REPORT No. 422

WIND-TUNNEL RESEARCH COMPARING LATERAL CONTROL DEVICES, PARTICULARLY AT HIGH ANGLES OF ATTACK

II.—SLOTTED AILERONS AND FRISE AILERONS

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SUMMARY

Three model wings, two with typical slotted ailerons and one with typical Frise ailerons, have been tested as part of a general investigation on lateral control devices, with particular reference to their effectiveness at high angles of attack, in the 7 by 10 foot wind tunnel of the National Advisory Committee for Aeronautics. Force tests, free-autorotation tests, and forced-rotation tests were made which show the effect of the various ailerons on the general performance of the wing, on the lateral controllability, and on the lateral stability. In general, the slotted and Frise ailerons tested were inferior in rolling control at 20° angle of attack to plain ailerons of the same size. The adverse yawing moments obtained with the slotted and Frise ailerons were, in most cases, slightly smaller than those obtained with plain ailerons of the same size and deflection. However, this improvement was small as compared to the improvement obtainable by the use of suitable differential movements with any of the ailerons, including the plain.

INTRODUCTION

This report is the second of a series giving the results of an investigation in which it is hoped to compare all types of lateral control devices which have been satisfactorily used or which show reasonable promise of being effective. In this program it is planned first to test the various types of ailerons and lateral control devices on rectangular wings of aspect ratio 6. Later the best ones are to be tested on wings of different shape. While these items have previously been tested in isolated cases, it is not possible to get a good comparison between most of them because the individual tests were made under different conditions in different wind tunnels or in isolated flight tests and with various degrees of completeness. In this investigation the various devices are subjected to the same series of wind-tunnel tests which, it is thought, include all the factors directly connected with lateral control and lateral stability that can be satisfactorily handled in a routine manner in a wind tunnel. The tests are designed to show the relative merit of the various control devices in regard to lateral controllability, lateral stability, and general usefulness. They include regular 6-component force tests with the ailerons or other control devices both neutral and deflected various amounts, rotation tests in which the model is rotated about the wind-tunnel axis and the rolling moment measured, and free-rotation tests showing the range and rate of autorotation. The tests are made not only at 0° yaw, but also with an angle of yaw of 20°, which represents the conditions in a fairly severe sideslip.

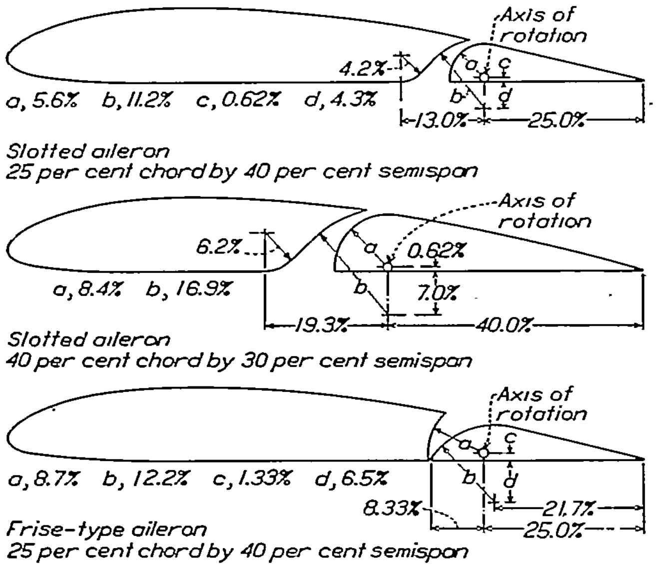
The first report of this series (reference 1) dealt with three different sizes of ordinary ailerons. One of these ailerons was of medium size taken from the average of a number of conventional airplanes, one was extremely short and wide, and the other was extremely long and narrow. All the ailerons were proportioned to give approximately equal controllability at angles of attack below the stall and with equal up-and-down deflection. The results were analyzed to show the relative merits of the three sizes of ailerons when set in the above manner and also in accordance with two differential movements, upward movement only, and with the ailerons arranged to float.

This report covers similar tests with typical slotted ailerons of two of the above-mentioned sizes (the medium and the short, wide ones) and one typical Frise aileron of the medium size. The long, narrow type was omitted in both these designs as the previous tests with ordinary ailerons indicated that ailerons of this shape would not give satisfactory control at high angles of attack. The results are given for the same five deflection movements as were used with the ordinary ailerons except that the Frise aileron was not tested in the floating condition. Inasmuch as the characteristics of slotted and Frise-type ailerons are somewhat sensitive to the exact shape and axis location, these tests are not necessarily representative of all designs of slotted or Frise ailerons.

METHODS AND APPARATUS

Wind tunnel.—All the present tests were made in the 7 by 10 foot open-jet wind tunnel of the National Advisory Committee for Aeronautics. In this tunnel the model is supported in such a manner that the forces and moments at the quarter-chord point of the mid section of the model are measured directly in coefficient form. For autorotation tests the standard force test tripod is replaced by a special mounting permitting the wing to rotate about the longitudinal wind axis passing through the midspan quarter-chord point. This apparatus is mounted on the balance, and the rolling-moment coefficient may be read directly during forced-rotation tests. A complete description of the above equipment is given in reference 2.

Models.—Three wing models, each having a 10-inch chord and a 60-inch span, were tested. Two of these models were equipped with slotted ailerons and the third one with Frise ailerons, as illustrated in Figure 1. The small slotted ailerons and the Frise type had the same span and chord (measured from the trailing edge to the axis of rotation) as the average-sized plain aileron discussed in reference 1, and the large slotted aileron had the same dimensions as the short, wide, plain aileron of reference 1.



Slotted aileron
25 per cent chord by 40 per cent semispan

Slotted aileron
40 per cent chord by 30 per cent semispan

Frise-type aileron
25 per cent chord by 40 per cent semispan

FIGURE 1.—Profiles of slotted and Frise ailerons on Clark Y airfoil. (All dimensions are in terms of the wing chord)

The models were constructed of laminated mahogany, except for the slotted ailerons which were built principally of balsa wood. The latter material was necessary in order that these ailerons could be mass balanced about their axis of rotation and consequently be capable of floating at an attitude of zero resultant air force.

For the above-mentioned floating condition the slotted ailerons were connected by a torque rod running through the wing. The ailerons were adjustable in angle of pitch relative to this rod, and the rod could be locked to the wing for normal aileron tests.

TESTS

This series of tests was conducted in accordance with the standard procedure and at the dynamic pressure and Reynolds Number employed throughout the present research on lateral control. (See reference 1.) The dynamic pressure was 16.37 pounds per square foot, corresponding to a speed of 80 miles per hour at sea level under standard atmospheric conditions, and the Reynolds Number was 609,000.

Aileron movements.—Four types of aileron deflection were used in these tests—equal up-and-down, upward movement only, downward movement only, and floating (except for the Frise type), with various relative angles of deflection between the ailerons. The rolling and yawing moments for the differential arrangements were assumed to be the sum of the moments obtained separately on the up-only and down-only tests at the simultaneous angles of attack given in Table I. This assumption is not rigorously correct owing to the difference in the effect of the ailerons on the span load distribution of the wing when they are deflected separately or together. However, check tests comparing the moments as obtained by either simultaneous or separate deflection show that the error due to this method of computation is small for the cases under discussion.

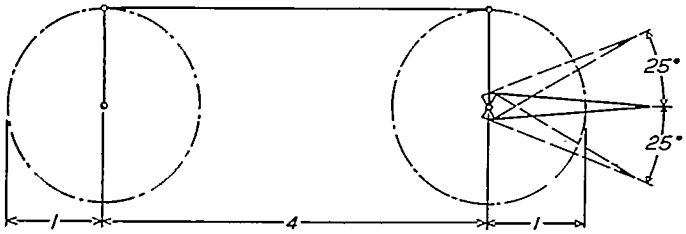
TABLE I

SIMULTANEOUS AILERON DISPLACEMENTS WITH ASSUMED DIFFERENTIAL ARRANGEMENTS

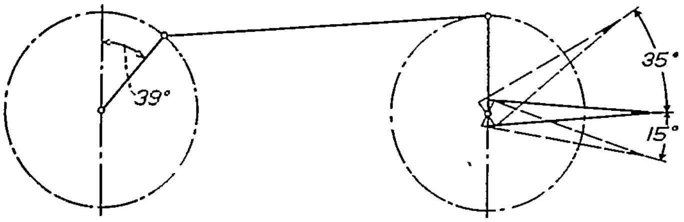
Average differential		Extreme differential	
Upward displacement	Downward displacement	Upward displacement	Downward displacement
Degrees	*Degrees*	*Degrees*	*Degrees*
0.0	0.0	0.0	0.0
10.0	8.5	10.0	7.0
20.0	13.0	20.0	12.0
30.0	15.0	30.0	14.0
35.0	15.0	40.0	11.5
		50.0	7.0

All the aileron arrangements are illustrated in Figure 2 and are identical with those discussed in relation to the plain ailerons in reference 1. The maximum deflections represent either normal practice or the physical limit to the aileron travel due to interference with the wing. Thus, 25° up and 25° down is the average maximum travel of ordinary-sized plain ailerons having no differential action and 35° up and 15° down is a conventional differential linkage giving approximately the same rolling moment at 10° angle of attack. The more extreme differential, 50° up and 7° down, was also designed to give the same rolling effectiveness at an angle of attack of 10° as the equal up-and-down arrangement of the plain ailerons. The up-only type of deflection is limited in some cases by interference between the aileron and the wing and in other cases by the deflection giving approximately the same rolling moments as the standard, plain ailerons with a deflection of ±25°.

