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AERODYNAMIC DATA ON A LARGE SEMISPAN TILTING WING WITH A 0.5-DIAMETER CHORD, A DOUBLE-SLOTTED FLAP, AND LEFT- AND RIGHT-HAND ROTATION OF A SINGLE PROPELLER, IN PRESENCE OF FUSELAGE

by Marvin P. Fink

Langley Research Center
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SUMMARY

An investigation has been made in the Langley full-scale tunnel to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller rotating in both left- and right-hand directions. The model was tested in the presence of a fuselage and the loads on the fuselage were measured separately. The wing had a chord-to-propeller-diameter ratio of 0.5, a double-slotted flap, an aspect ratio of 4.88 (2.44 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. Tests were made of the configuration with and without leading-edge slat and fences.

The data have not been analyzed in detail, but have been examined to observe the predominant trends. It was found that when leading-edge flow-control devices were not used, the direction of propeller rotation had a significant effect on the lift and descent capability attainable; however, when leading-edge slat and fences were used, either mode of propeller rotation would give approximately the same results. (The descent capability was determined from the highest values of drag-to-lift ratios attainable without stalling of any part of the wing within the propeller slipstream.) The use of flap deflection was very effective in increasing the descent capability for either mode of rotation. For example, with the most favorable combination of flow-control devices investigated, virtually no descent capability prior to wing stalling was achieved with 0° flap deflection; whereas, with 20°, 40°, or 60° flap deflection, a descent capability of about 20° was achieved.

INTRODUCTION

Most of the aerodynamic research that has been done on the tilt-wing propeller-driven V/STOL configuration in the past has been of an exploratory character and has been obtained with small-scale models. The interest in this type of airplane has now become so substantial, however, that there is a need for large-scale systematic aerodynamic design data for this type of airplane. A program has therefore been inaugurated at the Langley Research Center to provide such information by means of a large-scale semispan tilt-wing propeller-driven model. References 1 to 4 present results of previous work on this investigation for wing-alone configurations. The results of the present investigation are for a wing-fuselage configuration. The investigation was made with a model having a half-fuselage and a single propeller on the semispan wing. The wing had a chord-diameter ratio of 0.5, a double-slotted flap, and a slat leading-edge flow-control device. This particular wing was the same wing configuration that was used in the investigation of reference 4. The investigation covered a range of angles of attack from 0° to 90°. For most of the tests, the thrust coefficients ranged from 0.60 to 0.90; however, for a few tests, the thrust coefficients ranged from 0 to 1.00. Included in the investigation were tests with both left- and right-hand directions of propeller rotation. The lift, drag, and pitching moments were measured for the wing but only the lift loads were measured for the fuselage over the range of test conditions. The flow was observed by means of tufts on the upper surface of the wing and on the fuselage.

SYMBOLS

The positive sense of forces, moments, and angles is shown in figure 1. The pitching-moment coefficients are referred to the wing quarter-chord line. The slipstream coefficients are based on the dynamic pressure in the propeller slipstream. Conventional lift, drag, and pitching-moment coefficients based on the free-stream dynamic pressure can be obtained by dividing the slipstream coefficients by $\left(1 - C_{T,s}\right)$; for example, $C_L = C_{L,s}\Big/\left(1 - C_{T,s}\right)$. The thrust coefficient C_T' may be obtained from the equation $C_T' = C_{T,s}(A/S)\Big/\left(1 - C_{T,s}\right)$.

Measurements for this investigation were made in the U.S. Customary System of Units. Equivalent values are indicated herein in the International System (SI) in the interest of promoting the use of this system in future NASA reports. Factors relating the two systems for units used in this paper may be found in the appendix.

A	total propeller-disk area, feet^2 (meters^2)
b	propeller-blade chord, inches (meters); or wing span, feet (meters)
$C_{D,s}$	drag coefficient based on slipstream, $\frac{D}{q_s S}$
C_L	lift coefficient based on free airstream, $\frac{L}{qS}$

$C_{L,s}$ lift coefficient based on slipstream, $\frac{L}{q_s S}$

$C_{L,s(fus)}$ lift coefficient of fuselage

$C_{m,s}$ pitching-moment coefficient based on slipstream, $\frac{M_Y}{q_s Sc}$

C_T' thrust coefficient based on free airstream, $\frac{T}{qS}$

$C_{T,s}$ thrust coefficient based on slipstream, $\frac{T}{q_s \frac{\pi D^2}{4}}$

c wing chord, feet (meters)

c_f flap chord, 11.90 inches (30.23 centimeters)

c_v vane chord, 5.78 inches (14.68 centimeters)

D propeller diameter, feet (meters); also, total model drag, pounds force (newtons)

h thickness of propeller blade, inches (meters)

L total model lift, pounds force (newtons)

M_Y pitching moment, pounds force-feet (newton-meters)

q free-stream dynamic pressure, $\frac{\rho V^2}{2}$, pounds force/foot^2 (newtons/meter^2)

q_s slipstream dynamic pressure, $q + \frac{T}{\frac{\pi D^2}{4}}$, pounds force/foot^2 (newtons/meter^2)

R radius of propeller blade, 2.83 feet (0.86 meter)

r radius to element on propeller blade, feet (meters)

S area of semispan wing, 19.60 feet^2 (1.82 meters^2)

T	propeller thrust, pounds force (newtons)
V	free-stream velocity, feet/second (meters/second)
x,y	airfoil coordinates, feet (meter)
α	wing angle of attack, degrees
δ_f	flap deflection, degrees
δ_v	angle of vane, degrees
ρ	mass density of air, slugs/foot^3 (kilograms/meter^3)

APPARATUS

The model used in this investigation was a semispan model which would represent the left panel of the full-span wing and the left half of the fuselage. The principal dimensions of the wing are given in figure 2. A three-view drawing of the fuselage-wing combination is given in figure 3. A photograph showing the model mounted in the Langley full-scale tunnel is presented in figure 4 and the propeller-blade characteristics are given in figure 5.

The wing was mounted on the scale balance system in the tunnel so that the lift and drag of the wing were read directly about the wind axis. The wing pivoted about its quarter-chord line, and its pitching moments were measured about this point and are referred to this point for the data presentation. When the half-fuselage was added to the existing wing model, it was also necessary for the fuselage to move relative to the wing-quarter-chord point in order to avoid structural conflict between the wing and the fuselage. The fuselage was consequently mounted on a parallel arm arrangement so that it translated as the wing angle of attack was varied. The fuselage moved as though it were pivoted to the wing at the 58-percent-chord station on the wing lower surface. Since the fuselage was not actually attached to the wing, its forces did not register on the tunnel scale balance. Therefore, the loads on the fuselage (lift only) were measured on separate strain-gage balances. At all times, the fuselage remained at zero angle of attack relative to the airstream.

The wing was constructed to allow numerous changes to be made in the test configuration, such as a change of airfoil, the addition of flow-control devices, deflection of the trailing-edge flap, changing the direction of rotation of the propeller, and wing planform.

The basic structure of the wing consists of a heavy box-beam spar to which a power train to drive the propellers through spanwise shafting is attached and around which various airfoil contours can be fitted. The propeller location was such that the propeller tip extended out to the wing tip. In the present investigation both left- and right-hand directions of propeller rotation were used. The propeller thrust was measured by a strain-gage balance which was a part of the propeller shaft. The output was fed through sliprings to an indicating instrument. The required values of thrust for each value of $C_{T,s}$ were set by the operator by changing the speed of the drive motor. The blade angle at the 0.75R station of the propeller was held constant at 17° throughout the investigation. The thrust axis was inclined upward 4° from the chord line of the wing to correspond approximately to the zero-lift line of the airfoil.

The basic wing had an NACA 4415 airfoil section and the chord was 2.833 ft (0.864 m) long. This chord length gave a ratio of wing chord to propeller diameter of 0.5. The reference area of the wing, based on a semispan of 6.92 ft (2.11 m), was 19.6 ft^2 (1.82 m^2) and did not include the area of the tip fairing.

The model had a double-slotted trailing-edge flap which consisted of a 35-percent-chord flap and a 17-percent-chord vane. The coordinates of the flap and vane are given in table 1, and the positions of the flap and vane for various deflections are given in figure 2(c). The flap illustrated in figure 2(c) is deflected 60°.

The leading-edge slat shown in figure 2(b) was investigated either as a full-span or an inboard slat configuration. The slat was deflected 30° and was in a low position with respect to the wing chord line. For that part of the slat which extended across the top of the fuselage, the slat was deflected 10° and was in a high position to avoid touching the fuselage at low angles of attack ($\alpha = 5^{\circ}$); otherwise, the minimum angle of attack would have been limited to 15°.

Fences having a height of 0.20c and extending from 0.13c on the lower surface around the leading edge to about 0.75c on the upper surface were installed at two spanwise locations on the wing (see fig. 2(d)) in an attempt to confine the center-section stall inboard of the propeller slipstream. When tests were made with fences on, both fences were installed.

TESTS

The model was tested with and without leading-edge slat and fences for deflections of the double-slotted flap from 0° to 60°. The specific wing configurations tested, together with a list of tables and figures in which the data for each may be found, are given in the following table:

Direction of rotation	Configuration	Flap deflection, deg	Table (*)	Figure		
				Aerodynamic data	Fuselage lift coefficients	Comparisons with data from ref. 4
Down at tip	Basic leading edge	0	2	6	21	27(a)
	Basic leading edge	40	3	7	21	27(b)
	Basic leading edge	60	4	8	21	27(c)
	Inboard slat and fences on	0	5	9	22	----
	Inboard slat and fences on	40	6	10	22	28(a)
	Inboard slat and fences on	60	7	11	22	28(b)
Up at tip	Basic leading edge	40	8	12	23	----
	Basic leading edge	60	9	13	23	----
	Inboard slat	40	10	14	24	----
	Inboard slat	60	11	15	24	----
	Inboard slat and fences on	40	12	16	25	29(a)
	Inboard slat and fences on	60	13	17	25	29(b)
	Full-span slat and fences on	20	14	18	26	----
	Full-span slat and fences on	40	15	19	26	----
	Full-span slat and fences on	60	16	20	26	----

*The (a) part of each table gives the tabulated wing data and the (b) part gives the tabulated fuselage data.

The tests were made over a range of thrust coefficients from 0 to 1.0 for the basic wing configuration and from 0.6 to 0.9 for most of the other configurations. For any given test the thrust coefficient was held constant over the angle-of-attack range by adjusting the propeller speed to give the required thrust at each angle of attack. The angles of attack for the tests ranged from 0° for the basic-leading-edge configuration (or from 5° for the slat-leading-edge configuration) to that angle of attack required to stall the wing or develop a drag-to-lift ratio of about 0.3, whichever was lower. The test Reynolds number, based on the wing chord length and the velocity of the propeller slipstream, was about 2.38×10^{6} for thrust coefficients from 1.00 to 0.30 and about 1.95×10^{6} for $C_{T,s} = 0$.

No tunnel-wall corrections have been applied to the data since surveys and analysis had indicated that there would be no significant correction, as explained in reference 1.

DISCUSSION

The data presented have not been analyzed in detail but have been examined to observe general trends. One very general observation was that the force-test data could not be used as an indication of the occurrence or extent of wing stalling. The tuft-test results show that the onset of stalling over significant areas of the part of the wing within the propeller slipstream frequently occurs considerably below or above the angle of attack for maximum lift coefficient, dependent upon the mode of propeller rotation.

Effect of Variables

Effect of direction of propeller rotation.- The results of the force tests show no consistent or very significant effects of the direction of propeller rotation on lift or drag. The tuft tests, however, show significant effects of the direction of propeller rotation. Rotation of the propellers in the down-at-the-tip mode (left-hand direction) consistently causes stalling (of the part of the wing in the slipstream) to start inboard of the nacelle, that is, behind the upward-going blades; whereas, the up-at-the-tip mode (right-hand direction) may result in the onset of stalling occurring either inboard or outboard of the nacelle. The up-at-the-tip rotation generally results in a strong outward spanwise flow of the boundary layer prior to the onset of stalling, which is usually indicated by areas on the wing where the tufts are swirling violently or have become very limp and are pointed in random directions. As will be indicated in some detail in the subsequent discussion, however, just as favorable results with regard to wing stalling can be achieved with one mode of propeller rotation as with the other, if certain types of flow-control devices are used.

Effect of fences.- The effect of fences can be ascertained only for the configuration with up-at-the-tip rotation and inboard slat on. (Compare figs. 14 and 15 with figs. 16 and 17.) These data show that the fences do not increase the lift significantly; although they increase the drag-to-lift ratio at maximum lift coefficient and drag-to-lift ratio attainable prior to the onset of stalling or heavy flow disturbances on the part of the wing in the propeller slipstream.

Effect of slat.- In the present investigation, the effect of slat cannot be determined for down-at-the-tip rotation inasmuch as fences are also included on the configuration with this mode of propeller rotation. The effect of inboard slat, however, can be ascertained for the configuration with the up-at-the-tip mode of propeller rotation. (Compare figs. 12 and 13 with figs. 14 and 15.) The inboard slat has little effect on the lift or drag characteristics of the wing in the high lift range, nor does it have any significant effect on the stalling characteristics of the wing. The effect of the addition of the outboard segment of the slat can be ascertained only for the up-at-the-tip mode of propeller rotation for the configuration with the inboard slat and fences installed. (Compare figs. 16 and 17 with figs. 19 and 20.) The addition of the outboard segment of the slat has practically no effect on the characteristics of the wing in the high lift range.

Effect of flap deflection.- Deflecting the flaps greatly increased the drag-to-lift ratio achieved prior to stalling of any part of the wing within the propeller slipstream, as determined by tuft tests. There was a very large effect in this regard between flap deflections of 0° (configuration with basic leading edge and down-at-the-tip rotation, fig. 6) and 20° (configuration with full-span slat, fences on, and up-at-the-tip rotation, fig. 18). As flap deflection was increased from 20° to 60°, there was a small progressive increase in the drag-to-lift ratio and there was also a progressive increase in maximum lift coefficient. It should be pointed out here that in the discussion of drag-to-lift ratio in this paper the fuselage lift is not included with the wing lift.

Fuselage lift.- The fuselage lift coefficients plotted in figures 21 to 26 are based on the same parameters as used in the reduction of the data for the wing lift coefficients. In general, the maximum fuselage lift occurred near the wing angle of attack for maximum wing lift. This trend was true for both the 40° and 60° flap deflections with both directions of propeller rotation. The inboard slat and fences had no appreciable effect on the fuselage loading. (Compare fig. 21 with fig. 22.)

A comparison of the lift characteristics of the wing (in presence of the fuselage), wing plus fuselage, and wing alone (from ref. 4) is given in figures 27 to 29. In general, the fuselage and wing-fuselage interference effects seemed to have greater effect at the low thrust coefficients. In almost every case, adding the fuselage lift to the measured wing lift increased the overall lift at a given angle of attack; however, the fuselage sometimes was detrimental with regard to the maximum positive D/L.

A comparison of the tuft-test data from the present investigation with those of reference 4 for the same wing without a fuselage showed that the presence of the fuselage did not have any significant effect on the wing flow for the configurations with up-at-the-tip propeller rotation or for configurations with the fences. For down-at-the-tip propeller rotation, however, the presence of the fuselage delayed the onset of stalling of the part of the wing in the propeller slipstream by 5° to 10° in angle of attack. This result might have been expected since the wing tends to stall inboard of the nacelle for this mode of propeller rotation, and the presence of an extensively stalled wing center section (with no fuselage) might have been expected to trigger a somewhat earlier stall of the adjacent section of the wing in the propeller slipstream.

Evaluation of Configurations

As explained in reference 5, achievement of suitable positive values of D/L prior to the onset of serious flow separation is believed to be a necessary condition for the wing of a tilt-wing V/STOL aircraft to permit operation in descent and deceleration conditions. Many of the configurations tested in the present investigation do not produce a suitable positive value of the drag-to-lift ratio prior to the onset of stalling or violent flow disturbances (on the part of the wing immersed in the propeller slipstream). For example, none of the undeflected-flap configurations produced any positive values of drag-to-lift ratio prior to the onset of stalling, nor did the flap-down configurations with up-at-the-tip propeller rotation and no leading-edge flow-control devices. On the other hand, D/L values of 0.3 to 0.4 prior to the onset of stalling of any part of the wing within the propeller slipstream were achieved for the flap-down configurations with down-at-the-tip propeller rotation and with the slat and fences on. These values of D/L correspond to descent angles in flight of 17° to 22°. The other configurations tested fell between these two values.

CONCLUSIONS

An experimental investigation to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller rotating up or down at the tip (right- or left-hand direction of rotation, respectively) has been made. The wing, which had a double-slotted flap, was tested in the presence of a fuselage. The following conclusions were drawn from the results of this investigation:

1. The direction of propeller rotation had a significant effect on the lift and descent capability attainable when leading-edge flow-control devices were not used, with the up-at-the-tip mode of propeller rotation giving the more favorable results; but approximately the same favorable results could be achieved with down-at-the-tip rotation when leading-edge slats and fences were used.

2. Deflecting the flaps was very effective in increasing the descent capability for either mode of rotation. For example, with the most favorable combination of flow-control devices investigated, virtually no descent capability prior to wing stalling was achieved with 0° flap deflection; whereas, with 20°, 40°, or 60° flap deflection, a descent capability of about 20° was achieved.

Langley Research Center,
National Aeronautics and Space Administration,
Langley Station, Hampton, Va., June 14, 1966.

APPENDIX

CONVERSION FACTORS - U.S. CUSTOMARY UNITS TO SI UNITS

The International System of Units (SI) was adopted by the Eleventh General Conference on Weights and Measures, Paris, October 1960. (See ref. 6.) The following conversion factors are included in this report for convenience:

Physical quantity	U.S. Customary Unit	Conversion factor (*)	SI Unit
Area	ft^2	0.0929	meters (m)
Density	$slugs/ft^3$	515.379	kilograms/meter^3 (kg/m^3)
Force	lbf	4.44822	newtons (N)
Length	in.	0.0254	meters (m)
	ft	0.3048	meters (m)
Moment	lbf-ft	1.356	newton-meters (N-m)
Pressure . . .	lbf/ft^2	47.88	newtons/meter^2 (N/m^2)
Velocity	ft/sec	0.3048	meters/second (m/sec)

*Multiply value given in U.S. Customary Unit by conversion factor to obtain equivalent value in SI Unit.

REFERENCES

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2. Fink, Marvin P.; Mitchell, Robert G.; and White, Lucy C.: Aerodynamic Data on a Large Semispan Tilting Wing With 0.6-Diameter Chord, Single-Slotted Flap, and Single Propeller Rotating Down at Tip. NASA TN D-2412, 1964.

3. Fink, Marvin P.; Mitchell, Robert G.; and White, Lucy C.: Aerodynamic Data on Large Semispan Tilting Wing With 0.6-Diameter Chord, Single Slotted Flap, and Single Propeller Rotating Up at Tip. NASA TN D-1586, 1964.

4. Fink, Marvin P.; Mitchell, Robert G.; and White, Lucy C.: Aerodynamic Data on a Large Semispan Tilting Wing With 0.5-Diameter Chord, Double-Slotted Flap, and Both Left- and Right-Hand Rotation of a Single Propeller. NASA TN D-3375, 1966.

5. McKinney, M. O.; Kirby, R. H.; and Newsom, W. A.: Aerodynamic Factors to be Considered in the Design of Tilt-Wing V/STOL Airplanes. Vertical Take-Off and Landing (VTOL) Aircraft. Ann. N.Y. Acad. Sci., vol. 107, art. 1, Mar. 25, 1963, pp. 221-248.

6. Mechtly, E. A.: The International System of Units - Physical Constants and Conversion Factors. NASA SP-7012, 1964.

TABLE 1.- VANE AND FLAP ORDINATES

(a) Vane ordinates

x/c_v	y/c_v	
	Upper surface	Lower surface
0	0	0
.0125	.0381	-.0268
.0249	.0522	-.0343
.0500	.0739	-.0408
.0751	.0905	-.0446
.1000	.1040	-.0448
.1500	.1270	-.0408
.2000	.1439	-.0299
.3000	.1630	-.0140
.4000	.1661	.0010
.5000	.1600	.0180
.6000	.1439	.0299
.7000	.1170	.0300
.8000	.0830	.0299
.9000	.0450	.0180
.9500	.0260	.0107
1.0000	0	0

(b) Flap ordinates

x/c_f	y/c_f	
	Upper surface	Lower surface
0	0	0
.0125	.0456	-.0200
.0250	.0609	-.0276
.0500	.0853	-.0365
.0750	.1027	-.0413
.1000	.1165	-.0431
.1500	.1377	-.0466
.2000	.1532	
.2500	.1623	
.3000	.1671	
.3500	.1678	
.4286	.1586	-.0339
.7143	.0880	-.0192
1.0000	.0045	-.0045

TABLE 2.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, BASIC LEADING EDGE, AND $\delta_f = 0^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 1.00$			
0	0.144	-1.288	-0.002
5	.268	-1.272	.012
10	.383	-1.242	.016
15	.504	-1.184	.011
20	.593	-1.150	.008
25	----	-----	-----
30	.774	-1.039	-.001
35	----	-----	-----
40	.913	-.892	-.027
45	----	-----	-----
50	1.046	-.703	-.038
55	----	-----	-----
60	1.164	-.523	-.063
65	----	-----	-----
70	1.239	-.310	-.079
75	----	-----	-----
80	1.298	-.090	-.073
85	----	-----	-----
90	1.286	.138	-.089
$C_{T,s} = 0.95$			
0	0.159	-1.218	0.014
5	.303	-1.200	.027
10	.441	-1.156	.037
15	.566	-1.115	.047
20	.704	-1.037	.051
25	.824	-.966	.052
30	.939	-.874	.052
35	1.030	-.767	.068
40	1.120	-.664	.065
45	1.167	-.553	.073
50	1.217	-.431	.073
55	1.277	-.298	.076
60	1.306	-.165	.072
65	1.320	-.049	.075
70	1.311	.065	.077
75	1.307	.184	.092
80	1.278	.285	.087
85	1.255	.384	.082
$C_{T,s} = 0.90$			
0	0.187	-1.157	0.027
5	.349	-1.142	.041
10	.501	-1.081	.055
15	.647	-1.028	.075
20	.773	-.948	.083
25	.883	-.859	.083
30	.995	-.756	.095
35	1.109	-.629	.099
40	1.197	-.506	.095
45	1.263	-.375	.087
50	1.309	-.237	.089
55	1.335	-.112	.098
60	1.342	.007	.102
65	1.336	.118	.105
70	1.308	.217	.123
75	1.278	.320	.129
80	1.244	.413	.136
85	1.206	.493	.150

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
0	0.191	-1.020	0.024
5	.394	-1.002	.050
10	.565	-.951	.072
15	.739	-.883	.090
20	.889	-.797	.099
25	1.037	-.690	.113
30	1.123	-.566	.111
35	1.201	-.434	.102
40	1.281	-.297	.101
45	1.335	-.136	.102
50	1.353	.009	.101
55	1.352	.131	.109
60	1.337	.254	.114
65	1.309	.352	.128
70	1.261	.431	.138
75	1.219	.508	.149
$C_{T,s} = 0.60$			
0	0.244	-0.809	0.007
5	.482	-.776	.036
10	.700	-.716	.070
15	.932	-.650	.094
20	1.104	-.538	.106
25	1.266	-.427	.110
30	1.331	-.274	.107
35	1.372	-.094	.089
40	1.354	.152	.082
45	1.398	.281	.078
50	1.394	.385	.092
55	1.333	.482	.082
60	1.290	.546	.084
$C_{T,s} = 0.30$			
0	0.183	-0.373	-0.015
5	.471	-.343	.025
10	.753	-.293	.069
15	1.022	-.213	.097
20	1.234	-.100	.115
25	1.392	.033	.111
30	1.278	.200	.056
35	1.287	.347	.049
40	1.270	.452	.045
$C_{T,s} = 0$			
0	0.180	-0.006	-0.026
5	.496	.016	.035
10	.821	.080	.072
15	1.106	.168	.102
20	1.287	.292	.099
25	1.220	.409	.059
30	1.196	.554	.034
35	1.143	.645	.038
40	1.108	.771	-.009

TABLE 2.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, BASIC LEADING EDGE, AND $\delta_f = 0^o$ – Concluded

(b) Fuselage data

α, deg	$C_{L,s(fus)}$						
	$C_{T,s} = 1.00$	$C_{T,s} = 0.95$	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$	$C_{T,s} = 0.30$	$C_{T,s} = 0$
0	-0.008	0.005	-0.019	0.017	-0.002	-0.015	-0.030
5	-.027	-.004	.013	.018	.006	-.015	-.037
10	-.024	.005	.010	.020	.012	-.013	-.039
15	-.033	-.009	.004	.026	.020	-.012	-.038
20	-.036	-.015	.006	.038	.036	.006	-.029
25	-----	-.022	.016	.041	.050	.032	-.047
30	-.038	-.031	.017	.048	.061	.015	-.036
35	-----	-.029	.015	.047	.064	.039	-.016
40	-.027	-.035	.021	.050	.080	.062	-.007
45	-----	-.012	.017	.056	.088	-----	-----
50	-.044	-.010	.021	.056	.079	-----	-----
55	-----	-.013	.027	.062	.091	-----	-----
60	-.038	-.018	.027	.069	.092	-----	-----
65	-----	-.005	.027	.069	-----	-----	-----
70	-.037	-.020	.026	.069	-----	-----	-----
75	-----	-.020	.031	.069	-----	-----	-----
80	-.033	-.021	.022	----	-----	-----	-----
85	-----	-.024	.014	----	-----	-----	-----
90	-.042	----	-----	----	-----	-----	-----

TABLE 3.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, BASIC LEADING EDGE, AND $\delta_f = 40^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.90$		
0	0.754	-0.973	-0.285
5	.928	-.891	-.278
10	1.068	-.789	-.281
15	1.211	-.661	-.287
20	1.320	-.545	-.284
25	1.387	-.409	-.276
30	1.462	-.249	-.279
35	1.494	-.106	-.269
40	1.513	.034	-.265
45	1.487	.139	-.239
50	1.453	.238	-.224
55	1.411	.336	-.199
60	1.361	.409	-.167
65	1.309	.466	-.126
70	1.243	.494	-.083

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.80$		
0	0.897	-0.817	-0.314
5	1.101	-.717	-.319
10	1.288	-.593	-.324
15	1.451	-.465	-.325
20	1.571	-.302	-.331
25	1.621	-.146	-.318
30	1.656	.032	-.331
35	1.643	.154	-.307
40	1.608	.259	-.276
45	1.527	.349	-.228
50	1.456	.401	-.176
55	1.380	.456	-.128
60	1.313	.522	-.106

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.60$		
0	1.070	-0.511	-0.356
5	1.377	-.402	-.377
10	1.639	-.256	-.393
15	1.867	-.081	-.405
20	1.948	.088	-.386
25	1.933	.251	-.364
30	1.720	.368	-.336
35	1.631	.470	-.298
40	1.543	.550	-.262
45	1.463	.626	-.222
50	1.376	.692	-.181

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
0	-0.024	0.015	0.072
5	-.028	.011	.075
10	-.018	.034	.097
15	-.012	.047	.117
20	-.008	.057	.122
25	.001	.076	.110
30	0	.091	.098
35	.002	.088	.082
40	0	.075	.064
45	.022	.075	.058
50	.021	.051	.058
55	.022	.040	----
60	.016	.021	----
65	.006	----	----
70	-.018	----	----

TABLE 4.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, BASIC LEADING EDGE, AND $\delta_f = 60^\circ$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
0	0.900	-0.870	-0.327
5	1.055	-.776	-.335
10	1.188	-.661	-.335
15	1.297	-.525	-.332
20	1.385	-.400	-.329
25	1.460	-.255	-.325
30	1.493	-.113	-.322
35	1.510	.028	-.316
40	1.479	.125	-.286
45	1.453	.234	-.267
50	1.409	.324	-.241
55	1.362	.401	-.203
60	1.313	.454	-.169
65	1.253	.494	-.130
70	1.190	.518	-.081

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
0	1.075	-0.705	-0.377
5	1.276	-.592	-.381
10	1.436	-.454	-.387
15	1.594	-.299	-.405
20	1.653	-.152	-.387
25	1.680	.008	-.380
30	1.684	.159	-.363
35	1.628	.269	-.328
40	1.575	.347	-.287
45	1.471	.400	-.226
50	1.394	.449	-.185
55	1.320	.505	-.139
60	1.264	.554	-.111
65	1.197	.594	-.078

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
0	1.292	-0.402	-0.501
5	1.598	-.263	-.458
10	1.837	-.091	-.467
15	2.045	.097	-.487
20	2.051	.254	-.455
25	1.861	.373	-.406
30	1.696	.459	-.353
35	1.576	.534	-.298
40	1.499	.603	-.269
45	1.403	.667	-.226

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
0	-0.024	0.022	0.098
5	-.032	.023	.101
10	-.020	.038	.121
15	-.011	.056	.126
20	-.009	.062	.129
25	.003	.080	.116
30	.004	.090	.084
35	.005	.087	.056
40	.002	.066	.015
45	.009	.055	.053
50	.013	.039	----
55	.012	.021	----
60	-.003	.012	----
65	-.016	.016	----
70	-.019	----	----

TABLE 5.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, INBOARD SLAT, FENCES ON, AND $\delta_f = 0^o$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.90$		
5	0.360	-1.119	0.021
10	.521	-1.081	.037
15	.670	-1.025	.057
20	.804	-.952	.068
25	.921	-.861	.076
30	1.049	-.761	.088
35	1.144	-.634	.087
40	1.243	-.495	.088
45	1.329	-.345	.088
50	1.385	-.210	.090
55	1.404	-.056	.097
60	1.392	.066	.099
65	1.373	.178	.101
70	1.347	.282	.116
75	1.322	.386	.134
80	1.277	.473	.147

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.80$		
5	0.385	-0.984	0.030
10	.560	-.939	.054
15	.733	-.878	.070
20	.896	-.784	.076
25	1.033	-.684	.087
30	1.171	-.552	.093
35	1.281	-.415	.094
40	1.337	-.274	.104
45	1.402	-.120	.111
50	1.457	.030	.117
55	1.467	.187	.124
60	1.447	.303	.139
65	1.397	.393	.158
70	1.351	.483	.170
75	1.296	.559	.177
80	1.235	.612	.188

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.60$		
5	0.398	-0.719	0.018
10	.617	-.684	.047
15	.808	-.585	.054
20	.997	-.486	.075
25	1.178	-.367	.086
30	1.320	-.233	.099
35	1.426	-.089	.105
40	1.458	.045	.120
45	1.474	.201	.115
50	1.487	.347	.111
55	1.477	.474	.119
60	1.408	.575	.123

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	0.024	0.033	0.028
10	.021	.034	.035
15	.020	.031	.023
20	.017	.039	.029
25	.023	.037	.026
30	.027	.039	.029
35	.031	.047	.029
40	.021	.052	.038
45	.016	.052	.056
50	.020	.054	.062
55	.030	.058	.056
60	.036	.055	.060
65	.029	.050	----
70	.018	.052	----
75	.015	.056	----
80	.015	.059	----

TABLE 6.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, INBOARD SLAT, FENCES ON, AND $\delta_f = 40^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.915	-0.872	-0.292
10	1.071	-.769	-.297
15	1.218	-.647	-.306
20	1.326	-.524	-.306
25	1.437	-.378	-.304
30	1.533	-.215	-.310
35	1.565	-.061	-.307
40	1.582	.090	-.298
45	1.579	.235	-.288
50	1.570	.371	-.266
55	1.529	.476	-.233
60	1.453	.545	-.193
65	1.389	.605	-.148
70	1.321	.643	-.098

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	1.096	-0.709	-0.328
10	1.315	-.591	-.339
15	1.478	-.438	-.338
20	1.629	-.280	-.352
25	1.761	-.092	-.354
30	1.779	.062	-.344
35	1.791	.233	-.329
40	1.790	.370	-.308
45	1.747	.490	-.266
50	1.673	.574	-.213
55	1.568	.625	-.147
60	1.428	.589	-.077
65	1.348	.626	-.031

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.350	-0.393	-0.390
10	1.624	-.244	-.401
15	1.876	-.067	-.407
20	2.064	.134	-.406
25	2.187	.322	-.406
30	2.184	.503	-.386
35	1.985	.606	-.323
40	1.617	.473	-.223
45	1.584	.601	-.197
50	1.548	.725	-.161

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.30$			
5	1.575	0.023	-0.466
10	1.946	.207	-.483
15	2.336	.425	-.504
20	2.553	.646	-.506
25	2.573	.846	-.481
30	2.608	1.014	-.435
35	1.876	.801	-.256

(b) Fuselage data

α, deg	$C_{L,s(fus)}$			
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$	$C_{T,s} = 0.30$
5	-0.013	0.034	0.098	0.153
10	-.017	.036	.105	.168
15	-.008	.051	.119	.183
20	-.003	.061	.136	.168
25	.009	.070	.142	.137
30	.016	.095	.132	.122
35	.019	.098	.117	.014
40	.024	.097	.056	----
45	.029	.104	.033	----
50	.040	.099	.034	----
55	.040	.085	----	----
60	.028	.043	----	----
65	.004	.027	----	----
70	-.010	----	----	----

TABLE 7.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION DOWN AT TIP, INBOARD SLAT, FENCES ON, AND $\delta_f = 60^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	1.187	-0.631	-0.401
10	1.311	-.499	-.401
15	1.425	-.360	-.408
20	1.514	-.197	-.424
25	1.569	-.041	-.427
30	1.616	.112	-.419
35	1.638	.273	-.406
40	1.610	.393	-.377
45	1.551	.483	-.337
50	1.492	.561	-.301
55	1.434	.637	-.254
60	1.347	.676	-.213
65	1.274	.704	-.175
70	1.218	.711	-.113

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	1.392	-0.432	-0.440
10	1.577	-.280	-.461
15	1.735	-.097	-.467
20	1.824	.070	-.471
25	1.888	.245	-.461
30	1.819	.362	-.413
35	1.804	.495	-.385
40	1.746	.589	-.336
45	1.675	.664	-.279
50	1.568	.677	-.208
55	1.422	.655	-.129
60	1.328	.682	-.096

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.777	-0.092	-0.525
10	2.025	.102	-.545
15	2.214	.307	-.548
20	2.339	.508	-.540
25	2.344	.670	-.498
30	2.167	.742	-.414
35	2.060	.803	-.337
40	1.556	.607	-.237
45	1.506	.694	-.177

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	-0.015	0.038	0.119
10	-.005	.046	.129
15	.004	.058	.143
20	.026	.074	.169
25	.032	.090	.176
30	.026	.100	.131
35	.019	.097	.116
40	.019	.091	.016
45	.025	.094	-.013
50	.026	.077	----
55	.026	.048	----
60	0	.017	----
65	-.017	----	----
70	-.022	----	----

TABLE 8.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, BASIC LEADING EDGE, AND $\delta_f = 40^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
0	0.741	-0.949	-0.285
5	.904	-.857	-.288
10	1.063	-.748	-.300
15	1.209	-.621	-.312
20	1.348	-.472	-.321
25	1.414	-.340	-.312
30	1.475	-.194	-.314
35	1.516	-.059	-.295
40	1.519	.066	-.283
45	1.516	.182	-.260
50	1.483	.260	-.219
55	1.426	.306	-.178
60	1.381	.362	-.143
65	1.341	.435	-.117
70	1.293	.472	-.085
75	1.248	.517	-.026

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
0	0.896	-0.796	-0.334
5	1.112	-.693	-.348
10	1.309	-.565	-.357
15	1.487	-.401	-.369
20	1.640	-.240	-.386
25	1.685	-.090	-.365
30	1.688	.059	-.341
35	1.674	.167	-.299
40	1.631	.254	-.257
45	1.591	.341	-.218
50	1.548	.438	-.193
55	1.506	.522	-.147
60	1.468	.611	-.124
65	1.412	.671	-.076

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
0	1.045	-0.483	-0.381
5	1.359	-.363	-.406
10	1.645	-.200	-.429
15	1.888	-.015	-.437
20	2.006	.160	-.433
25	2.043	.324	-.396
30	1.883	.409	-.338
35	1.759	.474	-.265
40	1.660	.551	-.218
45	1.567	.613	-.178
50	1.432	.654	-.131

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
0	0.020	0.051	0.100
5	.016	.056	.108
10	.015	.067	.117
15	.032	.078	.153
20	.036	.087	.143
25	.037	.096	.135
30	.037	.096	.130
35	.031	.084	.114
40	.027	.081	.105
45	.024	.082	.092
50	.020	.080	.080
55	.018	.076	----
60	.005	.067	----
65	-.013	.058	----
70	-.015	----	----
75	-.019	----	----

TABLE 9.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, BASIC LEADING EDGE, AND $\delta_f = 60^\circ$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s}$ = 0.90		
0	0.880	-0.843	-0.340
5	1.047	-.734	-.358
10	1.193	-.606	-.367
15	1.316	-.467	-.370
20	1.418	-.327	-.372
25	1.487	-.179	-.371
30	1.539	-.023	-.371
35	1.538	.086	-.349
40	1.533	.201	-.319
45	1.498	.282	-.271
50	1.437	.312	-.227
55	1.376	.344	-.178
60	1.335	.394	-.146
65	1.295	.458	-.125
70	1.252	.480	-.066
75	1.208	.516	-.022

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s}$ = 0.80		
0	1.067	-0.661	-0.407
5	1.280	-.538	-.419
10	1.462	-.393	-.430
15	1.616	-.224	-.437
20	1.735	-.051	-.441
25	1.759	.080	-.411
30	1.690	.180	-.364
35	1.658	.262	-.312
40	1.592	.323	-.260
45	1.533	.410	-.227
50	1.500	.495	-.191
55	1.450	.568	-.160
60	1.418	.636	-.112
65	1.366	.695	-.079

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s}$ = 0.60		
0	1.281	-0.360	-0.452
5	1.598	-.212	-.486
10	1.870	-.025	-.513
15	2.074	.176	-.522
20	2.132	.364	-.500
25	2.054	.459	-.449
30	1.844	.491	-.333
35	1.736	.548	-.272
40	1.619	.602	-.211
45	1.495	.631	-.155
50	1.323	.652	-.129

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s}$ = 0.90	$C_{T,s}$ = 0.80	$C_{T,s}$ = 0.60
0	0.007	0.059	0.130
5	.009	.067	.132
10	.016	.077	.139
15	.021	.089	.152
20	.028	.093	.157
25	.035	.102	.143
30	.039	.087	.132
35	.029	.076	.115
40	.021	.078	.097
45	.020	.079	.083
50	.017	.067	.066
55	.004	.071	----
60	-.014	.051	----
65	-.019	.056	----
70	-.029	----	----
75	-.039	----	----

TABLE 10.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, INBOARD SLAT, AND $\delta_f = 40^o$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.723	-0.892	-0.201
10	.899	-.798	-.214
15	1.064	-.677	-.236
20	1.203	-.544	-.255
25	1.323	-.390	-.269
30	1.428	-.237	-.282
35	1.509	-.055	-.295
40	1.508	.047	-.269
45	1.499	.165	-.251
50	1.458	.238	-.218
55	1.422	.317	-.179
60	1.371	.354	-.139
65	1.325	.405	-.109
70	1.284	.443	-.064
75	1.242	.481	-.017
80	1.200	.509	.047

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	0.897	-0.721	-0.251
10	1.121	-.600	-.279
15	1.335	-.448	-.310
20	1.551	-.266	-.348
25	1.673	-.090	-.358
30	1.722	.055	-.345
35	1.678	.170	-.310
40	1.667	.280	-.267
45	1.627	.374	-.225
50	1.581	.455	-.184
55	1.532	.543	-.150
60	1.474	.614	-.124
65	1.406	.633	-.050

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.091	-0.421	-0.315
10	1.461	-.256	-.384
15	1.782	-.061	-.425
20	2.009	.154	-.437
25	2.112	.328	-.417
30	2.166	.484	-.380
35	2.049	.556	-.299
40	1.787	.571	-.209
45	1.704	.646	-.157
50	1.549	.701	-.137
55	1.372	.705	-.105

