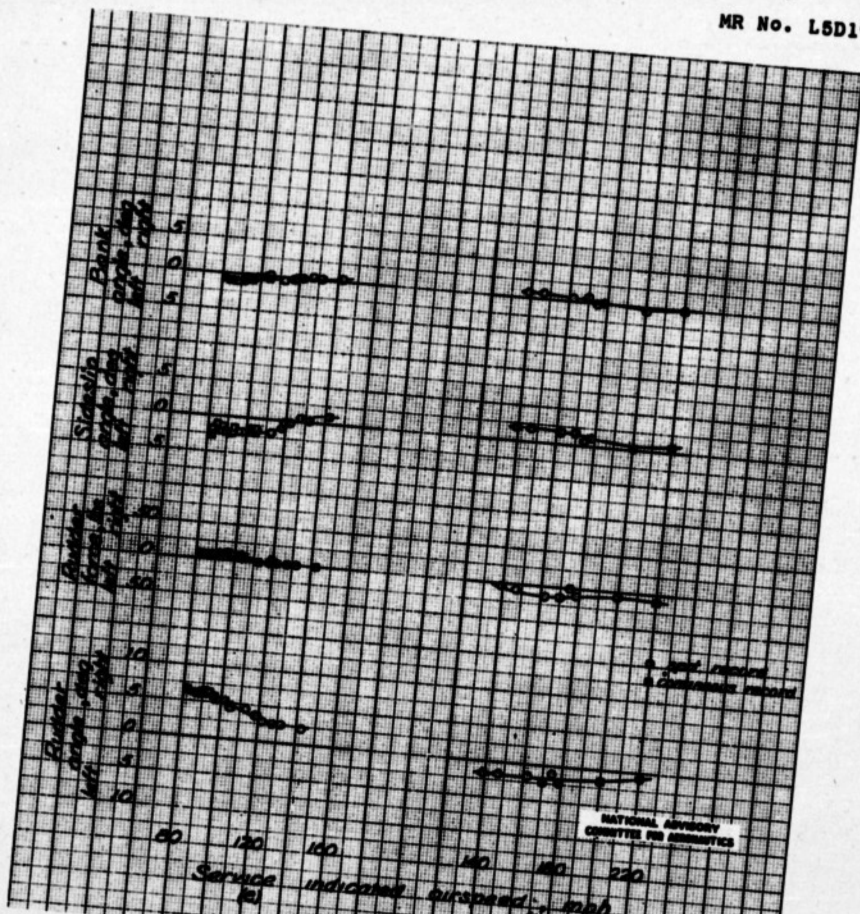
Figure 21. - Continued.



c. Flaps and landing gear down, engines idling, shutters open, center of gravity at 36.8 percent M.A.C., rudder tab 6.5 degrees left.

d. Flaps and landing gear down rated power (2650 rpm, 7 pounds boost), shutters open, center of gravity at 36.8 percent M.A.C., rudder tab 5.6 degrees left.

Figure 21. - Continued.



e. Flaps and landing gear down, approach power (2650 rpm, 0 boost), center of gravity at 36.8 percent M.A.C., rudder tab 4.2 degrees left.
f. Clean condition cruising power, (2650 rpm, 4 pounds boost) shutters open, center of gravity at 38.3 percent M.A.C., rudder tab at 0 degrees.

Figure 21. - Concluded.