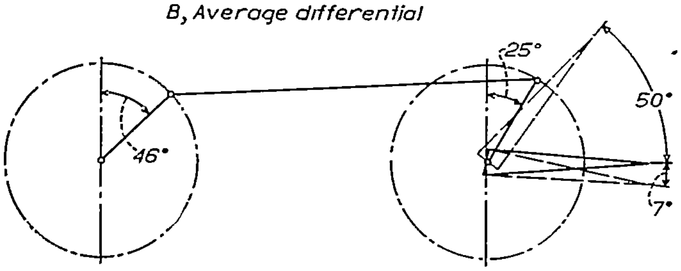
Accuracy.—The accuracy of the results presented in this report is the same as that obtained in Part I. (Reference 1.) It is considered satisfactory at all angles of attack except in the burbled region between 20° and 25° when the rolling and yawing moments are relatively unreliable owing to the critical, and often unsymmetrical, condition of the burbled air flow around the wing.



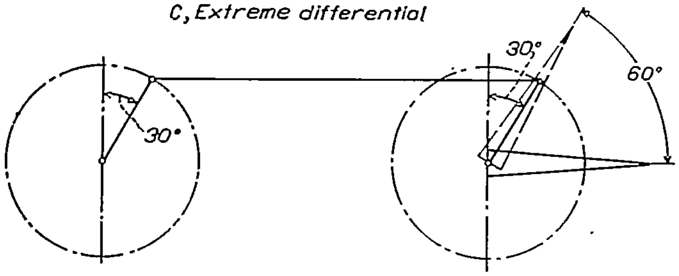
A, Equal up-and-down and floating



B, Average differential



C, Extreme differential



D, Up-only

FIGURE 2.—Aileron linkage systems

Oscillations of floating ailerons.—The wide, short, slotted ailerons show a tendency to oscillate when the wing is at angles of attack between 22° and 25°. This condition, which might give trouble in practice, is not a true flutter but appears to be due to the ailerons following the pattern of irregular, turbulent flow past the wing.

RESULTS

Coefficients.—The force-test results are given in the form of absolute coefficients of lift and drag and of rolling and yawing moments:

$$C_L=\frac{\text{Lift}}{qS}$$

$$C_D=\frac{\text{Drag}}{qS}$$

$$C_l'=\frac{\text{Rolling moment}}{qbS}$$

$$C_n'=\frac{\text{Yawing moment}}{qbS}$$

where S is the total wing area, b is the wing span, and q is the dynamic pressure. The coefficients as given above are obtained directly from the balance and refer to the wind (or tunnel) axes. In special cases in the discussion where the moments are used with reference to body axes the coefficients are not primed. Thus the symbols for the rolling and yawing moment coefficients about the body axes are C_l and C_n.

The results of the forced-rotation tests are given, also about the wind axes, by a coefficient representing the rolling moment due to rolling:

$$C_\lambda=\frac{\lambda}{qbS}$$

where λ is the rolling moment about the wind axis due to the asymmetric distribution of load along the span when the wing is rolling.

This coefficient may be used as a measure of the degree of lateral stability or instability of a wing under various rolling conditions. In the present case it is used to indicate the characteristics of a wing when it is subjected to a rolling velocity equal to the maximum that is normally encountered in controlled flight in very gusty air. This rolling velocity may be expressed in terms of a coefficient, incorporating the span and the air speed at the center section of the wing as follows:

$$\frac{p'b}{2V}=0.05$$

Tables.—The complete results of these tests are presented in Tables II to X, inclusive.

Table II covers the following data obtained on the unyawed wing having slotted ailerons of average size (25 per cent of the chord by 40 per cent of the semispan):

1. C_L and C_D at zero aileron deflection, both rigid and floating.
2. C_l' and C_n' for each aileron setting, both rigid and floating.
3. The floating angle of the left aileron relative to the wing (δ_{AF}).

Table III contains the same set of coefficients as those in Table II except that the wing is yawed −20°. Table IV contains the results of the autorotation and torque tests on the above wing.

Tables V, VI, and VII are similar to Tables II, III, and IV but cover the results obtained on the wing fitted with short, wide, slotted ailerons (40 per cent of the chord by 30 per cent of the semispan).

Tables VIII, IX, and X are also similar to II, III, and IV. In this series the data cover the results obtained on the wing with Frise-type ailerons.

DISCUSSION IN TERMS OF CRITERIONS

Table XI contains a series of criterions that were developed in reference 1 for the purpose of comparing the effect of various ailerons or other lateral control devices on the general performance of an airplane, on its lateral controllability, and on its lateral stability. Values of these criterions are given for the two sizes of slotted ailerons and the Frise-type ailerons of this report, and also for the average-sized plain ailerons previously reported. The latter are an example of normal present-day aileron design and are taken as a standard of comparison throughout the entire investigation.

GENERAL PERFORMANCE

Wing area required for desired landing speed.—If an airplane is equipped with a Clark Y wing having any of the slotted or Frise aileron systems discussed in this report, except the floating arrangements, the wing area required for a given weight and landing speed is essentially the same as that necessary when plain ailerons are used. In the floating condition, the maximum value of C_L is cut down about 10 per cent for average-sized slotted ailerons and 14 per cent for short, wide, slotted ailerons. This reduction requires a corresponding increase in wing area to satisfy the assumed condition of constant minimum speed.

Speed range.—The ratio $C_{L_{max}}/C_{D_{min}}$ is a convenient figure of merit for a comparison of the relative speed range obtainable with various wings. On this basis a Clark Y wing with average-sized slotted ailerons shows about the same range as one with plain ailerons. Frise ailerons of normal size or short, wide, slotted ailerons are somewhat worse in this respect than ordinary-sized plain ailerons. If the slotted ailerons of ordinary size are allowed to float, the wing has a somewhat lower speed-range criterion than if they were locked. The short, wide, slotted ailerons arranged to float decrease the speed range very markedly.

Rate of climb.—In order to establish a suitable criterion for the effect of the wing and ailerons on the rate of climb of an airplane, the performance curves of a number of types and sizes of airplanes were calculated, and the relation of the maximum rate of climb to the lift and drag curves was studied. This comparison showed that the L/D at $C_L=0.70$ gave a consistently reliable figure of merit for this purpose.

A comparison of the various slotted and Frise aileron arrangements on the basis of this criterion shows that there is no appreciable difference between them, either locked or floating, except for the wide, short, slotted ailerons arranged to float, which are poor.

LATERAL CONTROLLABILITY

Rolling criterion.—The rolling criterion upon which the control effectiveness of each of the aileron arrangements is judged is a figure of merit that is designed to be proportional to the initial acceleration of the wing tip, following a deflection of the ailerons from neutral, regardless of the air speed or wing-plan form of an airplane. Expressed in coefficient form for a rectangular monoplane wing the criterion becomes

$$RC=\frac{C_l}{C_L}$$

where C_l is the rolling-moment coefficient about the body axis due to the ailerons. The numerical value of this expression that has been found to represent satisfactory control conditions is approximately 0.075. A detailed explanation of the derivation of RC and its more general form which is applicable to any wing plan form is given in reference 1.

The comparison of the ailerons on the basis of this criterion is given in Table XI at four representative angles of attack; namely, 0°, 10°, 20°, and 30°. The first angle represents the high-speed attitude; $\alpha=10°$ represents the highest angle of attack at which entirely satisfactory control with ordinary ailerons can be maintained; $\alpha=20°$ represents the condition of greatest instability in rolling and is probably the greatest attainable angle of attack with most present-day airplanes; and finally, $\alpha=30°$ is given only for comparison with controls for possible future types of airplanes.

At $\alpha=0°$ the control produced by any of the aileron arrangements is much more than is necessary.

At $\alpha=10°$ and with the ailerons deflected equally up-and-down 25°, the following relations exist: The short, wide, slotted ailerons give slightly higher values of the rolling criterion, RC, than the average-sized plain ailerons; the average-sized slotted ailerons give slightly lower values of RC than the average-sized plain ailerons; the Frise-type ailerons give distinctly lower values. These differences do not represent inherent characteristics of the types of ailerons discussed, because, by the simple expedient of changing slightly the assumed maximum up-and-down deflections, any of these ailerons may be arranged to give the same moment at maximum deflection.

For all differential systems, including up-only, the slotted and Frise ailerons give a smaller moment than the standard-sized plain ailerons, by an amount that can not be readily compensated for by increased maximum deflections except, perhaps, in the case of the short, wide ailerons.

The slotted ailerons arranged to float give moments that are equal to those of the standard ailerons arranged to float, but in the case of the short, wide design, give moments that are less than those produced by the plain ailerons of the same size.

At $\alpha=20°$ the average-sized slotted or Frise ailerons give moments for equal up-and-down deflection that are comparable with the standard, or about 50 per cent of the satisfactory value. The slotted aileron gives, likewise, only about 50 per cent of the satisfactory moment for any differential or for the floating arrangement. Both differential settings and the up-only arrangement of the Frise ailerons give about 75 per cent of the corresponding values of the criterion at 10° angle of attack, but as the controllability at this angle is very low for all these arrangements of the Frise-type aileron the possibility of bringing up the moments to a satisfactory value by increasing the deflection is small.

The short, wide, slotted ailerons show the best characteristics at 20° angle of attack of any of the types tested thus far. Equal up-and-down deflection of these ailerons gives an appreciably higher rolling moment than the average-sized plain ailerons rigged this way and a slightly higher moment than the short, wide, plain ailerons. Differential arrangements are consistently better than the equal up-and-down, the extreme differential (50° upward, 7° downward) being the best. With this arrangement the value of $R\ C$ at $\alpha=20°$ is only 15 per cent less than that at $\alpha=10°$. However, even this rigging is less satisfactory than the corresponding plain aileron size and setting.

At 30° angle of attack all of the plain, slotted, or Frise ailerons are very unsatisfactory when rigged in any arrangement.

Lateral control with sideslip.—If a wing is yawed 20° a rolling moment is set up that tends to raise the forward tip with a magnitude that is always greater, at very high angles of attack, than the available rolling moment due to ailerons. The limiting angle of attack at which the ailerons can balance the rolling moment due to 20° yaw represents the greatest angle of attack than can be held in a sideslip. This angle is tabulated for all aileron arrangements as a criterion of control with sideslip.

It is apparent from Table XI that the controllable range in this attitude is about the same for all aileron arrangements tested and in all cases extends to, or slightly above, the angle of maximum lift in the yawed condition.