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	0.036	0.062	0.093
10	.044	.078	.115
15	.049	.079	.123
20	.051	.086	.121
25	.047	.087	.125
30	.042	.087	.113
35	.048	.091	.109
40	.047	.082	.104
45	.045	.072	.094
50	.044	.068	.075
55	.038	.065	.062
60	.027	.051	----
65	.011	.047	----
70	-.018	----	----
75	-.014	----	----
80	-.031	----	----

TABLE 11.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, INBOARD SLAT, AND $\delta_f = 60^o$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.90$		
5	0.983	-0.676	-0.324
10	1.148	-.543	-.350
15	1.276	-.384	-.373
20	1.396	-.212	-.395
25	1.459	-.077	-.393
30	1.529	.096	-.401
35	1.518	.210	-.380
40	1.473	.263	-.329
45	1.441	.327	-.281
50	1.389	.368	-.245
55	1.339	.433	-.212
60	1.280	.415	-.155
65	1.240	.462	-.118
70	1.200	.450	-.043

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.80$		
5	1.246	-0.457	-0.405
10	1.446	-.282	-.436
15	1.576	-.111	-.452
20	1.755	.092	-.471
25	1.793	.241	-.453
30	1.714	.275	-.375
35	1.631	.327	-.309
40	1.592	.415	-.272
45	1.548	.497	-.226
50	1.501	.558	-.183
55	1.458	.620	-.150
60	1.403	.670	-.109

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
	$C_{T,s} = 0.60$		
5	1.573	-0.133	-0.417
10	1.852	.078	-.518
15	2.079	.306	-.535
20	2.184	.488	-.508
25	2.156	.591	-.451
30	2.119	.663	-.360
35	1.912	.618	-.246
40	1.656	.610	-.170
45	1.552	.671	-.130
50	1.356	.677	-.099

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	0.012	0.082	0.136
10	.013	.095	.137
15	.015	.103	.138
20	.017	.099	.133
25	.016	.098	.118
30	.016	.094	.109
35	.015	.083	.106
40	.011	.073	.087
45	.011	.063	.065
50	.009	.064	.051
55	.008	.064	----
60	.013	.044	----
65	.005	----	----
70	.008	----	----

TABLE 12.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, INBOARD SLAT, FENCES ON, AND $\delta_f = 40^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.706	-0.895	-0.189
10	.878	-.805	-.200
15	1.036	-.694	-.213
20	1.177	-.569	-.232
25	1.305	-.413	-.250
30	1.404	-.250	-.258
35	1.473	-.095	-.266
40	1.534	.072	-.280
45	1.538	.211	-.265
50	1.515	.303	-.239
55	1.435	.334	-.185
60	1.385	.371	-.143
65	1.335	.417	-.106
70	1.291	.457	-.065
75	1.265	.527	-.013
80	1.257	.564	.076

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	0.879	-0.729	-0.244
10	1.110	-.602	-.272
15	1.317	-.416	-.284
20	1.519	-.277	-.322
25	1.659	-.092	-.348
30	1.764	.096	-.347
35	1.785	.255	-.338
40	1.760	.384	-.303
45	1.707	.457	-.258
50	1.646	.520	-.206
55	1.551	.555	-.149
60	1.477	.618	-.126
65	1.391	.698	-.075

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.077	-0.416	-0.306
10	1.443	-.246	-.373
15	1.791	-.047	-.418
20	2.009	.159	-.438
25	2.139	.361	-.427
30	2.210	.529	-.395
35	2.178	.645	-.332
40	2.015	.751	-.270
45	1.920	.824	-.217

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	0.040	0.062	0.093
10	.046	.074	.126
15	.049	.081	.137
20	.048	.090	.144
25	.050	.095	.145
30	.054	.102	.134
35	.044	.091	.141
40	.035	.081	.133
45	.030	.069	.114
50	.025	.060	----
55	.022	.052	----
60	.014	.048	----
65	.005	.055	----
70	.003	----	----
75	-.016	----	----
80	-.074	----	----

TABLE 13.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, INBOARD SLAT, FENCES ON, AND $\delta_f = 60^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.967	-0.681	-0.336
10	1.128	-.538	-.344
15	1.257	-.396	-.363
20	1.374	-.243	-.380
25	1.446	-.092	-.377
30	1.516	.087	-.392
35	1.531	.219	-.385
40	1.510	.329	-.359
45	1.490	.429	-.319
50	1.418	.432	-.263
55	1.339	.416	-.203
60	1.292	.432	-.162
65	1.247	.447	-.108
70	1.208	.522	-.087

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	1.241	-0.456	-0.410
10	1.467	-.274	-.442
15	1.608	-.115	-.455
20	1.771	.100	-.477
25	1.827	.284	-.472
30	1.821	.419	-.443
35	1.783	.516	-.388
40	1.696	.547	-.326
45	1.611	.580	-.263
50	1.546	.610	-.203
55	1.460	.649	-.166
60	1.414	.695	-.124

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.579	-0.096	-0.489
10	1.921	.110	-.539
15	2.140	.361	-.573
20	2.288	.567	-.555
25	2.319	.713	-.510
30	2.256	.791	-.423
35	2.111	.833	-.342
40	1.925	.862	-.254
45	1.745	.873	-.185
50	1.516	.837	-.149

(b) Fuselage data

α, deg	$C_{L,s(fus)}$		
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$
5	0.045	0.082	0.079
10	.052	.098	.165
15	.065	.106	.179
20	.063	.111	.186
25	.058	.118	.176
30	.059	.113	.157
35	.047	.094	.141
40	.040	.075	.120
45	.034	.066	.093
50	.022	.055	.064
55	.008	.053	----
60	.001	.051	----
65	.041	----	----
70	.024	----	----

TABLE 14.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, FULL-SPAN SLAT, FENCES ON, AND $\delta_f = 20^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.520	-0.987	-0.094
10	.696	-.916	-.099
15	.862	-.837	-.104
20	1.010	-.730	-.102
25	1.150	-.603	-.114
30	1.248	-.473	-.120
35	1.337	-.325	-.130
40	1.412	-.173	-.131
45	1.452	-.039	-.123
50	1.455	.085	-.120
55	1.426	.175	-.102
60	1.387	.249	-.085
65	1.355	.332	-.064
70	1.320	.400	-.037
75	1.309	.496	.025

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	0.610	-0.839	-0.120
10	.839	-.767	-.127
15	1.066	-.649	-.139
20	1.269	-.516	-.159
25	1.430	-.362	-.158
30	1.570	-.195	-.159
35	1.620	-.035	-.170
40	1.649	.126	-.164
45	1.653	.253	-.143
50	1.639	.366	-.116
55	1.579	.451	-.082
60	1.507	.524	-.059
65	1.427	.581	-.029

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	0.708	-0.569	-0.159
10	1.084	-.455	-.195
15	1.412	-.310	-.215
20	1.633	-.152	-.204
25	1.826	.021	-.202
30	1.957	.204	-.182
35	2.023	.376	-.166
40	1.971	.531	-.160
45	1.947	.671	-.142
50	1.874	.772	-.095
55	1.763	.827	-.055

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.30$			
5	0.849	-0.174	-0.205
10	1.316	-.044	-.259
15	1.711	.115	-.265
20	1.997	.292	-.244
25	2.234	.483	-.245
30	2.317	.689	-.247
35	2.390	.891	-.229
40	2.342	1.015	-.187
45	2.166	1.119	-.170

(b) Fuselage data

α, deg	$C_{L,s(fus)}$			
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$	$C_{T,s} = 0.30$
5	0.038	0.051	0.067	0.090
10	.035	.056	.095	.120
15	.036	.063	.099	.115
20	.038	.066	.103	.113
25	.042	.072	.105	.112
30	.047	.082	.109	.098
35	.040	.086	.118	.098
40	.033	.071	.133	.108
45	.033	.066	.120	.118
50	.029	.064	.104	----
55	.029	.064	.089	----
60	.029	.060	----	----
65	.012	.053	----	----
70	0	----	----	----
75	-.032	----	----	----

TABLE 15.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, FULL-SPAN SLAT, FENCES ON, AND $\delta_f = 40^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.676	-0.889	-0.198
10	.865	-.791	-.219
15	1.015	-.686	-.232
20	1.162	-.564	-.242
25	1.298	-.404	-.261
30	1.381	-.255	-.272
35	1.446	-.100	-.277
40	1.505	.065	-.280
45	1.514	.195	-.262
50	1.498	.308	-.240
55	1.433	.344	-.200
60	1.371	.380	-.154
65	1.338	.426	-.111
70	1.287	.458	-.072

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	0.863	-0.718	-0.250
10	1.096	-.598	-.283
15	1.315	-.449	-.299
20	1.512	-.273	-.333
25	1.658	-.074	-.357
30	1.735	.090	-.350
35	1.751	.252	-.337
40	1.740	.372	-.306
45	1.688	.459	-.260
50	1.640	.526	-.204
55	1.566	.578	-.145
60	1.482	.637	-.118
65	1.394	.646	-.065

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.041	-0.417	-0.299
10	1.441	-.253	-.381
15	1.784	-.049	-.427
20	1.988	.143	-.444
25	2.133	.351	-.424
30	2.190	.513	-.391
35	2.165	.645	-.337
40	2.056	.753	-.291
45	1.983	.842	-.232
50	1.881	.897	-.165

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.30$			
5	1.252	-0.009	-0.390
10	1.817	.208	-.484
15	2.219	.445	-.512
20	2.504	.644	-.517
25	2.673	.870	-.494
30	2.615	1.036	-.442
35	2.561	1.166	-.371

(b) Fuselage data

α, deg	$C_{L,s(fus)}$			
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$	$C_{T,s} = 0.30$
5	0.036	0.060	0.093	0.130
10	.044	.074	.122	.167
15	.049	.082	.133	.170
20	.047	.089	.139	.171
25	.055	.089	.145	.170
30	.052	.102	.144	.136
35	.044	.092	.138	.119
40	.040	.077	.134	----
45	.032	.072	.116	----
50	.029	.064	.081	----
55	.017	.052	----	----
60	.012	.053	----	----
65	.006	.047	----	----

TABLE 16.- TABULATED AERODYNAMIC DATA FOR CONFIGURATION WITH PROPELLER ROTATION UP AT TIP, FULL-SPAN SLAT, FENCES ON, AND $\delta_f = 60^{\circ}$

(a) Wing data

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.90$			
5	0.959	-0.672	-0.331
10	1.109	-.541	-.342
15	1.236	-.409	-.365
20	1.376	-.244	-.358
25	1.433	-.097	-.375
30	1.499	.073	-.390
35	1.508	.208	-.383
40	1.508	.332	-.354
45	1.474	.409	-.308
50	1.415	.429	-.257
55	1.340	.408	-.187
60	1.284	.428	-.154
65	1.245	.437	-.101
70	1.205	.489	-.068

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.80$			
5	1.216	-0.451	-0.412
10	1.433	-.283	-.444
15	1.590	-.117	-.457
20	1.747	.095	-.474
25	1.820	.284	-.468
30	1.818	.419	-.440
35	1.766	.506	-.380
40	1.692	.550	-.327
45	1.607	.575	-.252
50	1.539	.614	-.192
55	1.445	.651	-.176
60	1.406	.697	-.117
65	1.308	.657	-.059

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.60$			
5	1.540	-0.119	-0.496
10	1.865	.102	-.543
15	2.141	.354	-.576
20	2.273	.562	-.563
25	2.296	.704	-.505
30	2.199	.760	-.409
35	2.082	.818	-.327
40	1.985	.889	-.276

α, deg	$C_{L,s}$	$C_{D,s}$	$C_{m,s}$
$C_{T,s} = 0.30$			
5	1.862	0.304	-0.552
10	2.325	.582	-.620
15	2.622	.840	-.647
20	2.789	1.055	-.618
25	2.711	1.144	-.519
30	2.477	1.173	-.401
35	2.368	1.235	-.313

(b) Fuselage data

α, deg	$C_{L,s(fus)}$			
	$C_{T,s} = 0.90$	$C_{T,s} = 0.80$	$C_{T,s} = 0.60$	$C_{T,s} = 0.30$
5	0.041	0.077	0.118	0.195
10	.051	.093	.117	.228
15	.059	.106	.117	.217
20	.060	.108	.114	.215
25	.057	.113	.113	.169
30	.061	.110	.112	.117
35	.045	.086	.111	.096
40	.040	.071	.112	----
45	.051	.055	----	----
50	.020	.050	----	----
55	.006	.055	----	----
60	-.004	.043	----	----
65	-.006	.041	----	----
70	.004	----	----	----

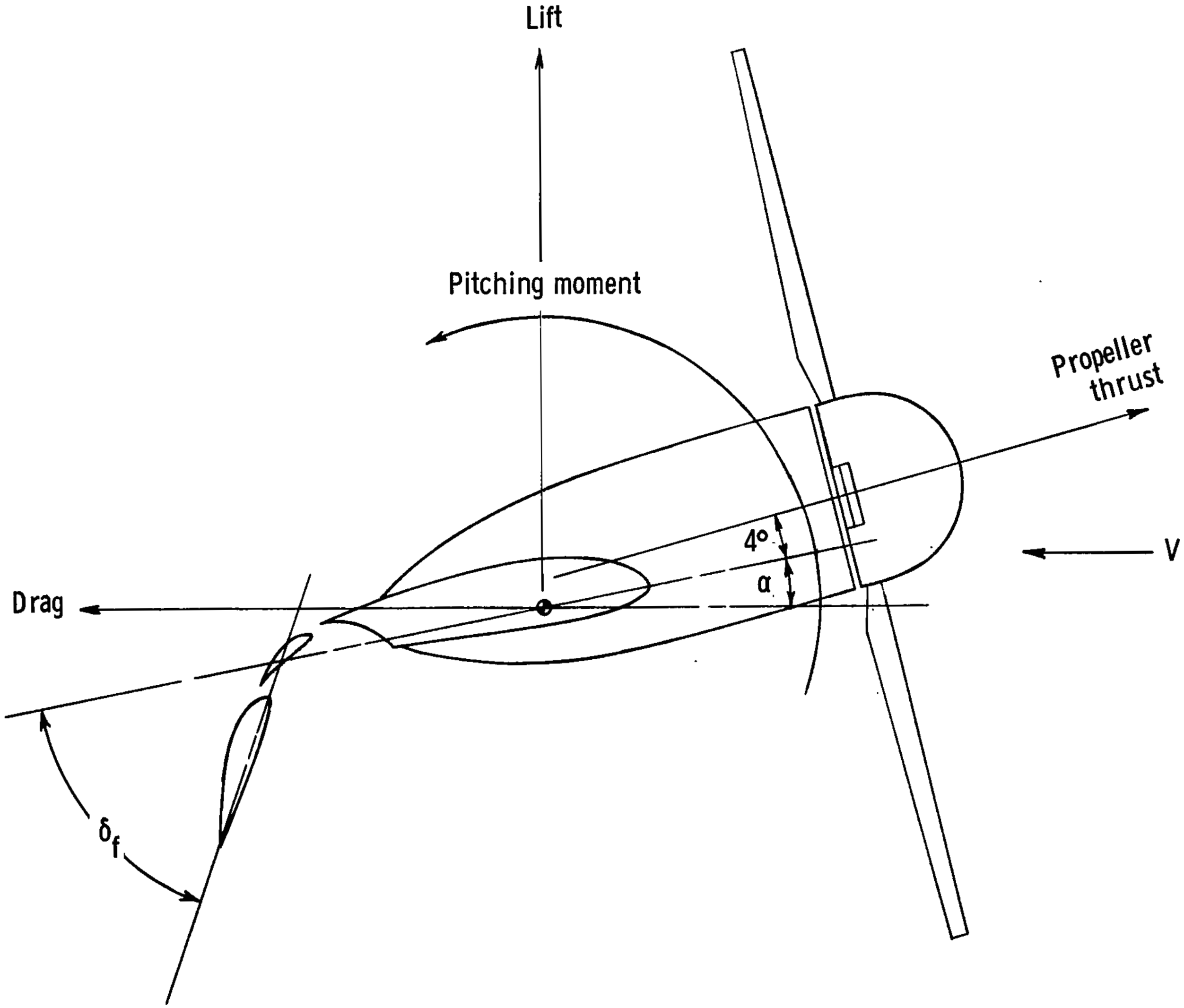
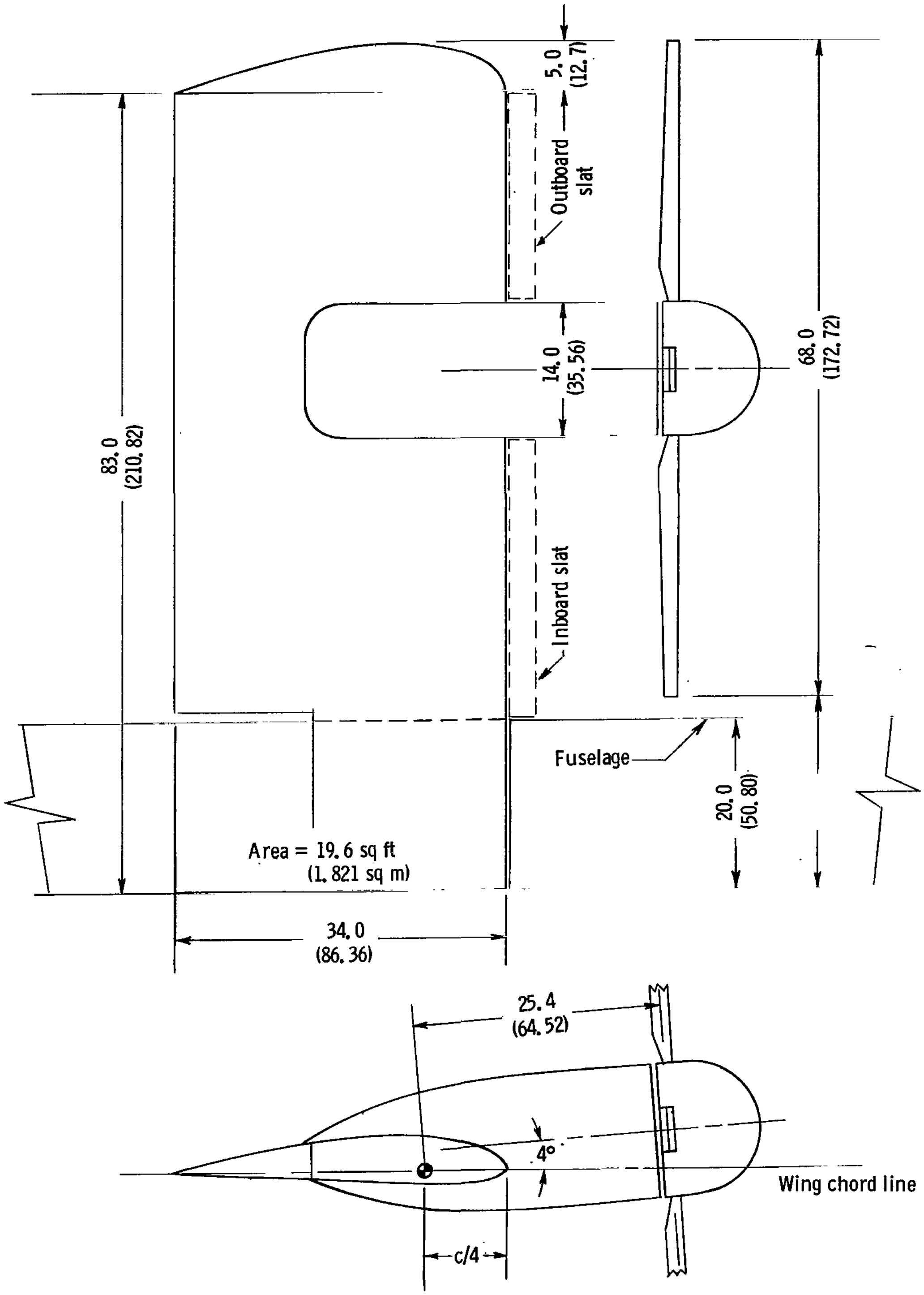
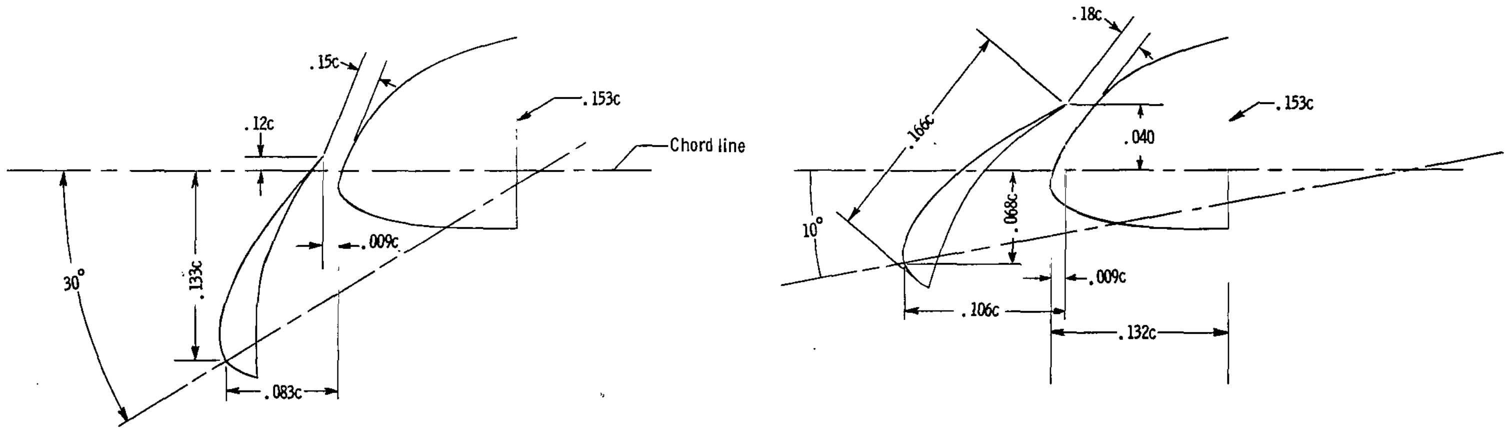


Figure 1.- The positive sense of forces, moments, and angles.



(a) Principal dimensions are in inches; numbers in parentheses are in centimeters.

Figure 2.- Principal dimensions of model.

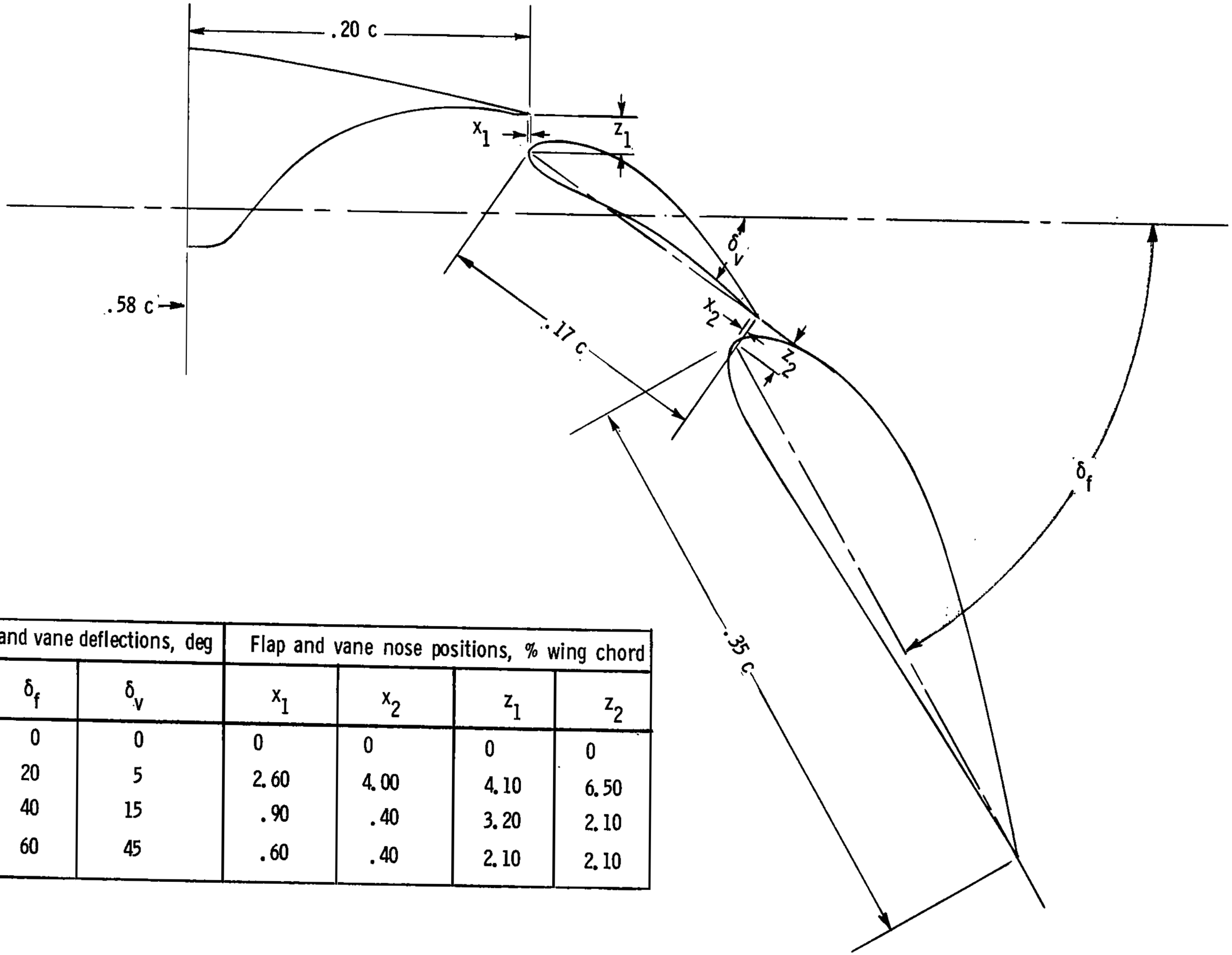


Leading-edge slat position

Slat position over fuselage

(b) Sectional views of leading-edge slat configuration.

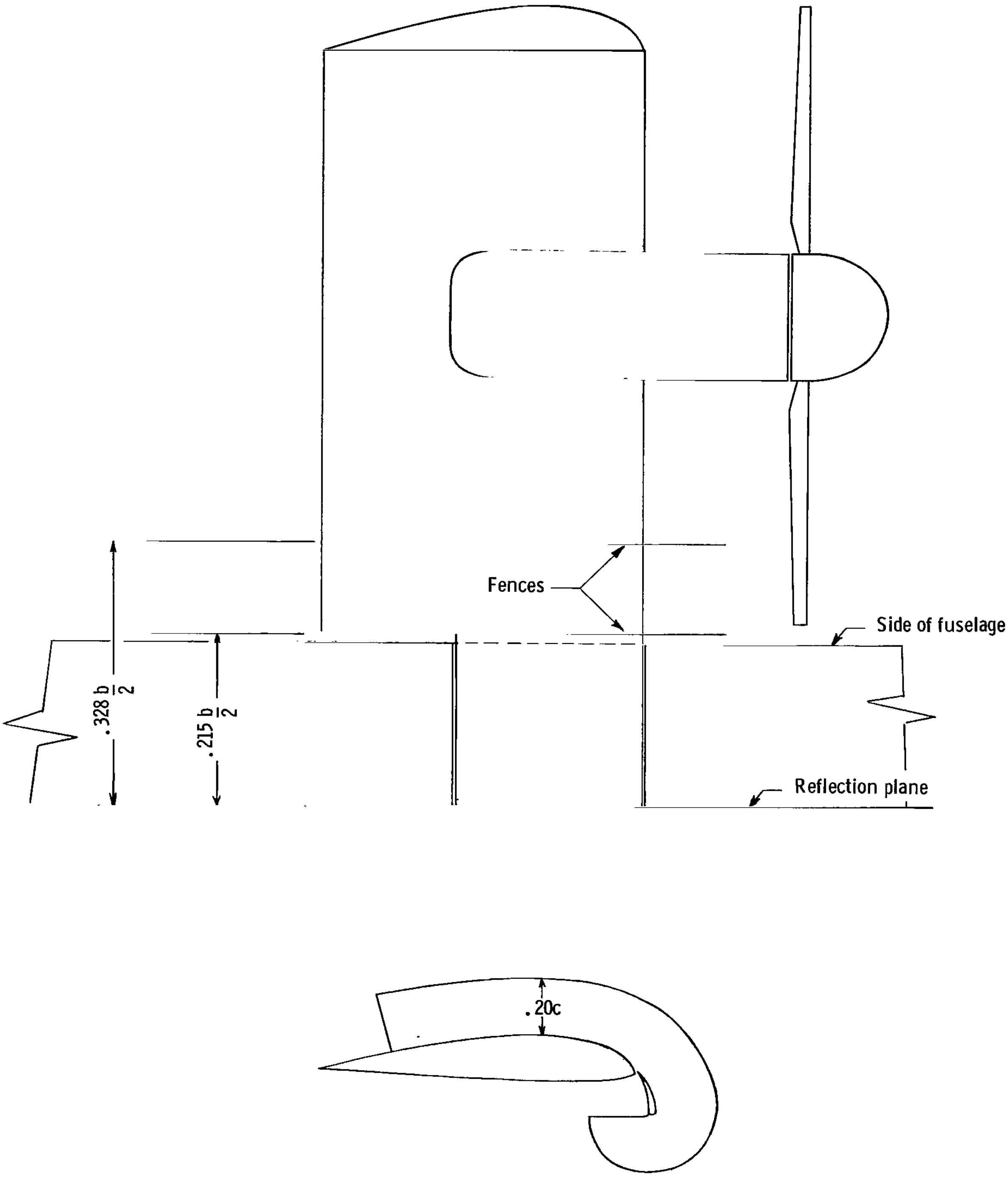
Figure 2.- Continued.



Flap and vane deflections, deg		Flap and vane nose positions, % wing chord			
δ_f	δ_v	x_1	x_2	z_1	z_2
0	0	0	0	0	0
20	5	2.60	4.00	4.10	6.50
40	15	.90	.40	3.20	2.10
60	45	.60	.40	2.10	2.10

(c) Sectional view of trailing-edge flap.

Figure 2.- Continued.



(d) Sectional view and location of fences.

Figure 2.- Concluded.

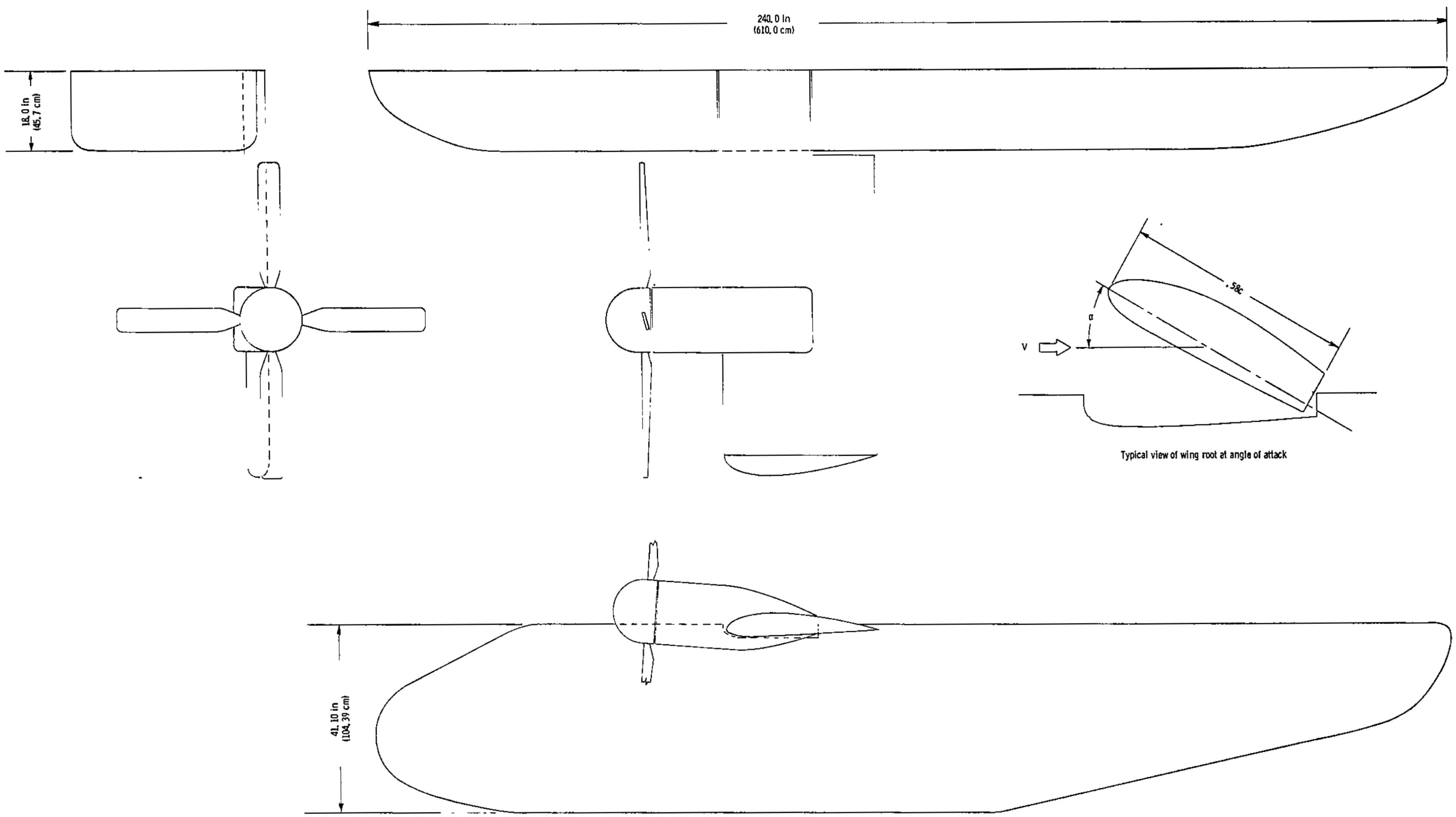


Figure 3.- Three-view drawing of the wing and fuselage.

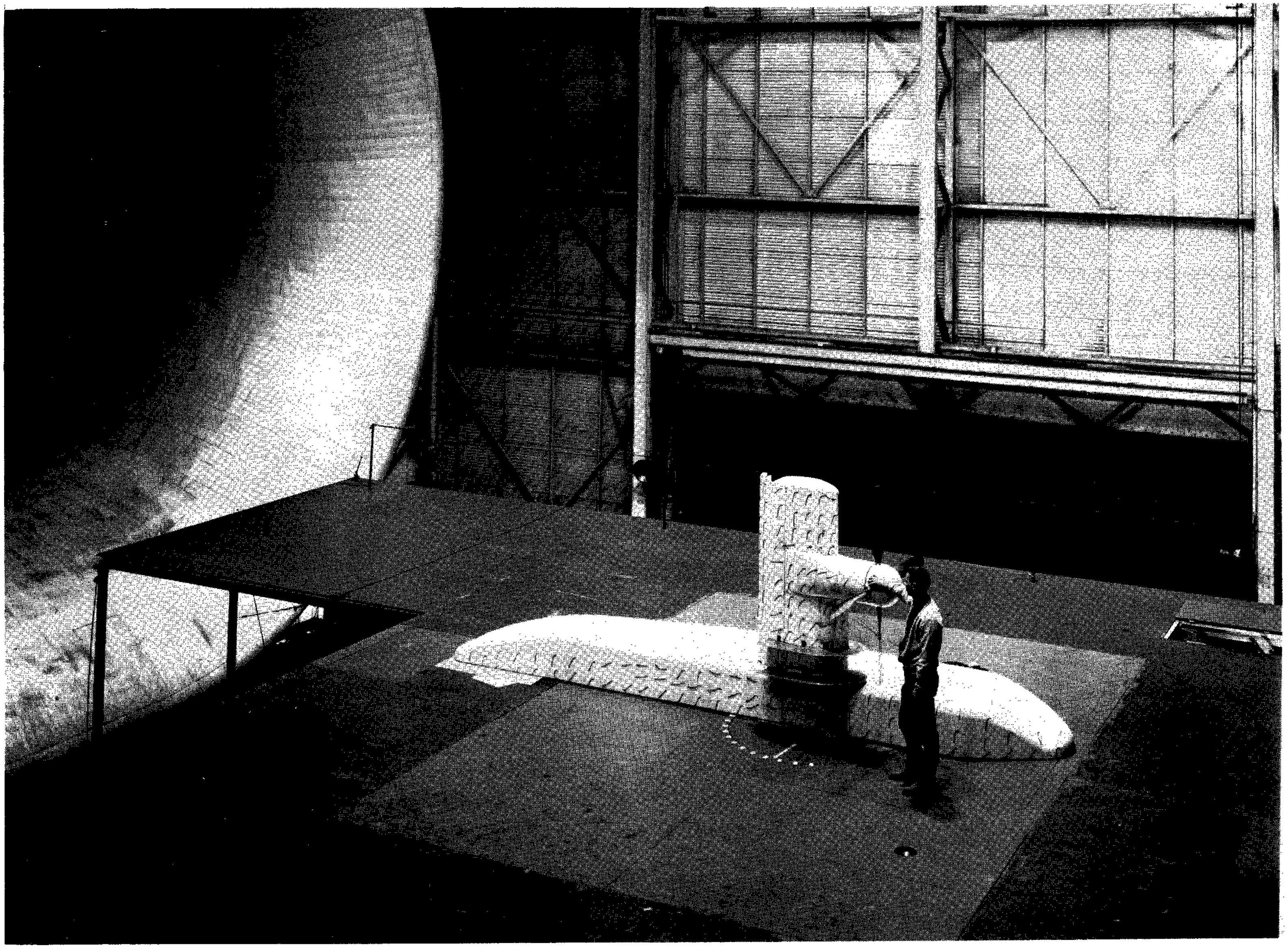


Figure 4.- Photograph of model in the tunnel.