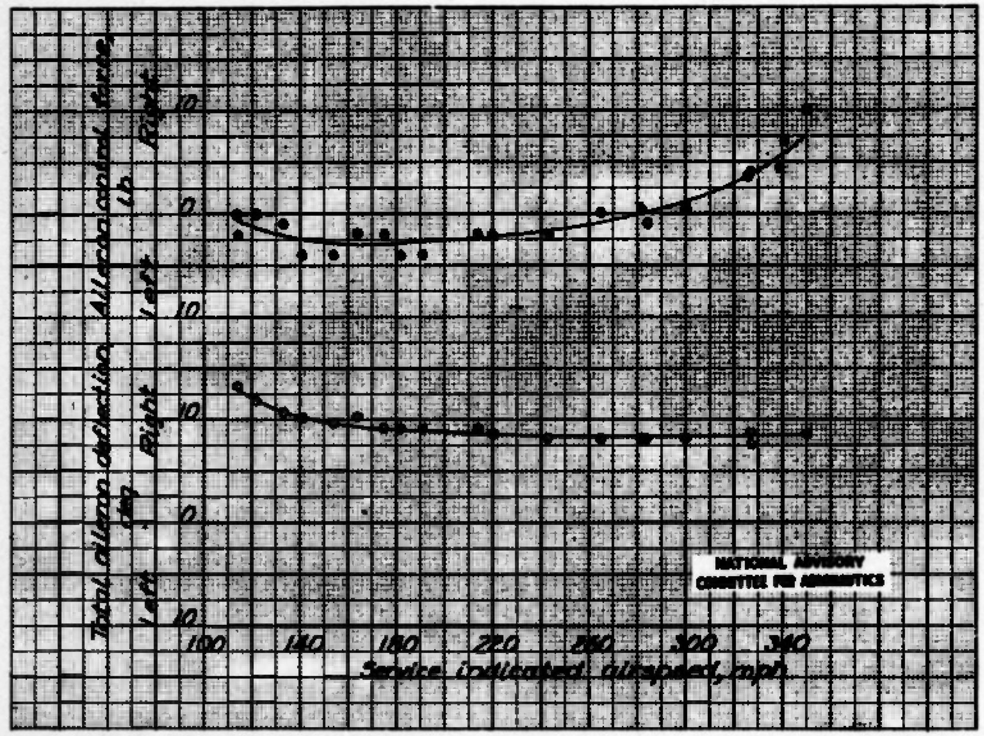


Figure 22. - Variation of aileron deflection and control force for trim with indicated airspeed, in the rated-power, clean condition, De-Havilland Mosquito F-8 airplane.

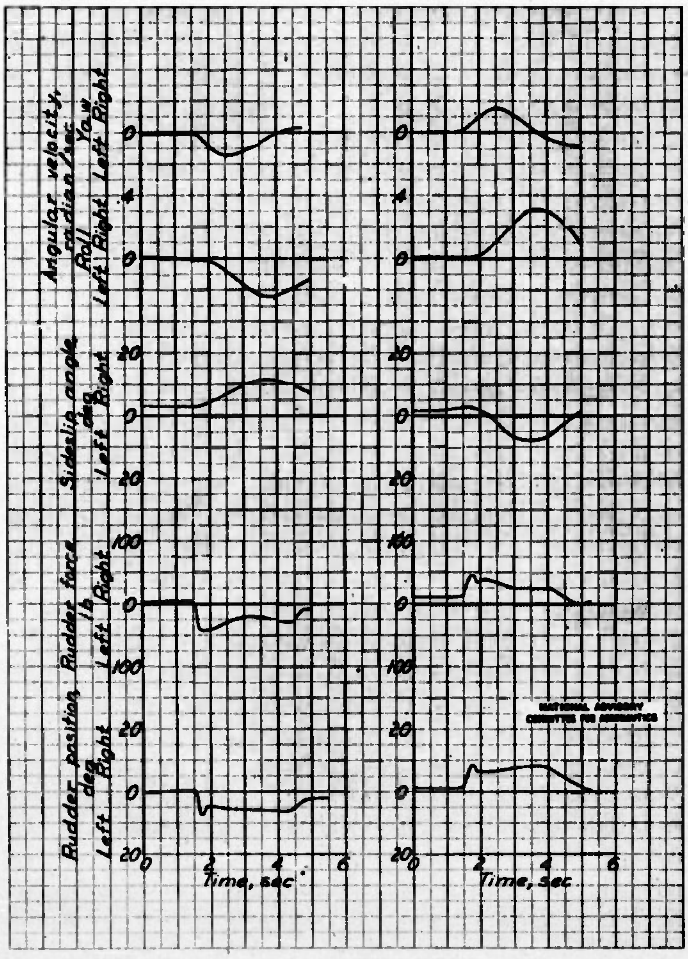


Figure 23. - Time histories of rudder kicks at 200 miles per hour in the clean condition with power for level flight in which deflection was held to maximum sideslip, DeHavilland Mosquito F-8 airplane.