Yawing moment due to ailerons.—The desirable yawing moment due to ailerons differs to some extent with the type of airplane that is being considered. For a highly maneuverable military or acrobatic machine, complete independence of the controls as they affect the turning moments about the various body axes is no doubt a desirable feature. On the other hand, for large transport airplanes or machines to be operated by relatively inexperienced pilots, a favorable yawing moment of proper magnitude would be an appreciable aid to safe flying. Finally, it is obvious that a yawing moment tending to turn the airplane out of its bank is never desirable under any circumstances.

Comparing the various aileron arrangements from the standpoint of maximum favorable or maximum unfavorable C_n at the same representative angles of attack as were used in the comparison of $R\ C$, it may be seen from Table XI that the plain, slotted, or Frise ailerons when set up-and-down 25° give nothing but unfavorable moments at all angles of attack. Differential settings of the ailerons improve the yawing characteristics of the wing in all cases by decreasing the unfavorable moments and increasing the favorable. This effect increases with the degree of differential motion employed until up-only displacement gives practically no unfavorable moments for any aileron deflection and any angle of attack up to 20°. At angles of attack greater than 20° they give strong favorable moments at large aileron deflections, but at small deflections give small unfavorable moments. The short, wide, slotted aileron in the up-only position is the best design of any tested in this group, but even this arrangement is less desirable than the plain ailerons of the same size and deflections.

Except for the above case and the differential arrangements of the short, wide, plain ailerons, the slotted and Frise aileron systems usually showed slightly improved yawing-moment characteristics when compared to plain ailerons of the same size and setting. It should be noted, however, that this improvement is small relative to the improvement obtainable with any of the ailerons by use of suitable differential movements.

Like the average-sized plain ailerons arranged to float, slotted ailerons of average size arranged to float show small yawing moments, ranging from slightly unfavorable moments at low angles of attack and high aileron deflections to slightly favorable moments at high angles of attack. The wide, slotted ailerons when allowed to float show almost ideal moments from the standpoint of control as the yawing moments are favorable at all angles of attack, are small at low angles, and are of about the magnitude of normal rudder moments at high angles.

LATERAL STABILITY

Angle of attack above which autorotation is self-starting.—This characteristic was measured by free-rotation tests of the wing with ailerons neutral. The angle at which it started to rotate without any appreciable initial rate of roll marked the theoretical limit to the useful angle-of-attack range in which the wing was laterally stable in smooth air.

These tests indicated that the type of aileron or its arrangement had very little influence on the limiting angle for lateral stability. In all cases the limit was reached either at the stall or a degree or so beyond.

Stability against rolling caused by gusts.—Test flights have shown that in severe gusts a rolling velocity such that $\frac{p'b}{2V}=0.05$ is not uncommon. Consequently, the rolling moment of a wing due to rolling at this velocity gives a measure of its stability characteristics in rough air. In the present case the angle at which this rolling moment becomes zero is used as a criterion to indicate the practical upper limit of the useful angle-of-attack range rather than the theoretical limit previously discussed.

Under the above-mentioned conditions and with the wing at 0° yaw all the aileron arrangements become unstable at about 1° lower angle of attack than the neutrally stable point for zero rate of rolling. At 20° yaw all the arrangements become unstable at angles of attack from 4° to 7° lower than in the unyawed position. The floating, slotted aileron systems are the best in this respect.

The above criterion shows the critical range below which stability is such that any rolling up to the maximum rate likely to be caused by gusty air conditions is damped out, and above which the instability may be weak or intense. The criterion, maximum C_λ, indicates the degree of this instability.

If the slotted ailerons are arranged to float they reduce instability substantially at both 0° and 20° yaw, but only in about the same proportion that floating plain ailerons accomplish the same result.

CONTROL FORCE REQUIRED

The hinge moments were not measured for the slotted or Frise ailerons, but it is likely that they would have consistently lower values than those for the plain ailerons, owing to the balance area ahead of the axis in each case.

CONCLUSIONS

1. None of the ailerons discussed in this report gives satisfactory rolling control above the stall.
2. In general the slotted or Frise ailerons tested do not give as good control at an angle of attack of 20° in either the yawed or unyawed attitude as the same size of ordinary ailerons.
3. Equal up-and-down deflection with the plain, the slotted, or the Frise ailerons gives adverse yawing moments at all angles of attack. The magnitude of the adverse moment produced by the Frise ailerons is about half of that produced by either the plain or slotted types.
4. Any differential movements, including upward deflection only, of slotted or Frise ailerons produce yawing moments that are only a slight, if any, improvement over those produced by the corresponding plain ailerons and settings.
5. The use of differential aileron settings is much more effective in obtaining desirable yawing moments than the use of either slotted or Frise-type ailerons.
6. The general performance characteristics of a wing equipped with short, wide, slotted ailerons arranged to float are distinctly below normal and the lateral control available above the stall is not satisfactory. However, this aileron arrangement gives apparently ideal yawing moments at all angles of attack and appreciably reduces the unstable rolling moment due to rolling at both 0° and 20° yaw.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., *February 12, 1932.*

REFERENCES

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2. Harris, Thomas A.: The 7 by 10 Foot Wind Tunnel of the National Advisory Committee for Aeronautics. T. R. No. 412, N. A. C. A., 1932.

TABLE II

FORCE TESTS. 10 BY 60 INCH CLARK Y WING WITH SLOTTED AILERONS 25 PER CENT *c* BY 40 PER CENT *b*/2
R. N.=609,000. VELOCITY=80 M.P.H. YAW=0°

α degrees		−10	−5	−3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50	59
	δ_A degrees	AILERONS LOCKED—NEUTRAL																		
C_L	0	−0.362	0.006	0.147	0.355	0.715	1.041	1.153	1.243	1.282	1.295	1.296	1.308	1.294	0.912	0.803	0.853	0.802	0.682	0.595
C_D	------	.033	.016	.016	.021	.047	.087	.106	.128	.161	.179	.200	.231	.253	.287	.420	.540	.719	.879	1.020
		LEFT AILERON DOWN. RIGHT AILERON 0°																		
C_l'	10	------	------	------	0.023	------	0.022	------	0.022	0.019	------	0.015	------	0.002	0.000	------	−0.001	0.001	------	------
C_n'	------	------	------	------	−.002	------	−.006	------	−.007	−.008	------	−.008	------	−.008	−.007	------	−.003	−.004	------	------
C_l'	20	------	------	------	.040	------	.040	------	.037	.033	------	.027	------	.003	−.002	------	−.002	.001	------	------
C_n'	------	------	------	------	−.006	------	−.013	------	−.016	−.016	------	−.016	------	−.015	−.013	------	−.006	−.009	------	------
C_l'	30	------	------	------	.046	------	.044	------	.047	.045	------	.035	------	−.002	.004	------	−.005	−.001	------	------
C_n'	------	------	------	------	−.012	------	−.019	------	−.022	−.024	------	−.025	------	−.019	−.017	------	−.010	−.013	------	------
C_l'	40	------	------	------	.053	------	.048	------	.046	.045	------	.041	------	.002	−.002	------	−.004	−.003	------	------
C_n'	------	------	------	------	−.016	------	−.024	------	−.026	−.028	------	−.031	------	−.026	−.021	------	−.015	−.016	------	------
		RIGHT AILERON UP. LEFT AILERON 0°																		
C_l'	10	------	------	------	0.019	------	0.022	------	0.023	0.022	------	0.023	------	0.018	0.008	------	0.003	0.002	------	------
C_n'	------	------	------	------	.000	------	−.004	------	−.006	−.006	------	−.007	------	−.008	−.007	------	−.004	−.004	------	------
C_l'	20	------	------	------	.021	------	.028	------	.031	.031	------	.033	------	.024	.018	------	.015	.010	------	------
C_n'	------	------	------	------	.001	------	−.002	------	−.004	−.006	------	−.007	------	−.008	−.009	------	−.006	−.007	------	------
C_l'	30	------	------	------	.024	------	.034	------	.037	.037	------	.040	------	.030	.022	------	.012	.016	------	------
C_n'	------	------	------	------	.006	------	.001	------	−.002	−.004	------	−.005	------	−.007	−.007	------	−.003	−.006	------	------
C_l'	40	------	------	------	.029	------	.041	------	.043	.043	------	.046	------	.036	.036	------	.008	.013	------	------
C_n'	------	------	------	------	.009	------	.003	------	.000	−.001	------	−.003	------	−.005	−.003	------	−.001	−.003	------	------
C_l'	54.25	------	------	------	.037	------	.048	------	.050	.050	------	.053	------	.044	.040	------	.006	.008	------	------
C_n'	------	------	------	------	.013	------	.008	------	.004	.002	------	.000	------	−.001	−.001	------	.001	.000	------	------
		RIGHT AILERON UP. LEFT AILERON DOWN																		
C_l'	10	------	------	------	0.041	------	0.044	------	0.042	0.040	------	0.037	------	0.022	0.004	------	0.003	0.005	------	------
C_n'	------	------	------	------	−.002	------	−.009	------	−.012	−.013	------	−.014	------	−.015	−.013	------	−.006	−.003	------	------
C_l'	20	------	------	------	.064	------	.068	------	.068	.064	------	.058	------	.034	.016	------	.016	.013	------	------
C_n'	------	------	------	------	−.004	------	−.014	------	−.018	−.020	------	−.024	------	−.024	−.022	------	−.014	−.016	------	------
C_l'	30	------	------	------	.068	------	.077	------	.082	.081	------	.075	------	.036	.021	------	.009	.017	------	------
C_n'	------	------	------	------	−.006	------	−.018	------	−.024	−.027	------	−.030	------	−.026	−.025	------	−.014	−.019	------	------
C_l'	40	------	------	------	.082	------	.088	------	.090	.090	------	.087	------	.048	.026	------	.006	.012	------	------
C_n'	------	------	------	------	−.007	------	−.021	------	−.026	−.029	------	−.034	------	−.030	−.026	------	−.017	−.019	------	------
C_l'	50	------	------	------	.094	------	.096	------	.094	.090	------	.090	------	.053	.030	------	.005	.005	------	------
C_n'	------	------	------	------	−.009	------	−.022	------	−.026	−.029	------	−.034	------	−.032	−.027	------	−.021	−.021	------	------
		AILERONS FLOATING—NEUTRAL																		
C_L	0	−0.382	−0.057	0.073	0.267	0.607	0.892	1.004	1.092	1.142	1.156	1.160	1.168	1.159	1.110	0.676	0.667	0.642	------	------
C_D	------	.035	.019	.017	.020	.037	.069	.086	.104	.129	.146	.168	.189	.207	.244	.369	.444	.611	------	------
δ_{AF}	------	−6	−6	−6	−9	−11	−14	−12	−14	−13	−14	−14	−13	−14	−15	−19	−20	−21	------	------
		RIGHT AILERON UP. LEFT AILERON DOWN																		
C_l'	10	------	------	------	0.038	------	0.037	------	0.036	0.035	------	0.036	------	0.020	0.011	------	−0.006	0.003	------	------
C_n'	------	------	------	------	.000	------	−.004	------	−.006	−.006	------	−.007	------	−.007	−.005	------	.005	.004	------	------
δ_{AF}	------	------	------	------	7	------	5	------	3	2	------	1	------	0	−5	------	−17	−20	------	------
C_l'	20	------	------	------	.062	------	.061	------	.058	.054	------	.050	------	.035	.023	------	−.004	.002	------	------
C_n'	------	------	------	------	−.003	------	−.009	------	−.010	−.011	------	−.012	------	−.012	−.010	------	.006	.005	------	------
δ_{AF}	------	------	------	------	20	------	14	------	11	10	------	9	------	8	3	------	−15	−17	------	------
C_l'	30	------	------	------	.069	------	.083	------	.081	.076	------	.065	------	.048	.023	------	.006	.008	------	------
C_n'	------	------	------	------	−.002	------	−.013	------	−.016	−.017	------	−.018	------	−.016	−.014	------	.000	−.001	------	------
δ_{AF}	------	------	------	------	28	------	25	------	24	20	------	20	------	17	15	------	2	4	------	------
C_l'	40	------	------	------	.081	------	.091	------	.095	.092	------	.080	------	.043	.029	------	.006	.009	------	------
C_n'	------	------	------	------	−.003	------	−.013	------	−.019	−.022	------	−.023	------	−.019	−.018	------	−.007	−.010	------	------
δ_{AF}	------	------	------	------	34	------	31	------	30	30	------	30	------	30	27	------	23	22	------	------