L-65-2147

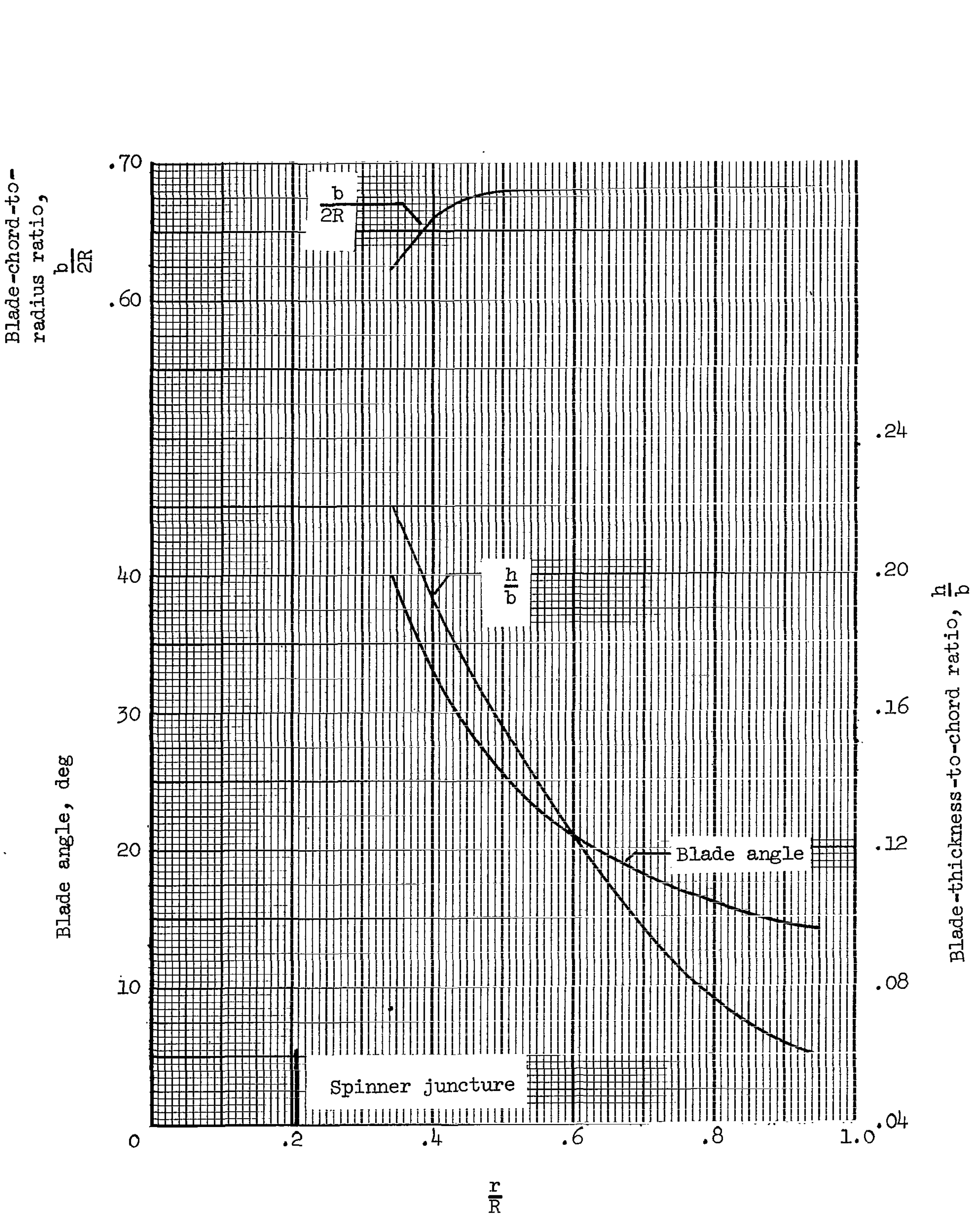
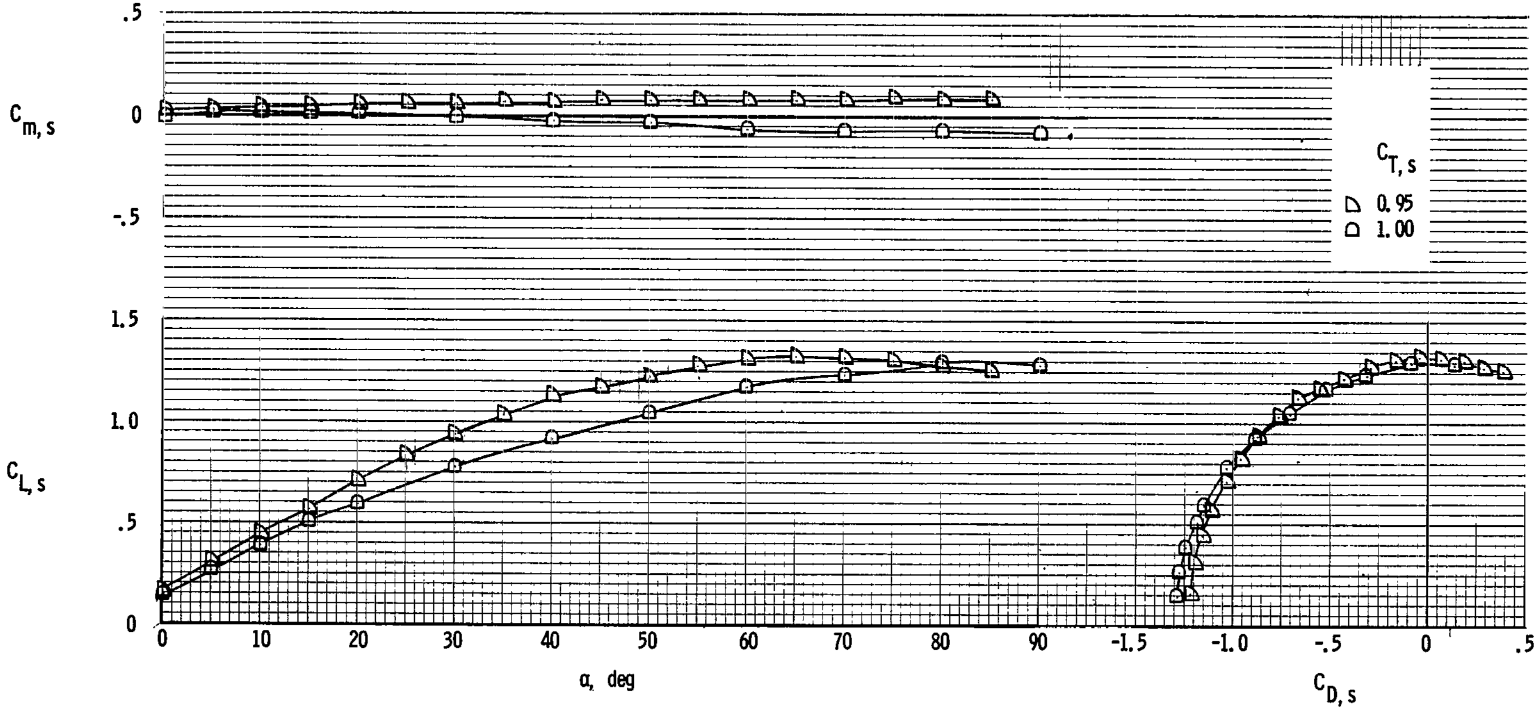
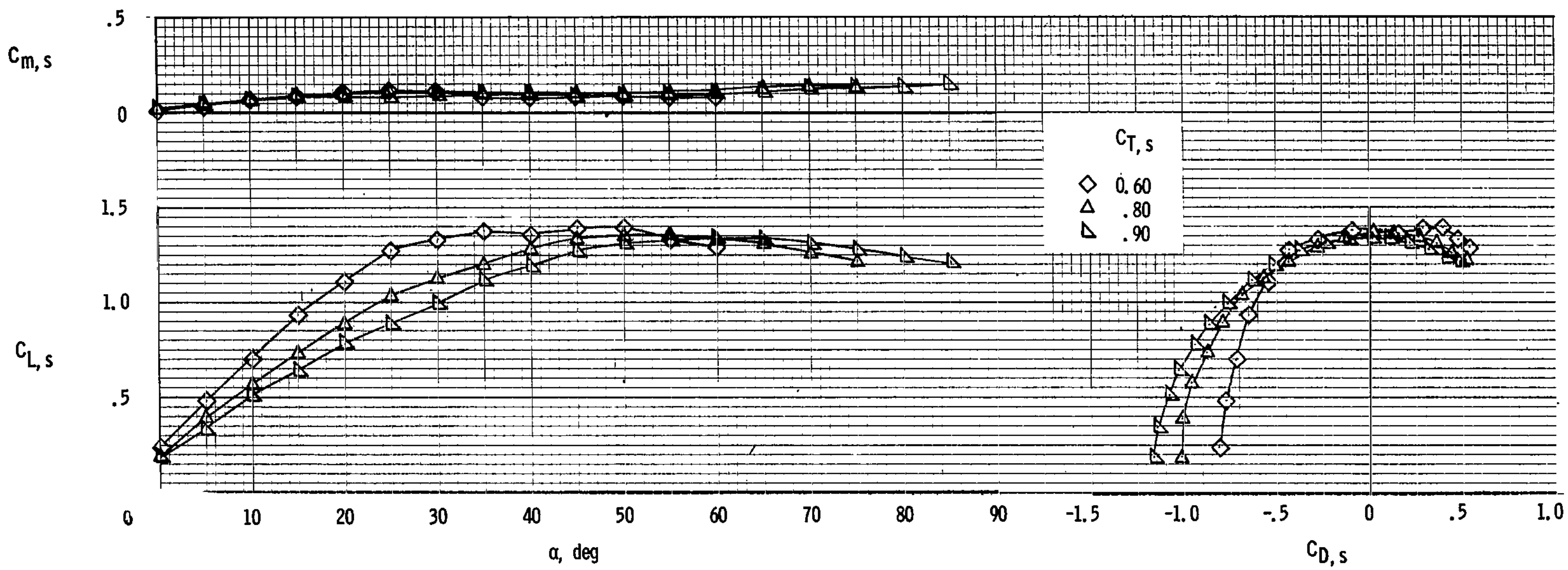


Figure 5.- Propeller blade form curves.



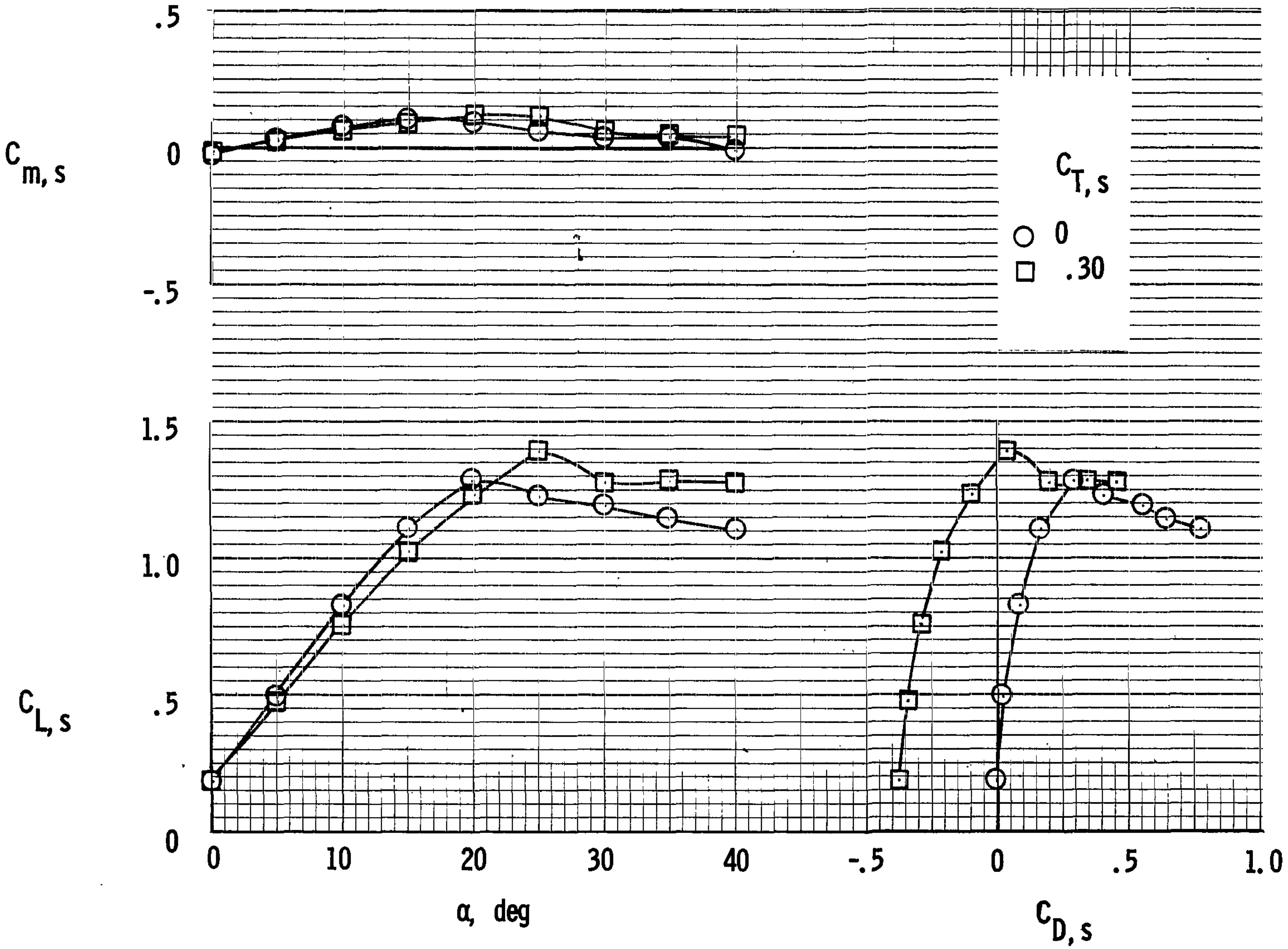
(a) Aerodynamic characteristics.

Figure 6.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Basic leading edge; $\delta_f = 0^0$.



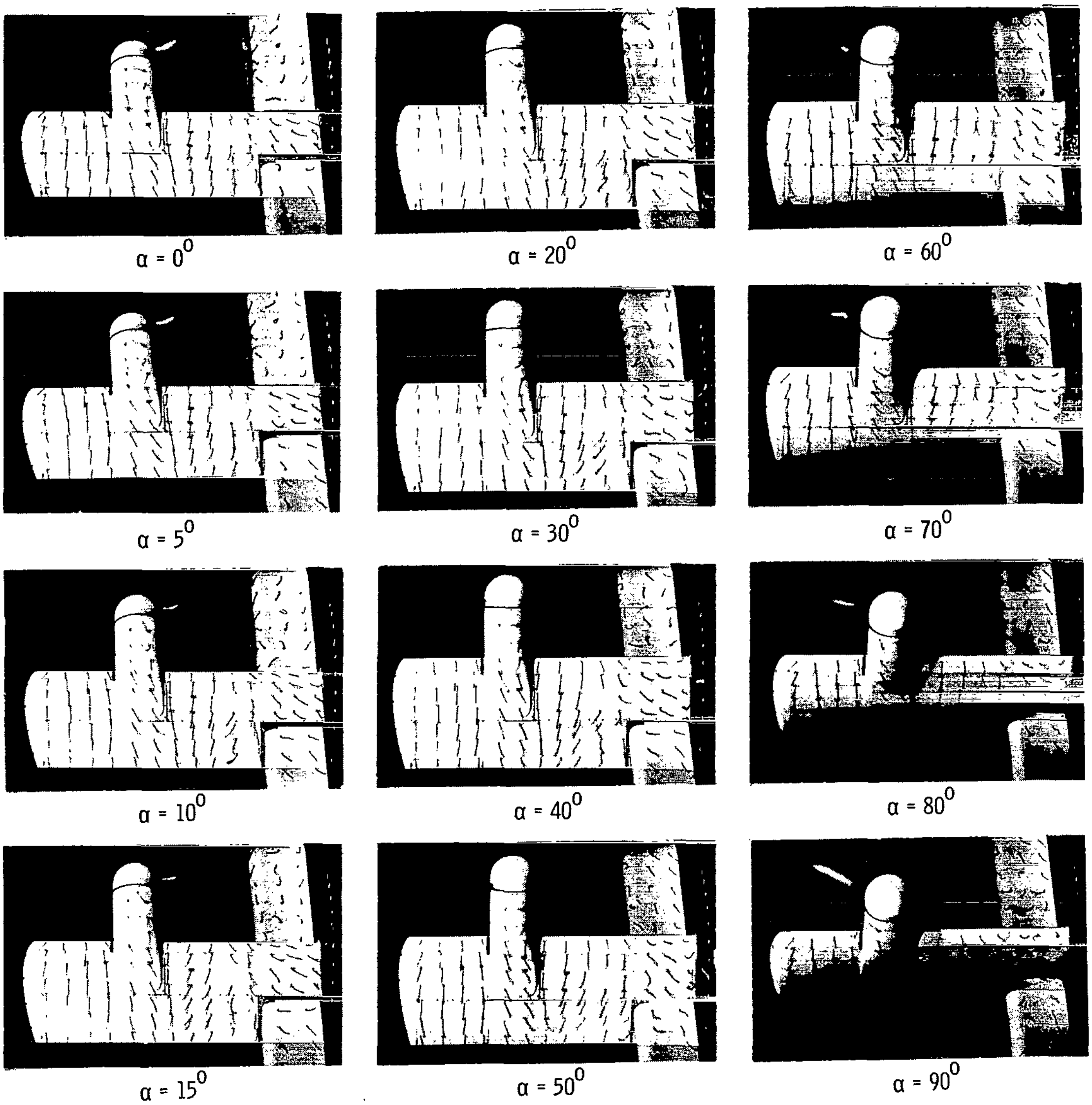
(a) Continued.

Figure 6.- Continued.



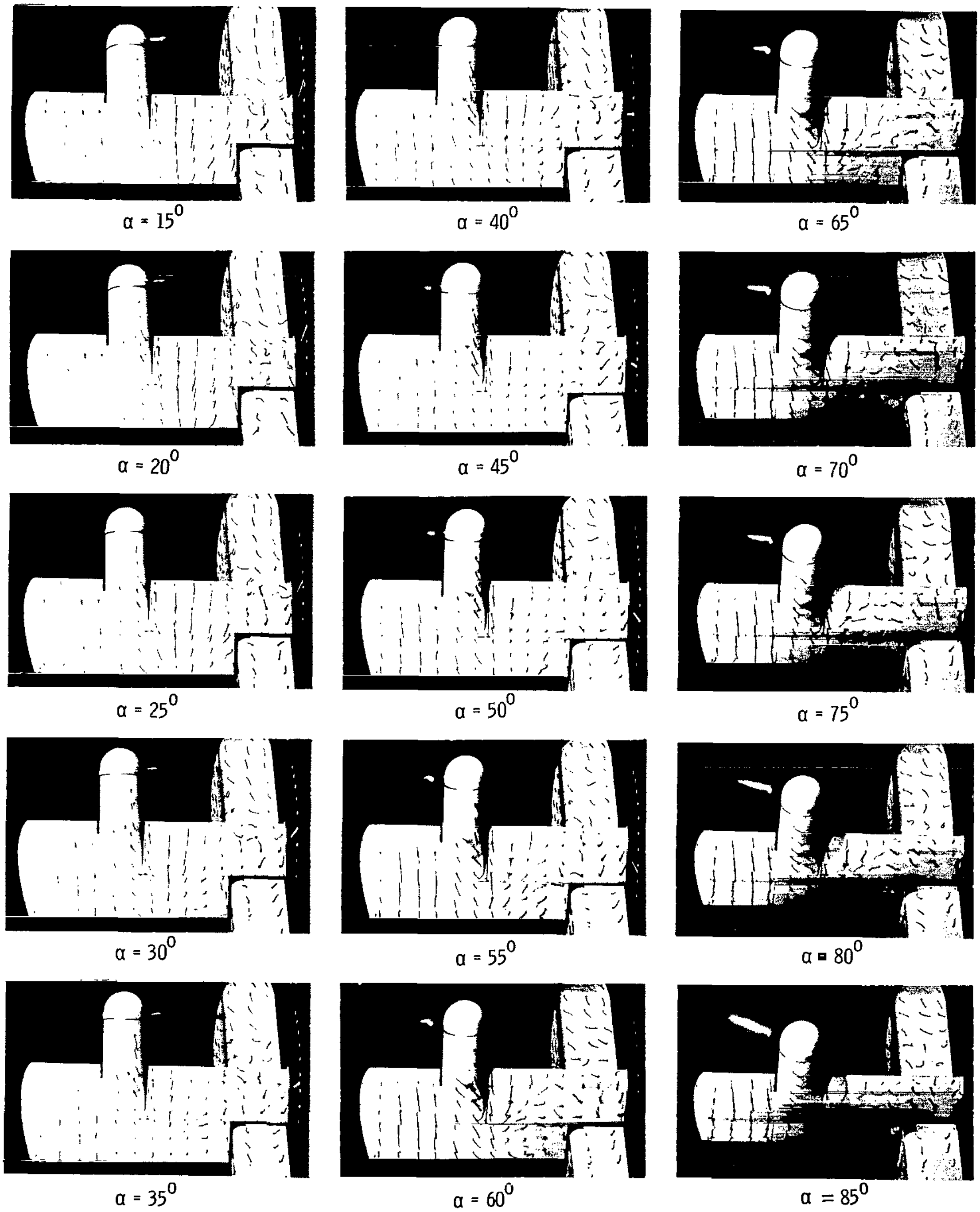
(a) Concluded.

Figure 6.- Continued.



(b) Flow characteristics; $C_{T,s} = 1.00$. L-66-4469

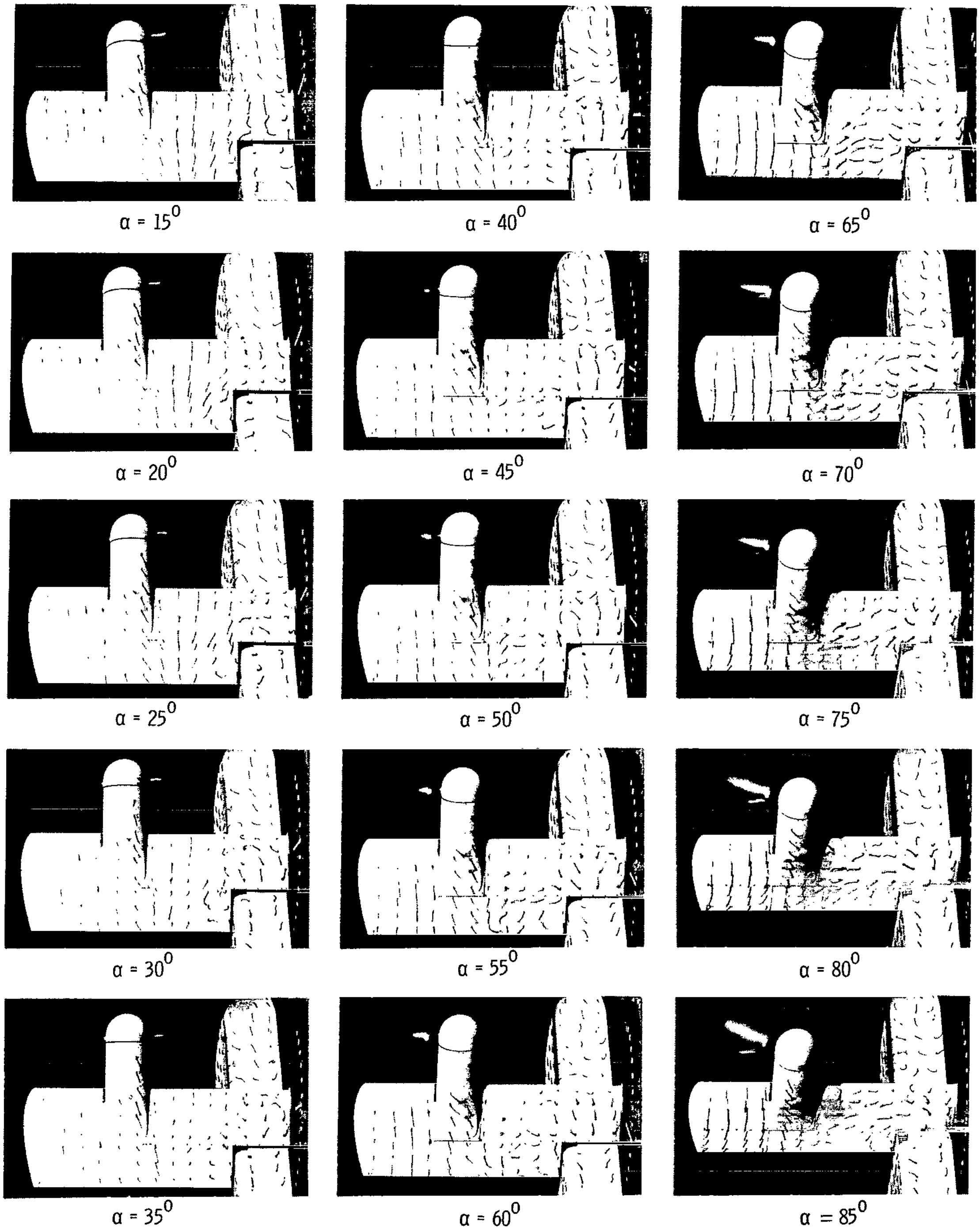
Figure 6.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.95$.

L-66-4470

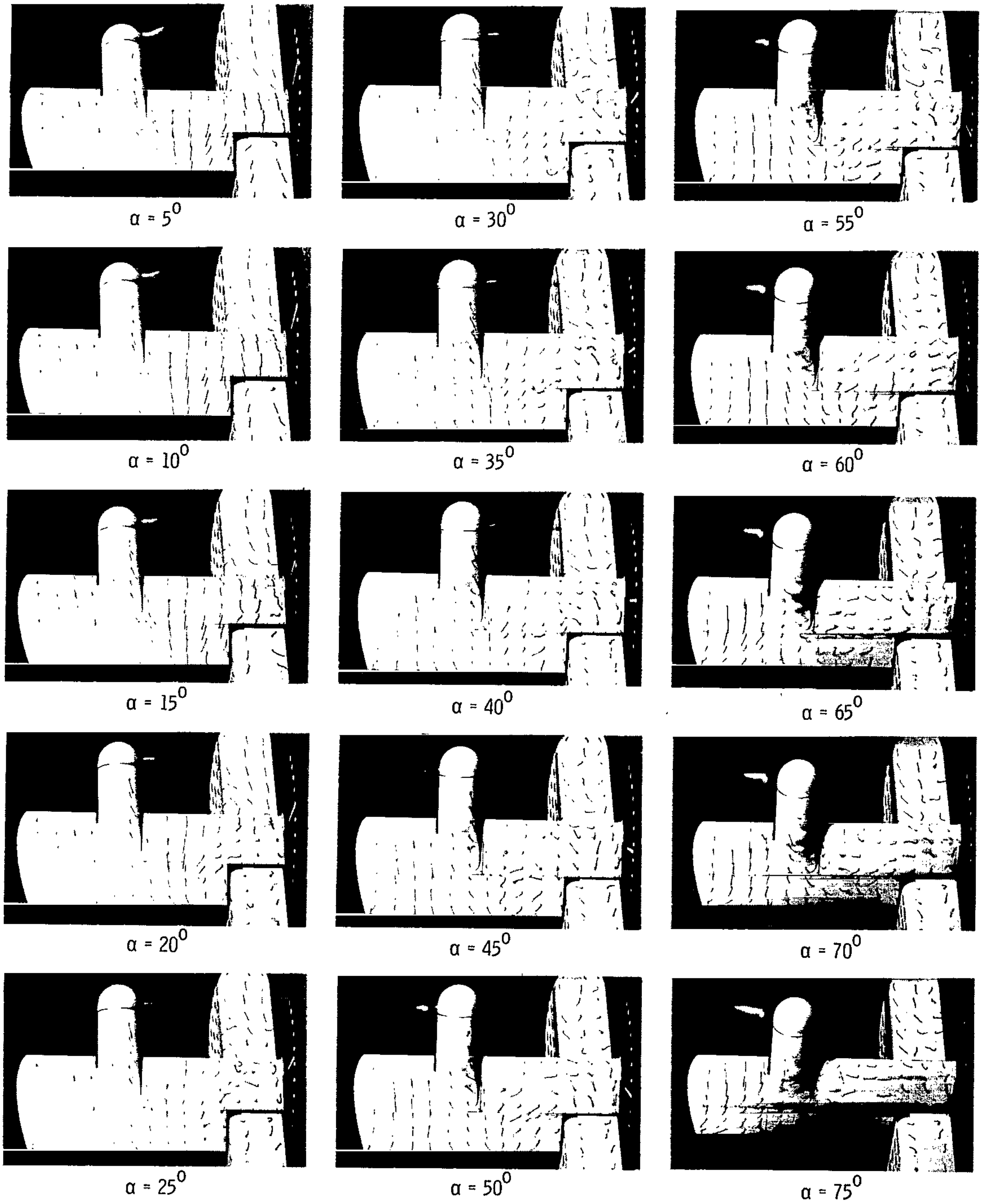
Figure 6.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.90$.

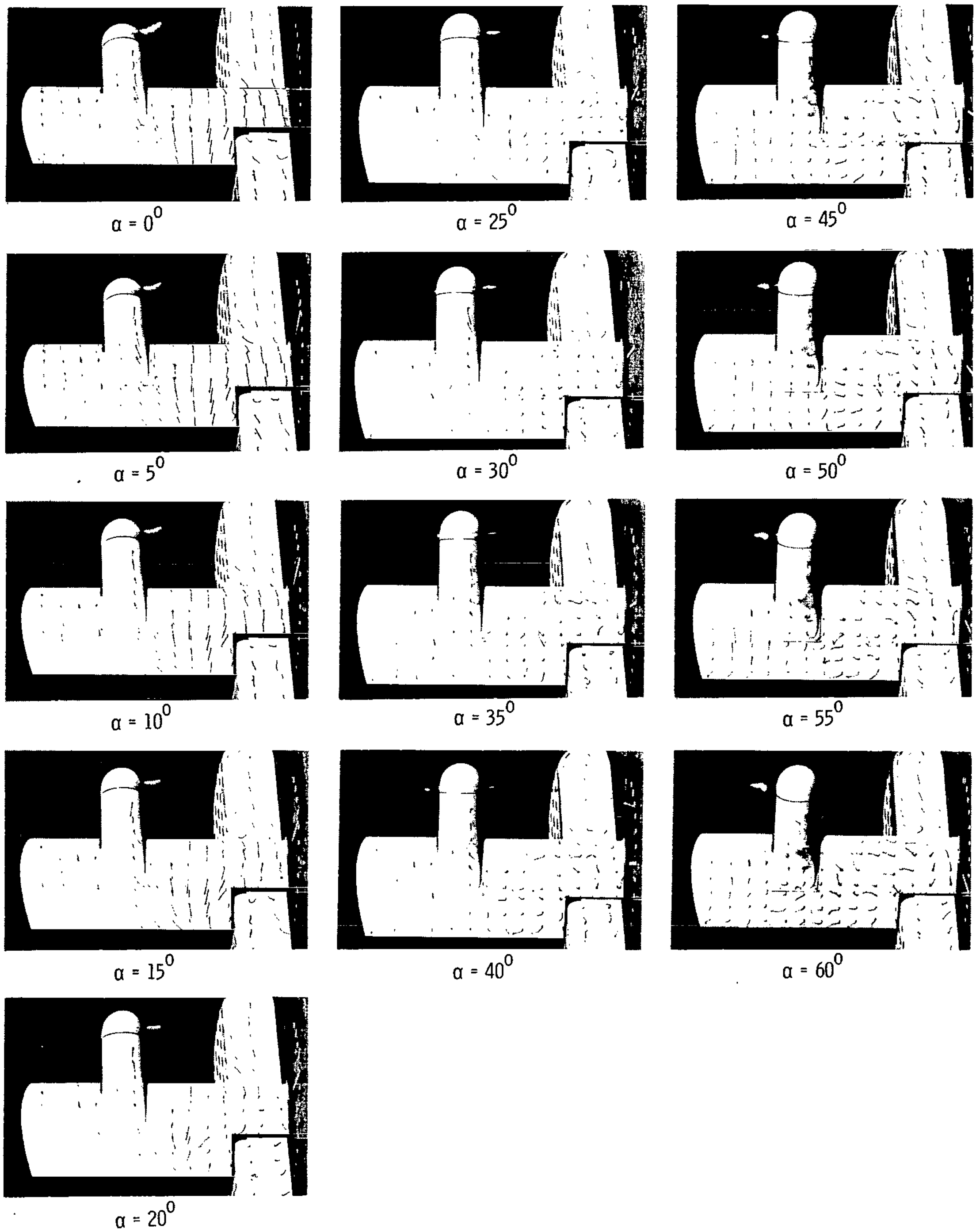
L-66-4471

Figure 6.- Continued.



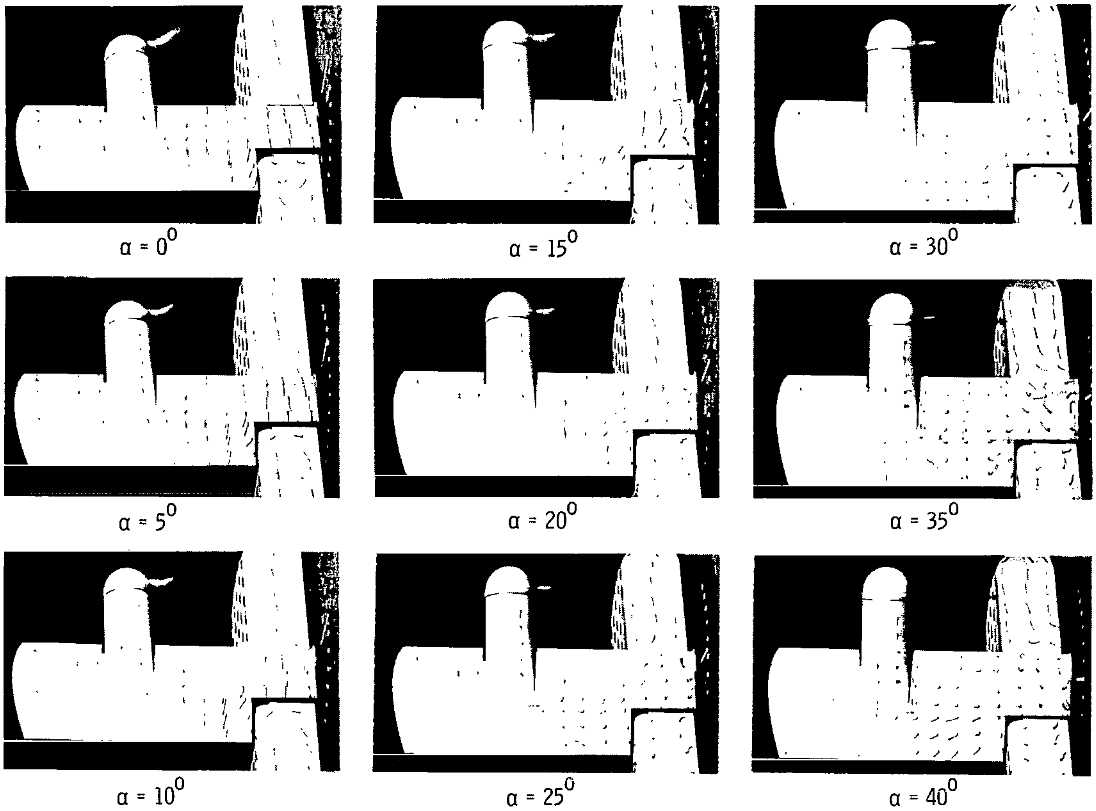
(e) Flow characteristics; $C_{T,s} = 0.80$. L-66-4472

Figure 6.- Continued.



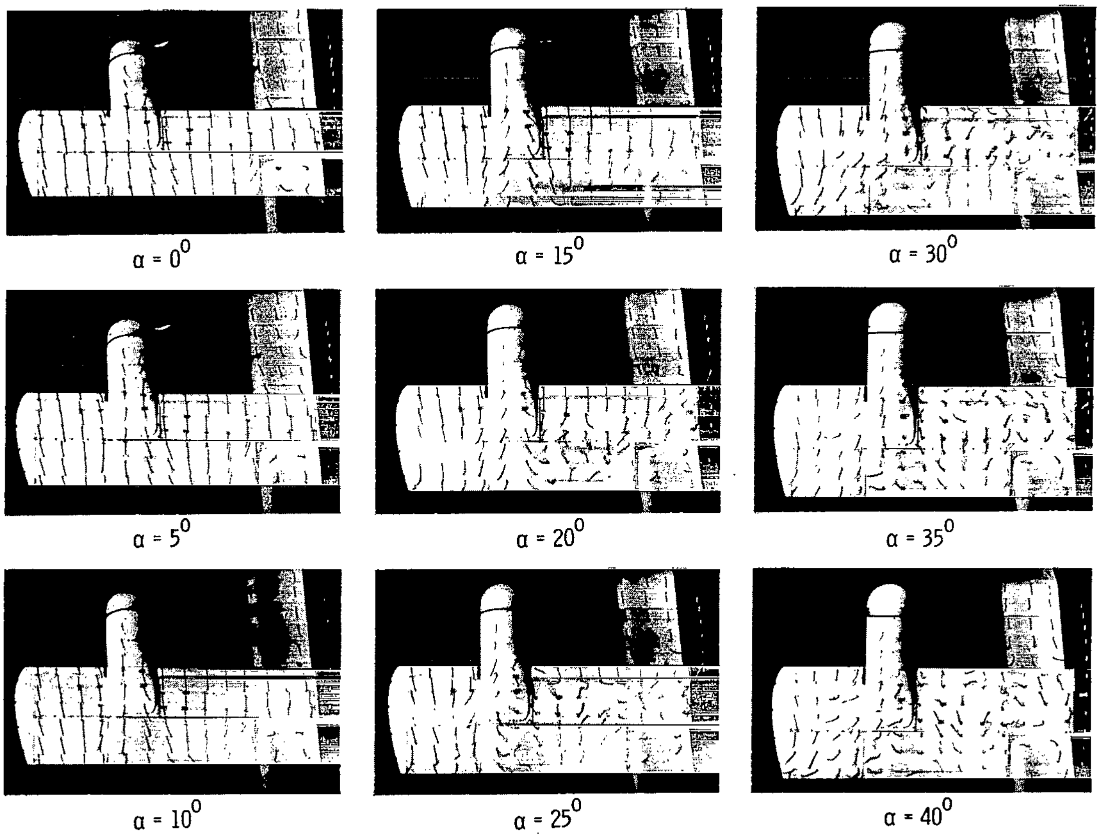
(f) Flow characteristics; $C_{T,s} = 0.60$. L-66-4473

Figure 6.- Continued.



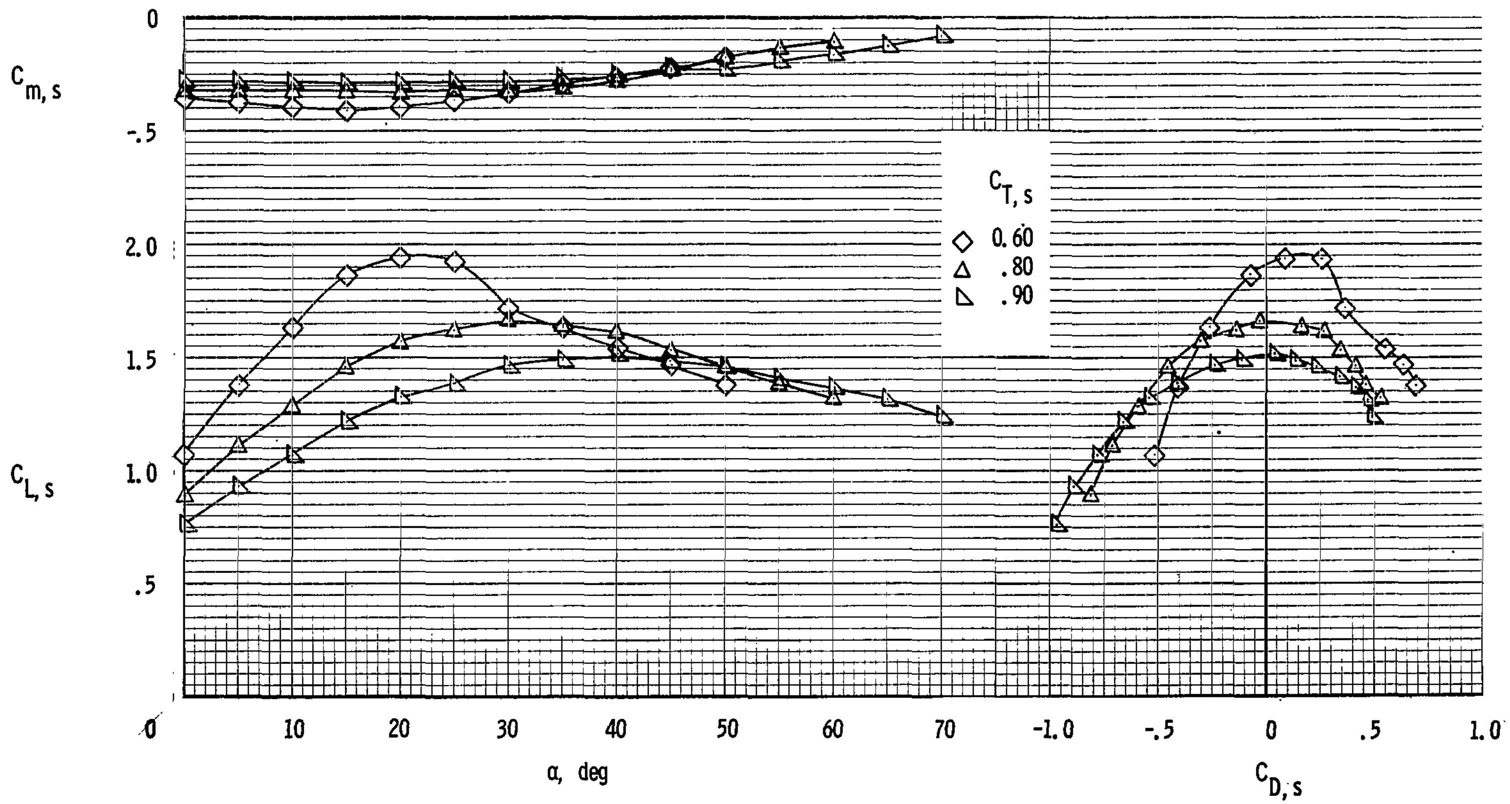
(g) Flow characteristics; $C_{T,s} = 0.30$. L-66-4474

Figure 6.- Continued.