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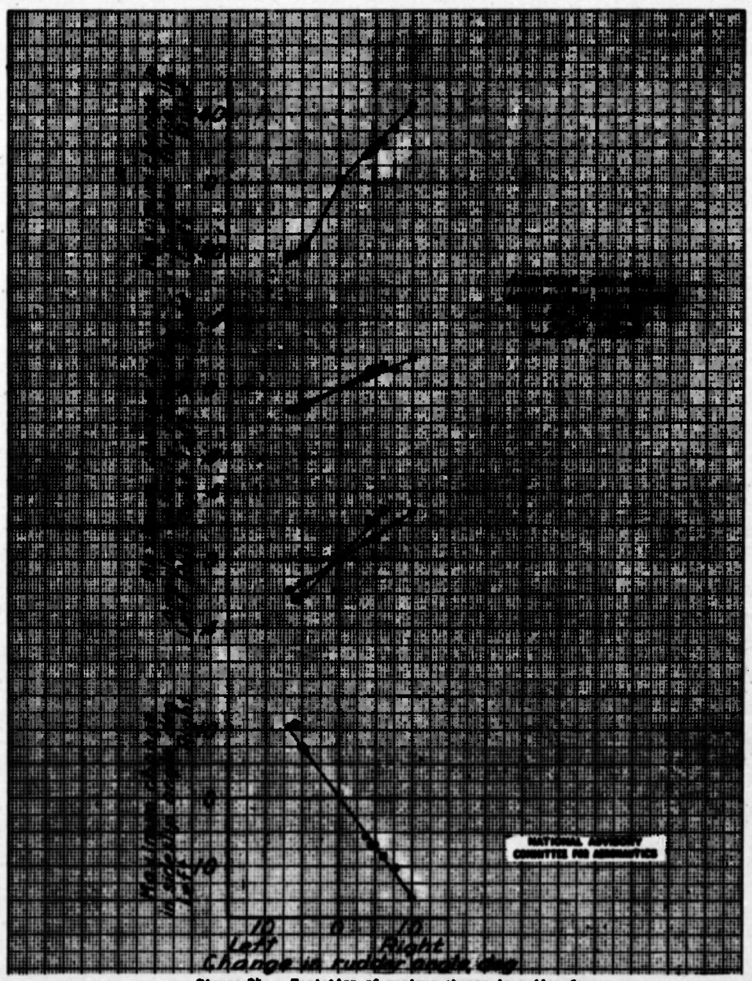

Figure 24. - Variation of maximum change in rudder force, rolling and yawing velocity, and sideslip angle with rudder position in rudder kicks at 140 and 200 miles per hour in the clean condition with power for level flight, DeHavilland Mosquito F-8 airplane.

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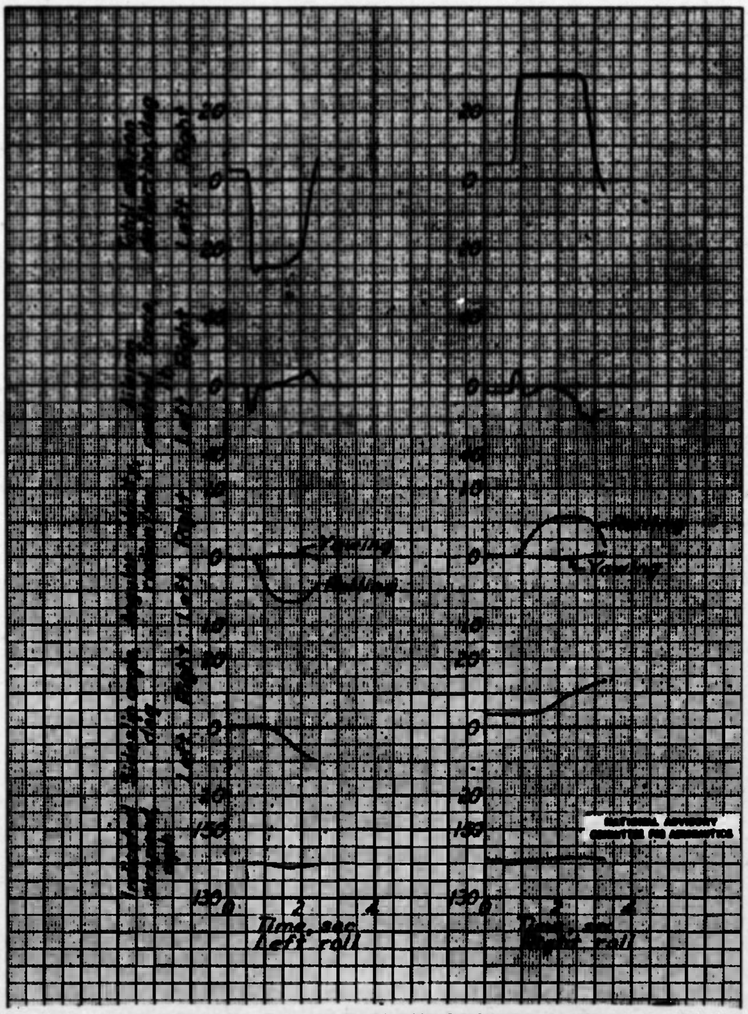

Figure 85. Time histories of rudder-fixed, abrupt aileron rolls at 140 miles per hour, indicated, in the clean condition using power for level flight shutters open, DeHavilland Mosquito F-8 airplane.