TABLE III

FORCE TESTS. 10 BY 60 INCH CLARK Y WINGS WITH SLOTTED AILERONS 25 PER CENT c BY 40 PER CENT b/2 R.N.=609,000. VELOCITY=80 M.P.H. YAW=-20°

α degrees		-10	-5	-3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50	60
	δ_A degrees	AILERONS LOCKED—NEUTRAL																		
C_L		-0.319	0.001	0.129	0.319	0.647	0.942	1.043	1.120	1.181	1.204	1.213	1.226	1.219	1.197	1.007	0.886	0.800	0.735	0.609
C_D		.031	.018	.017	.021	.042	.080	.096	.114	.138	.153	.166	.187	.222	.267	.408	.517	.676	.866	1.020
C_l'		-.001	-.005	-.006	-.007	-.008	-.014	-.016	-.020	-.032	-.043	-.051		-.072	-.054	-.047	-.095	-.059	-.049	-.041
C_n'		.003	.002	.001	.002	.002	.005	.007	.009	.011	.014	.015		.018	.030	.041	.052	.045	.051	053
		LEFT AILERON DOWN. RIGHT AILERON 0°																		
C_l'	10				0.017		0.016		0.014	0.014		0.010		0.006	0.007		0.003	0.003		
C_n'					-.002		-.004		- 005	-.005		-.004		-.004	-.006		-.005	-.005		
C_l'	20				.032		.031		.028	.024		.018		.012	.013		.003	.003		
C_n'					-.005		-.010		-.011	-.010		-.009		-.009	-.011		-.010	-.010		
C_l'	30				.045		.040		.038	.034		.026		.018	.016		.006	.003		
C_n'					-.011		-.017		-.019	-.017		-.014		-.014	-.017		-.015	-.014		
C_l'	40				.051		.046		.044	.039		.032		.020	.019		.007	.002		
C_n'					-.016		-.024		-.025	-.023		-.020		-.019	-.022		-.019	-.018		
		RIGHT AILERON UP. LEFT AILERON 0°																		
C_l'	10				0.019		0.022		0.021	0.022		0.021		0.020	0.016		0.006	0.002		
C_n'					.000		-.004		-.005	-.006		-.007		-.007	-.011		-.008	-.004		
C_l'	20				.026		.024		.031	.034		.035		.036	.031		.017	.008		
C_n'					.003		-.002		-.005	-.006		-.008		-.009	-.015		-.015	-.007		
C_l'	30				.030		.039		.041	.043		.045		.046	.040		.028	.015		
C_n'					.007		.000		-.003	-.004		.006		.008	.015		.017	.008		
C_l'	40				033		.044		.048	.051		.053		.054	.046		.034	.014		
C_n'					.009		.002		-.001	-.003		-.004		-.006	-.014		-.016	-.006		
C_l'	54.25				.041		.053		.058	.062		.066		.067	.046		.039	.013		
C_n'					.014		.006		.002	.000		-.003		-.003	-.017		-.015	-.005		
		RIGHT AILERON UP. LEFT AILERON DOWN																		
C_l'	10				0.035		0.037		0.036	0.034		0.033		0.027	0.023		0.008	0.004		
C_n'					-.002		- 008		-.010	-.010		-.010		-.011	-.016		-.012	-.008		
C_l'	20				.058		.062		.061	.060		.056		.051	.044		.025	.011		
C_n'					-.002		-.002		-.016	-.017		-.017		-.018	-.026		-.026	-.015		
C_l'	30				.072		.078		.078	.077		.073		.066	.047		.037	.017		
C_n'					-.005		-.017		-.022	-.022		-.021		-.023	-.039		-.033	-.021		
C_l'	40				.082		.091		.092	.092		.090		.081	.060		.045	.016		
C_n'					-.008		-.002		-.026	-.027		-.025		-.025	-.043		-.037	-.023		
C_l'	50				.087		.098		.099	.103		.101		.092	.050		.047	.013		
C_n'					-.007		-.025		-.029	-.031		-.028		-.028	-.039		-.039	-.034		
		AILERONS FLOATING—NEUTRAL																		
C_L		-0.334	-0.050	0.067	0.246	0.546	0.810	0.905	0.985	1.049	1.062	1.087	1.092	1.084	0.944	0.817	0.778	0.702		
C_D		.035	.020	.018	.021	.036	.066	.080	.096	.114	.125	1.40	.160	.190	.291	.359	.465	.622		
C_l'		.000	-.002	-.004	-.004	-.005	-.007	-.008	-.013	-.023	-.030	-.036	-.047	-.054	-.051	-.052	-.089	-.060		
C_n'		.003	.002	.002	.002	.003	.005	.006	.008	.010	.011	.012	.012	.012	.021	.032	.042	.047		
δ_{AF}		-4	-6	-7	-8	-12	-15	-16	-15	-15	-18	-19	-18	-18	-18	-19	-22	-28		
		RIGHT AILERON UP. LEFT AILERON DOWN																		
C_l'	10				0.032		0.031		0.028	0.026		0.023		0.016	0.021		0.016	0.004		
C_n'					.000		-.003		-.004	-.005		-.004		-.002	-.005		-.003	.002		
δ_{AF}					6		4		2	2		0		-2	-2		-7	-18		
C_l'	20				.055		.052		.051	.048		.042		.034	.036		.028	.005		
C_n'					-.003		-.009		-.011	-.011		-.009		-.008	-.012		-.010	.002		
δ_{AF}					21		18		18	15		15		13	15		8	-15		
C_l'	30				.068		.072		.070	.066		.059		.049	.047		.037	.013		
C_n'					-.003		-.013		-.016	-.017		-.014		-.012	-.018		-.017	-.005		
δ_{AF}					30		28		28	28		26		26	24		22	4		
C_l'	40				.079		.082		.084	.082		.073		.063	.050		.042	.016		
C_n'					-.003		-.014		-.018	-.020		-.017		-.015	.028		-.022	-.014		
δ_{AF}					35		33		33	34		33		33	33		31	21		

TABLE IV

ROTATION TESTS. 10 BY 60 INCH CLARK Y WING WITH SLOTTED AILERONS 25 PER CENT *c* BY 40 PER CENT *b*/2. R. N.=609,000. VELOCITY=80 M. P. H.