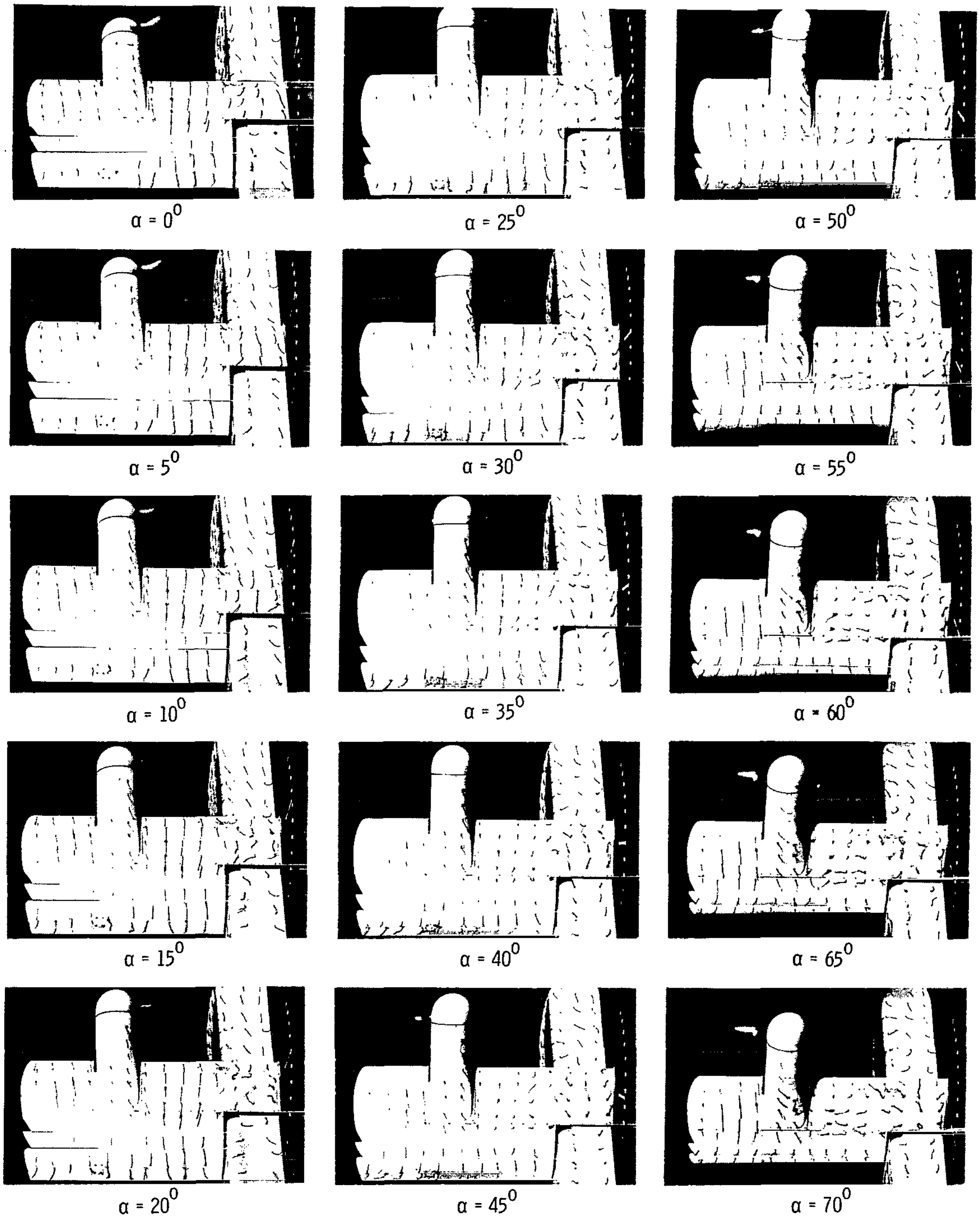
(h) Flow characteristics; $C_{T,s} = 0$. L-66-4475

Figure 6.- Concluded.



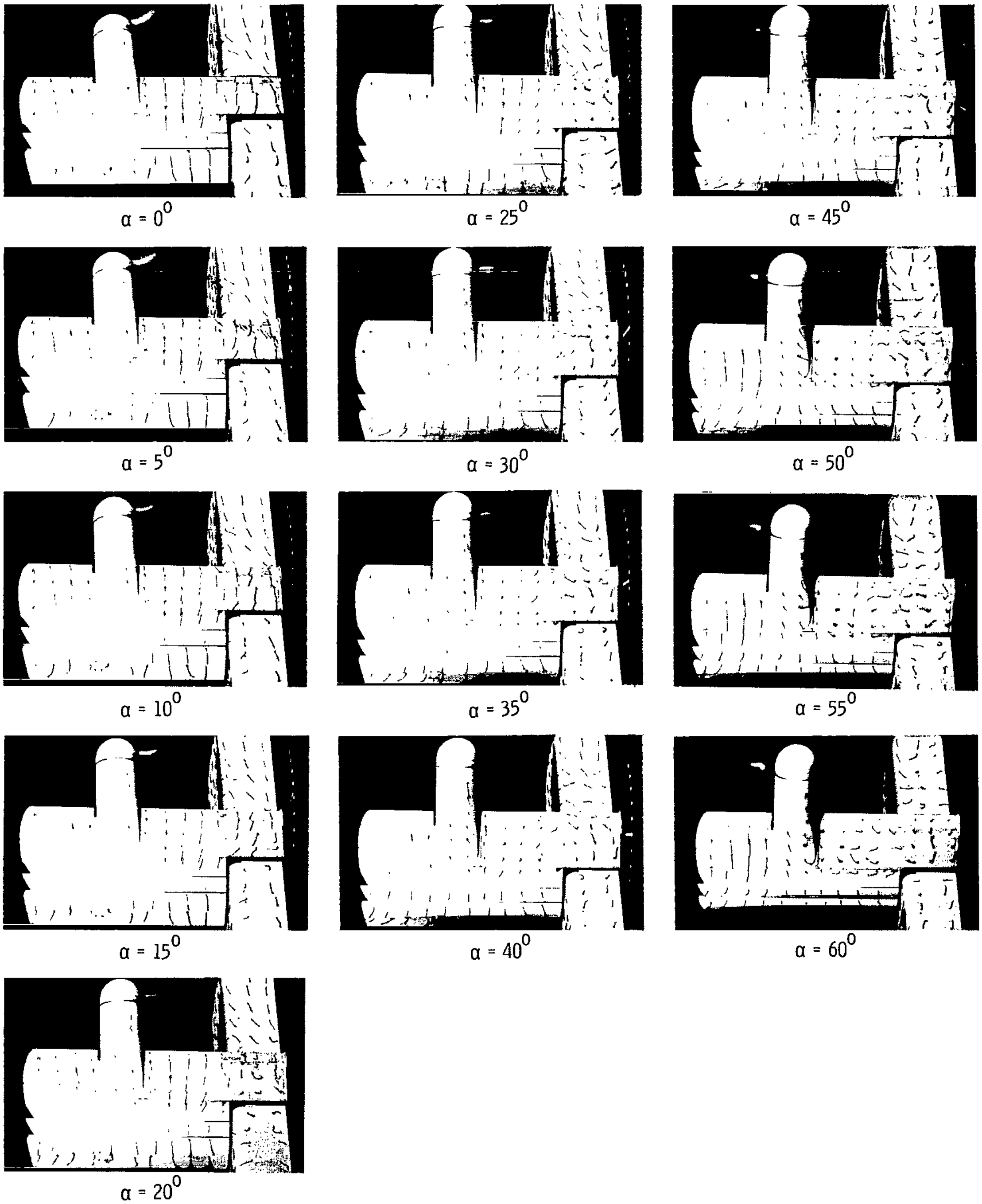
(a) Aerodynamic characteristics.

Figure 7.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Basic leading edge; $\delta_f = 40^0$.



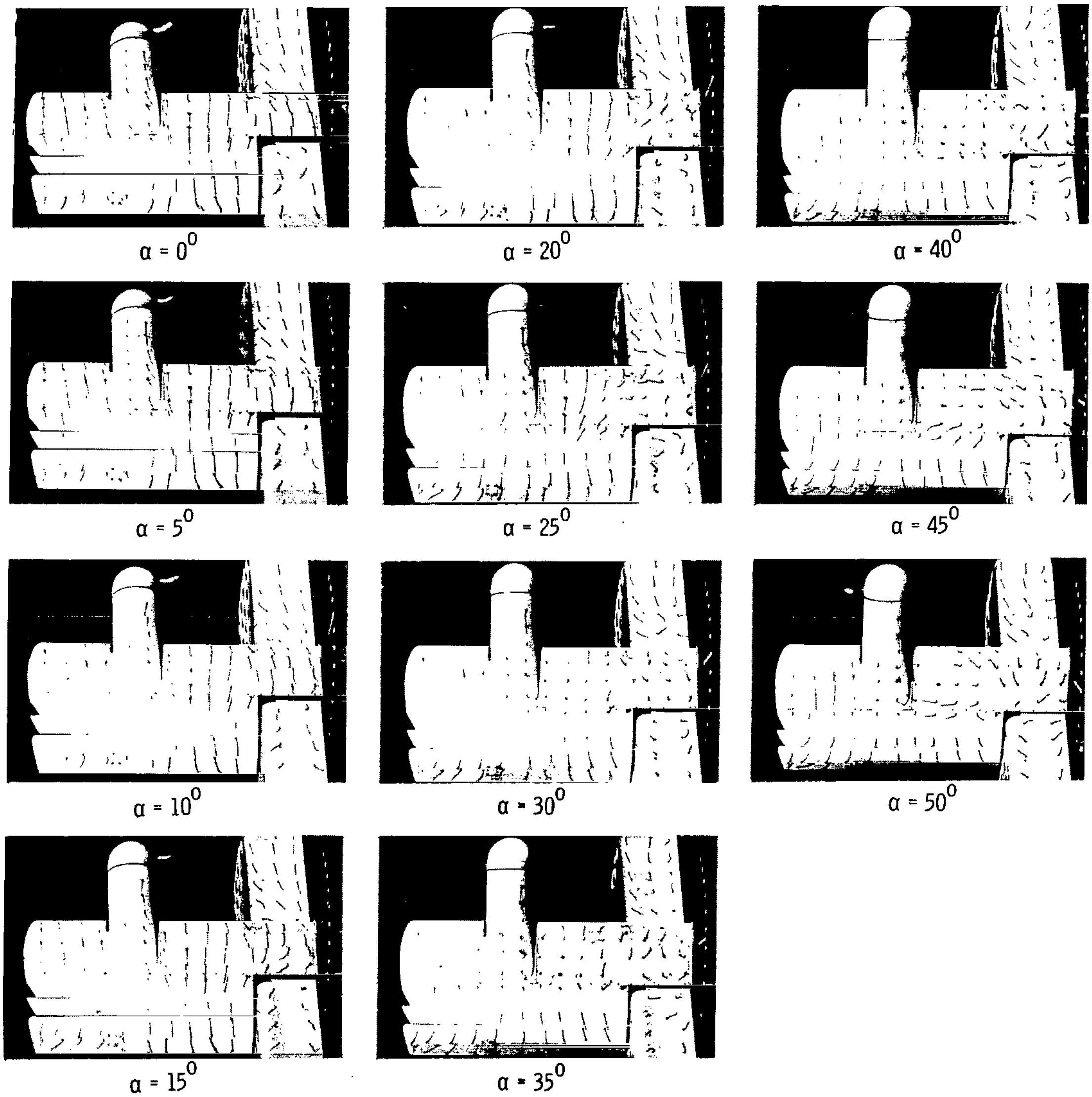
(b) Flow characteristics; $C_{T,s} = 0.90$.   L-66-4476

Figure 7.- Continued.



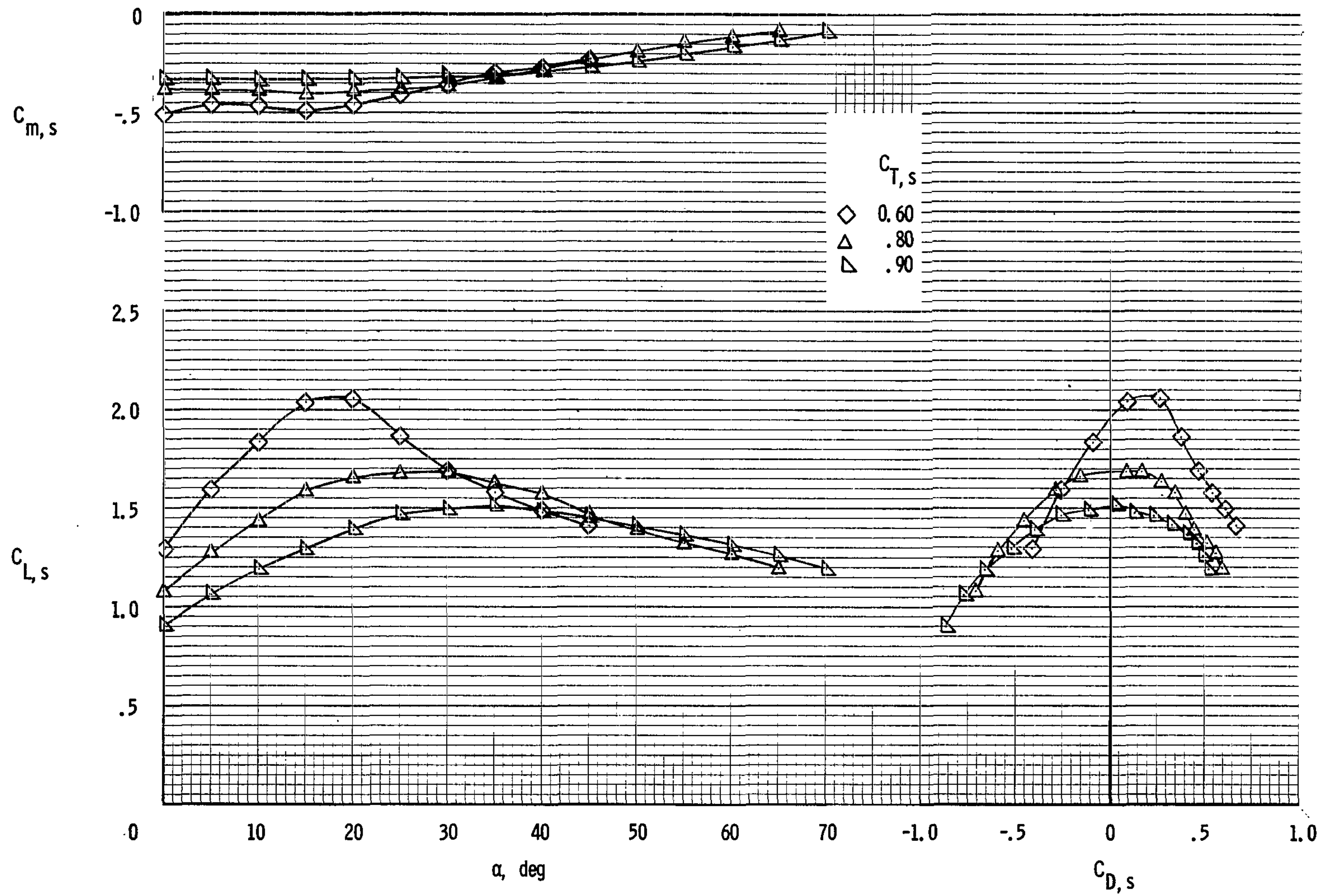
(c) Flow characteristics; $C_{T,s}$ = 0.80. L-66-4477

Figure 7.- Continued.



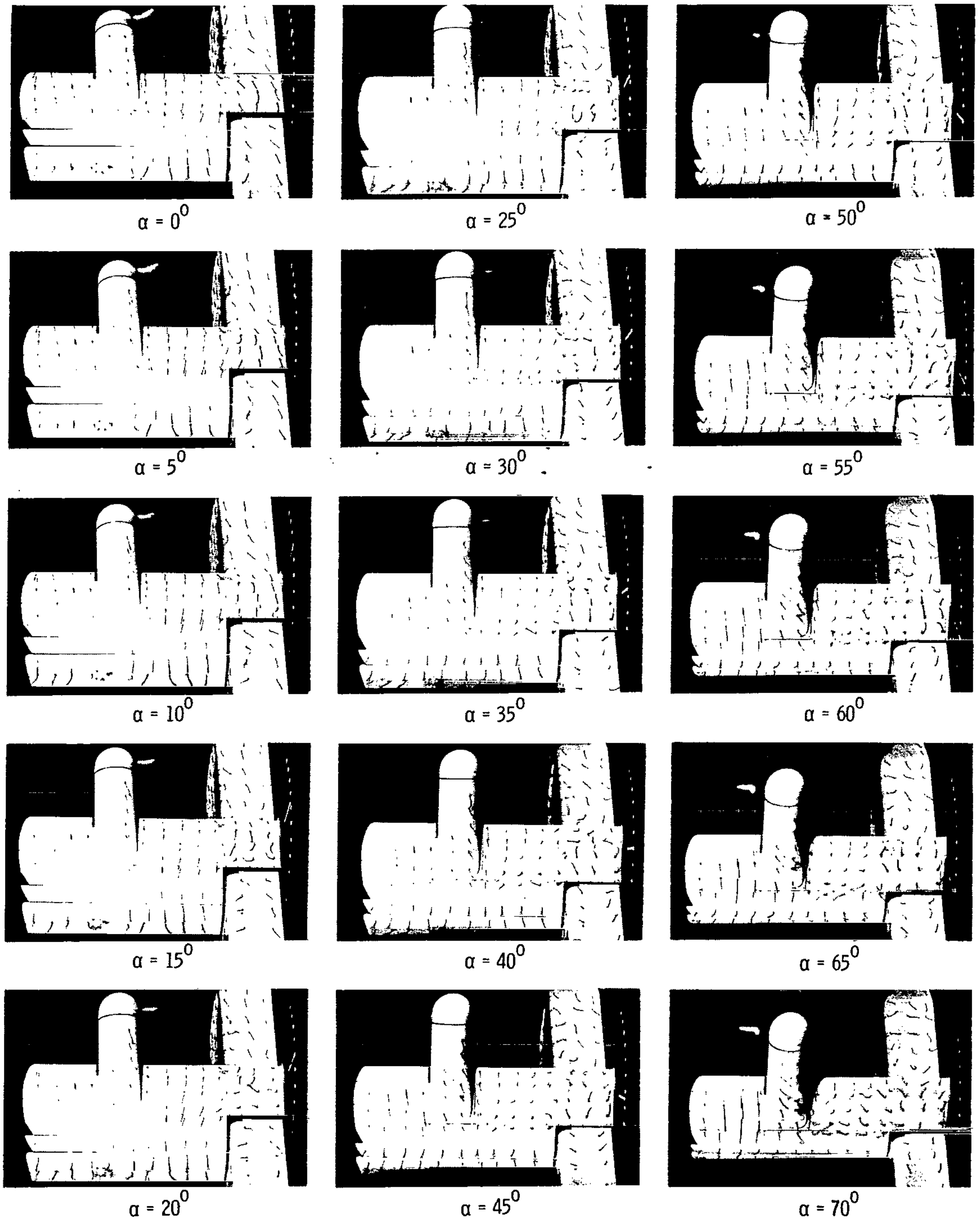
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4478

Figure 7.- Concluded.



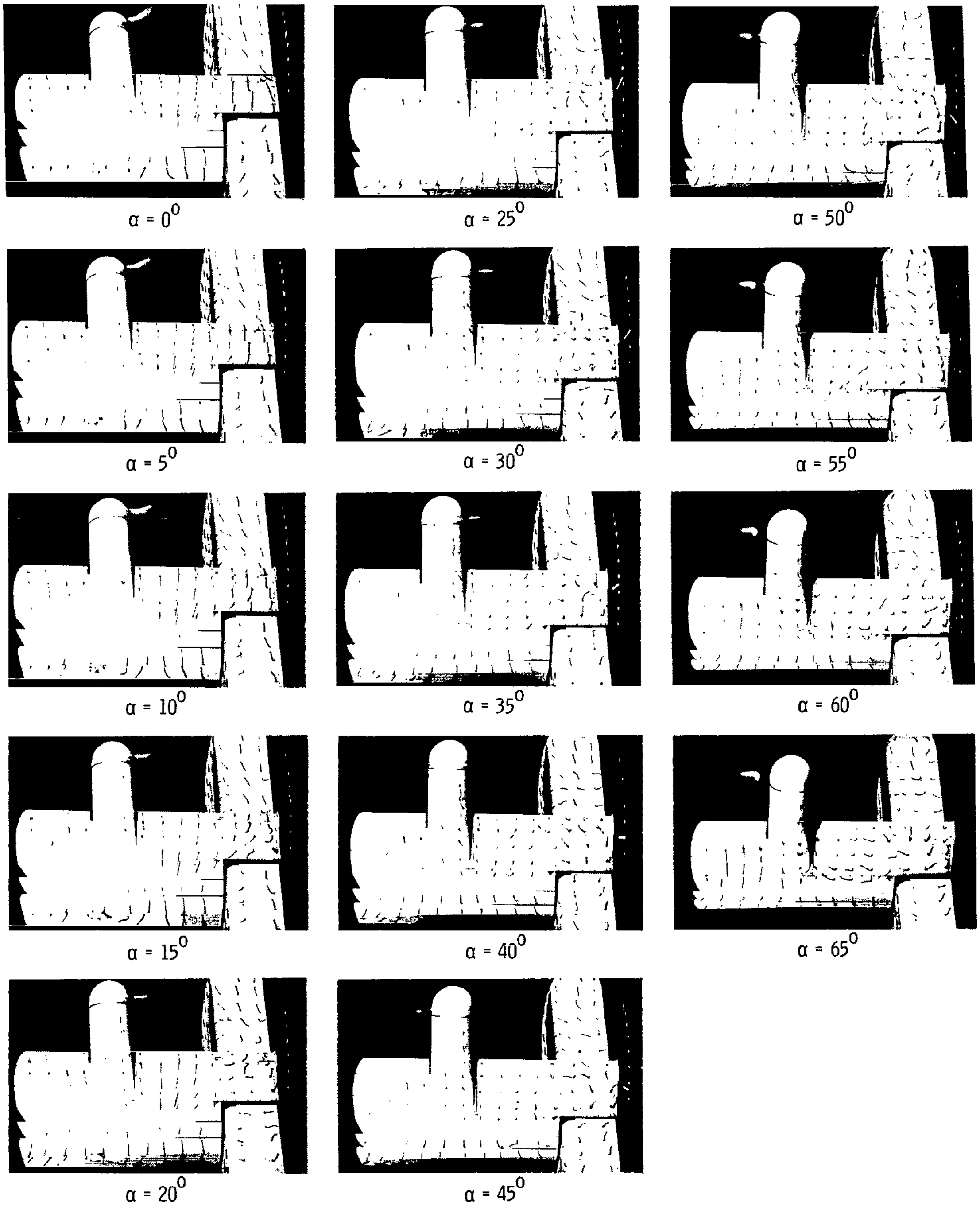
(a) Aerodynamic characteristics.

Figure 8.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Basic leading edge; $\delta_f = 60^0$.



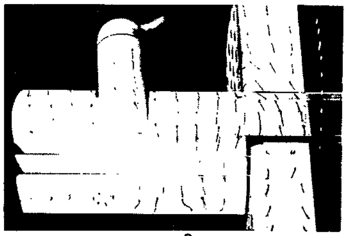
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4479

Figure 8.- Continued.

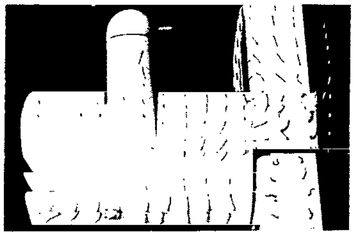


(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4480

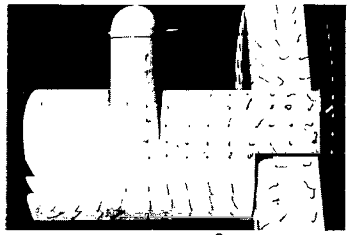
Figure 8.- Continued.



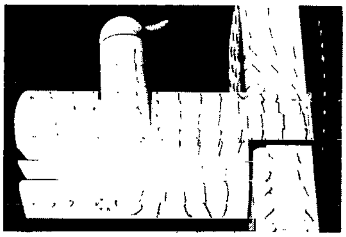
$\alpha = 0^{0}$



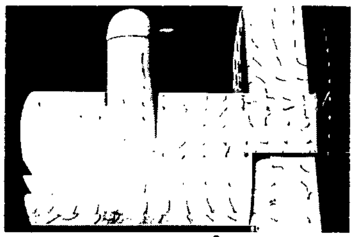
$\alpha = 20^{0}$



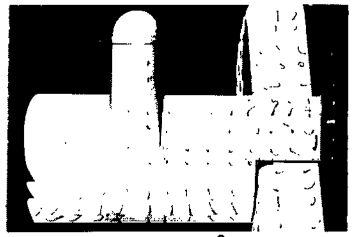
$\alpha = 35^{0}$



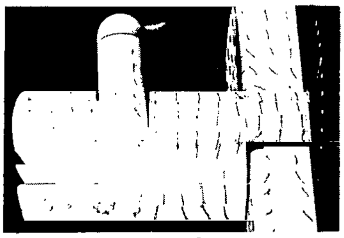
$\alpha = 5^{0}$



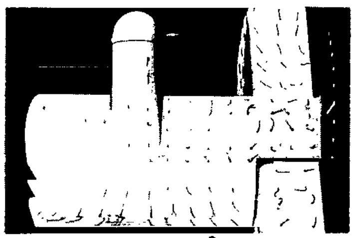
$\alpha = 25^{0}$



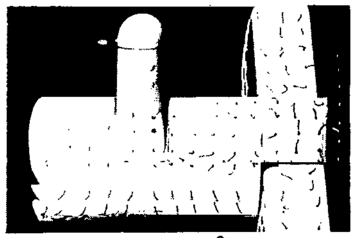
$\alpha = 40^{0}$



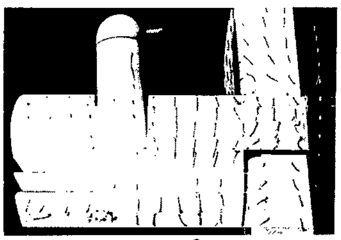
$\alpha = 10^{0}$



$\alpha = 30^{0}$



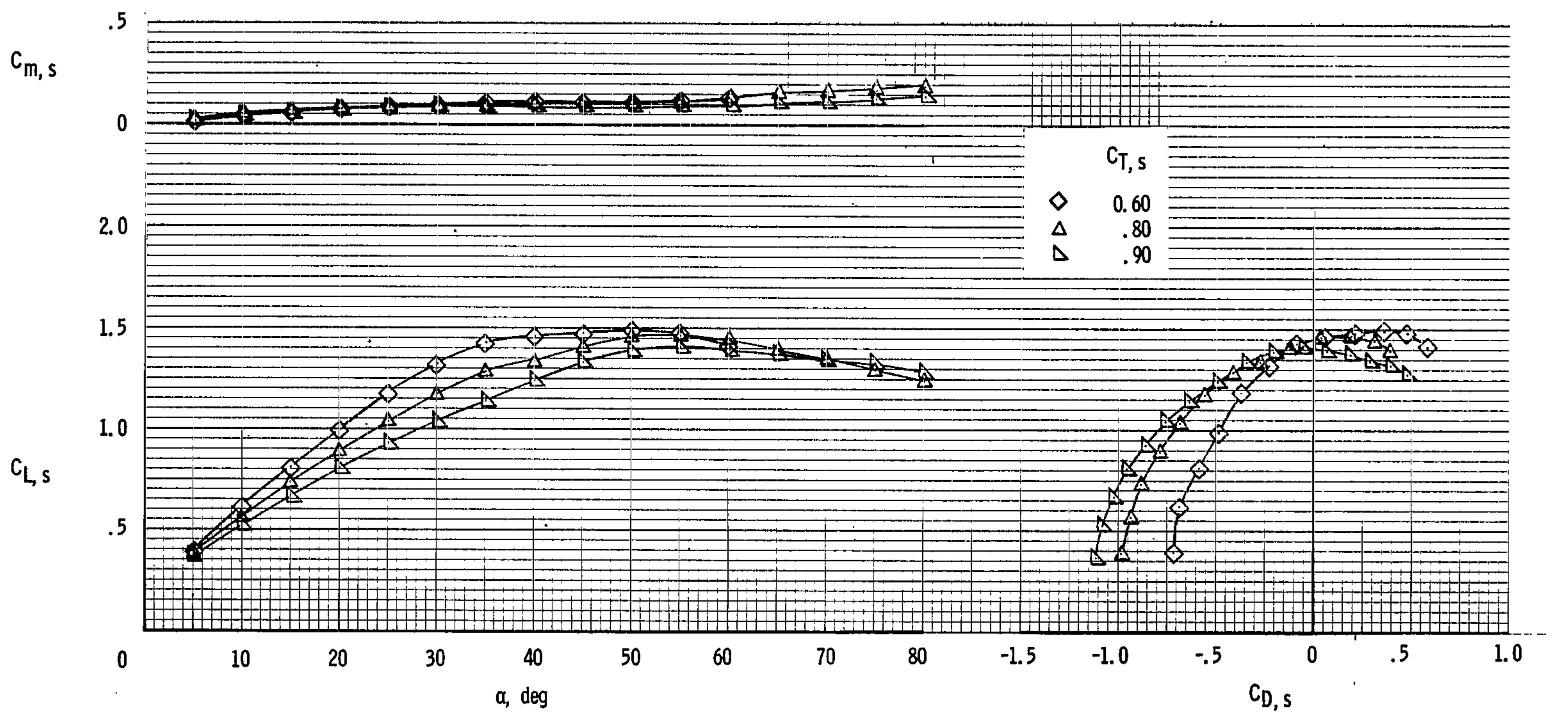
$\alpha = 45^{0}$



$\alpha = 15^{0}$

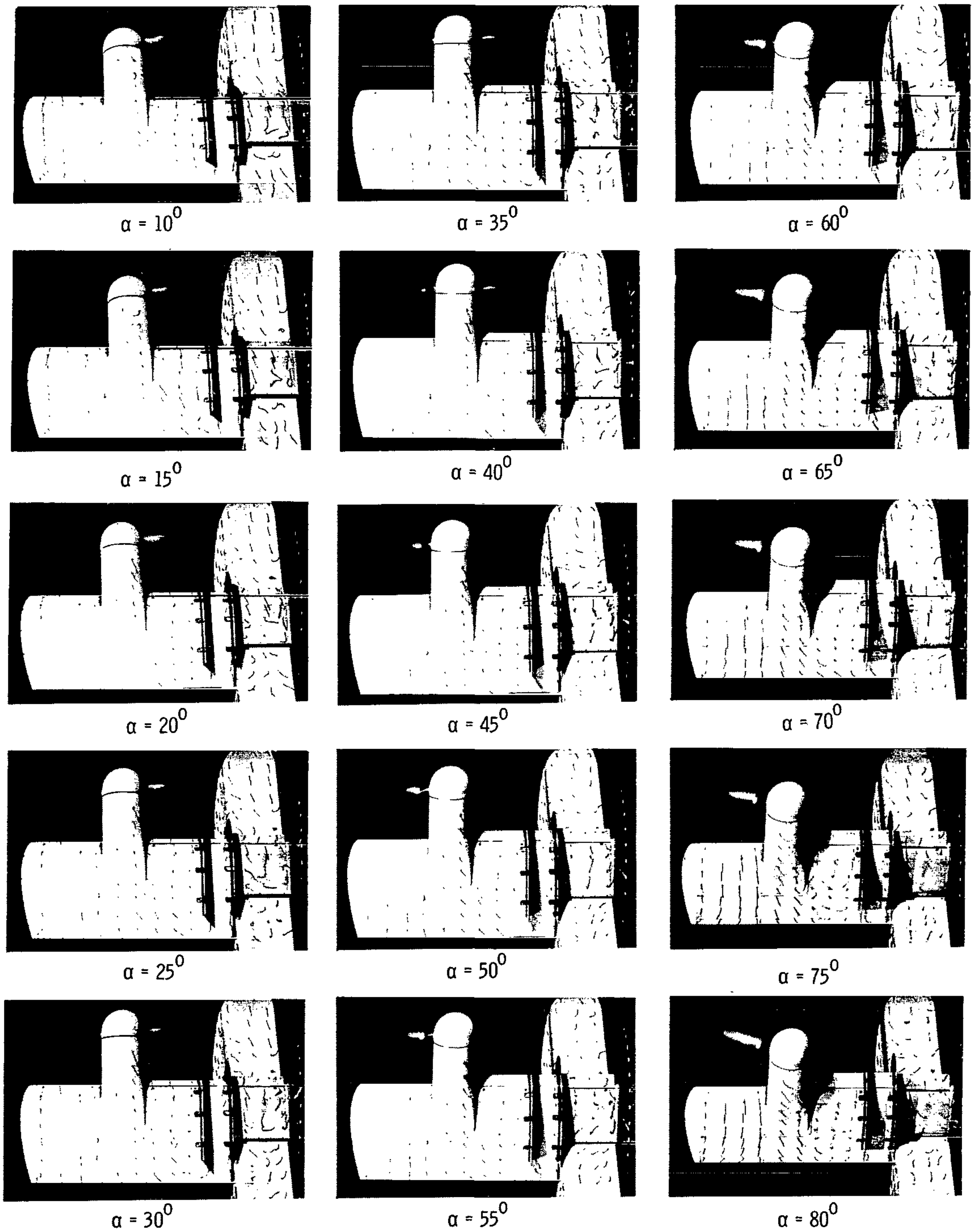
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4481

Figure 8.- Concluded.



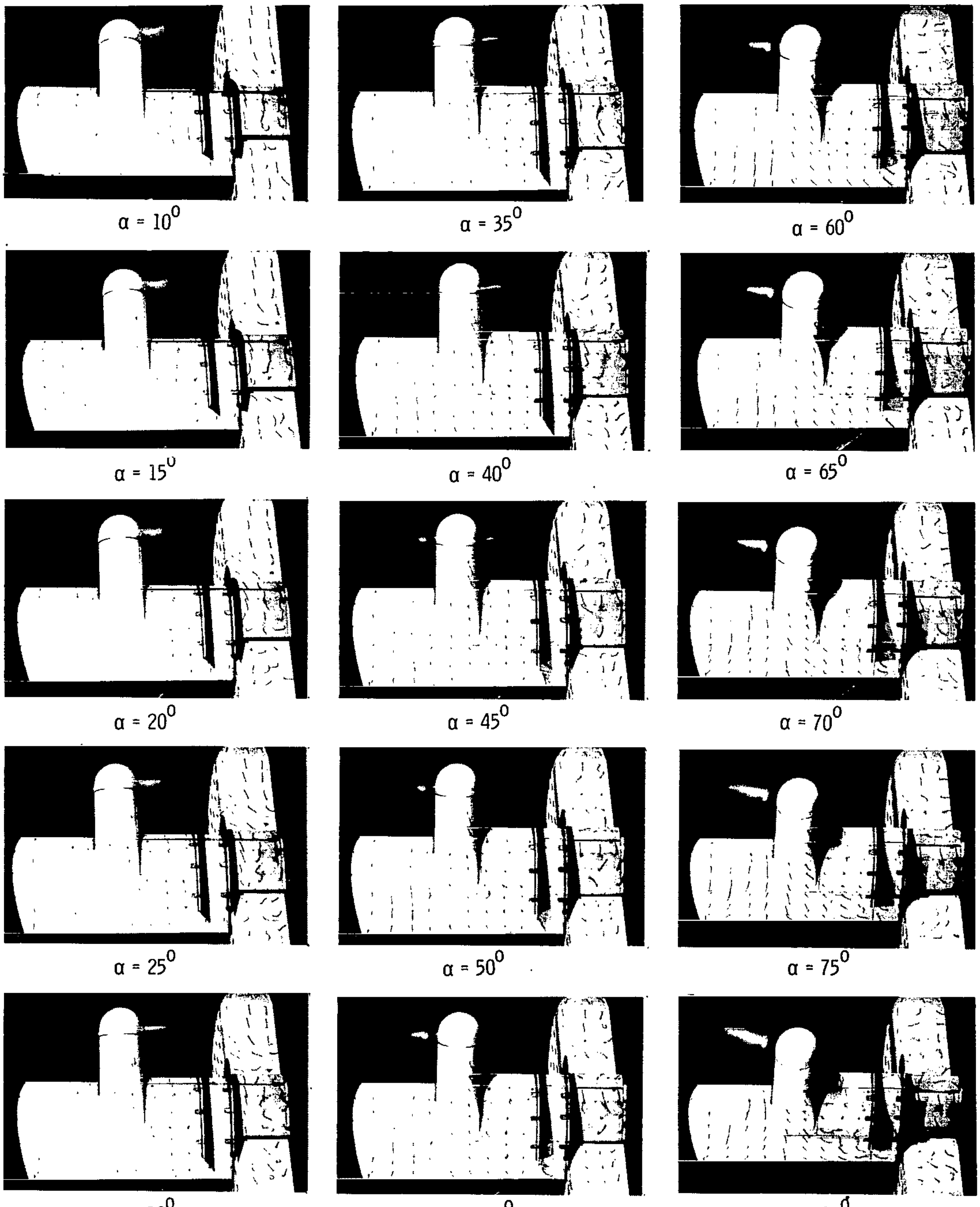
(a) Aerodynamic characteristics.

Figure 9.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Inboard slat on; fences on; $\delta_f = 0^o$.



(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4482

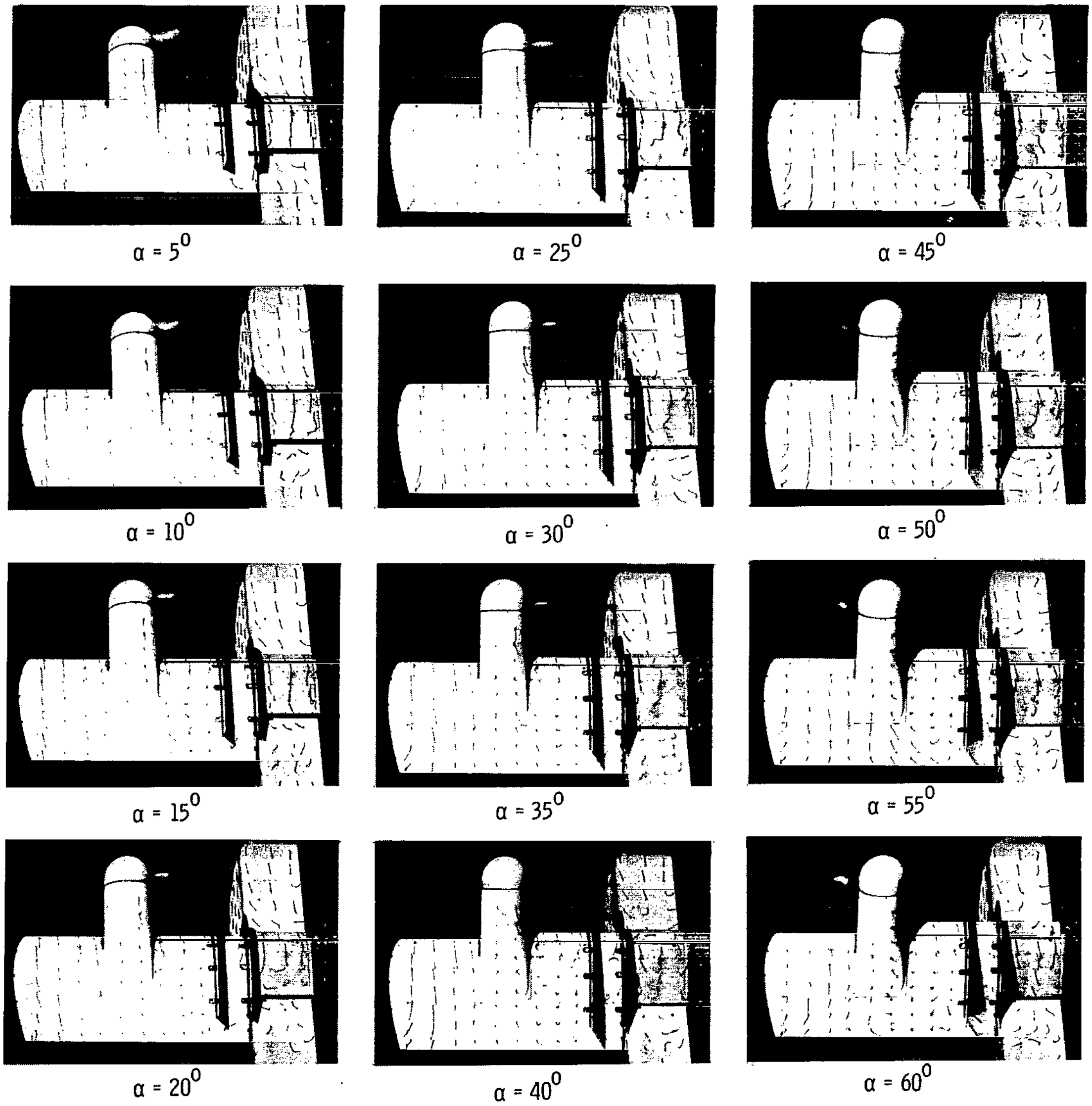
Figure 9.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80$.