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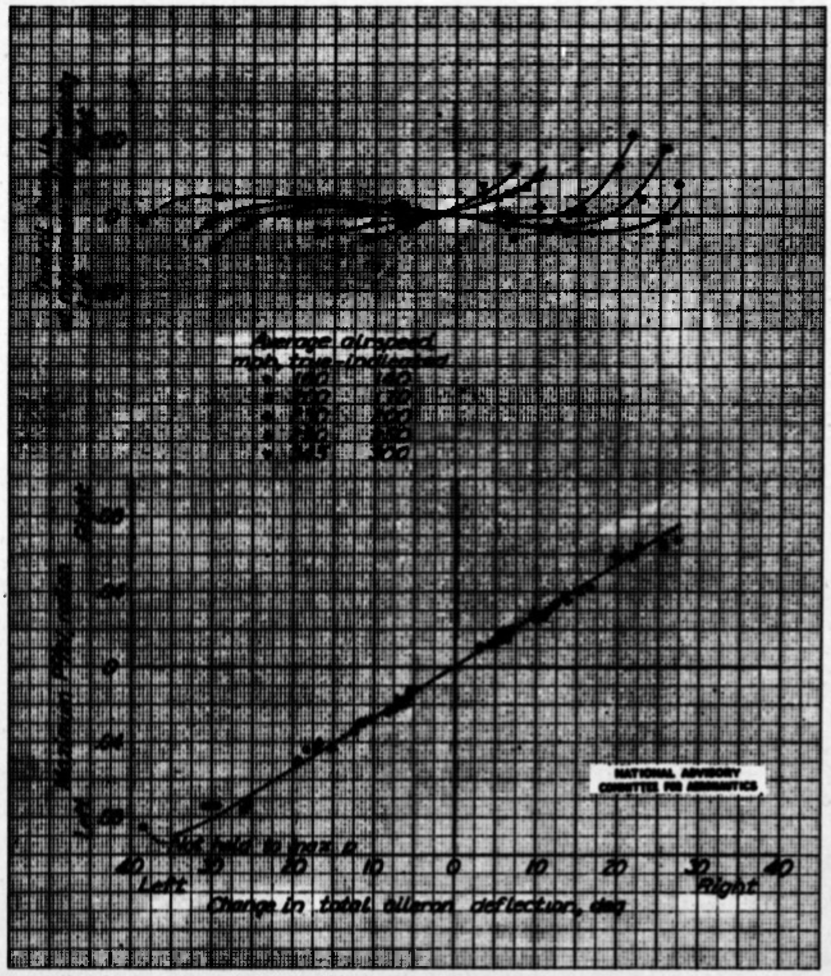

Figure 26. - Variation of aileron control force and effectiveness with total aileron deflection in the clean condition at various speeds using power for level flight or rated power, DeHavilland Mosquito F-8 airplane.

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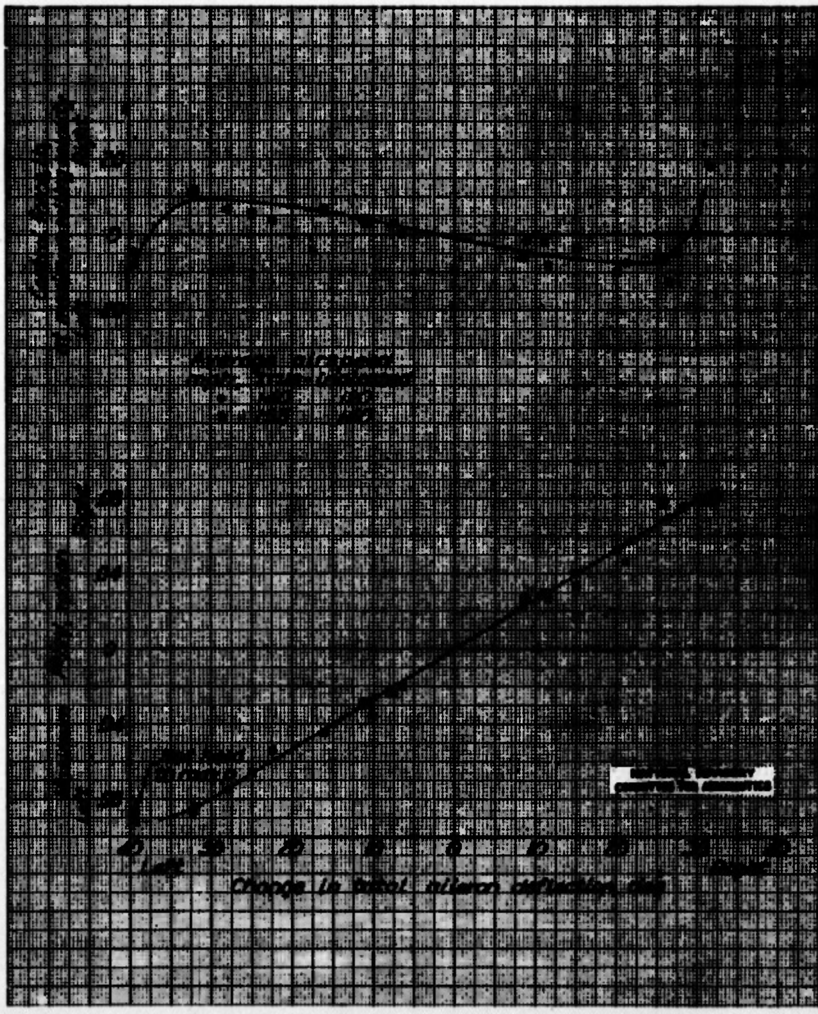