C_λ is given for forced rotation at $p'b/2V=0.05$. $p'b/2V$ values are for free autorotation. (+) Aiding the rotation. (−) Damping the rotation

	α degrees	0	12	14	16	18	19	20	21	22	24	25	26	27	28	30	31	32	33	35	36	37	40
		YAW=0° AILERONS LOCKED—NEUTRAL																					
(+) Rotation (clockwise)	C_λ	−0.027	−0.024	−0.020	−0.012	0.000	------	−0.001	------	0.011	------	0.003	------	------	------	−0.001	------	------	------	------	------	------	−0.003
	$\frac{p'b}{2V}$	------	------	------	------	.139	0.332	.354	0.350	.349	0.349	.358	0.358	0.367	0.372	.376	0.372	0.208	0.072	0.054	0.062	0.047	------
(−) Rotation (counterclockwise)	C_λ	−.019	−.017	−.014	−.004	.000	------	.039	------	.024	------	.007	------	------	------	.001	------	------	------	------	------	------	.000
	$\frac{p'b}{2V}$	------	------	------	------	.322	.340	.349	.356	.362	.390	.403	.398	.394	.398	.408	.157	.141	.076	.067	.063	.050	------
		AILERONS FLOATING—NEUTRAL																					
(+) Rotation (clockwise)	C_λ	−0.025	−0.024	−0.024	−0.022	−0.017	------	0.004	------	0.010	------	0.004	------	------	------	−0.001	------	------	------	------	------	------	−0.007
	$\frac{p'b}{2V}$	------	------	------	------	------	------	------	0.304	.318	0.291	.313	0.284	0.284	0.300	------	------	------	------	------	------	------	------
(−) Rotation (counterclockwise)	C_λ	−.017	−.014	−.013	−.006	−.002	------	.001	------	.021	------	.012	------	------	------	−.002	------	------	------	------	------	------	−.005
	$\frac{p'b}{2V}$	------	------	------	------	------	------	.290	.309	.313	.326	.362	.347	.331	$\left\{\begin{matrix}.347\\.087\end{matrix}\right\}$	------	------	------	------	------	------	------	------
		YAW=−20° AILERONS LOCKED—NEUTRAL																					
(+) Rotation (clockwise)	C_λ	−0.017	−0.002	0.004	0.015	0.033	------	0.055	------	0.082	------	0.086	------	------	------	0.078	------	------	------	------	------	------	0.048
(−) Rotation (counterclockwise)	C_λ	−.024	−.036	−.039	−.048	−.069	------	−.071	------	−.058	------	−.087	------	------	------	−.076	------	------	------	------	------	------	−.054
		AILERONS FLOATING—NEUTRAL																					
(+) Rotation (clockwise)	C_λ	−0.019	−0.011	−0.006	0.002	0.016	------	0.034	------	0.066	------	0.072	------	------	------	0.070	------	------	------	------	------	------	0.050
(−) Rotation (counterclockwise)	C_λ	−.021	−.025	−.027	−.033	−.043	------	−.054	------	−.050	------	−.074	------	------	------	−.070	------	------	------	------	------	------	−0.52

TABLE V

FORCE TESTS. 10 BY 60 INCH CLARK Y WING WITH SLOTTED AILERONS 40 PER CENT *c* BY 30 PER CENT *b*/2.
R. N.=609,000. VELOCITY=80 M. P. H. YAW=0°

α degrees	δ_A degrees	-10	-5	-3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50
AILERONS LOCKED—NEUTRAL																			
C_L	0	-0.306	0.002	0.144	0.358	0.714	1.047	1.163	1.230	1.240	1.222	1.207	1.193	1.165	1.119	0.801	0.895	0.834	0.709
C_D	------	.070	.018	.017	.022	.046	.087	.109	.130	.164	.185	.205	.222	.244	.283	.418	.552	.747	.874
LEFT AILERON DOWN. RIGHT AILERON 0°																			
C_l'	10	------	------	------	0.020	------	0.021	------	0.020	0.015	------	0.012	------	0.009	0.006	------	-0.001	0.001	------
C_n'	------	------	------	------	-.003	------	-.006	------	-.008	-.008	------	-.009	------	-.009	-.003	------	-.005	-.006	------
C_l'	20	------	------	------	.038	------	.040	------	.035	.026	------	.020	------	.011	.002	------	-.004	.000	------
C_n'	------	------	------	------	-.008	------	-.015	------	-.018	-.019	------	-.019	------	-.017	-.012	------	-.009	-.011	------
C_l'	30	------	------	------	.046	------	.052	------	.046	.038	------	.023	------	.008	-.002	------	-.008	-.004	------
C_n'	------	------	------	------	-.015	------	-.025	------	-.028	-.029	------	-.026	------	-.022	-.016	------	-.012	-.015	------
C_l'	40	------	------	------	.050	------	.055	------	.055	.047	------	.027	------	.004	-.007	------	-.011	-.009	------
C_n'	------	------	------	------	-.020	------	-.033	------	-.039	-.039	------	-.030	------	-.024	-.020	------	-.017	-.018	------
RIGHT AILERON UP. LEFT AILERON 0°																			
C_l'	10	------	------	------	0.019	------	0.022	------	0.022	0.022	------	0.022	------	0.020	0.014	------	0.001	0.003	------
C_n'	------	------	------	------	.000	------	-.003	------	-.005	-.006	------	-.007	------	-.008	-.008	------	-.004	-.003	------
C_l'	20	------	------	------	.027	------	.038	------	.040	.040	------	.042	------	.041	.036	------	.010	.008	------
C_n'	------	------	------	------	.005	------	-.001	------	-.004	-.006	------	-.008	------	-.010	-.012	------	-.006	-.007	------
C_l'	30	------	------	------	.027	------	.041	------	.044	.043	------	.047	------	.047	.043	------	.014	.018	------
C_n'	------	------	------	------	.008	------	.002	------	-.001	-.004	------	-.005	------	-.008	-.010	------	-.005	-.008	------
C_l'	40	------	------	------	.034	------	.050	------	.053	.052	------	.055	------	.053	.047	------	.014	.022	------
C_n'	------	------	------	------	.012	------	.005	------	.001	-.001	------	-.003	------	-.005	-.007	------	-.004	-.006	------
C_l'	53.5	------	------	------	.043	------	.062	------	.066	.062	------	.067	------	.065	.056	------	.016	.016	------
C_n'	------	------	------	------	.019	------	.012	------	.007	.004	------	.001	------	-.001	-.003	------	-.002	-.003	------
RIGHT AILERON UP. LEFT AILERON DOWN																			
C_l'	10	------	------	------	0.039	------	0.044	------	0.042	0.036	------	0.034	------	0.029	0.020	------	0.001	0.003	------
C_n'	------	------	------	------	-.002	------	-.010	------	-.012	-.014	------	-.015	------	-.015	-.015	------	-.008	-.009	------
C_l'	20	------	------	------	.062	------	.076	------	.074	.064	------	.061	------	.052	.038	------	.007	.008	------
C_n'	------	------	------	------	-.004	------	- 016	------	-.022	-.025	------	-.027	------	-.027	-.024	------	-.015	-.017	------
C_l'	30	------	------	------	.072	------	.090	------	.090	.081	------	.068	------	.055	.042	------	.011	.017	------
C_n'	------	------	------	------	-.007	------	-.022	------	-.028	-.032	------	-.031	------	-.028	-.025	------	-.019	-.024	------
C_l'	40	------	------	------	.083	------	.103	------	.106	.097	------	.082	------	.058	.031	------	.006	.016	------
C_n'	------	------	------	------	-007	------	-.027	------	-.036	-.038	------	-.034	------	-.029	-.026	------	-.022	-.028	------
C_l'	50	------	------	------	.091	------	.102	------	.101	.098	------	.094	------	.067	.027	------	.004	.007	------
C_n'	------	------	------	------	-.007	------	-.022	------	-.030	-.036	------	-.035	------	-.030	-.028	------	-.025	-.028	------
AILERONS FLOATING—NEUTRAL																			
C_L	------	-0.350	-0.088	0.045	0.242	0.568	0.878	0.974	1.047	1.067	1.032	1.040	1.032	1.017	0.963	0.667	0.653.	0.624	0.580
C_D	------	.075	.024	.023	.026	.043	.073	.089	.104	.129	.145	.161	.178	.194	.227	.362	.440	.600	.765
δ_{AF}	------	-5	-10	-11	-13	-15	-15	-15	-17	-17	-17	-17	-18	-18	-18	-22	-26	-33	-39
RIGHT AILERON UP. LEFT AILERON DOWN																			
C_l'	10	------	------	------	0.036	------	0.037	------	0.034	0.033	------	0.035	------	0.025	0.021	------	0.002	0.006	------
C_n'	------	------	------	------	.001	------	-.001	------	-.001	-.002	------	-.003	------	-.004	-.005	------	.003	.001	------
δ_{AF}	------	------	------	------	3	------	-2	------	-5	-7	------	-7	------	-7	-10	------	-24	-26	------
C_l'	20	------	------	------	.058	------	.059	------	.058	.056	------	.045	------	.041	.033	------	.010	.012	------
C_n'	------	------	------	------	.000	------	-.003	------	-.004	-.004	------	-.006	------	-.006	-.006	------	.002	-.008	------
δ_{AF}	------	------	------	------	16	-	7	------	5	3	------	2	------	1	0	------	[a]-15	[a]-15	------
C_l'	30	------	------	------	.071	------	.087	------	.086	.077	------	.065	------	.058	.044	------	.017	.014	------
C_n'	------	------	------	------	.002	------	-.006	------	-.011	-.011	------	-.012	------	-.012	-.012	------	-.003	-.004	------
δ_{AF}	------	------	------	------	21	------	17	------	16	13	------	13	------	10	12	------	7	[a]5	------
C_l'	40	------	------	------	.087	------	.108	------	.108	.101	------	.079	------	.063	.040	------	.014	.014	------
C_n'	------	------	------	------	.002	------	-.010	------	-.017	-.019	------	-.021	------	-.018	-.016	------	-.012	-.015	------
δ_{AF}	------	------	------	------	[a]32	------	[a]32	------	[a]32	[a]32	------	[a]32	------	[a]32	[a]32	------	[a]32	[a]32	------

[a] Floating ailerons were in extreme position, against stop.