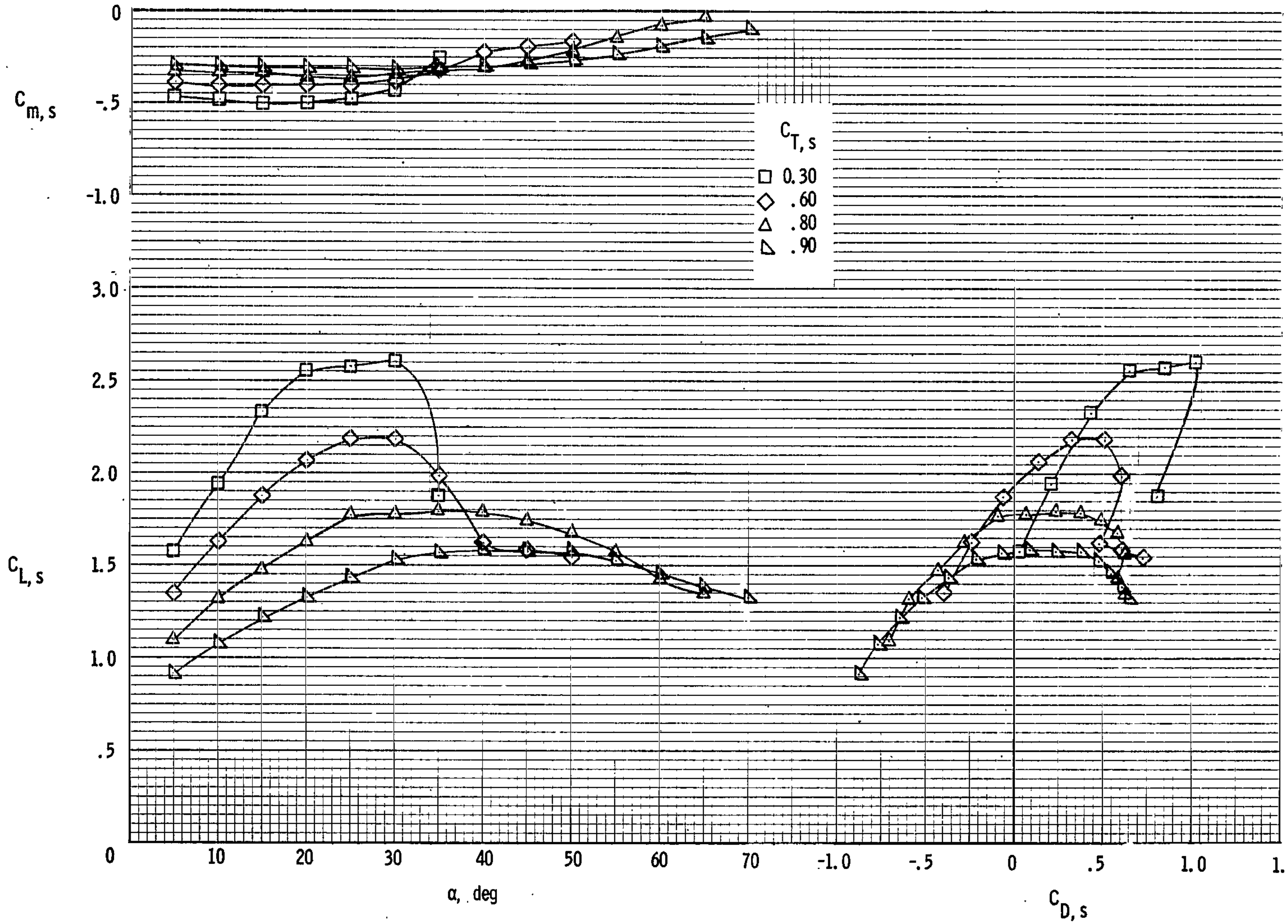
L-66-4483

Figure 9.- Continued.



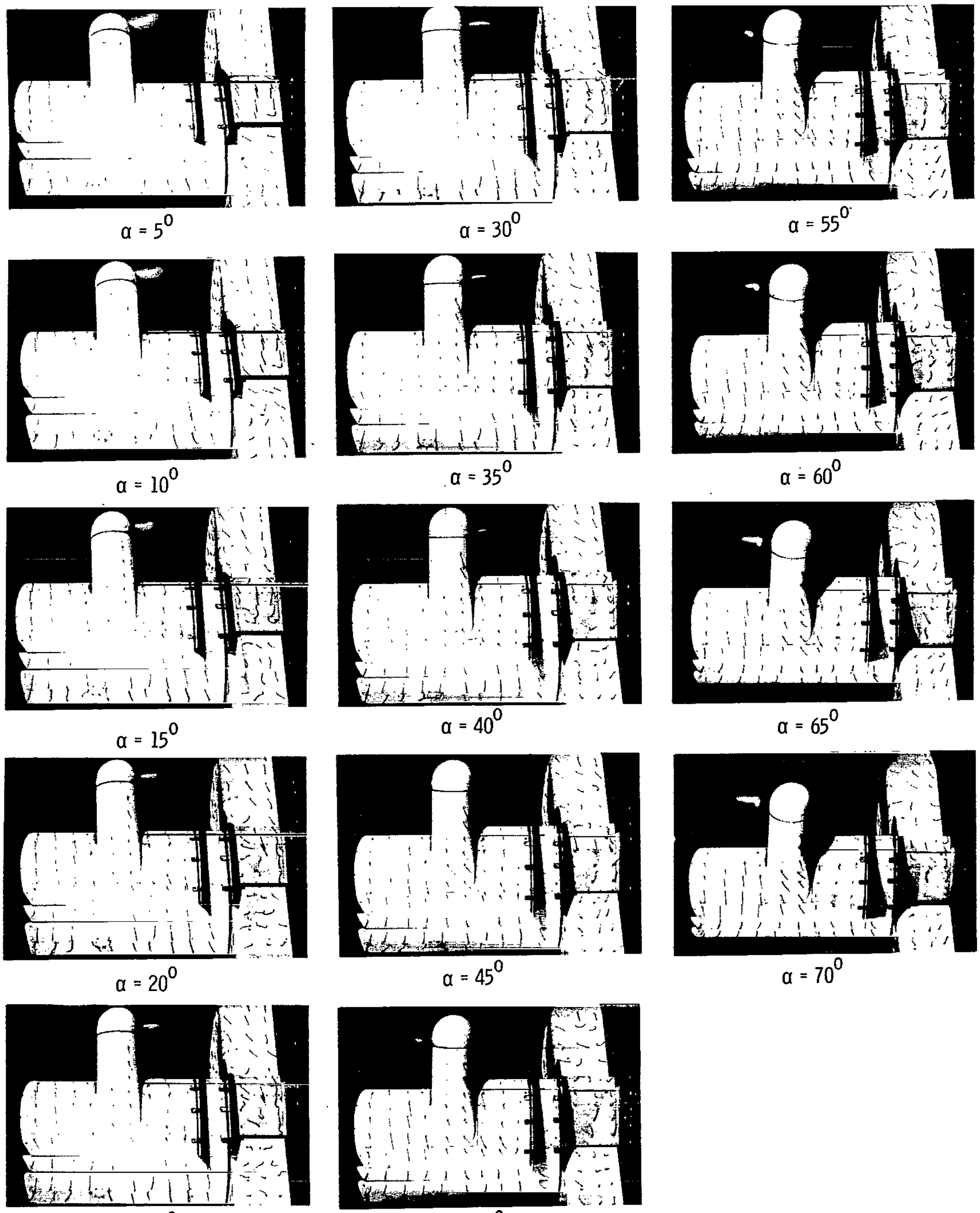
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4484

Figure 9.- Concluded.



(a) Aerodynamic characteristics.

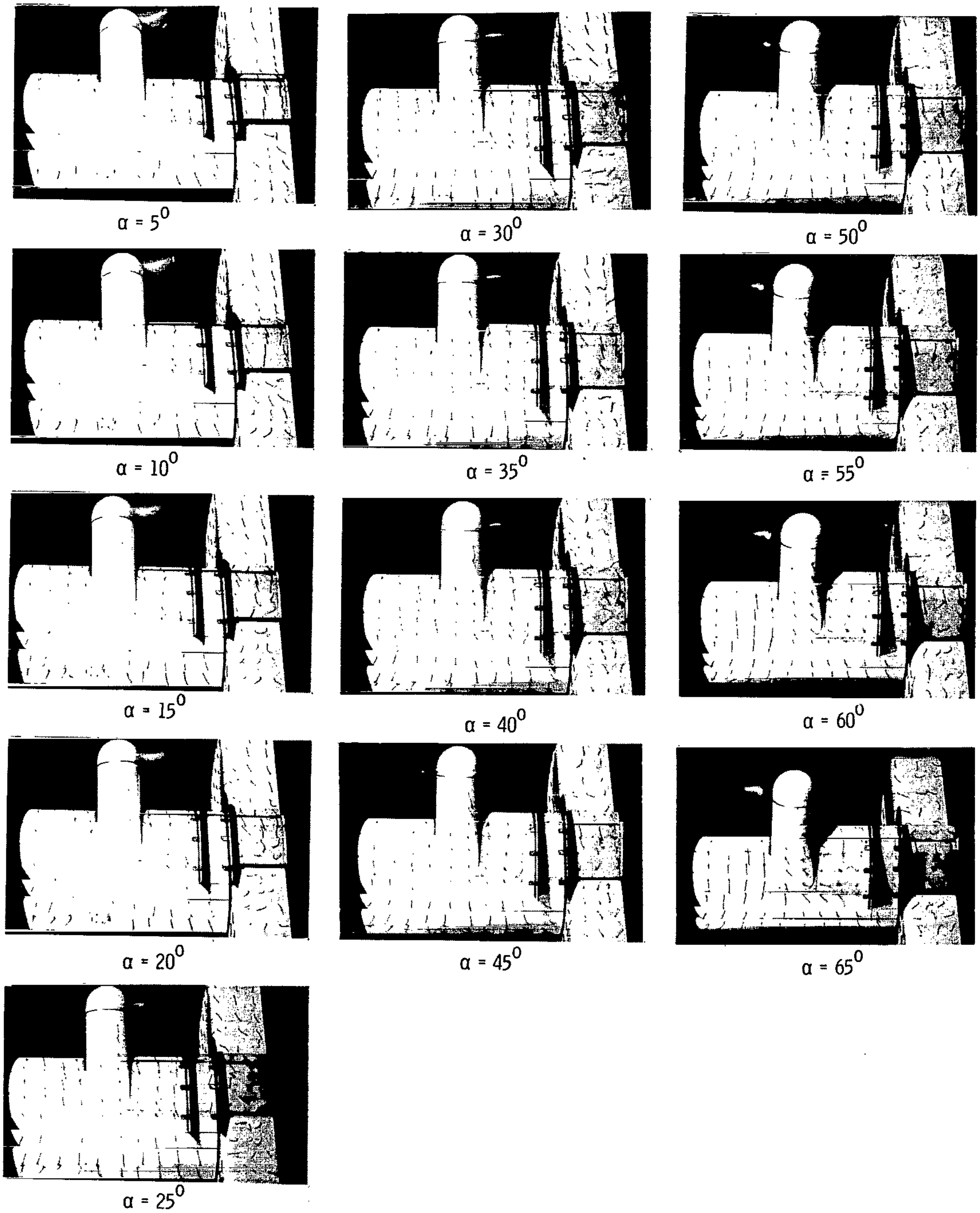
Figure 10.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Inboard slat on; fences on; $\delta_f = 40^0$.



(b) Flow characteristics; $C_{T,s} = 0.90$.

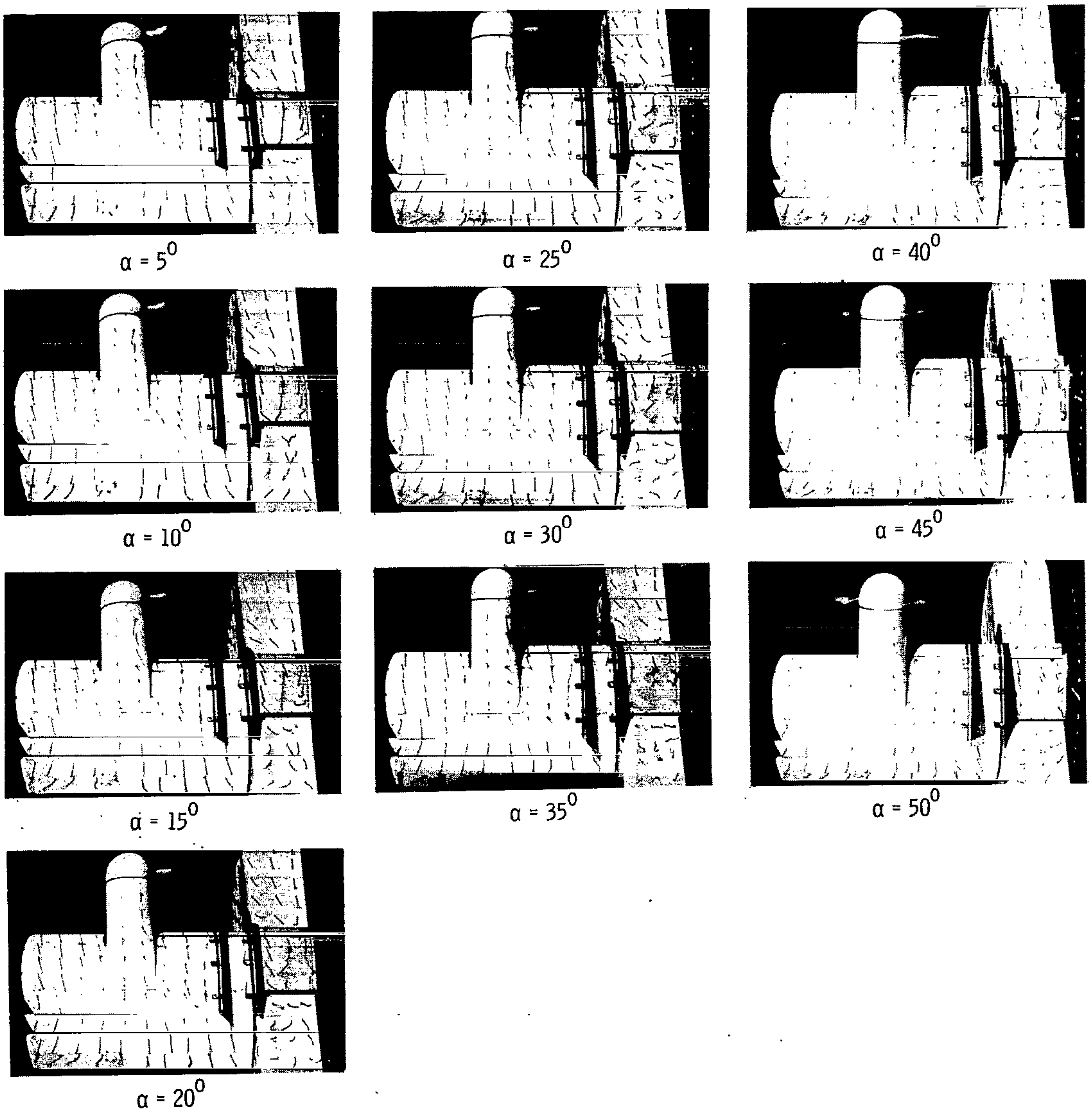
L-66-4485

Figure 10.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4486

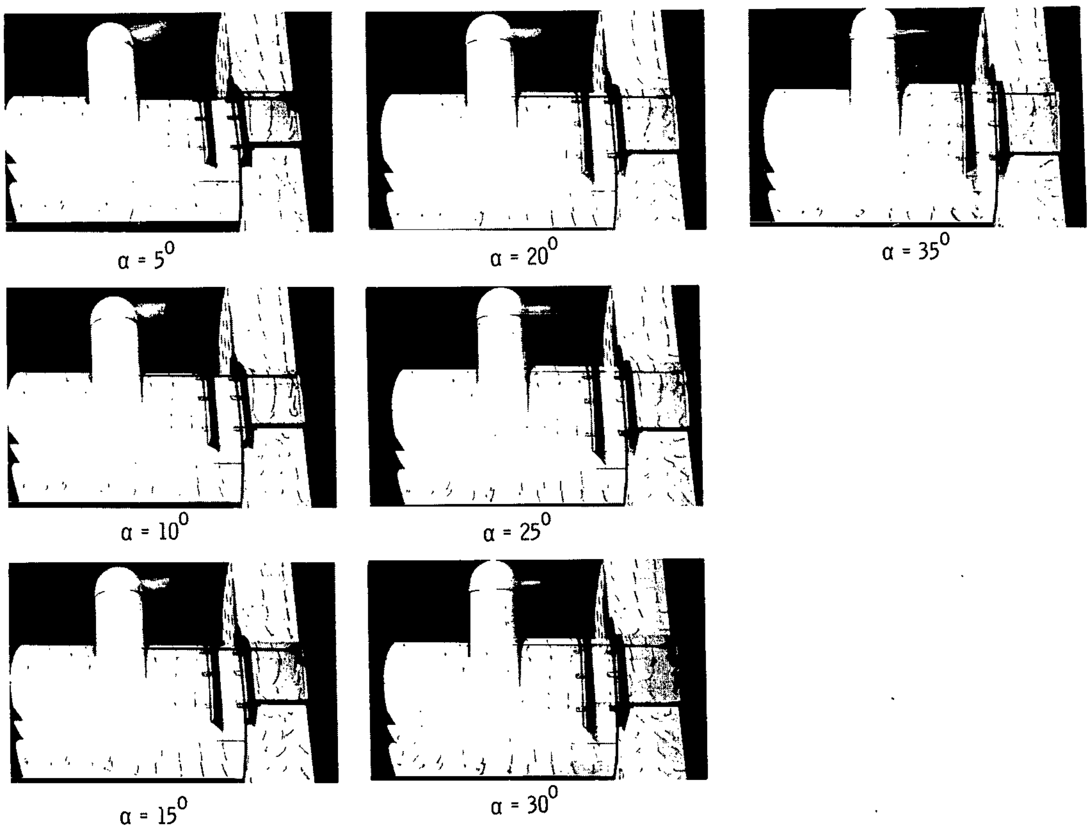
Figure 10.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

L-66-4487

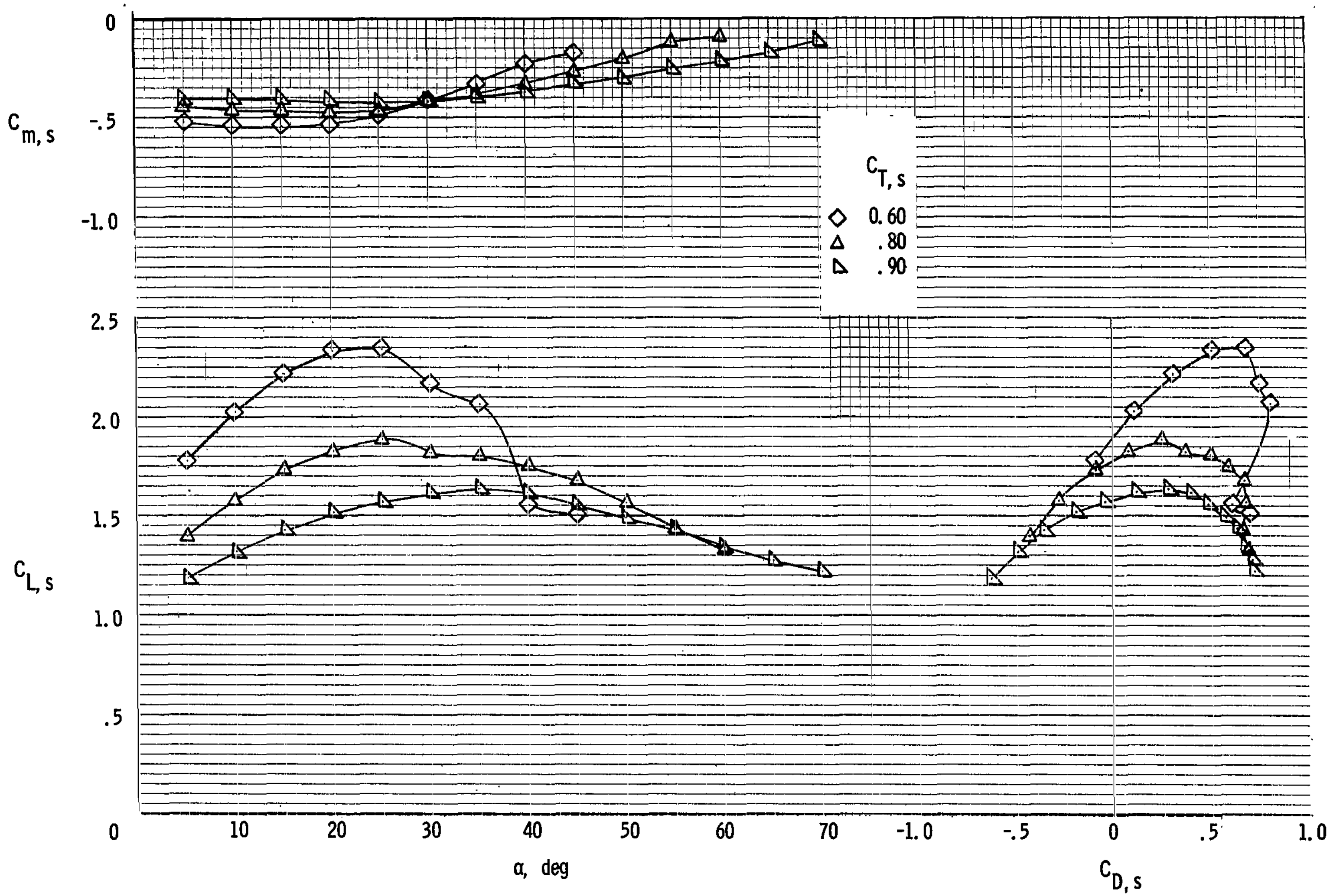
Figure 10.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.30$.

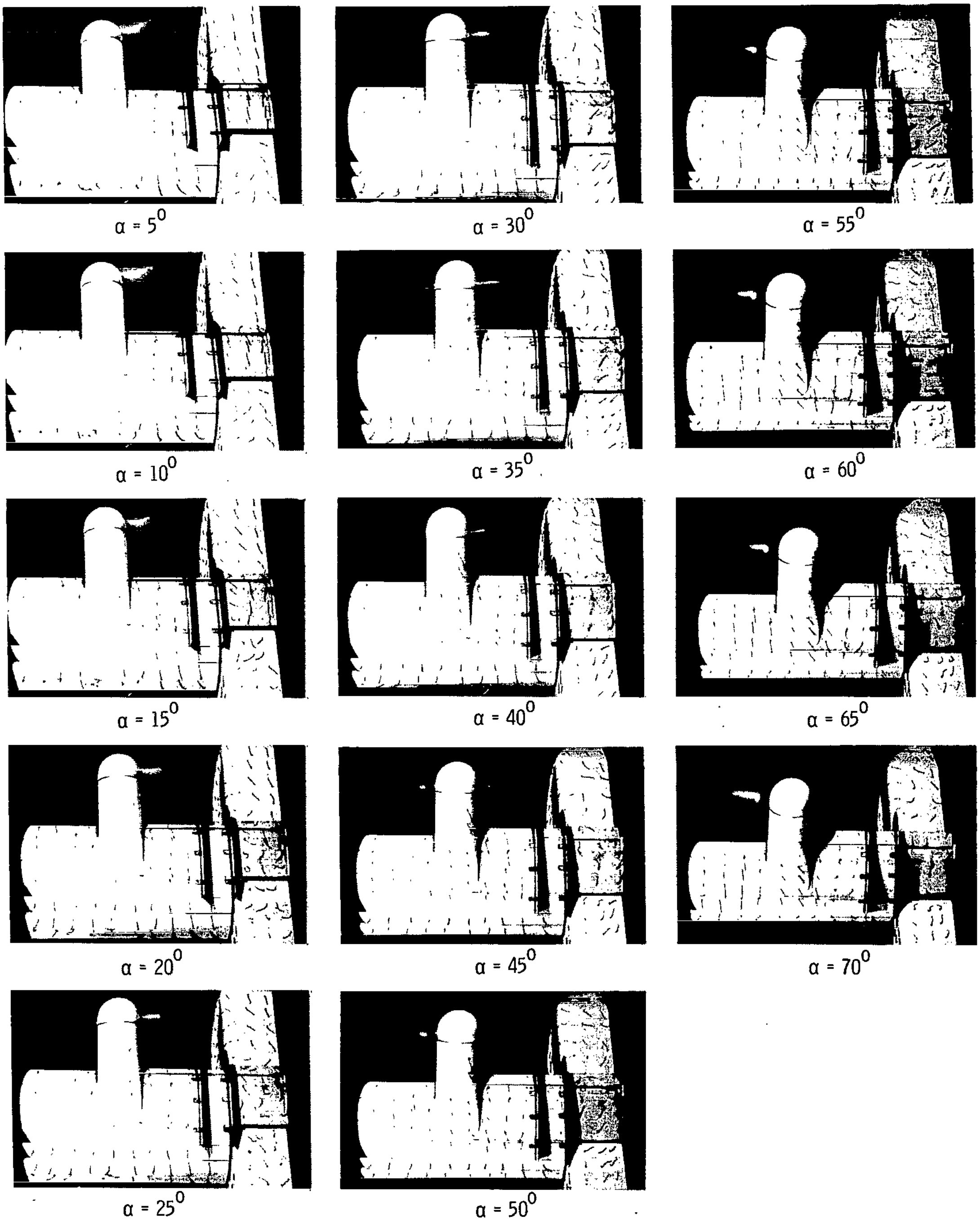
L-66-4488

Figure 10.- Concluded.



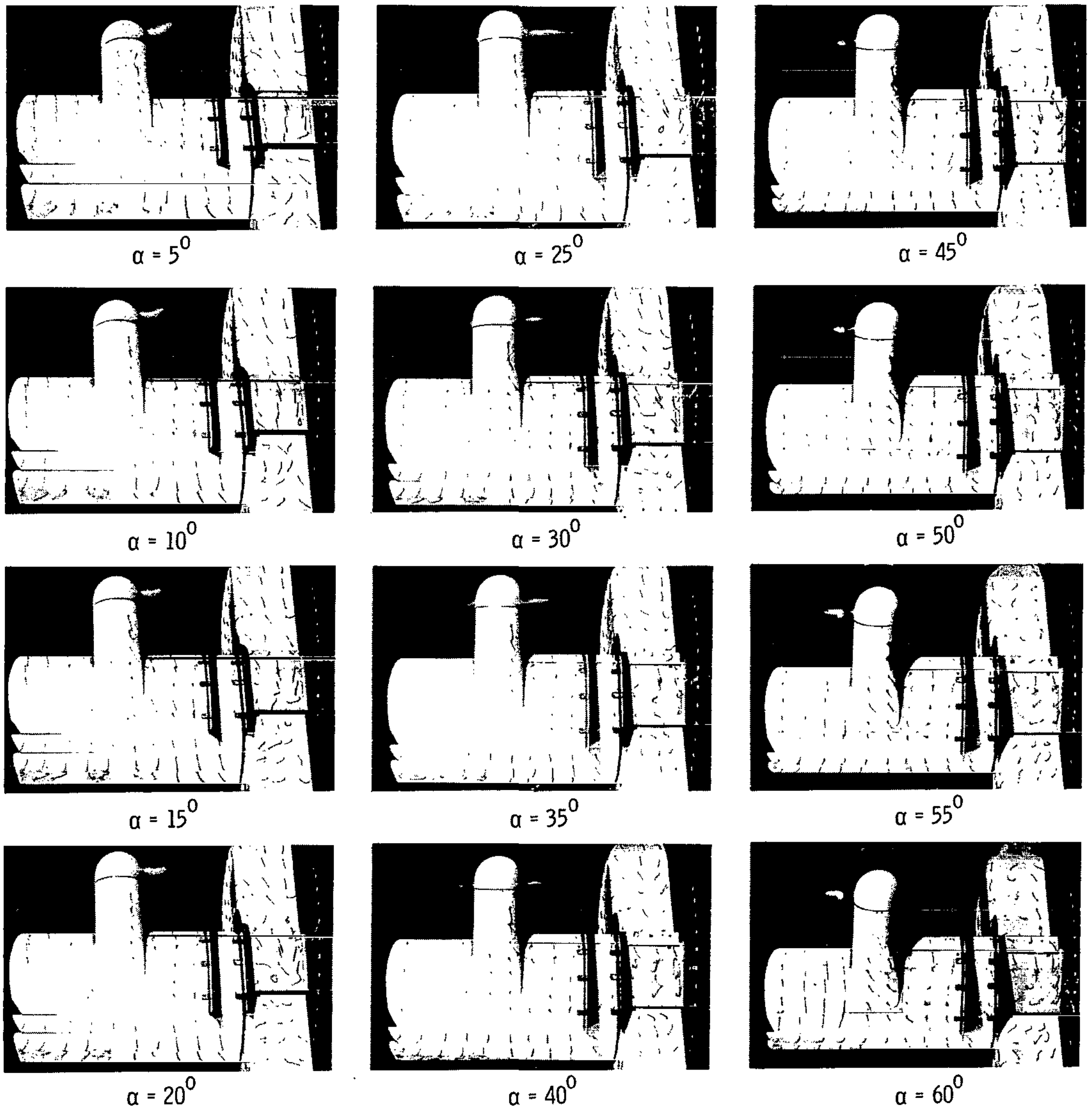
(a) Aerodynamic characteristics.

Figure 11.- Aerodynamic and flow characteristics of the wing with propeller rotation down at the tip. Inboard slat on; fences on; $\delta_f = 60^0$.



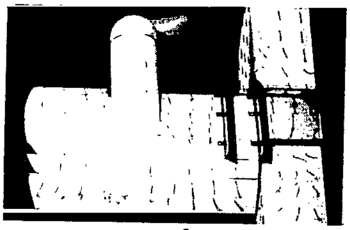
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4489

Figure 11.- Continued.

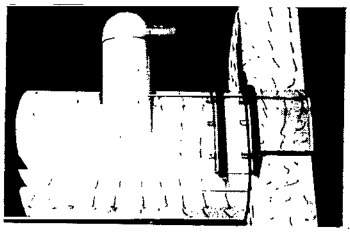


(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4490

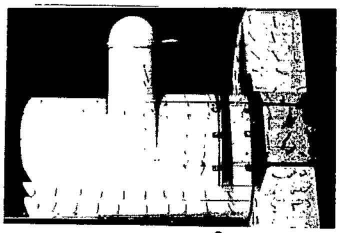
Figure 11.- Continued.



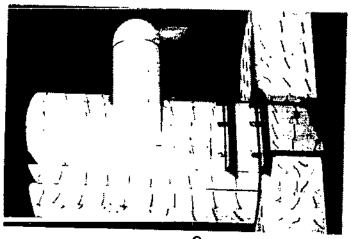
$\alpha = 5^0$



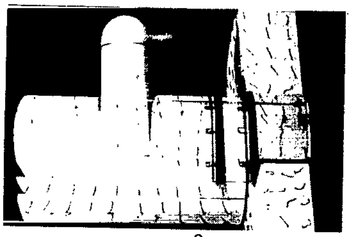
$\alpha = 20^0$



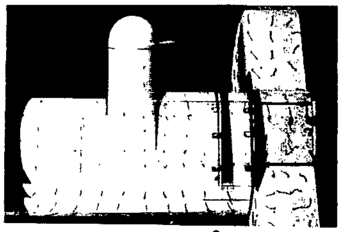
$\alpha = 35^0$



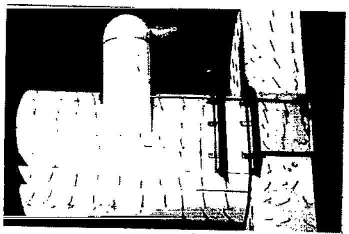
$\alpha = 10^0$



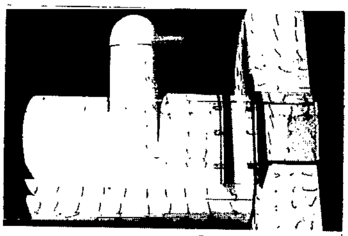
$\alpha = 25^0$



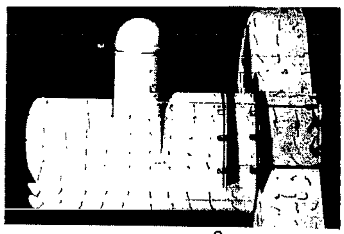
$\alpha = 40^0$



$\alpha = 15^0$



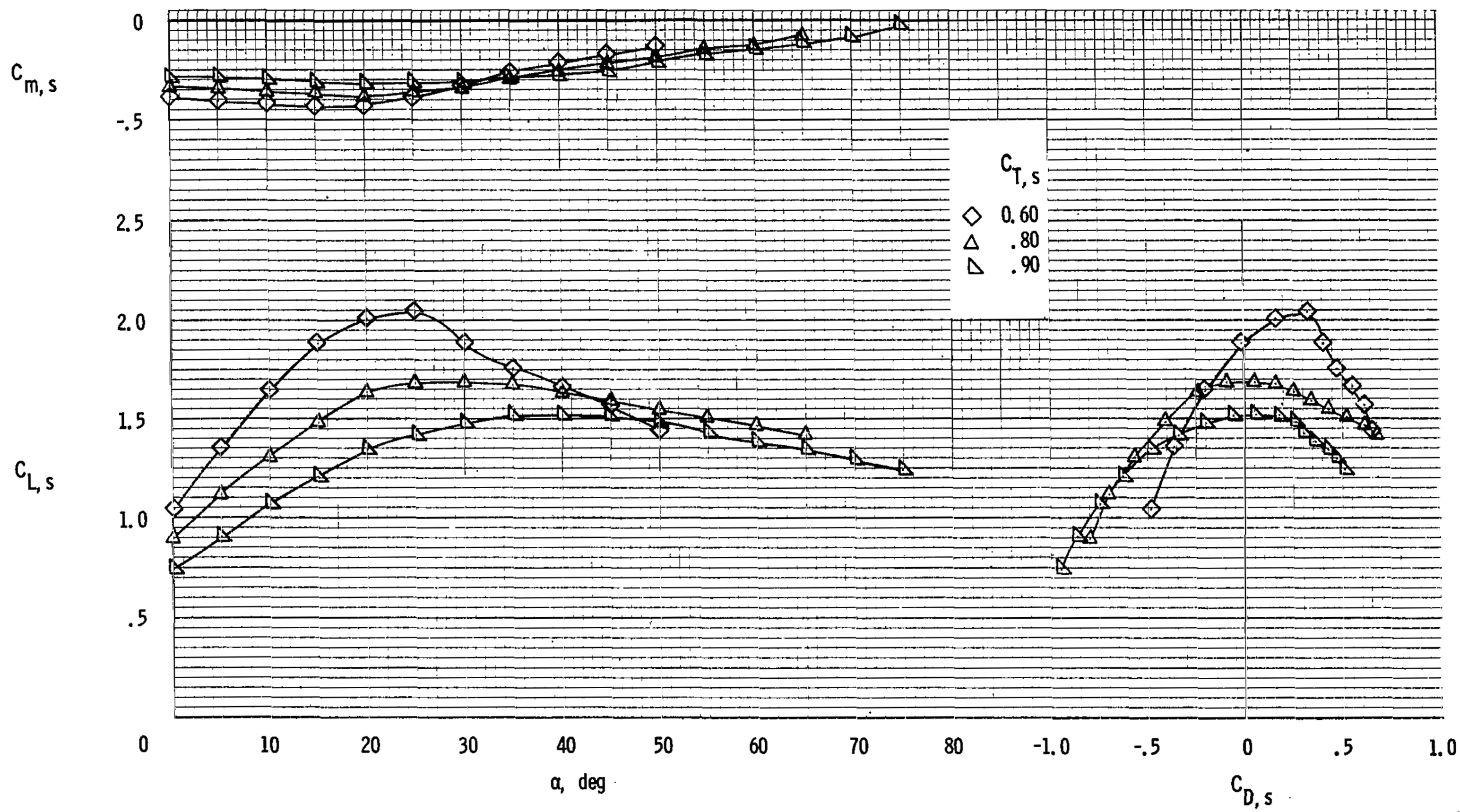
$\alpha = 30^0$



$\alpha = 45^0$

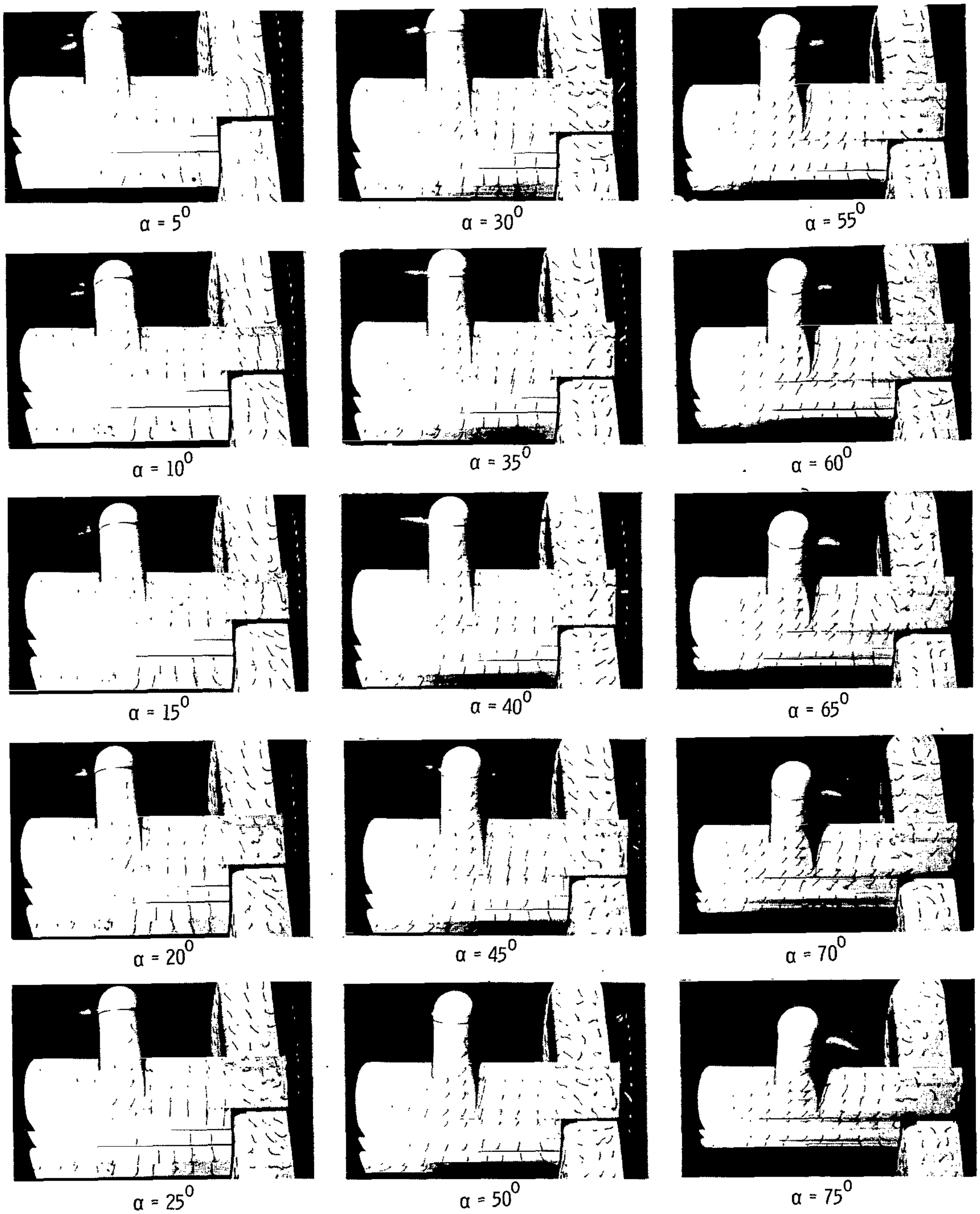
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4491

Figure 11.- Concluded.