Figure 27. - Variation of aileron control force and effectiveness with total aileron deflection at 120 and 140 miles per hour with flaps down, landing gear down, and engines idling, DeHavilland Mosquito F-8 airplane.

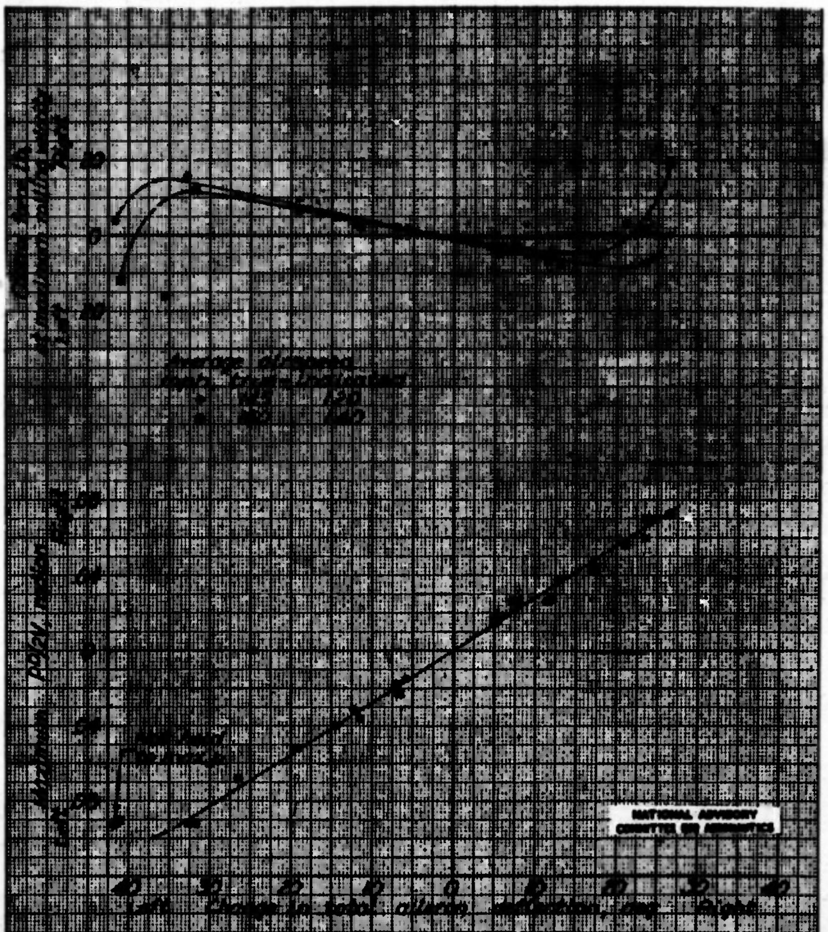

Figure 28, - Variation of aileron control force and effectiveness with total aileron deflection at 120 and 140 miles per hour with flaps down, and landing gear down using power for level flight, DeHavilland Mosquito F-8 airplane.

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AUTHOR(S): Crane, H. L.; Talmadge, D. B.; Gray, W. E.
ORIGINATING AGENCY: Langley Memorial Aeronautical Laboratory, Langley Field, Va.

PUBLISHED BY: National Advisory Committee for Aeronautics, Washington, D. C.

DATE	DOC. CLASS.	COUNTRY	LANGUAGE	PAGES	ILLUSTRATIONS
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SUBJECT HEADINGS: Airplanes - Flight characteristics (08443); Airplanes - Stability (08487); Airplanes - Control characteristics (08393); F-8 - Flight tests (34552.2)

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