TABLE VI

FORCE TESTS. 10 BY 60 INCH CLARK Y WING WITH SLOTTED AILERONS 40 PER CENT *c* BY 30 PER CENT *b*/2. R. N.=609,000. VELOCITY=80 M. P. H. YAW=−20°

α degrees		−10	−5	−3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50
	δ_A degrees	AILERONS LOCKED—NEUTRAL																	
C_L	0	−0.306	−0.004	0.132	0.329	0.647	0.940	1.038	1.105	1.158	1.174	1.178	1.184	1.188	0.904	0.899	0.894	0.807	0.733
C_D	------	.033	.018	.017	.022	.041	.079	.096	.113	.136	.150	.170	.190	.217	.345	.412	.513	.667	.847
C_l'	------	−.002	−.006	−.007	−.008	−.009	−.013	−.017	−.023	−.039	−.045	−.051	−.060	−.069	−.095	−.101	−.096	−.059	−.049
C_n'	------	.002	.001	.001	.001	.003	.006	.007	.009	.012	.014	.015	.016	.017	.026	.038	.050	.046	.048
		LEFT AILERON DOWN. RIGHT AILERON 0°																	
C_l'	10	------	------	------	0.017	------	0.016	------	0.014	0.014	------	0.011	------	0.009	0.006	------	0.004	0.002	------
C_n'	------	------	------	------	−.002	------	−.005	------	−.005	−.005	------	−.005	------	−.005	−.005	------	−.005	−.006	------
C_l'	20	------	------	------	.034	------	.031	------	.028	.027	------	.021	------	.016	.010	------	.004	.002	------
C_n'	------	------	------	------	−.006	------	−.012	------	−.013	−.013	------	−.011	------	−.011	−.011	------	−.010	−.011	------
C_l'	30	------	------	------	.049	------	.043	------	.039	.035	------	.029	------	.020	.013	------	.003	.001	------
C_n'	------	------	------	------	−.014	------	−.021	------	−.022	−.021	------	−.018	------	−.017	−.018	------	−.015	−.015	------
C_l'	40	------	------	------	.066	------	.062	------	.047	.042	------	.033	------	.022	.013	------	.002	−.003	------
C_n'	------	------	------	------	−.026	------	−.038	------	−.033	−.029	------	−.024	------	−.023	−.024	------	−.020	−.019	------
		RIGHT AILERON UP. LEFT AILERON 0°																	
C_l'	10	------	------	------	0.018	------	0.020	------	0.019	0.020	------	0.022	------	0.021	0.016	------	0.005	0.001	------
C_n'	------	------	------	------	.000	------	−.004	------	−.005	−.006	------	−.007	------	−.008	−.011	------	−.010	−.008	------
C_l'	20	------	------	------	.034	------	.038	------	.040	.041	------	.042	------	.042	.034	------	.022	.007	------
C_n'	------	------	------	------	.005	------	−.003	------	−.005	−.008	------	−.009	------	−.011	−.019	------	−.020	−.011	------
C_l'	30	------	------	------	.037	------	.050	------	.054	.058	------	.060	------	.060	.051	------	.040	.017	------
C_n'	------	------	------	------	.009	------	.001	------	−.003	−.005	------	−.008	------	−.010	−.020	------	−.024	−.015	------
C_l'	40	------	------	------	.040	------	.056	------	.062	.066	------	.070	------	.070	.061	------	.054	.025	------
C_n'	------	------	------	------	.013	------	.004	------	.000	−.002	------	−.005	------	−.007	−.017	------	−.025	−.015	------
C_l'	53.5	------	------	------	.047	------	.067	------	.076	.081	------	.087	------	.087	.095	------	.063	.030	------
C_n'	------	------	------	------	.019	------	.010	------	.006	.003	------	.000	------	−.002	−.011	------	−.021	−.013	------
		RIGHT AILERON UP. LEFT AILERON DOWN																	
C_l'	10	------	------	------	0.035	------	0.036	------	0.033	0.034	------	0.031	------	0.028	0.020	------	0.008	0.004	------
C_n'	------	------	------	------	−.002	------	−.009	------	−.011	−.011	------	−.011	------	−.013	−.017	------	−.015	−.012	------
C_l'	20	------	------	------	.067	------	.068	------	.067	.067	------	.064	------	.057	.043	------	.028	.009	------
C_n'	------	------	------	------	−.002	------	−.014	------	−.019	−.020	------	−.020	------	−.022	−.031	------	−.031	−.022	------
C_l'	30	------	------	------	.085	------	.093	------	.093	.094	------	.092	------	.082	.065	------	.048	.018	------
C_n'	------	------	------	------	−.005	------	−.020	------	−.025	−.027	------	−.026	------	−.027	−.038	------	−.042	−.030	------
C_l'	40	------	------	------	.105	------	.116	------	.107	.108	------	.107	------	.095	.077	------	.060	.023	------
C_n'	------	------	------	------	−.013	------	−.034	------	−.033	−.032	------	−.030	------	−.030	−.042	------	−.047	−.035	------
C_l'	50	------	------	------	.095	------	.130	------	.121	.123	------	.121	------	.106	.083	------	.066	.026	------
C_n'	------	------	------	------	−.009	------	−.044	------	−.040	−.037	------	−.033	------	−.033	−.047	------	−.049	−.037	------
		AILERONS FLOATING—NEUTRAL																	
C_L	0	−0.318	−0.066	0.046	0.214	0.514	0.783	0.878	0.946	0.998	1.010	1.012	1.016	1.008	0.874	0.762	0.760	0.700	------
C_D	------	.036	.024	.024	.027	.043	.070	.083	.097	.114	.126	.141	.162	.185	.283	.361	.448	.618	------
C_l'	------	−.002	−.004	−.004	−.005	−.006	−.010	−.011	−.017	−.026	−.033	−.042	−.051	−.055	−.077	−.068	−.071	−051	------
C_n'	------	.003	.002	.002	.002	.003	.005	.006	.007	.009	.010	.010	.010	.011	.012	.020	.031	.038	------
δ_{AF}	------	−3	−7	−10	−11	−14	−16	−17	−17	−20	−21	−21	−22	−23	−25	−26	−31	−40	------
		RIGHT AILERON UP. LEFT AILERON DOWN																	
C_l'	10	------	------	------	0.032	------	0.034	------	0.032	0.030	------	0.026	------	0.023	0.013	------	0.012	0.006	------
C_n'	------	------	------	------	.001	------	−.001	------	−.002	−.002	------	−.002	------	−.002	−.009	------	.000	.003	------
δ_{AF}	------	------	------	------	5	------	−1	------	−4	−5	------	−8	------	−10	−12	------	−12	−25	------
C_l'	20	------	------	------	.064	------	.065	------	.062	.059	------	.050	------	.043	.028	------	.027	.017	------
C_n'	------	------	------	------	−.001	------	−.006	------	−.008	−.007	------	−.006	------	−.006	−.014	------	−.007	.000	------
δ_{AF}	------	------	------	------	20	------	15	------	12	9	------	10	------	7	5	------	2	−10	------
C_l'	30	------	------	------	.080	------	.083	------	.082	.079	------	.071	------	.060	.042	------	.037	.023	------
C_n'	------	------	------	------	−.001	------	−.009	------	−.013	−.014	------	−.012	------	−.012	−.014	------	−.016	−.007	------
δ_{AF}	------	------	------	------	28	------	26	------	22	22	------	22	------	23	20	------	19	6	------
C_l'	40	------	------	------	.095	------	.102	------	.102	.098	------	.088	------	.074	.051	------	.043	.024	------
C_n'	------	------	------	------	−.003	------	−.013	------	−.018	−.020	------	−.017	------	−.016	−.027	------	−.023	−.017	------
δ_{AF}	------	------	------	------	36	------	[a] 32	------	[a] 32	[a] 32	------	[a] 32	------	[a] 32	[a] 32	------	[a] 32	[a] 32	------

[a] Floating ailerons were in extreme position, against stop.

TABLE VII

ROTATION TESTS. 10 BY 60 INCH CLARK Y WING WITH SLOTTED AILERONS 40 PER CENT *c* BY 30 PER CENT *b*/2. R. N.=609,000. VELOCITY=80 M. P. H.

C_λ is given for forced rotation at $p'b/2V=0.05$. $p'b/2V$ values are for free autorotation. (+) Aiding the rotation. (—) Damping the rotation

	α degrees	0	12	14	16	17	18	19	20	21	22	24	25	26	30	35	37	40
		YAW=0°																
		AILERONS LOCKED—NEUTRAL																
(+) Rotation (clockwise)	C_λ	−0.025	−0.025	−0.015	−0.002	------	0.005	------	0.029	------	0.019	------	0.001	------	−0.001	------	------	−0.002
	$\frac{p'b}{2V}$	------	------	------	------	0.073	.289	0.296	.305	0.307	.318	------	.350	------	.363	0.074	0.056	------
(—) Rotation (counterclockwise)	C_λ	−.020	−.018	−.015	−.008	------	−.001	------	------	------	.006	------	.000	------	.001	------	------	−.001
	$\frac{p'b}{2V}$	------	------	------	------	------	.291	------	.300	.309	.325	------	.347	0.354	------	------	------	------
		AILERONS FLOATING—NEUTRAL																
(+) Rotation (clockwise)	C_λ	−0.025	−0.023	−0.019	−0.007	------	−0.001	------	0.010	------	0.003	------	0.003	------	−0.003	------	------	−0.003
	$\frac{p'b}{2V}$	------	------	------	------	------	------	0.161	.164	0.164	.164	0.094	.105	0.065	------	------	------	------
(—) Rotation (counterclockwise)	C_λ	−.020	−.017	−.015	−.011	------	−.006	------	−.003	------	−.002	------	−.001	------	−.006	------	------	−.001
	$\frac{p'b}{2V}$	------	------	------	------	------	------	.143	.137	------	------	------	------	------	------	------	------	------
		YAW=−20°																
		AILERONS LOCKED—NEUTRAL																
(+) Rotation (clockwise)	C_λ	−0.016	0.001	0.010	0.025	------	0.046	------	0.083	------	0.082	------	0.083	------	0.078	------	------	0.050
(—) Rotation (counterclockwise)	C_λ	−.026	−.038	−.044	−.055	------	−.070	------	−.079	------	−.066	------	−.088	------	−.075	------	------	−.055
		AILERONS FLOATING—NEUTRAL																
(+) Rotation (clockwise)	C_λ	−0.017	−0.004	.001	0.009	------	0.023	------	0.047	------	0.049	------	0.051	------	0.054	------	------	0.042
(—) Rotation (counterclockwise)	C_λ	−.024	−.031	−.034	−.042	------	−.054	------	−.055	------	.058	------	.059	------	.060	------	------	.046

TABLE VIII

FORCE TESTS. 10 BY 60 INCH CLARK Y WING WITH FRISE AILERONS 25 PER CENT *c* BY 40 PER CENT *b*/2 R. N.=609,000. VELOCITY=80 M. P. H. YAW=0°