(a) Aerodynamic characteristics.

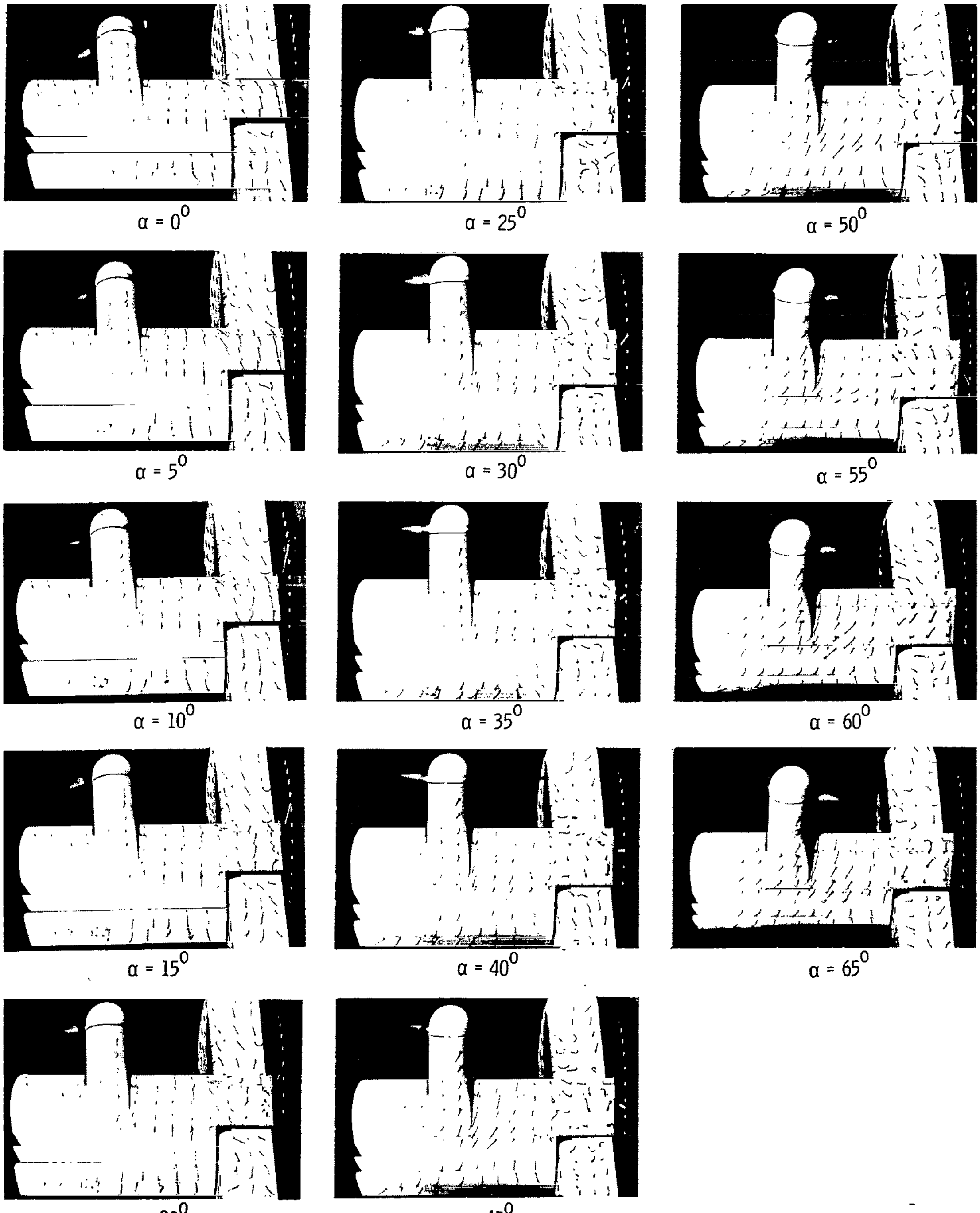
Figure 12.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Basic leading edge; $\delta_f = 40^o$.



(b) Flow characteristics; $C_{T,s} = 0.90$.

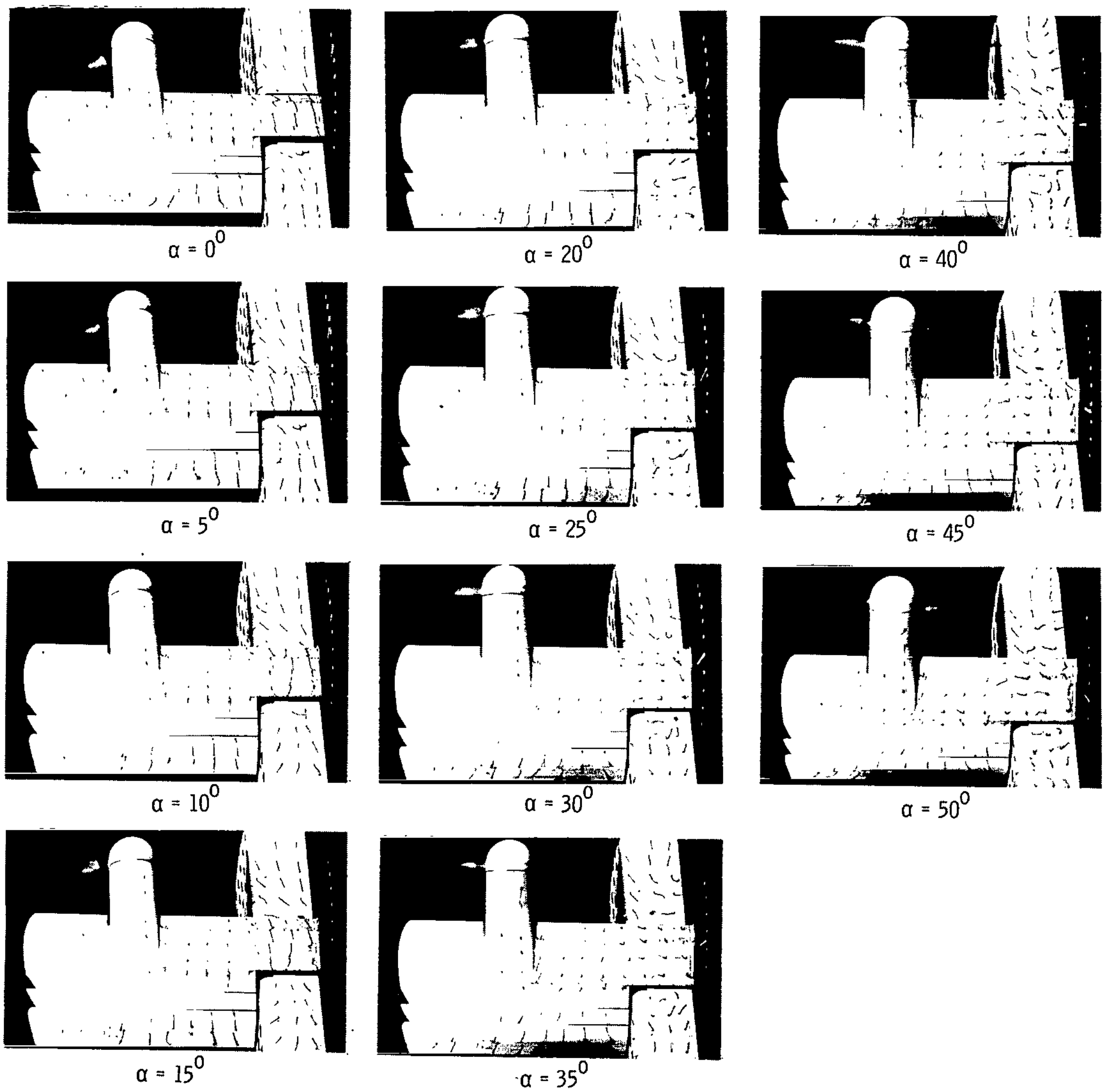
L-66-4492

Figure 12.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4493

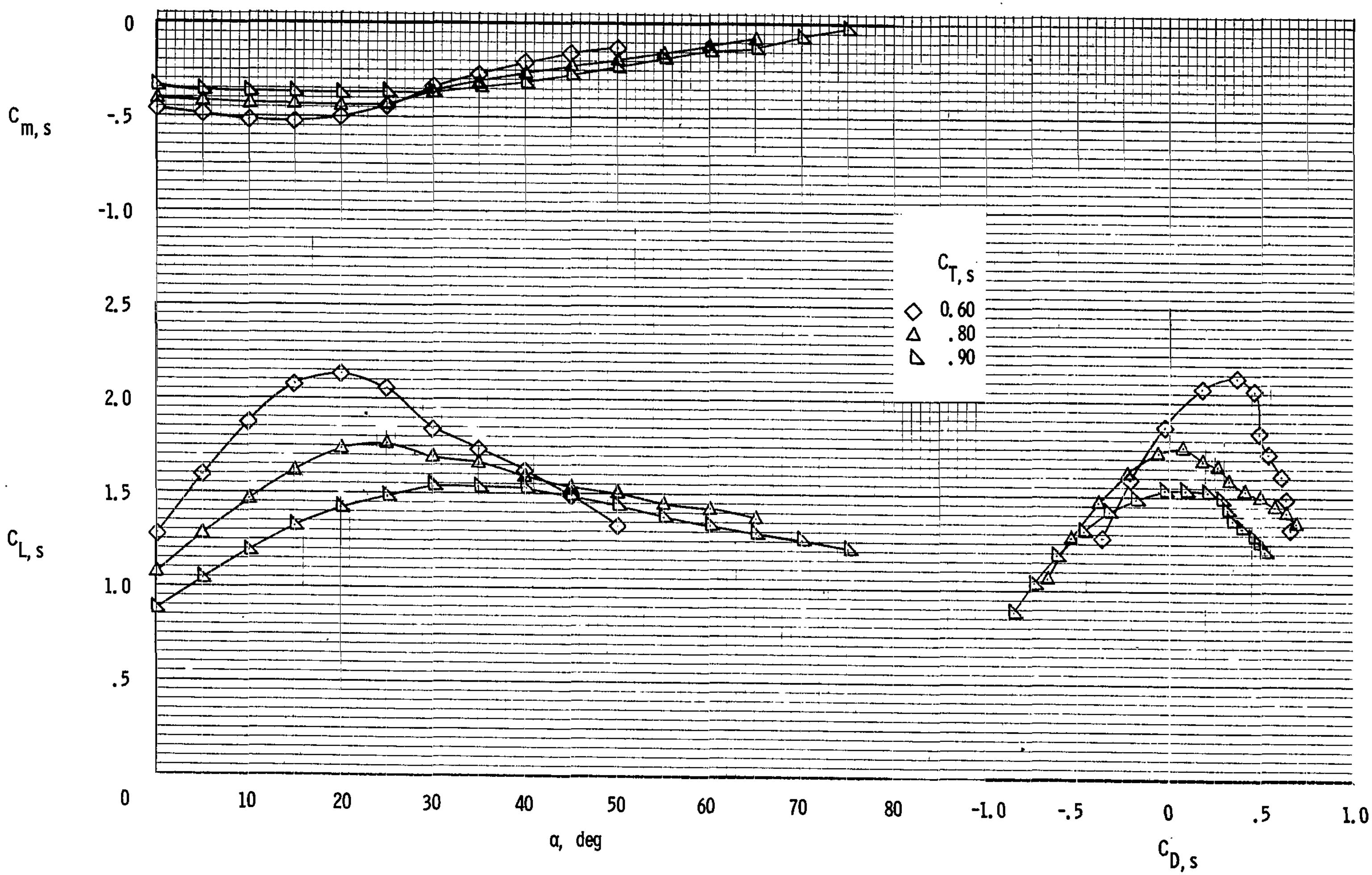
Figure 12.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

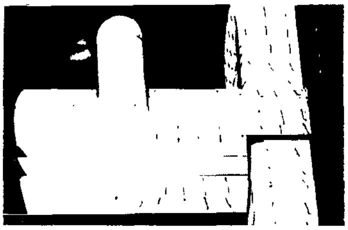
L-66-4494

Figure 12.- Concluded.

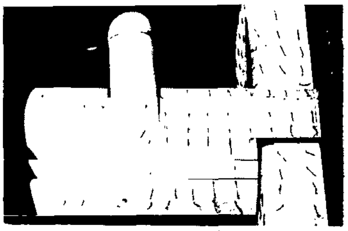


(a) Aerodynamic characteristics.

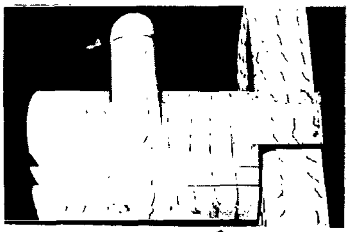
Figure 13.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Basic leading edge; $\delta_f = 60^0$.



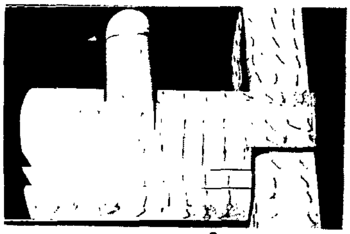
$\alpha = 5^0$



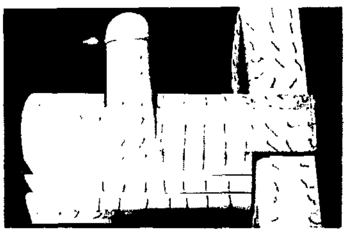
$\alpha = 10^0$



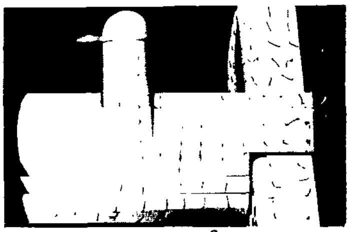
$\alpha = 15^0$



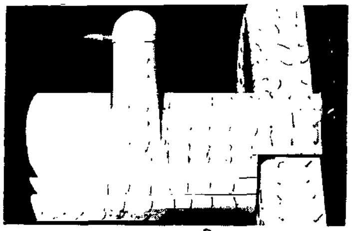
$\alpha = 20^0$



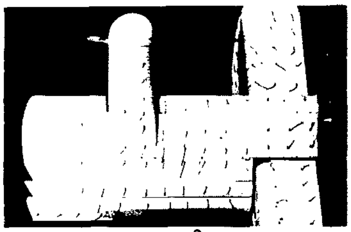
$\alpha = 25^0$



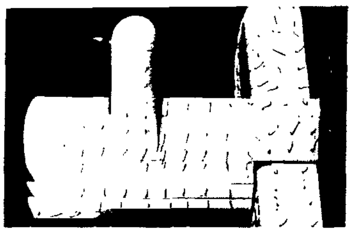
$\alpha = 30^0$



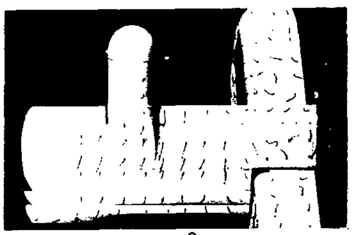
$\alpha = 35^0$



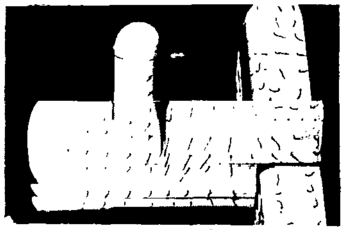
$\alpha = 40^0$



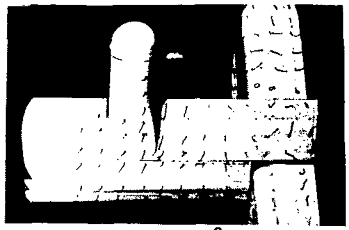
$\alpha = 45^0$



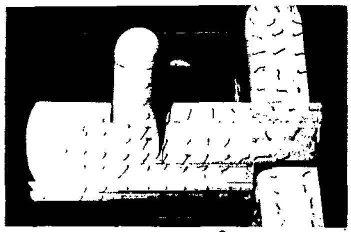
$\alpha = 50^0$



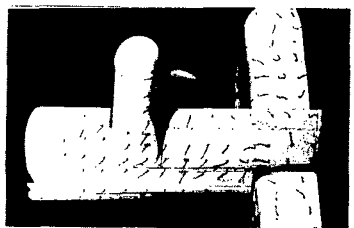
$\alpha = 55^0$



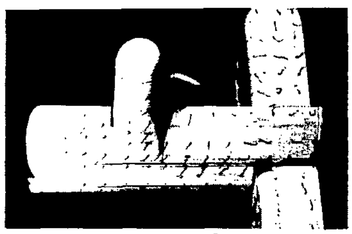
$\alpha = 60^0$



$\alpha = 65^0$



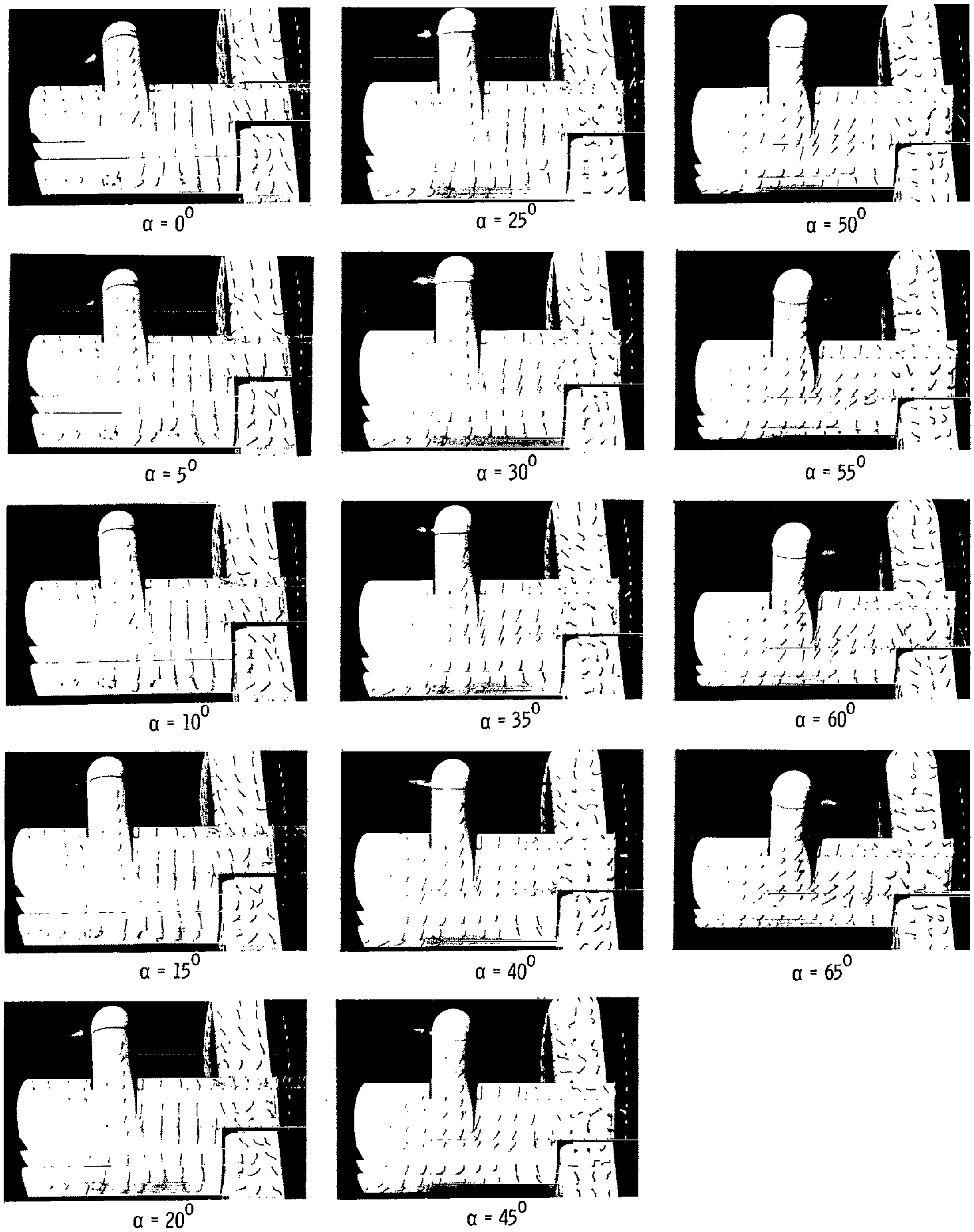
$\alpha = 70^0$



$\alpha = 75^0$

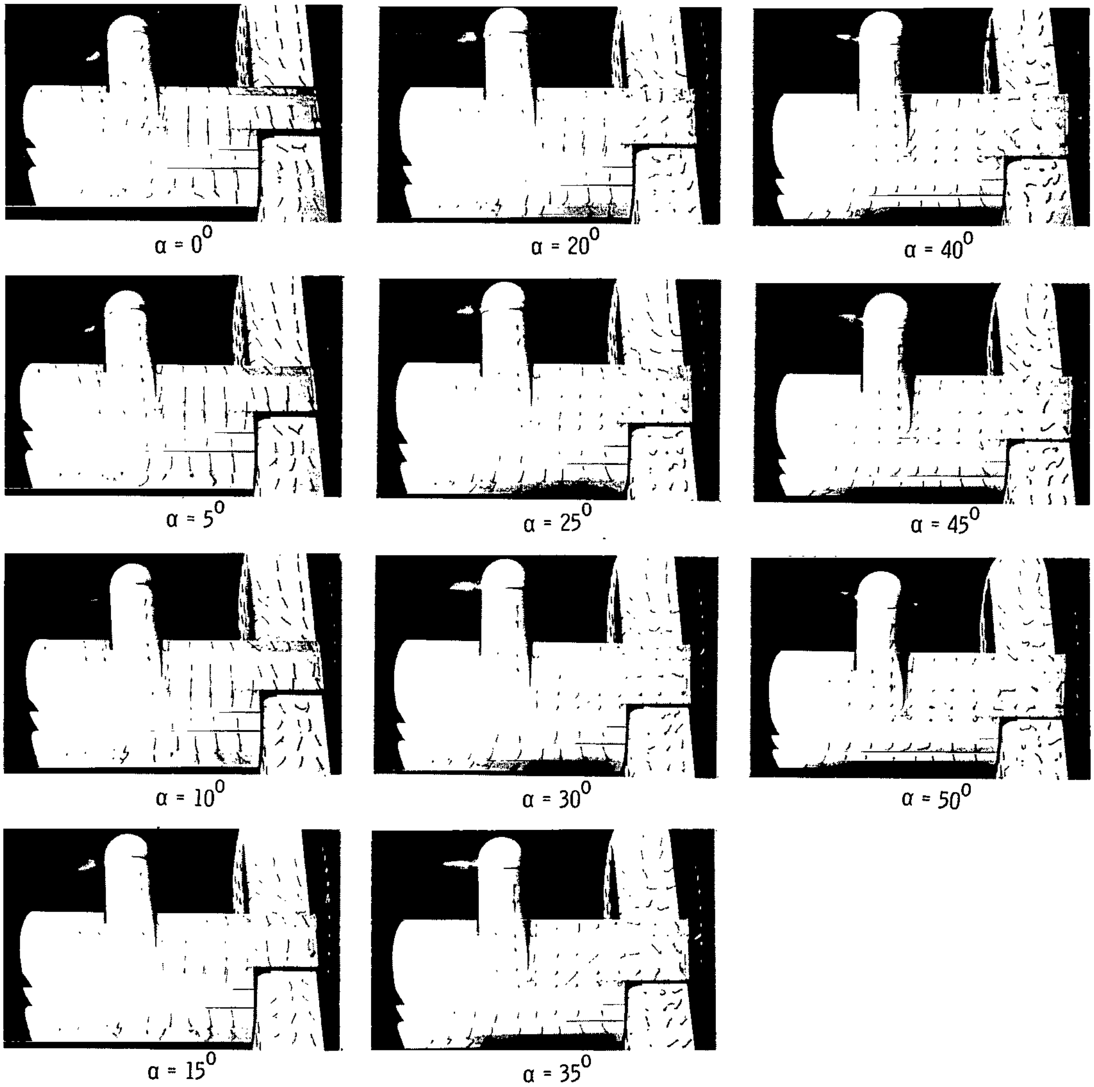
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4495

Figure 13.- Continued.



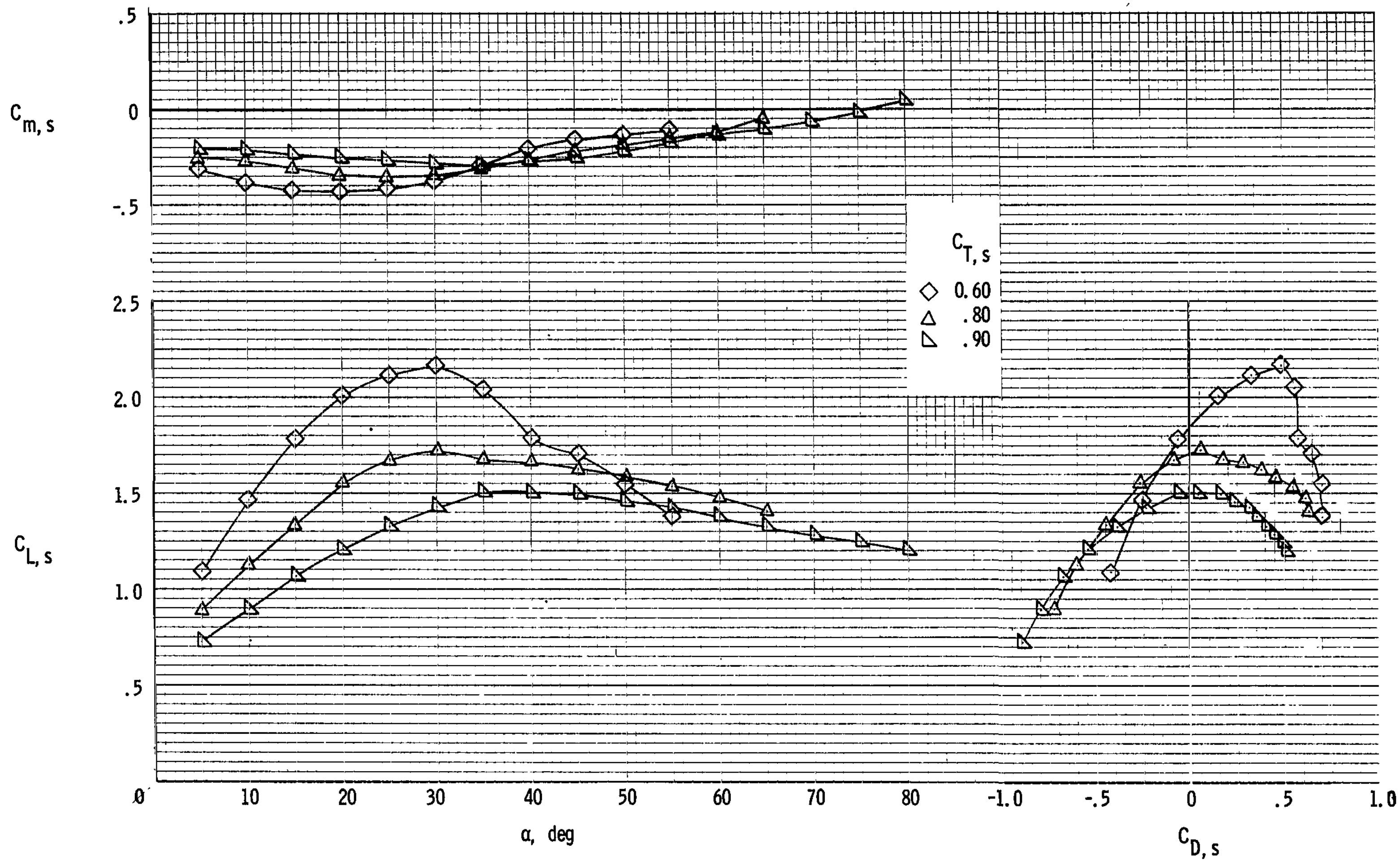
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4496

Figure 13.- Continued.



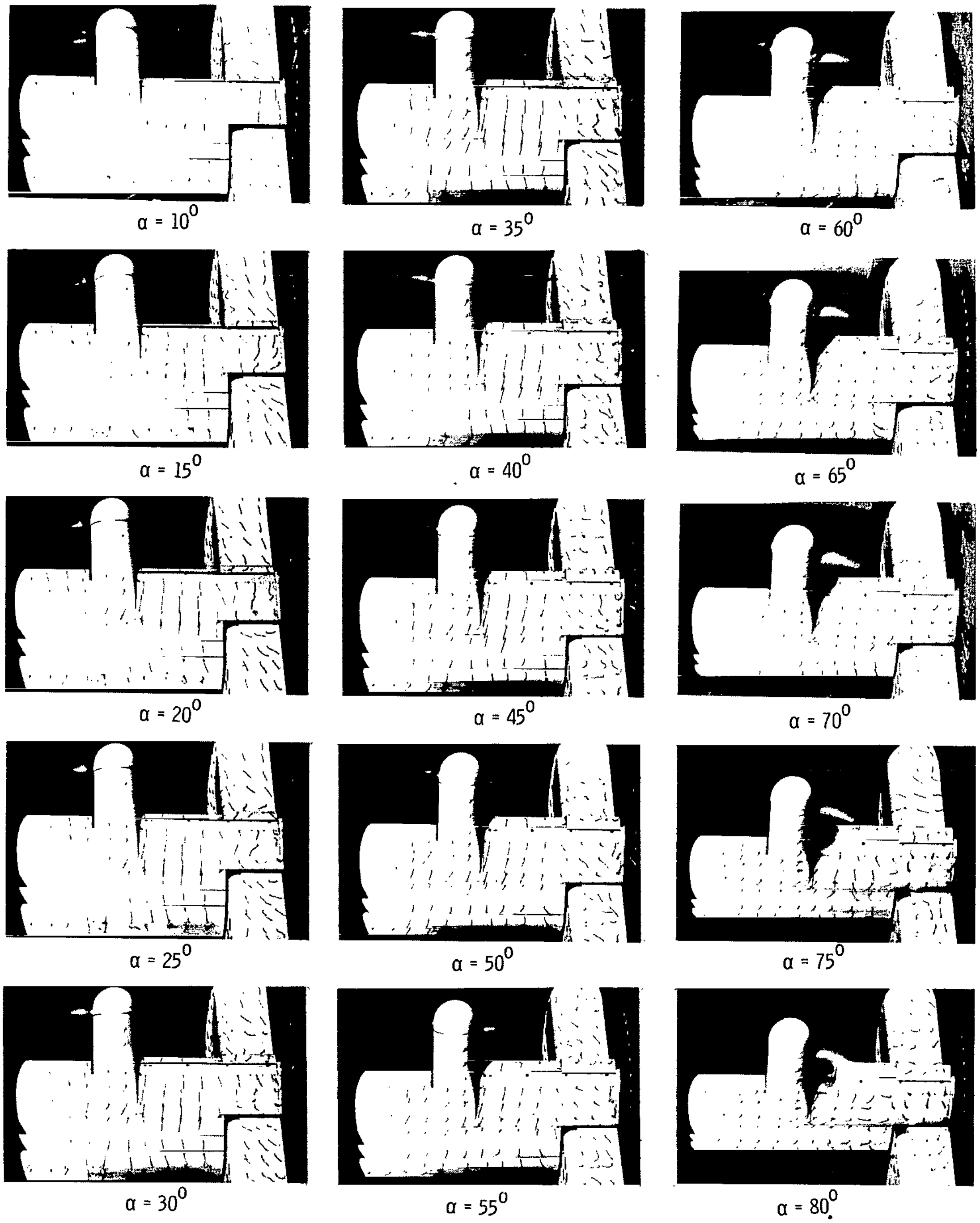
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4497

Figure 13.- Concluded.



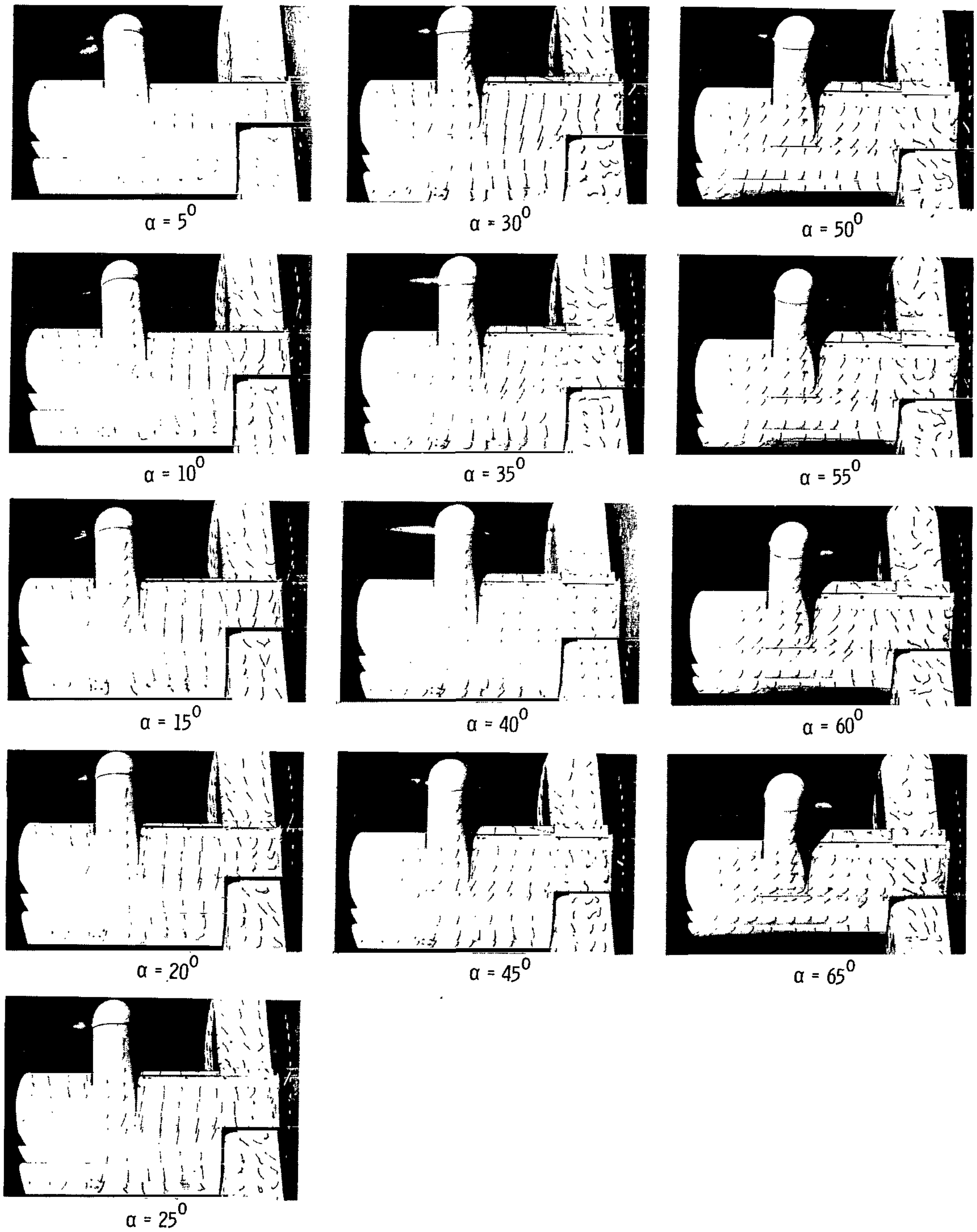
(a) Aerodynamic characteristics.

Figure 14.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Inboard slat on; $\delta_f = 40^0$.



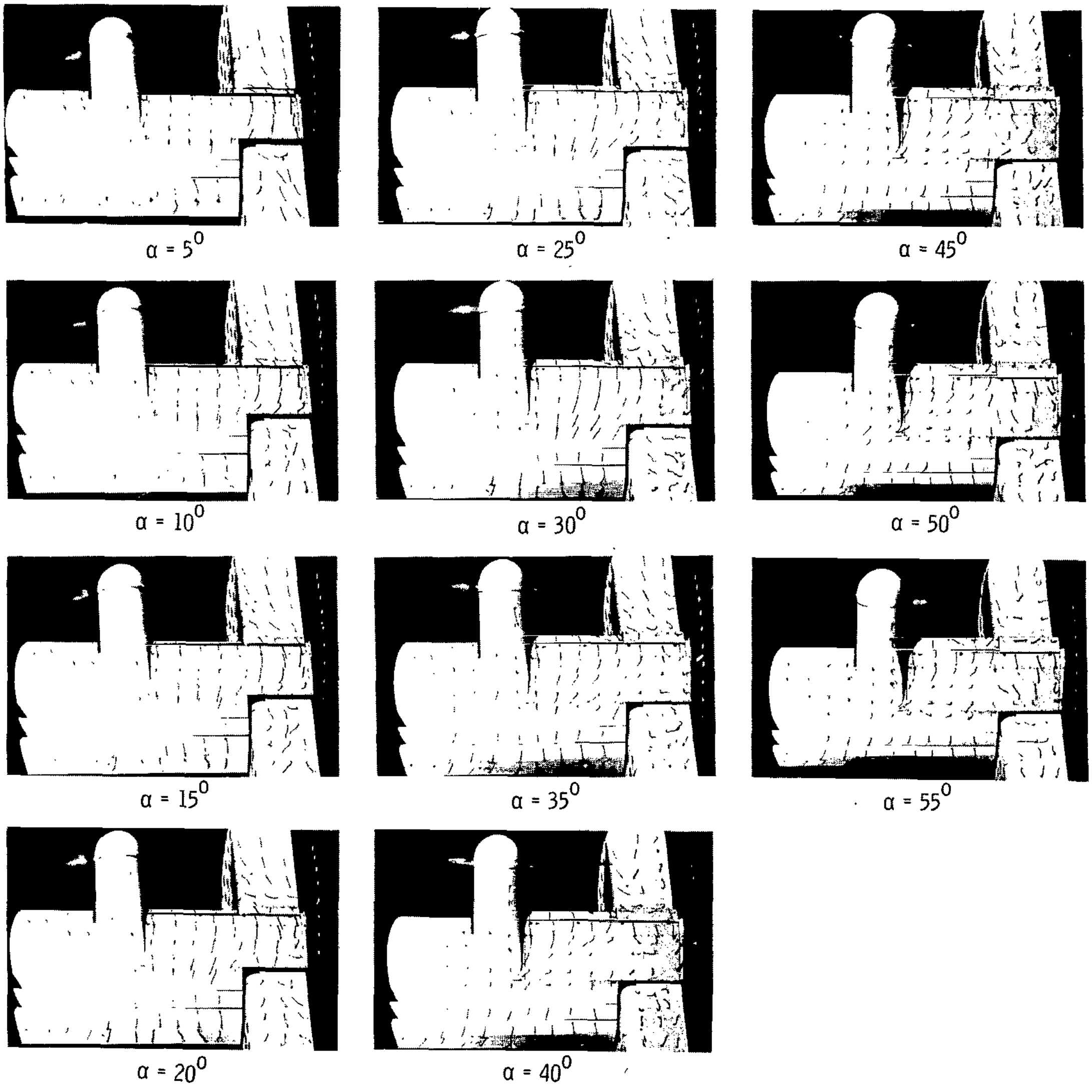
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4498

Figure 14.- Continued.