α degrees		−10	−5	−3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50	60
	δ_A degrees	AILERONS LOCKED—NEUTRAL																		
C_L	0	−0.308	0.014	0.158	0.358	0.723	1.044	1.153	1.240	1.265	1.278	1.282	1.280	1.254	1.157	0.792	0.855	0.803	0.697	0.580
C_D	------	.059	.017	.017	.022	.046	.088	.109	.129	.142	.159	.175	1.95	.247	.290	.416	.537	.723	.868	1.040
		LEFT AILERON DOWN. RIGHT AILERON 0°																		
C_l'	10	------	------	------	0.020	------	0.014	------	0.012	------	0.009	------	------	0.003	−0.003	0.001	0.001	0.000	------	------
C_n'	------	------	------	------	−.002	------	−.004	------	−.005	------	−.005	------	------	−.005	−.005	−.004	−.003	−.003	------	------
C_l'	20	------	------	------	.036	------	.027	------	.025	------	.019	------	------	.020	−.001	.001	.000	.001	------	------
C_n'	------	------	------	------	−.006	------	−.010	------	−.011	------	−.012	------	------	−.011	−.010	−.007	−.007	−.009	------	------
C_l'	30	------	------	------	.044	------	.037	------	.033	------	.027	------	------	.002	−.002	.000	−.003	−.001	------	------
C_n'	------	------	------	------	−.010	------	−.016	------	−.018	------	−.018	------	------	−.015	−.013	−.011	−.010	−.012	------	------
C_l'	40	------	------	------	.054	------	.045	------	.040	------	.033	------	------	.004	−.004	.000	−.002	−.004	------	------
C_n'	------	------	------	------	−.016	------	−.022	------	−.023	------	−.023	------	------	−.020	−.016	−.015	−.015	−.014	------	------
C_l'	50	------	------	------	.058	------	.047	------	.042	------	.034	------	------	.006	−.007	−.002	−.003	−.007	------	------
C_n'	------	------	------	------	−.020	------	−.026	------	−.027	------	−.028	------	------	−.025	−.019	−.018	−.020	−.018	------	------
		RIGHT AILERON UP. LEFT AILERON 0°																		
C_l'	10	------	------	------	0.024	------	0.025	------	0.023	------	0.019	------	------	0.018	0.005	.0003	0.002	−0.001	------	------
C_n'	------	------	------	------	.000	------	−.003	------	−.005	------	−.006	------	------	−.007	−.007	−.003	−.002	−.002	------	------
C_l'	20	------	------	------	.026	------	.032	------	.034	------	.033	------	------	.034	.019	.011	.012	.007	------	------
C_n'	------	------	------	------	.004	------	−.001	------	−.004	------	−.006	------	------	−.008	−.009	−.004	−.004	−.006	------	------
C_l'	30	------	------	------	.028	------	.037	------	.038	------	.038	------	------	.038	.024	.010	.011	.014	------	------
C_n'	------	------	------	------	.007	------	.001	------	−.001	------	−.004	------	------	−.006	−.008	−.002	−.003	−.005	------	------
C_l'	40	------	------	------	.032	------	.042	------	.045	------	.045	------	------	.044	.032	.008	.006	.014	------	------
C_n'	------	------	------	------	.011	------	.004	------	.002	------	−.001	------	------	−.004	−.006	.000	.000	−.003	------	------
C_l'	50	------	------	------	.036	------	.049	------	.051	------	.051	------	------	.054	.040	.009	.003	.012	------	------
C_n'	------	------	------	------	.014	------	.007	------	.004	------	.002	------	------	−.002	−.003	.002	.001	.000	------	------
C_l'	60	------	------	------	.032	------	.054	------	.056	------	.056	------	------	.058	.044	.010	.004	.007	------	------
C_n'	------	------	------	------	.018	------	.010	------	.007	------	.004	------	------	.001	−.001	.003	.003	.001	------	------
C_l'	80	------	------	------	.036	------	.063	------	.065	------	.058	------	------	.062	.053	.016	.012	.004	------	------
C_n'	------	------	------	------	.022	------	.014	------	.011	------	.009	------	------	.006	.005	.005	.001	.003	------	------
		LEFT AILERON DOWN. RIGHT AILERON UP																		
C_l'	10	------	------	------	0.045	------	0.040	------	0.036	0.033	------	0.020	------	0.019	0.003	0.005	0.003	0.001	------	------
C_n'	------	------	------	------	−.002	------	−.008	------	−.010	−.011	------	−.012	------	−.013	−.014	−.007	−.006	−.007	------	------
C_l'	20	------	------	------	.062	------	.060	------	.059	.057	------	.054	------	.034	.021	.013	.013	.009	------	------
C_n'	------	------	------	------	−.003	------	−.012	------	−.015	−.017	------	−.018	------	−.019	−.020	−.011	−.012	−.014	------	------
C_l'	30	------	------	------	.072	------	.076	------	.073	------	0.060	------	------	.042	.025	.011	.012	.017	------	------
C_n'	------	------	------	------	−.004	------	−.016	------	−.019	------	−.022	------	------	−.023	−.023	−.013	−.015	−.019	------	------
C_l'	40	------	------	------	.086	------	.088	------	.087	------	.081	------	------	.052	.031	.011	.008	.014	------	------
C_n'	------	------	------	------	−.005	------	−.017	------	−.021	------	−.024	------	------	−.024	−.024	−.015	−.016	−.019	------	------
C_l'	50	------	------	------	.094	------	.098	------	.095	------	.089	------	------	.064	.037	.011	.007	.009	------	------
C_n'	------	------	------	------	−.007	------	−.018	------	−.024	------	−.027	------	------	−.028	−.025	−.018	−.020	−.020	------	------

TABLE IX

FORCE TESTS. 10 BY 60 INCH CLARK Y WING WITH FRISE AILERONS 25 PER CENT *c* BY 40 PER CENT *b*/2
R. N.=609,000. VELOCITY=80 M. P. H. YAW=20°

α degrees		−10	−5	−3	0	5	10	12	14	16	17	18	19	20	22	25	30	40	50	60
	δ_A degrees	AILERONS LOCKED—NEUTRAL																		
C_L	0	−0.296	0.004	0.135	0.329	0.649	0.937	1.033	1.110	1.138	1.164	1.182	1.193	1.200	0.980	0.890	0.860	0.793	0.734	0.621
C_D	------	.031	.018	.017	.020	.041	.076	.093	.111	.120	.131	.144	.160	.204	.353	.410	.507	.664	.858	1.026
C_l'	------	−.002	−.005	−.007	−.008	−.010	−.015	−.018	−.023	−.028	−.033	−.042	−.052	−.063	−.080	−.103	−.088	−.055	−.048	−.044
C_n'	------	.002	.001	.001	.002	.003	.007	.009	.013	.014	.016	.016	.018	.022	.025	.042	.051	.046	.053	.063
		LEFT AILERON DOWN. RIGHT AILERON 0°																		
C_l'	10	------	------	------	0.015	------	0.011	------	0.010	------	0.009	------	------	0.006	0.000	−0.003	0.002	0.003	------	------
C_n'	------	------	------	------	−.002	------	−.003	------	−.006	------	−.004	------	------	−.004	−.004	−.006	−.004	−.005	------	------
C_l'	20	------	------	------	.028	------	.023	------	.022	------	.019	------	------	.014	.001	.007	.004	.003	------	------
C_n'	------	------	------	------	−.005	------	−.008	------	−.011	------	−.009	------	------	−.009	−.008	−.010	−.008	−.010	------	------
C_l'	30	------	------	------	.038	------	.032	------	.030	------	.028	------	------	.019	.000	.009	.004	.003	------	------
C_n'	------	------	------	------	−.009	------	−.014	------	−.017	------	−.018	------	------	−.015	−.013	−.019	−.012	−.013	------	------
C_l'	40	------	------	------	.045	------	.040	------	.038	------	.035	------	------	.023	.001	.010	.004	.002	------	------
C_n'	------	------	------	------	−.015	------	−.021	------	−.024	------	−.020	------	------	−.019	−.017	−.020	−.015	−.016	------	------
C_l'	50	------	------	------	.049	------	.045	------	.044	------	.039	------	------	.025	.000	.010	.001	.000	------	------
C_n'	------	------	------	------	−.009	------	−.026	------	−.030	------	−.026	------	------	−.024	−.020	−.030	−.019	−.024	------	------
		RIGHT AILERON UP. LEFT AILERON 0°																		
C_l'	10	------	------	------	0.023	------	0.024	------	0.024	------	0.024	------	------	0.022	0.017	0.011	0.000	0.000	------	------
C_n'	------	------	------	------	.001	------	−.004	------	−.008	------	−.007	------	------	−.009	−.013	−.022	−.006	−.003	------	------
C_l'	20	------	------	------	.030	------	.036	------	.038	------	.039	------	------	.039	.032	.027	.012	.003	------	------
C_n'	------	------	------	------	.004	------	−.002	------	−.007	------	−.008	------	------	−.012	−.018	−.019	−.013	−.006	------	------
C_l'	30	------	------	------	.032	------	.043	------	.046	------	.047	------	------	.048	.042	.038	.026	.013	------	------
C_n'	------	------	------	------	.008	------	.000	------	−.005	------	−.006	------	------	−.010	−.018	−.020	−.016	−.008	------	------
C_l'	40	------	------	------	.035	------	.048	------	.052	------	.056	------	------	.059	.050	.046	.033	.014	------	------
C_n'	------	------	------	------	.011	------	.003	------	−.003	------	−.004	------	------	−.008	−.017	−.020	−.015	−.006	------	------
C_l'	50	------	------	------	.039	------	.054	------	.059	------	.066	------	------	.070	.052	.051	.038	.015	------	------
C_n'	------	------	------	------	.015	------	.006	------	.000	------	−.002	------	------	−.006	−.008	−.019	−.014	−.002	------	------
C_l'	60	------	------	------	.040	------	.060	------	.066	------	.073	------	------	.076	.074	.056	.042	.017	------	------
C_n'	------	------	------	------	.018	------	.009	------	.002	------	.000	------	------	−.004	−.006	−.017	−.012	−.005	------	------
C_l'	80	------	------	------	.038	------	.083	------	.071	------	.078	------	------	.085	.086	.058	.045	.022	------	------
C_n'	------	------	------	------	.023	------	.015	------	.009	------	.007	------	------	.003	.003	−.010	−.008	−.005	------	------
		LEFT AILERON DOWN. RIGHT AILERON UP																		
C_l'	10	------	------	------	0.039	------	0.036	------	0.034	0.033	------	0.034	------	0.030	0.014	0.015	0.003	0.002	------	------
C_n'	------	------	------	------	−.002	------	−.008	------	−.011	−.012	------	−.011	------	−.013	−.017	−.017	−.010	−.008	------	------
C_l'	20	------	------	------	.059	------	.059	------	.060	.061	------	.060	------	.055	.032	.037	.018	.004	------	------
C_n'	------	------	------	------	−.001	------	−.011	------	−.017	−.018	------	−.018	------	−.020	−.027	−.030	−.023	−.014	------	------
C_l'	30	------	------	------	.070	------	.076	------	.077	------	0.078	------	------	.071	.043	.050	.035	.014	------	------
C_n'	------	------	------	------	−.003	------	−.015	------	−.021	------	−.022	------	------	−.025	−.031	−.036	−.032	−.020	------	------
C_l'	40	------	------	------	.080	------	.089	------	.090	------	.093	------	------	.087	.052	.060	.043	.016	------	------
C_n'	------	------	------	------	−.004	------	−.016	------	−.023	------	−.025	------	------	−.027	−.033	−.040	−.035	−.022	------	------
C_l'	50	------	------	------	.089	------	.099	------	.104	------	.108	------	------	.100	.087	.066	.048	.016	------	------
C_n'	------	------	------	------	−.005	------	−.021	------	−.028	------	−.029	------	------	−.029	−.039	−.044	−.037	−.024	------	------

TABLE X

ROTATION TESTS. 10 by 60-INCH CLARK Y WING WITH FRISE AILERONS 25 PER CENT *c* BY 40 PER CENT *b*/2
R.N.=609,000. VELOCITY=80 M.P.H.

C_λ is given for forced rotation at $\frac{p'b}{2V}=0.05$. $\frac{p'b}{2V}$ values are for free rotation. (+) Aiding rotation. (−) Damping rotation

	α degrees	0	12	14	16	18	19	20	22	25	26	27	28	30	40
		YAW=0° AILERONS LOCKED—NEUTRAL													
(+) Rotation (clockwise)	C_λ	−0.024	−0.021	−0.019	−0.011	0.002	------	0.026	0.017	0.003	------	------	------	−0.002	−0.001
	$\frac{p'b}{2V}$	------	------	------	------	.102	0.332	------	.377	.386	------	0.414	0.050	------	------
(−) Rotation (counterclockwise)	C_λ	−.018	−.018	−.016	−.009	.001	------	.011	.027	.010	------	------	------	.000	.000
	$\frac{p'b}{2V}$	------	------	------	------	.166	.332	------	.361	.402	0.442	.460 .055	------	------	------
		YAW=−20° AILERONS LOCKED—NEUTRAL													
(+) Rotation (clockwise)	C_λ	−0.014	0.001	0.006	0.018	0.034	------	0.055	0.087	0.084	------	------	------	0.074	0.046
(−) Rotation (counterclockwise)	C_λ	−.025	−.036	−.041	−.048	−.060	------	−.037	−.058	−.084	------	------	------	−.071	−.053

TABLE XI

CRITERIONS SHOWING RELATIVE MERITS OF AILERONS

Subject	Criterion	25 per cent c by 40 per cent $b/2$ plain ailerons					25 per cent c by 40 per cent $b/2$ slotted ailerons				
		Standard 25° up, 25° down	Differential No. 1, 35° up, 15° down	Differential No. 2, 50° up, 7° down	Up-only, 60°	Floating, 50° difference	Standard 25° up, 25° down	Differential No. 1, 35° up, 15° down	Differential No. 2, 50° up, 7° down	Up-only, 54.25°	Floating, 50° difference
Wing area or minimum speed	Maximum C_L	1.270	1.270	1.270	1.270	1.168	1.308	1.308	1.308	1.308	1.168
Speed range	Max. C_L/min. C_D $\delta_A=0°$	79.4	79.4	79.4	79.4	77.8	81.7	81.7	81.7	81.7	63.6
Rate of climb	L/D at $C_L=0.70$	15.9	15.9	15.9	15.9	16.3	15.5	15.5	15.5	15.5	15.5
Lateral controllability	RC $\alpha=0°$	.204	.202	.214	.196	.243	.186	.172	.146	.105	.251
	RC $\alpha=10°$	.076	.074	.074	.072	.083	.072	.066	.058	.044	.035
	RC $\alpha=20°$	.038	.051	.055	.054	.035	.032	.031	.033	.032	.039
	RC $\alpha=30°$	.017	.005	.002	.002	−.018	.022	.011	.007	.006	.002
Lateral control with sideslip	Maximum α at which ailerons will balance C_l' due to 20° yaw.	20°	20°	21°	22°	19°	19°	19°	19°	19°	19°
Yawing moments due to ailerons: (+) Favorable; (−) unfavorable.	C_n $\alpha=0°$	---- −.007	+.002 −[b].003	+.010 −[b].002	+.016 ----	---- −.002	---- −.005	+.004 −[a].001	+.011 −[d].001	+.013 ----	---- −[b].003
	C_n $\alpha=10°$	---- −.004	+.004 −[b].002	+.013 −[b].001	+.018 ----	+.002 ----	---- −.003	+.004 −[a].002	+.011 −[a].001	+.014 ----	+.002 ----
	C_n $\alpha=20°$	---- −.010	---- −[b].007	+.008 −[b].006	+.013 −[a].003	---- −.002	---- −.012	---- −[b].008	+.008 −[d].007	+.014 −[a].001	+.001 ----
	C_n $\alpha=30°$	---- −.008	---- −[b].008	---- −[b].007	+.002 −[b].004	+.002 −[f].003	---- −.005	---- −[a].004	---- −[a].004	+.004 −[a].002	+.003 ----
Lateral stability ($\delta_A=0°$)	α for initial instability in rolling	19°	19°	19°	19°	21°	18°	18°	18°	18°	20°
	α for initial instability at $p'b/2V=0.05$: Yaw=0°	18°	18°	18°	18°	21°	17°	17°	17°	17°	20°
	Yaw=20°	11°	11°	11°	11°	15°	13°	13°	13°	13°	10°
	Maximum unstable C_l: Yaw=0°	.048	.048	.048	.048	.016	.039	.039	.039	.039	.020
	Yaw=20°	.093	.093	.093	.093	.071	.035	.085	.085	.085	.072

Subject	Criterion	40 per cent c by 30 per cent $b/2$ slotted ailerons					25 per cent c by 40 per cent $b/2$ Frise ailerons				
		Standard, 25° up, 25° down	Differential No. 1, 35° up, 15° down	Differential No. 2, 50° up, 7° down	Up-only, 53.5°	Floating, 50° difference	Standard, 25° up, 25° down	Differential No. 1, 35° up, 15° down	Differential No. 2, 50° up, 7° down	Up-only, 60°	Floating, 50° difference
Wing area or minimum speed	Maximum C_L	1.240	1.240	1.240	1.240	1.067	1.283	1.283	1.283	1.283	----------
Speed range	Max. C_L/min. C_D $\delta_A=0°$	72.9	72.9	72.9	72.9	46.4	75.5	75.5	75.5	75.5	----------
Rate of climb	L/D at $C_L=0.70$	15.6	15.6	15.6	15.6	13.0	15.9	15.9	15.9	15.9	----------
Lateral controllability	RC $\alpha=0°$	.188	.166	.156	.120	.271	.187	.163	.140	.091	----------
	RC $\alpha=10°$	.082	.072	.069	.063	.083	.066	.058	.055	.050	----------
	RC $\alpha=20°$	.052	.055	.058	.053	.049	.034	.043	.043	.043	----------
	RC $\alpha=30°$	.019	.019	.017	.017	.020	.022	.012	.004	.002	----------
Lateral control with sideslip	Maximum α at which ailerons will balance C_l' due to 20° yaw.	20°	21°	22°	22°	19°	20°	20°	21°	21°	----------
Yawing moments due to ailerons: (+) Favorable; (−) unfavorable.	C_n $\alpha=0°$	---- −.006	+.005 −[a].002	+.016 −[a].001	+.019 ----	+.001 ----	---- −.003	+.004 −[a].002	+.012 −[a].002	+.018 ----	---------- ----------
	C_n $\alpha=10°$	---- −.005	+.006 −[a].001	+.019 ----	+.022 ----	+.008 ----	---- −.002	+.006 ----	+.014 ----	+.019 ----	---------- ----------
	C_n $\alpha=20°$	---- −.008	+.002 −[a].005	+.015 −[a].004	+.021 ----	+.009 ----	---- −.007	+.005 −[a].004	+.014 −[a].003	+.021 −[a].001	---------- ----------
	C_n $\alpha=30°$	---- −.010	---- −[b].007	+.002 −[b].006	+.006 −[a].003	+.008 ----	---- −.005	---- −[a].003	+.002 −[a].002	+.004 −[a].001	---------- ----------
Lateral stability ($\delta_A=0°$)	α for initial instability in rolling	18°	18°	18°	18°	19°	19°	19°	19°	19°	----------
	α for initial instability at $p'b/2V=0.05$: Yaw=0°	17°	17°	17°	17°	19°	18°	18°	18°	18°	----------
	Yaw=20°	11°	11°	11°	11°	14°	11°	11°	11°	11°	----------
	Maximum unstable C_l: Yaw=0°	.031	.031	.031	.031	.009	.027	.027	.027	.027	----------
	Yaw=20°	.083	.083	.083	.083	.054	.087	.087	.037	.087	----------

[a] to [f] Where the maximum yawing moment occurred below maximum deflection, the letters indicate the deflection of the up ailerons as follows: [a]=10°, [b]=15°, [c]=20°, [d]=25°, [e]=30°, [f]=40°.