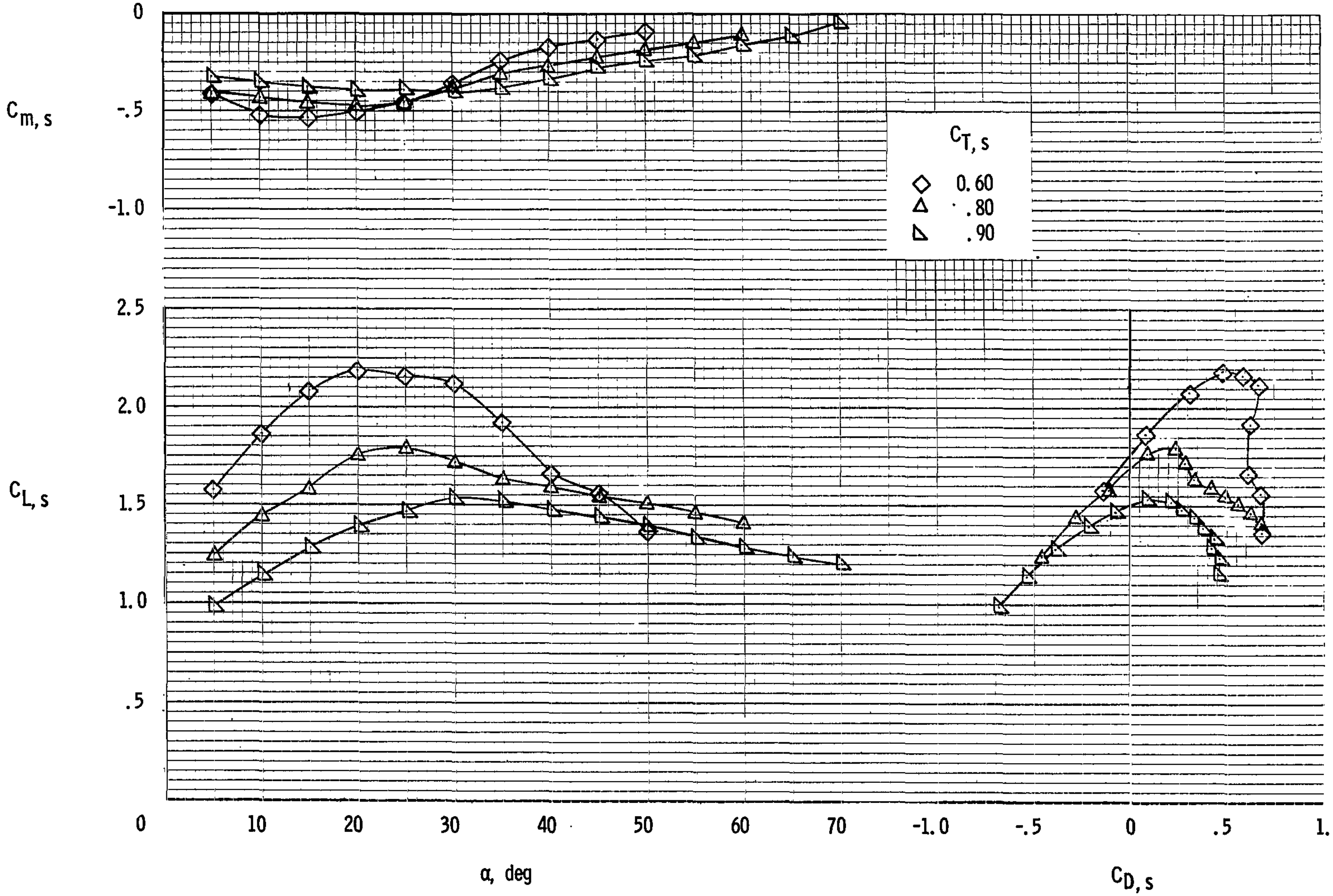
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4499

Figure 14.- Continued.



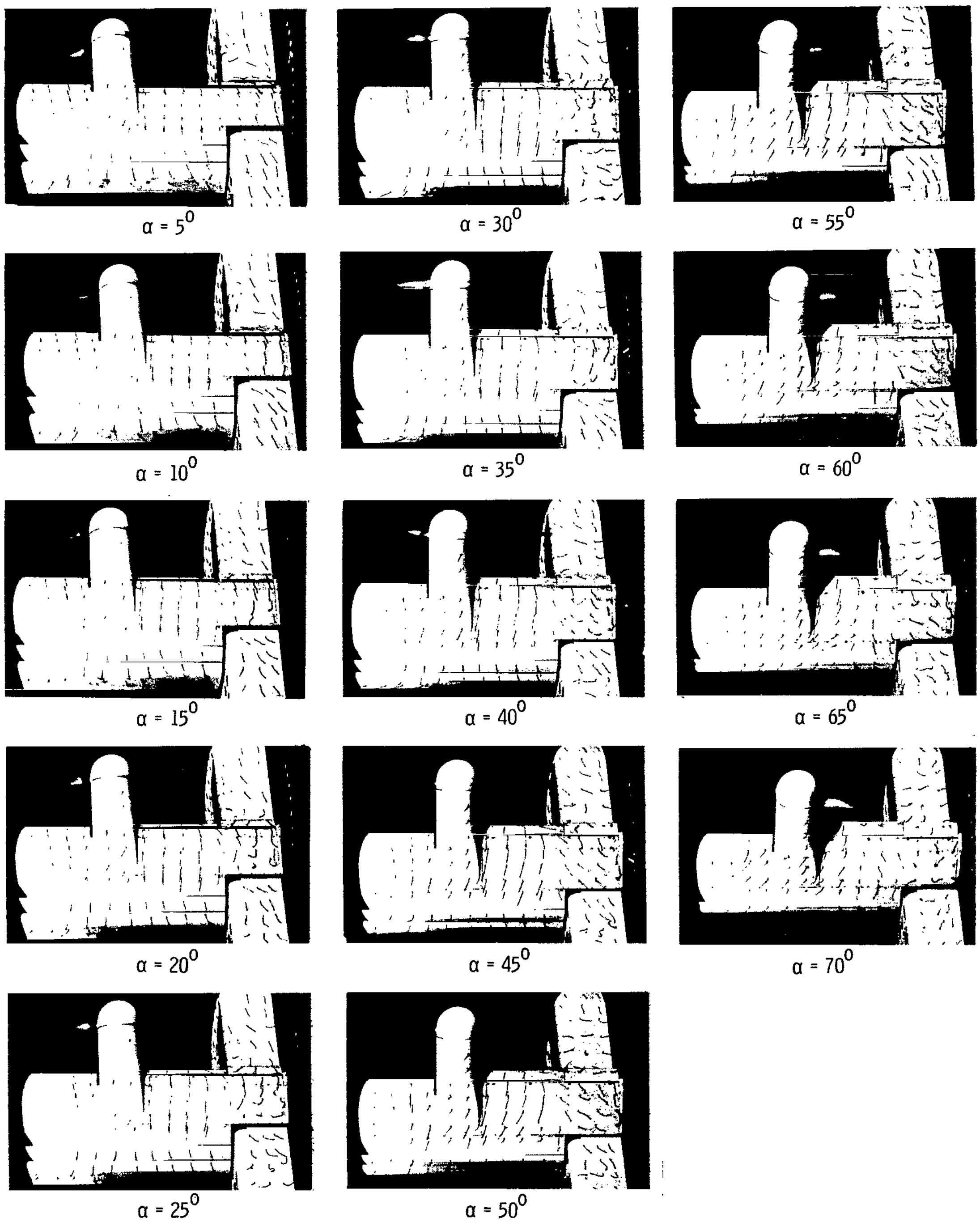
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4500

Figure 14.- Concluded.



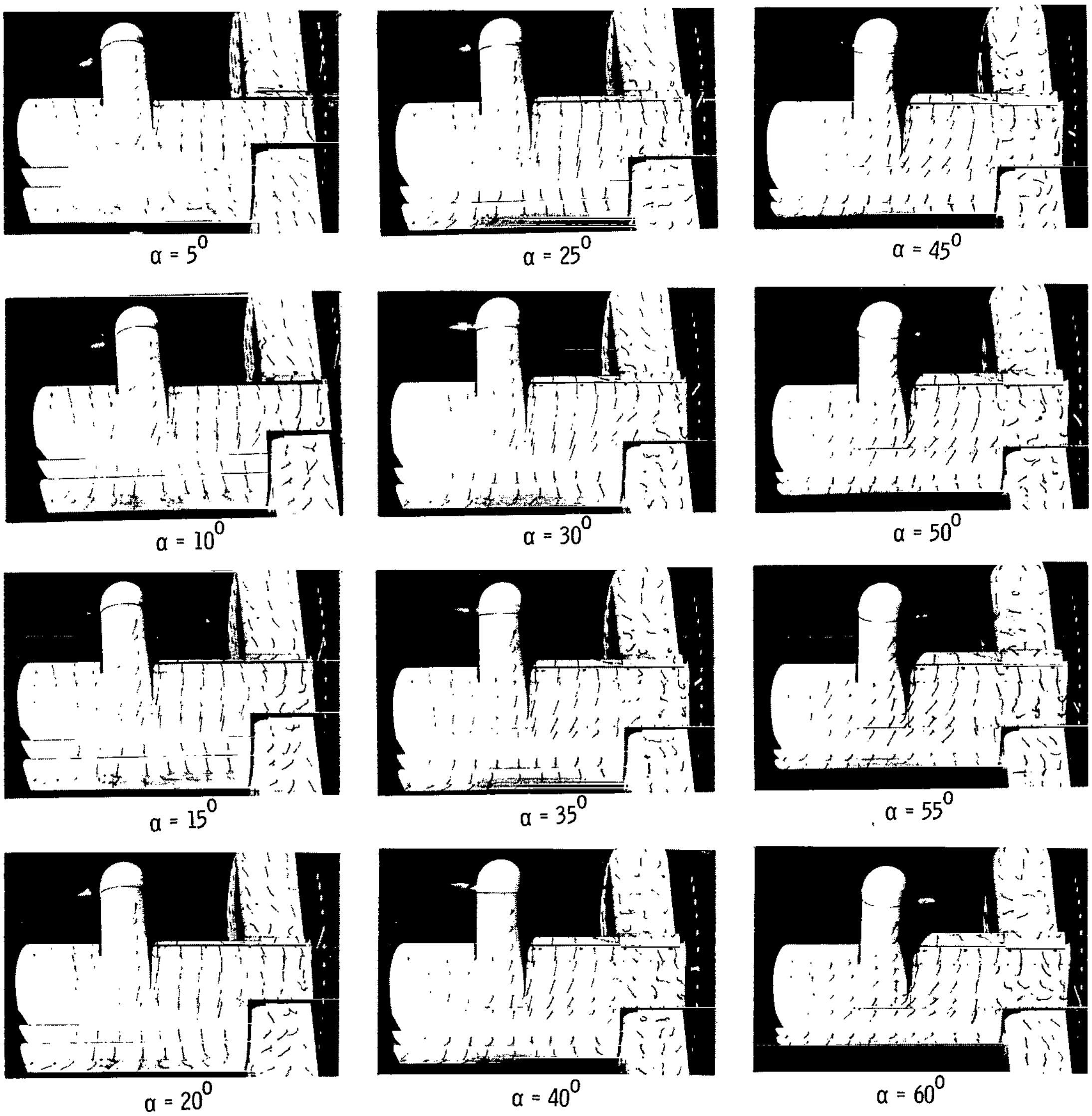
(a) Aerodynamic characteristics.

Figure 15.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Inboard slat on; $\delta_f = 60^0$.



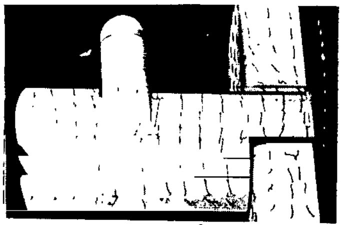
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4501

Figure 15.- Continued.



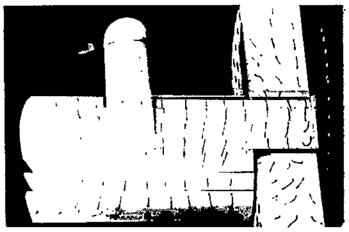
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4502

Figure 15.- Continued.

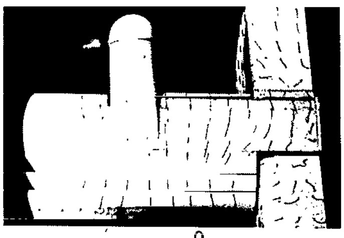


$\alpha = 5^0$

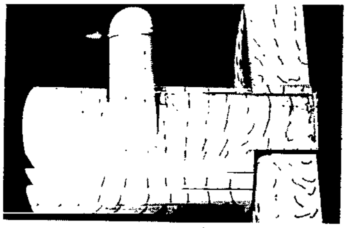
$\alpha = 10^0$



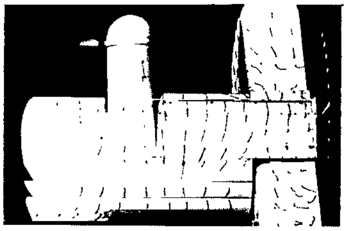
$\alpha = 15^0$



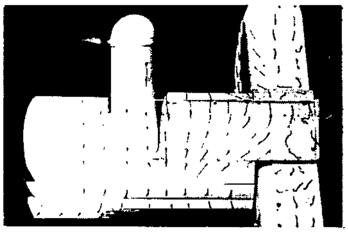
$\alpha = 20^0$



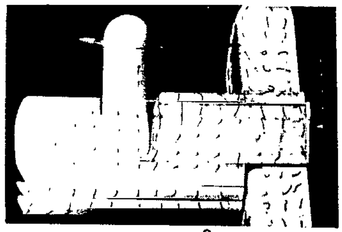
$\alpha = 25^0$



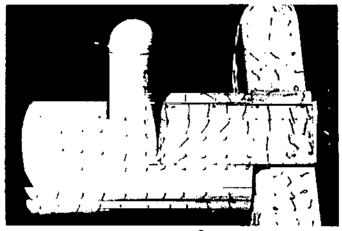
$\alpha = 30^0$



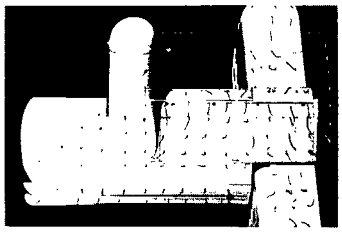
$\alpha = 35^0$



$\alpha = 40^0$



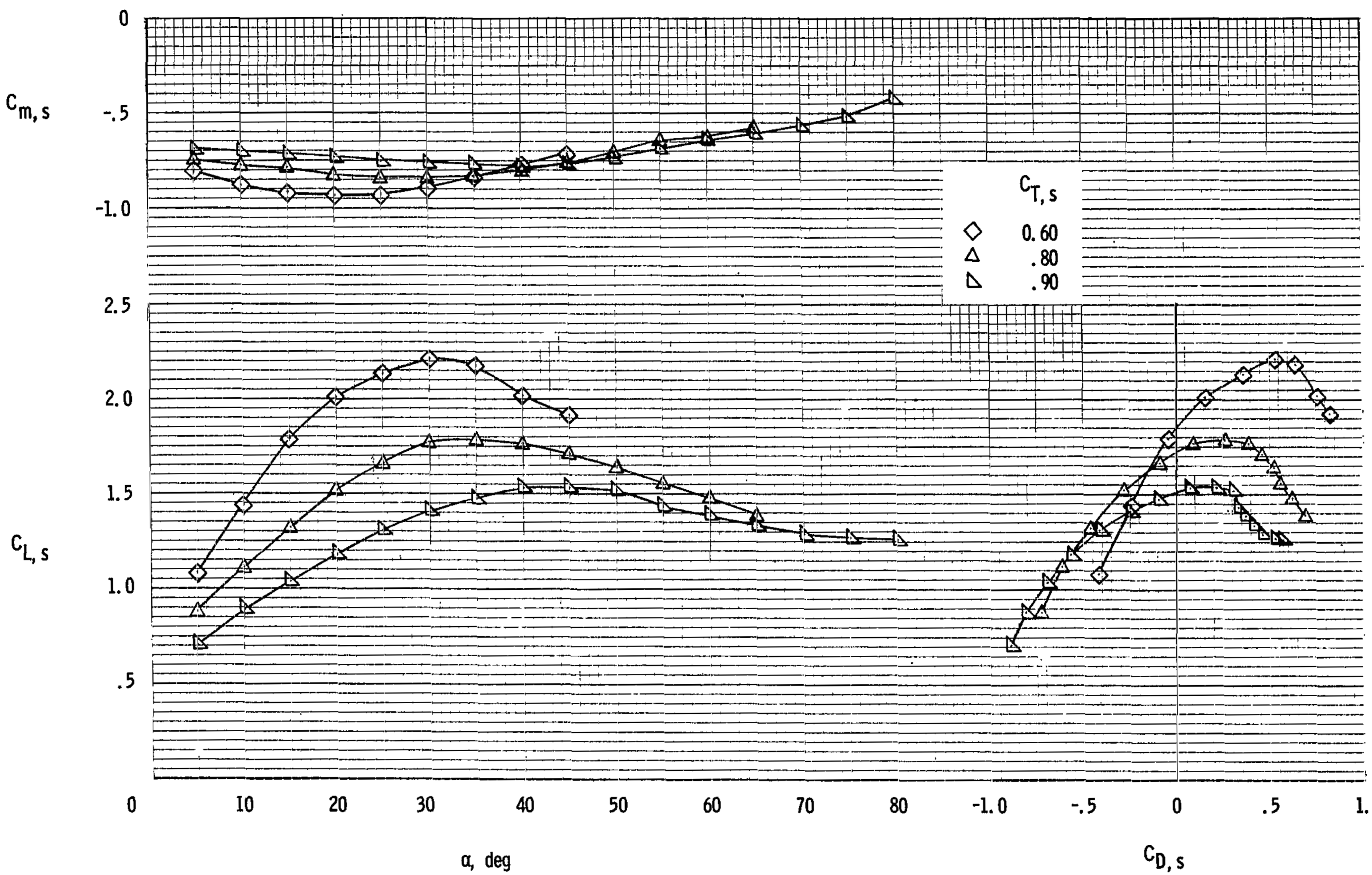
$\alpha = 45^0$



$\alpha = 50^0$

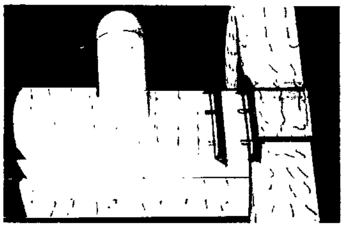
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4503

Figure 15.- Concluded.



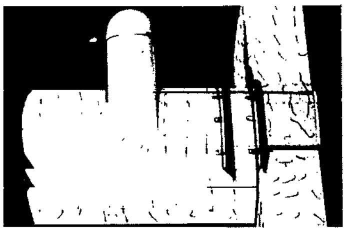
(a) Aerodynamic characteristics.

Figure 16.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Inboard slat on; fences on; $\delta_f = 40^0$.

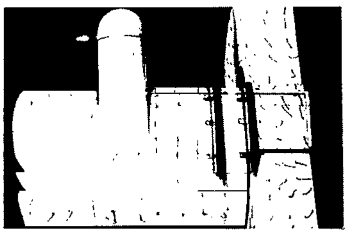


α = 10°

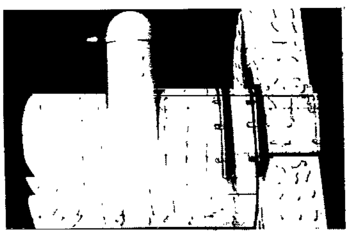
α = 15°



α = 20°

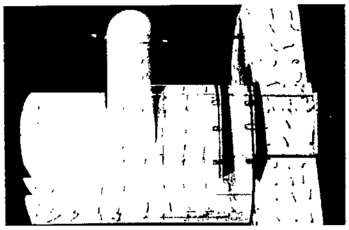


α = 25°

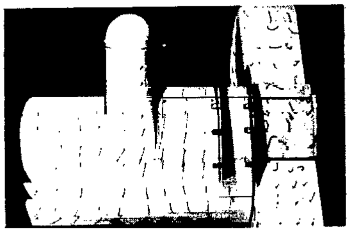


α = 30°

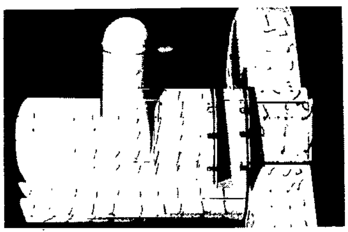
α = 35°



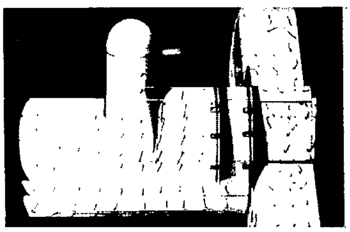
α = 40°



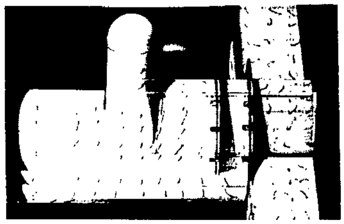
α = 45°



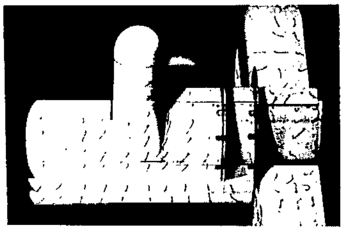
α = 50°



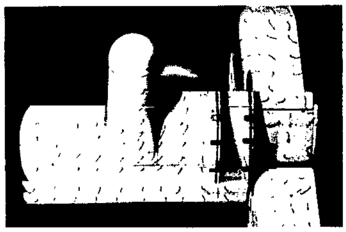
α = 55°



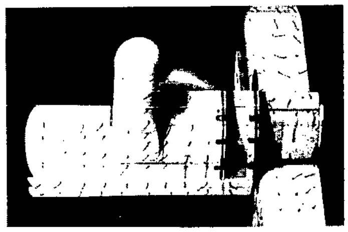
α = 60°



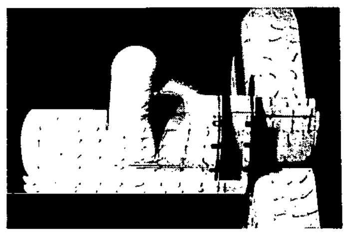
α = 65°



α = 70°



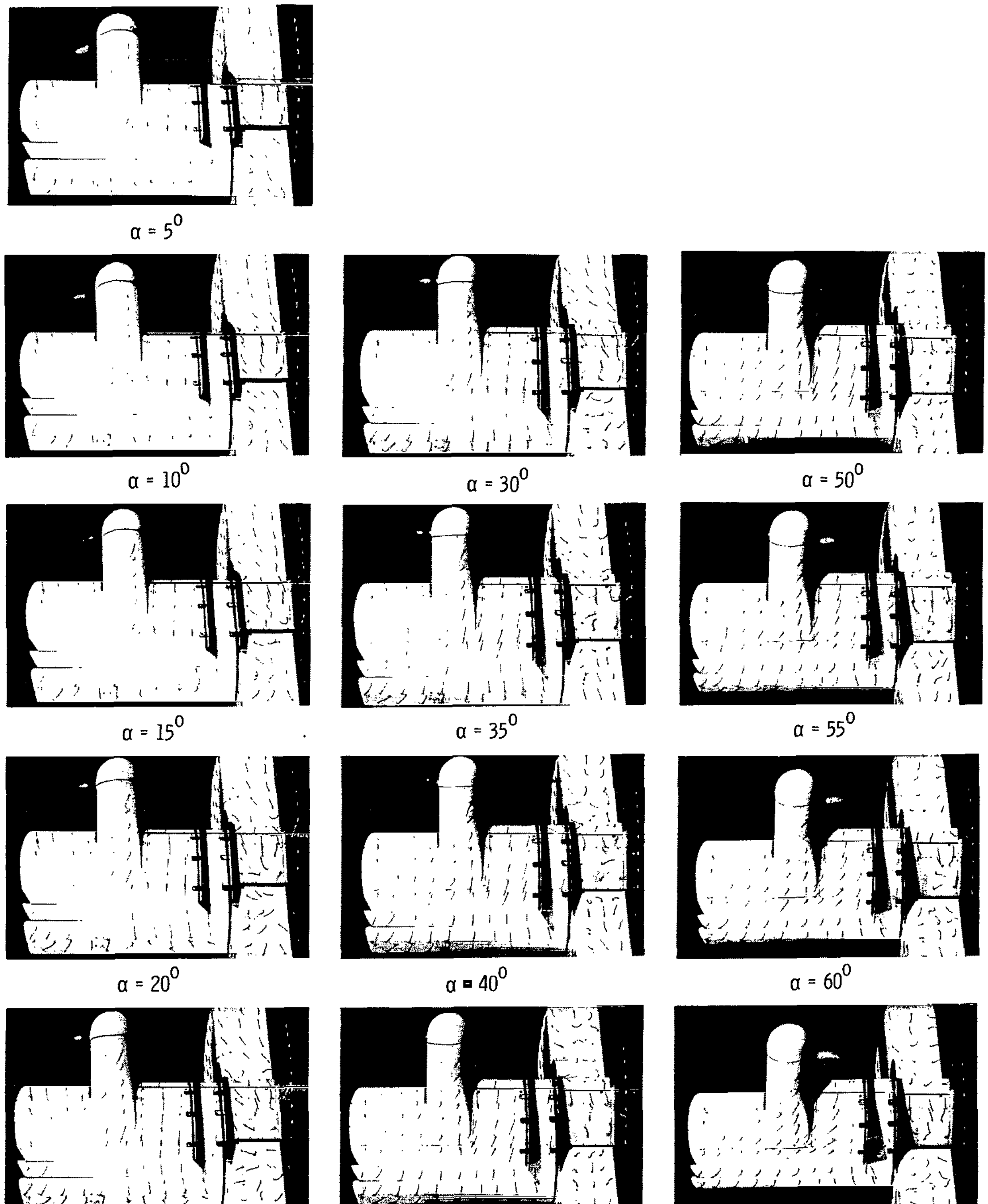
α = 75°



α = 80°

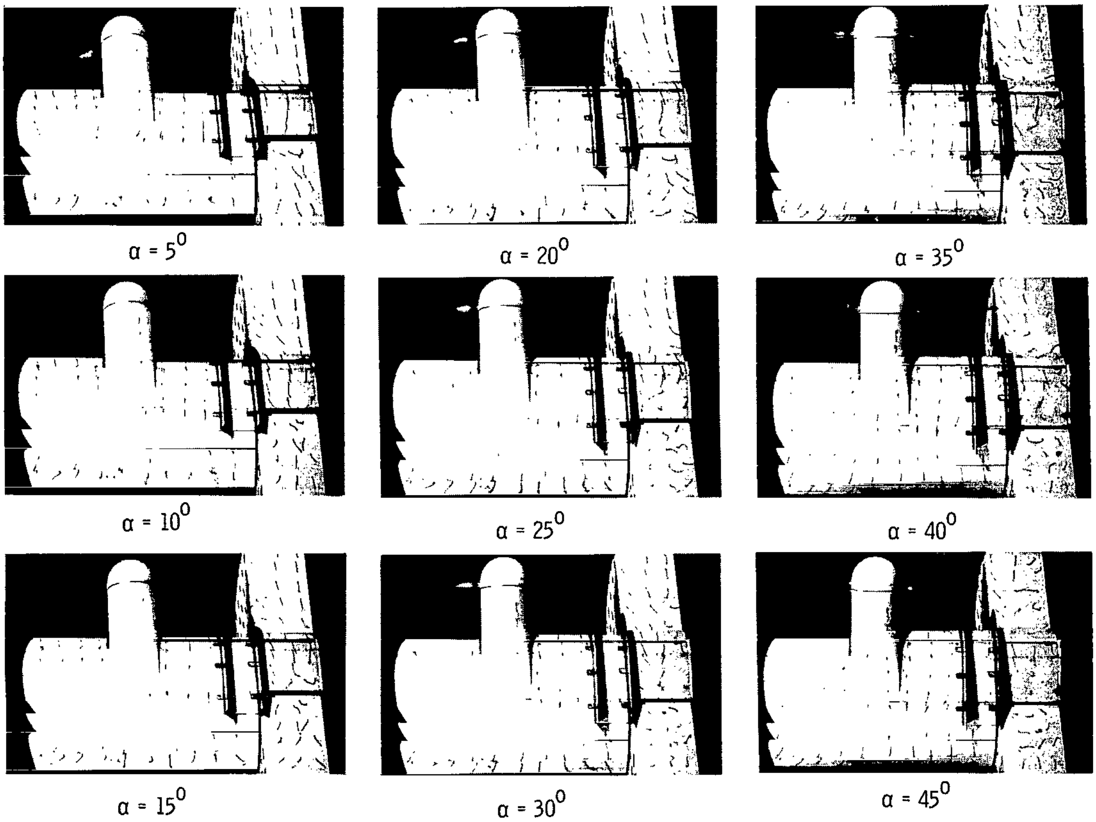
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4504

Figure 16.- Continued.



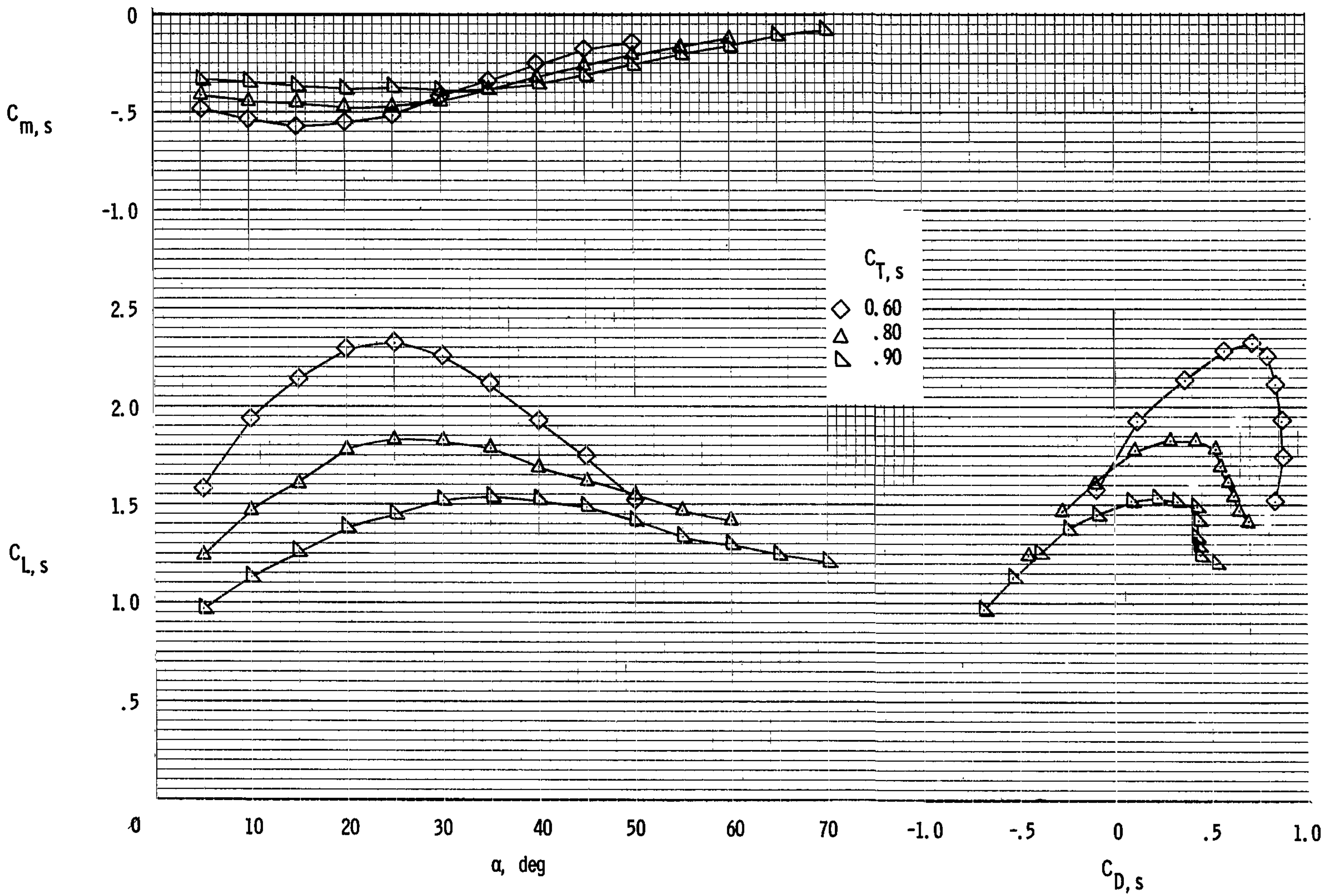
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4505

Figure 16.- Continued.



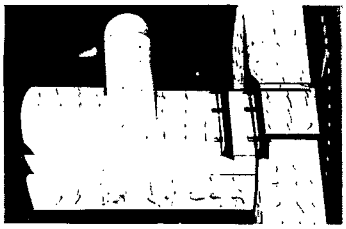
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4506

Figure 16.- Concluded.

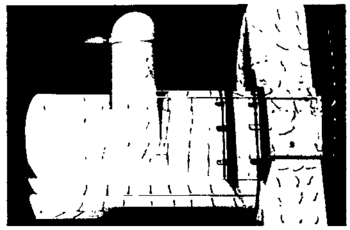


(a) Aerodynamic characteristics.

Figure 17.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Inboard slat on; fences on; $\delta_f = 60^0$.

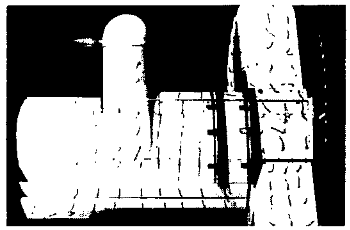


$\alpha = 5^0$

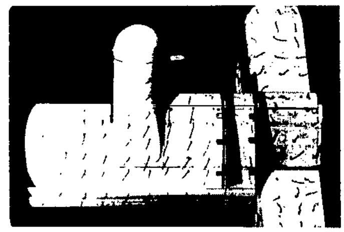


$\alpha = 30^0$

$\alpha = 10^0$

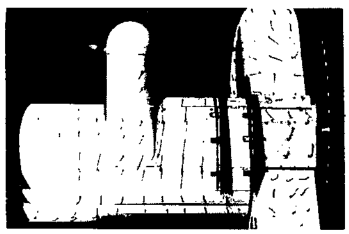


$\alpha = 35^0$



$\alpha = 55^0$

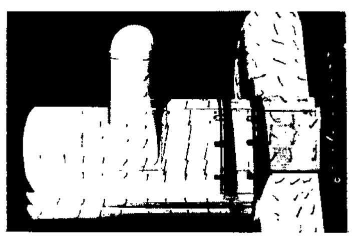
$\alpha = 15^0$



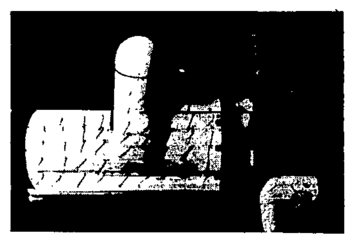
$\alpha = 40^0$

$\alpha = 60^0$

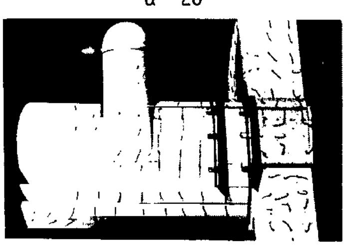
$\alpha = 20^0$



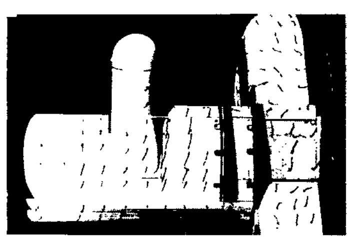
$\alpha = 45^0$



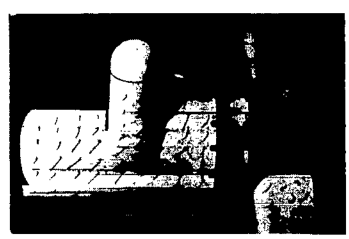
$\alpha = 65^0$



$\alpha = 25^0$



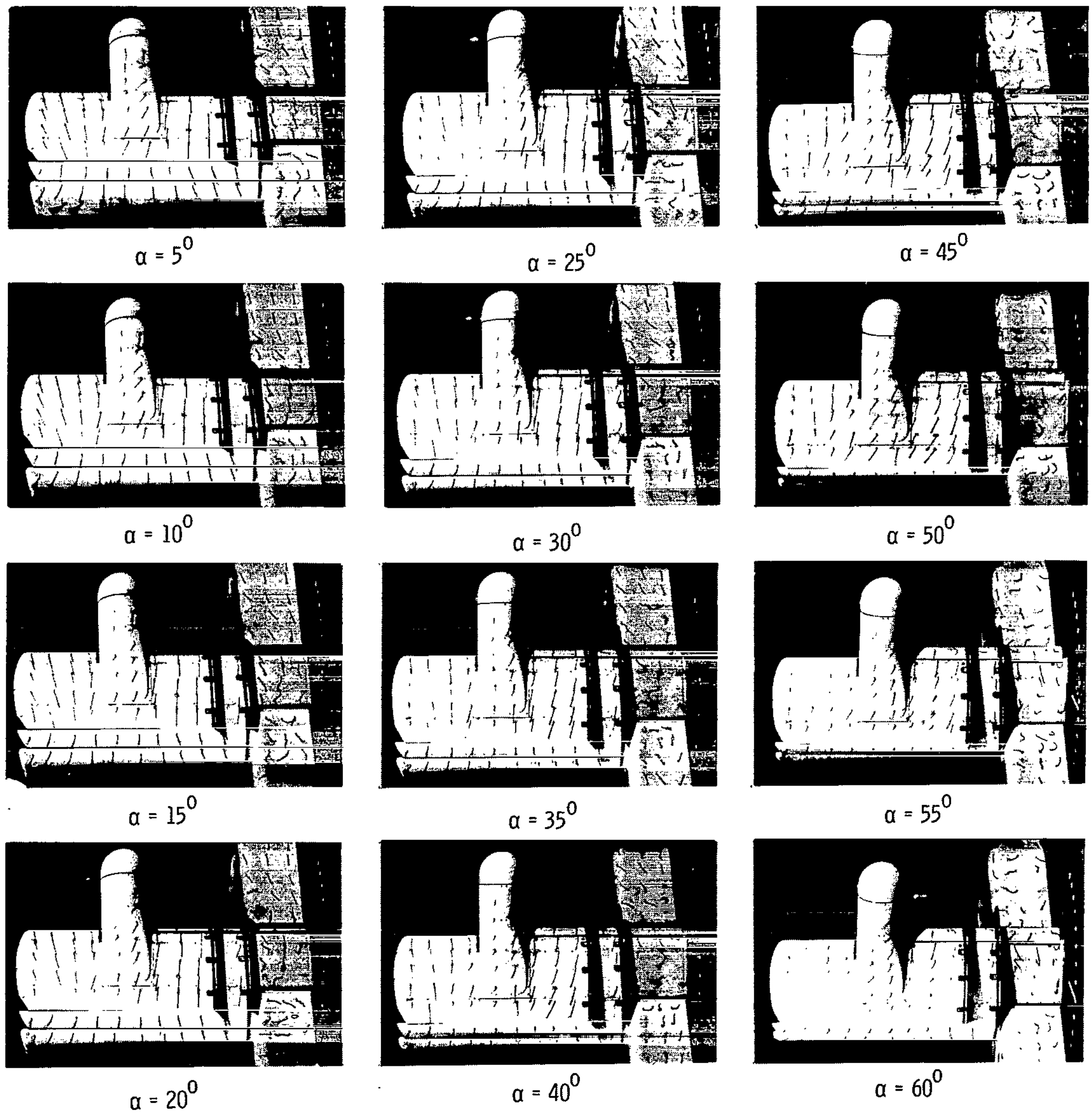
$\alpha = 50^0$



$\alpha = 70^0$

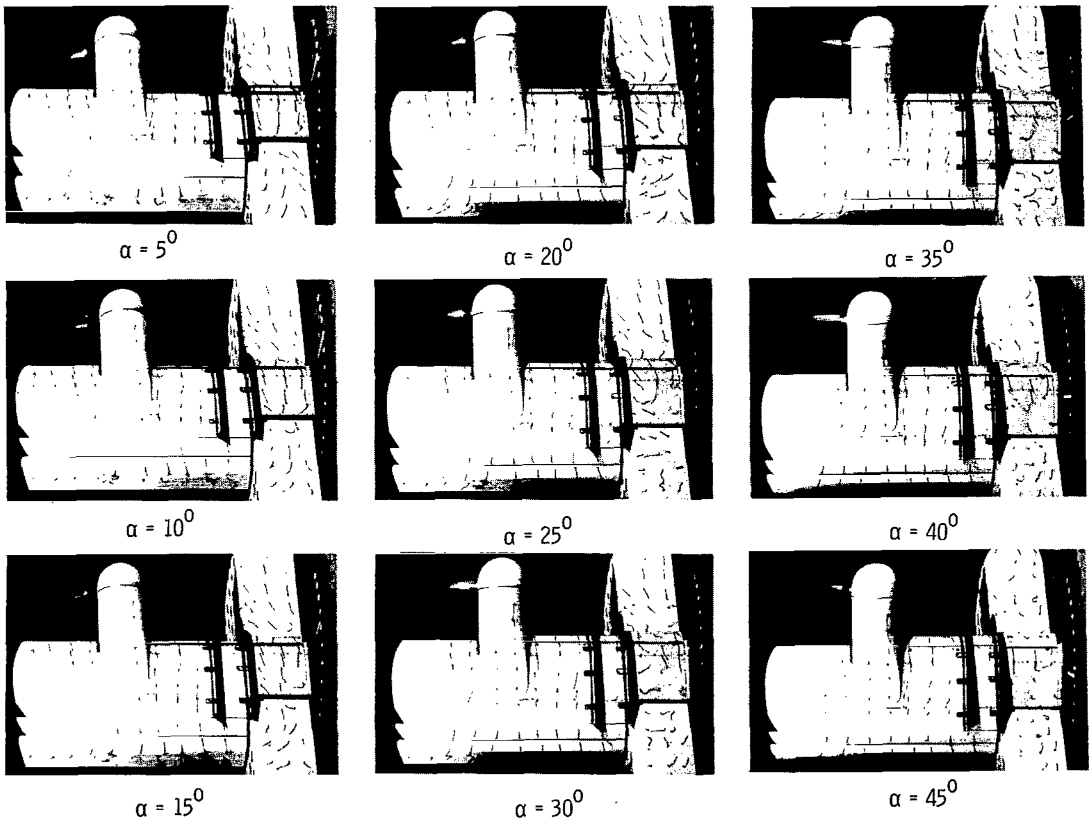
(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4507

Figure 17.- Continued.



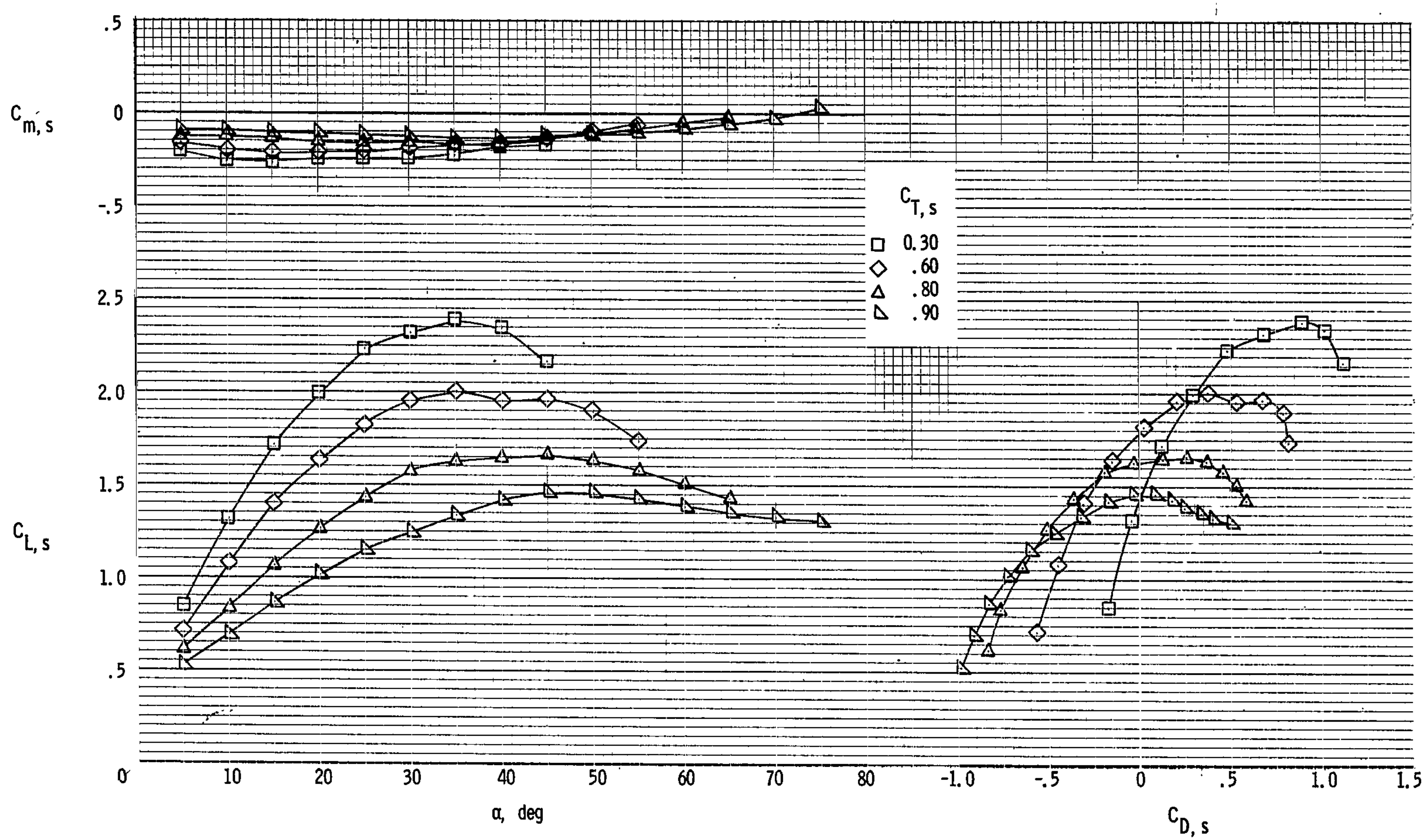
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4508

Figure 17.- Continued.



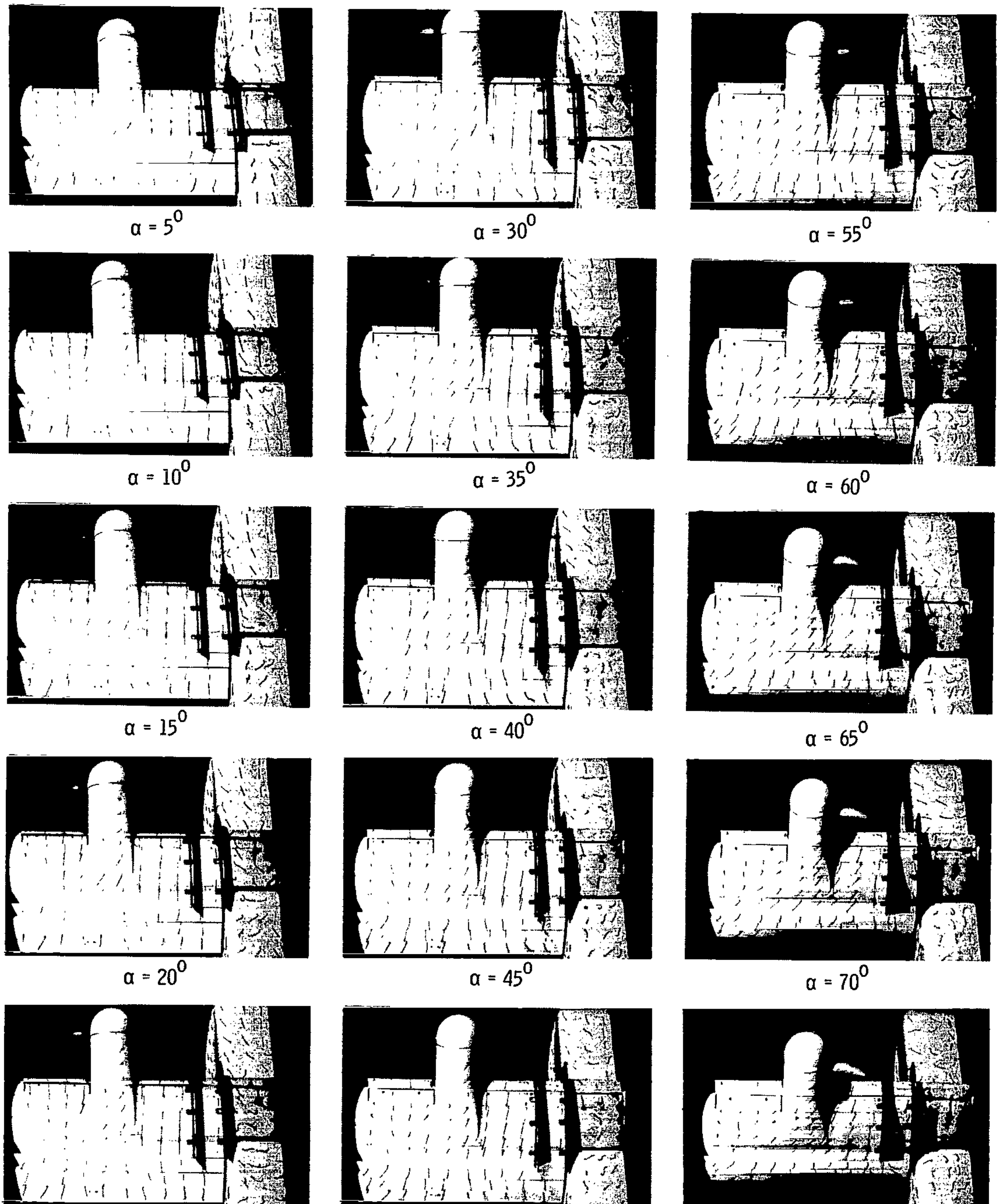
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4509

Figure 17.- Concluded.



(a) Aerodynamic characteristics.

Figure 18.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Full-span slat on; fences on; $\delta_f = 20^0$.



$\alpha = 5^0$ $\alpha = 30^0$ $\alpha = 55^0$

$\alpha = 10^0$ $\alpha = 35^0$ $\alpha = 60^0$

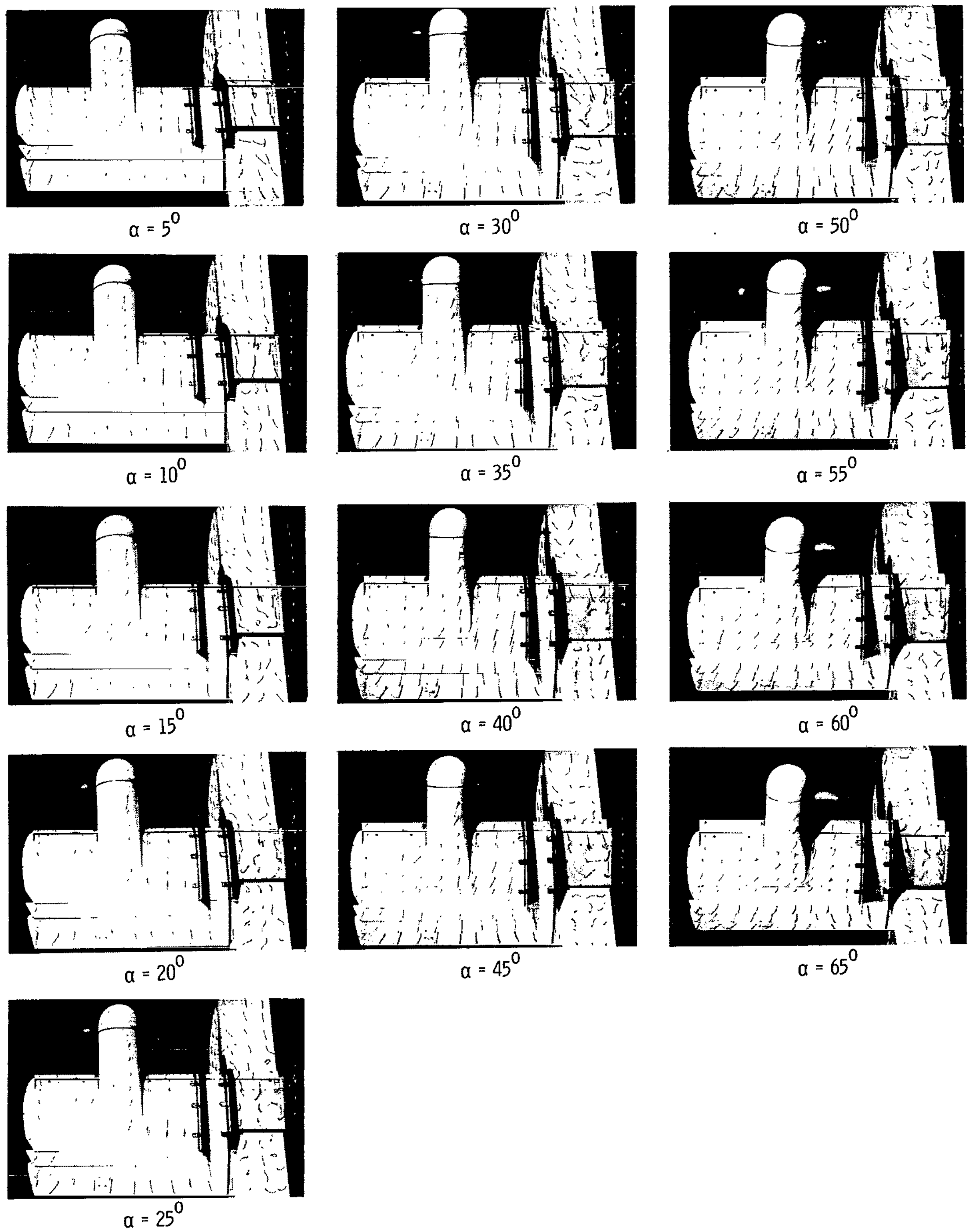
$\alpha = 15^0$ $\alpha = 40^0$ $\alpha = 65^0$

$\alpha = 20^0$ $\alpha = 45^0$ $\alpha = 70^0$

$\alpha = 25^0$ $\alpha = 50^0$ $\alpha = 75^0$

(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4510

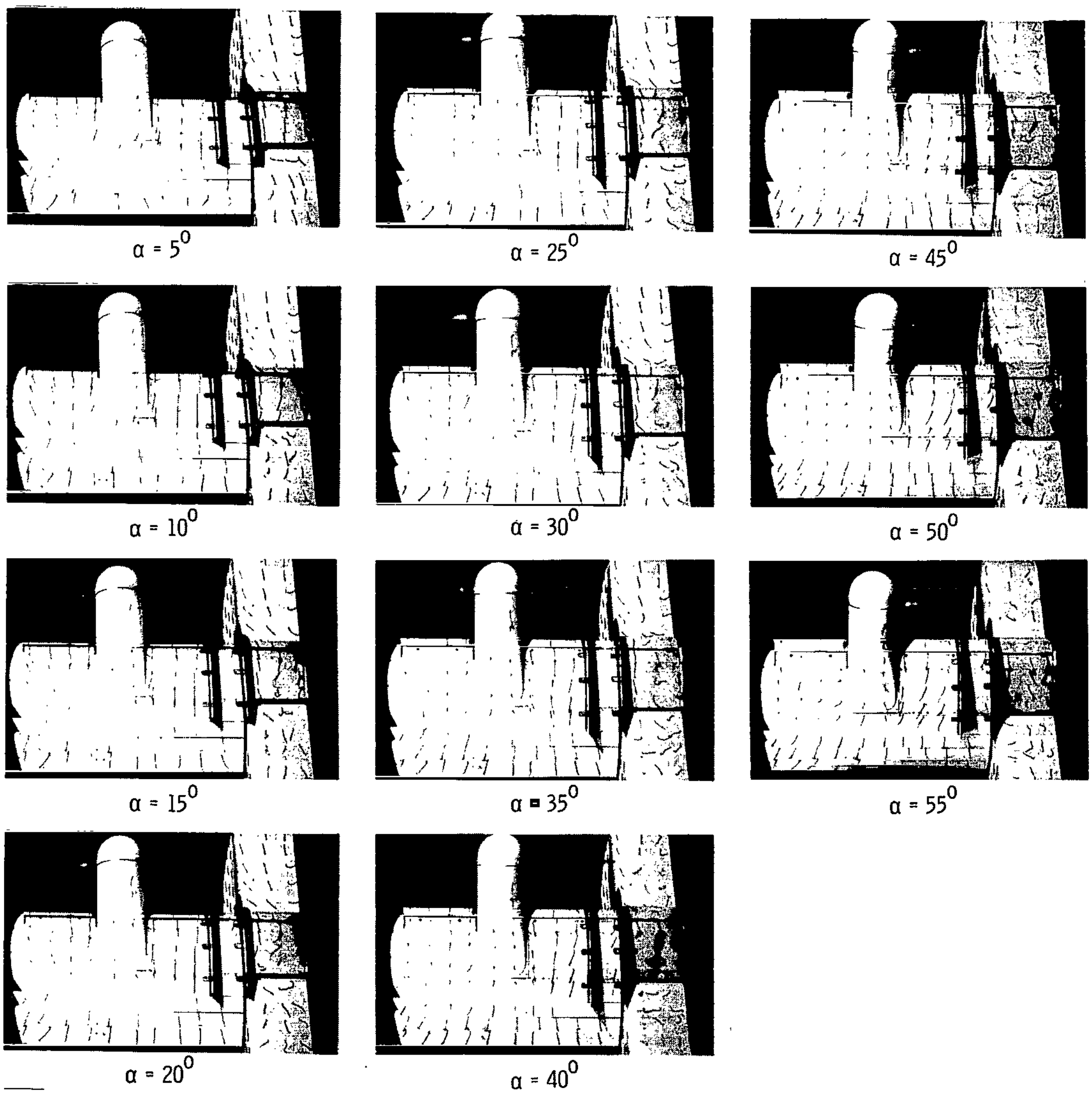
Figure 18.- Continued.



(c) Flow characteristics; $C_{T,s} = 0.80$.

L-66-4511

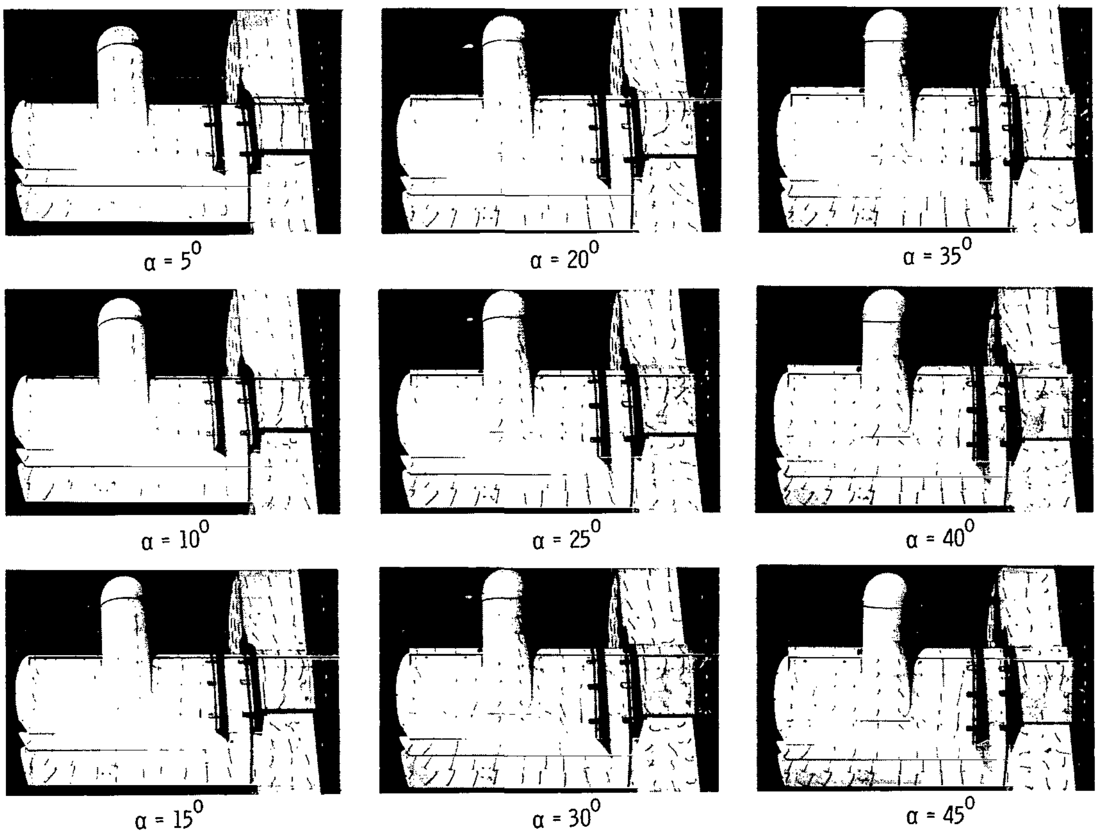
Figure 18.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$.

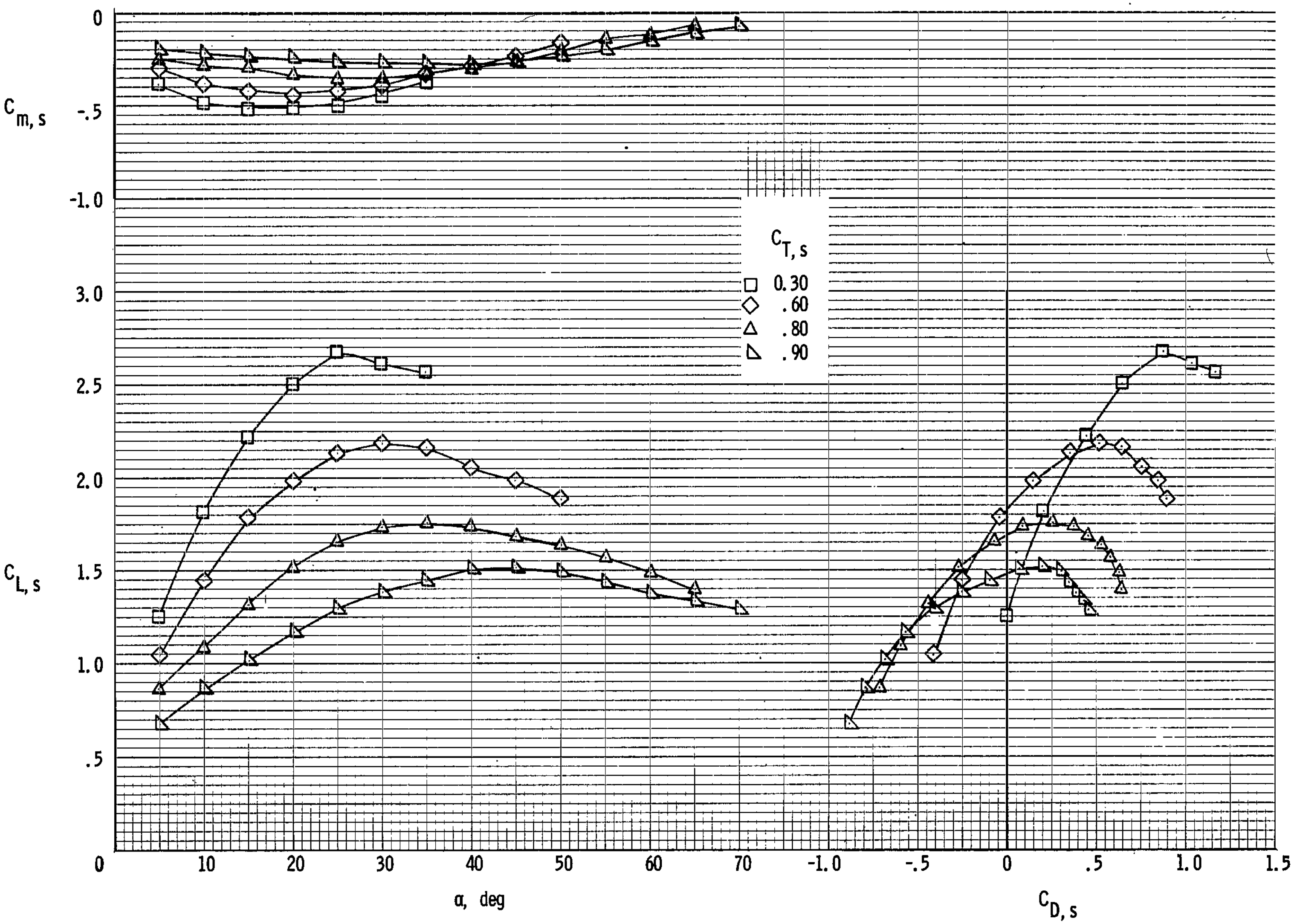
L-66-4512

Figure 18.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.30$. L-66-4513

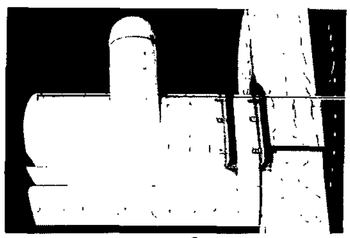
Figure 18.- Concluded.



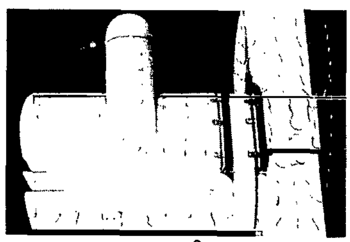
(a) Aerodynamic characteristics.

Figure 19.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Full-span slat on; fences on; $\delta_f = 40^0$.

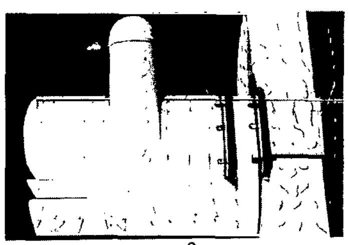
$\alpha = 5^0$



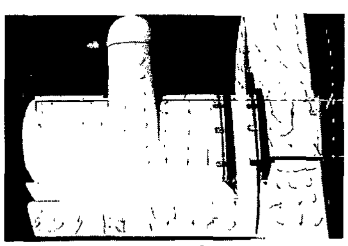
$\alpha = 10^0$



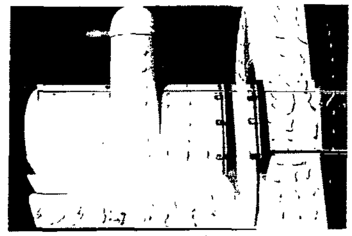
$\alpha = 15^0$



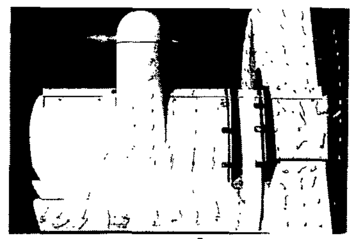
$\alpha = 20^0$



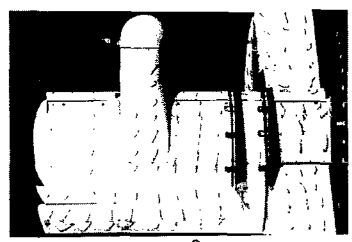
$\alpha = 25^0$



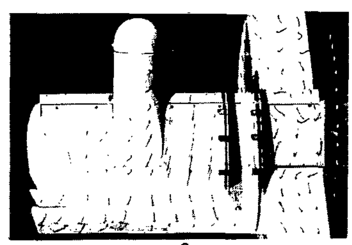
$\alpha = 30^0$



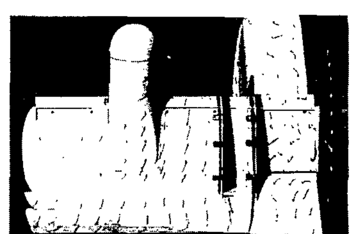
$\alpha = 35^0$



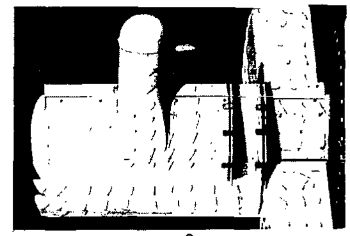
$\alpha = 40^0$



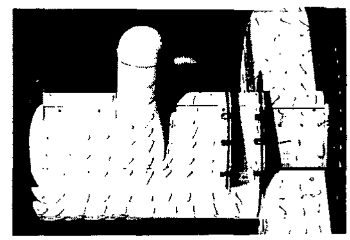
$\alpha = 45^0$



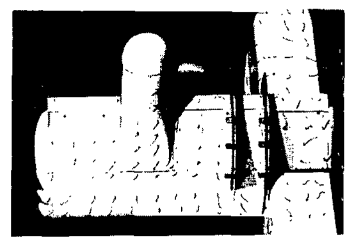
$\alpha = 50^0$



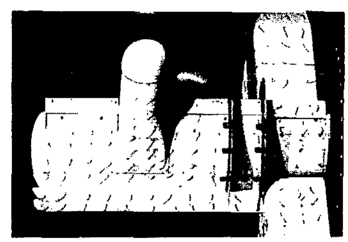
$\alpha = 55^0$



$\alpha = 60^0$



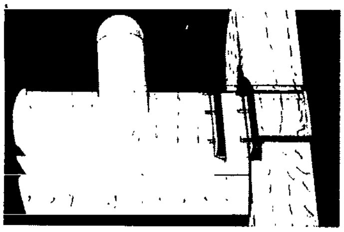
$\alpha = 65^0$



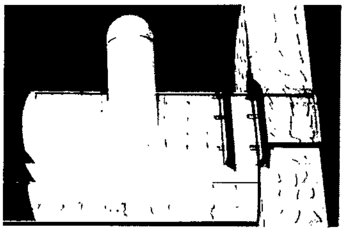
$\alpha = 70^0$

(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4514

Figure 19.- Continued.



$\alpha = 5^0$



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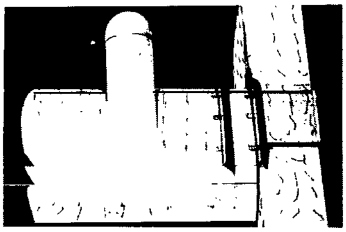
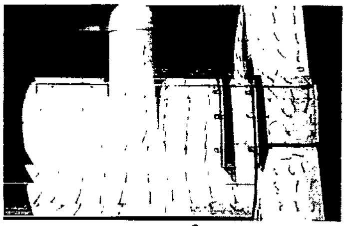


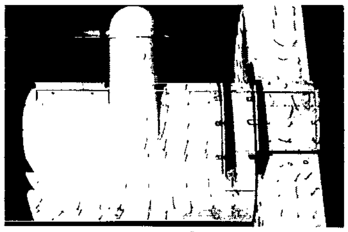
$\alpha = 15^0$

$\alpha = 20^0$

$\alpha = 25^0$



$\alpha = 30^0$



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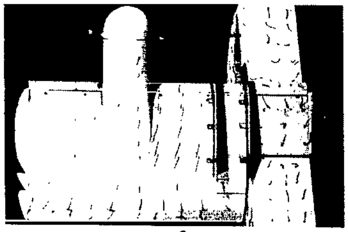
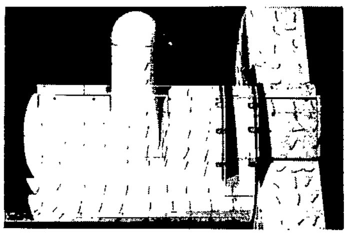
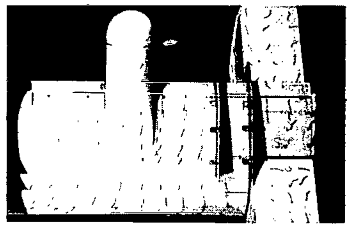


$\alpha = 40^0$

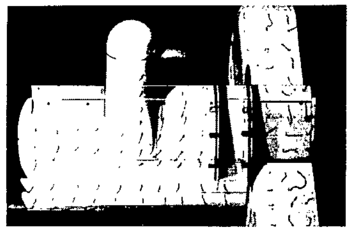


$\alpha = 45^0$



$\alpha = 50^0$

$\alpha = 55^0$



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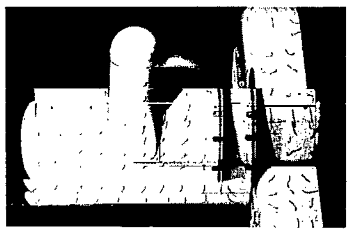
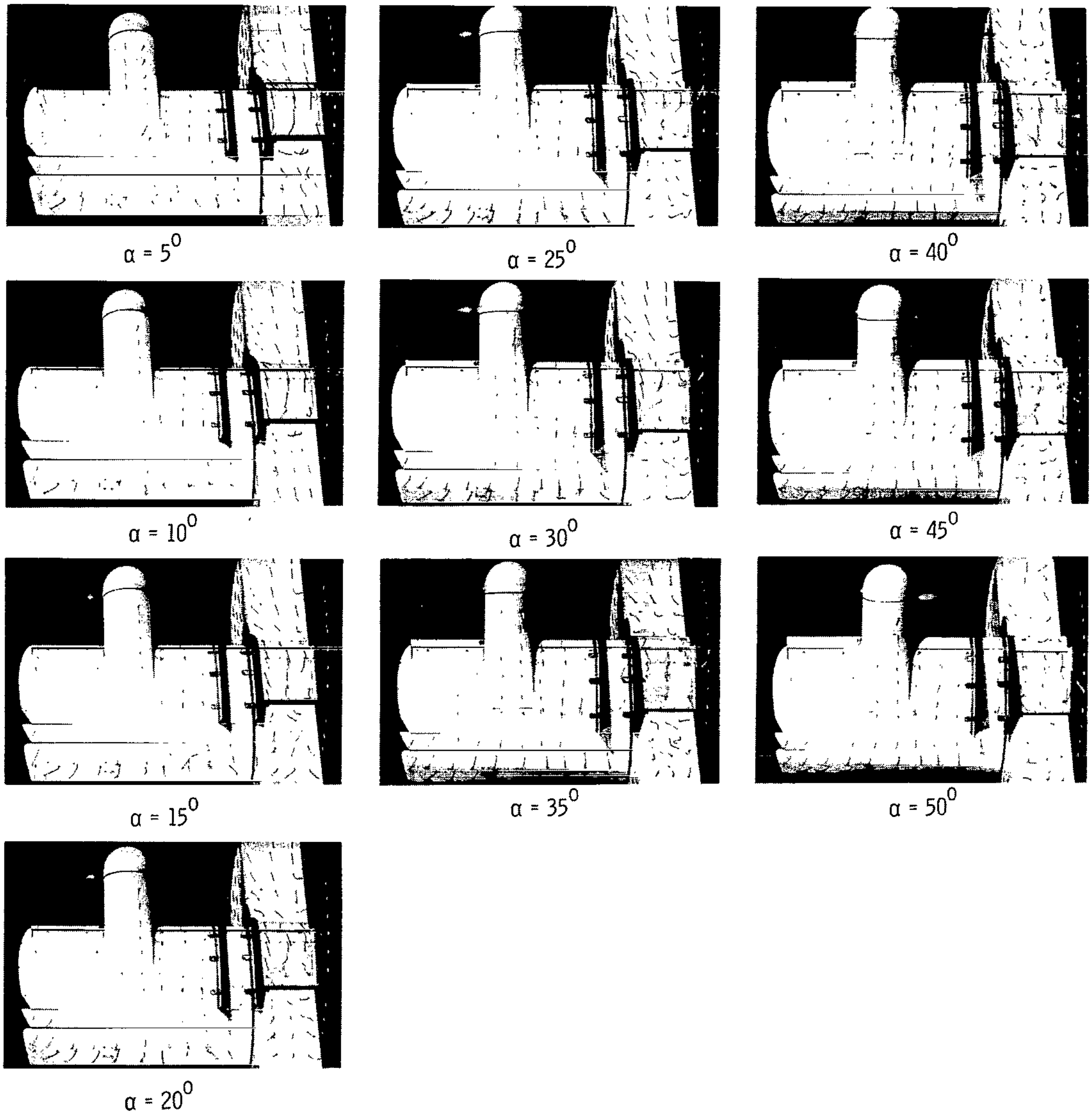


$\alpha = 65^0$

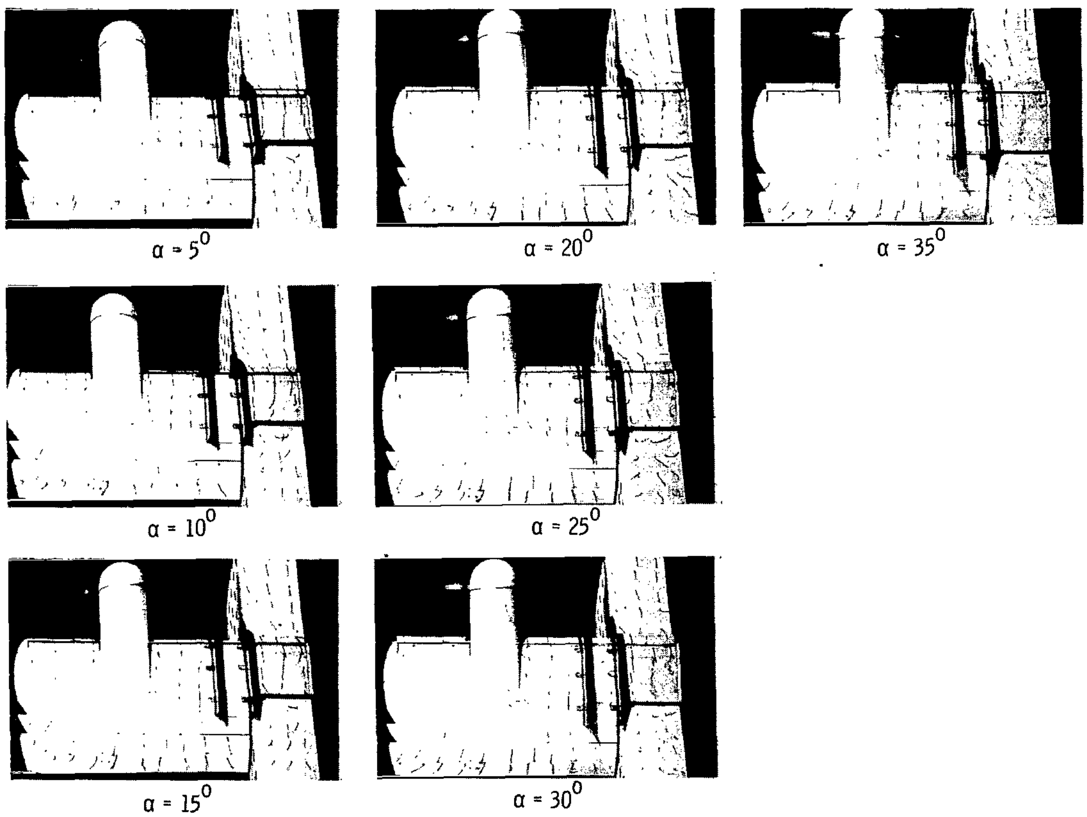
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4515

Figure 19.- Continued.



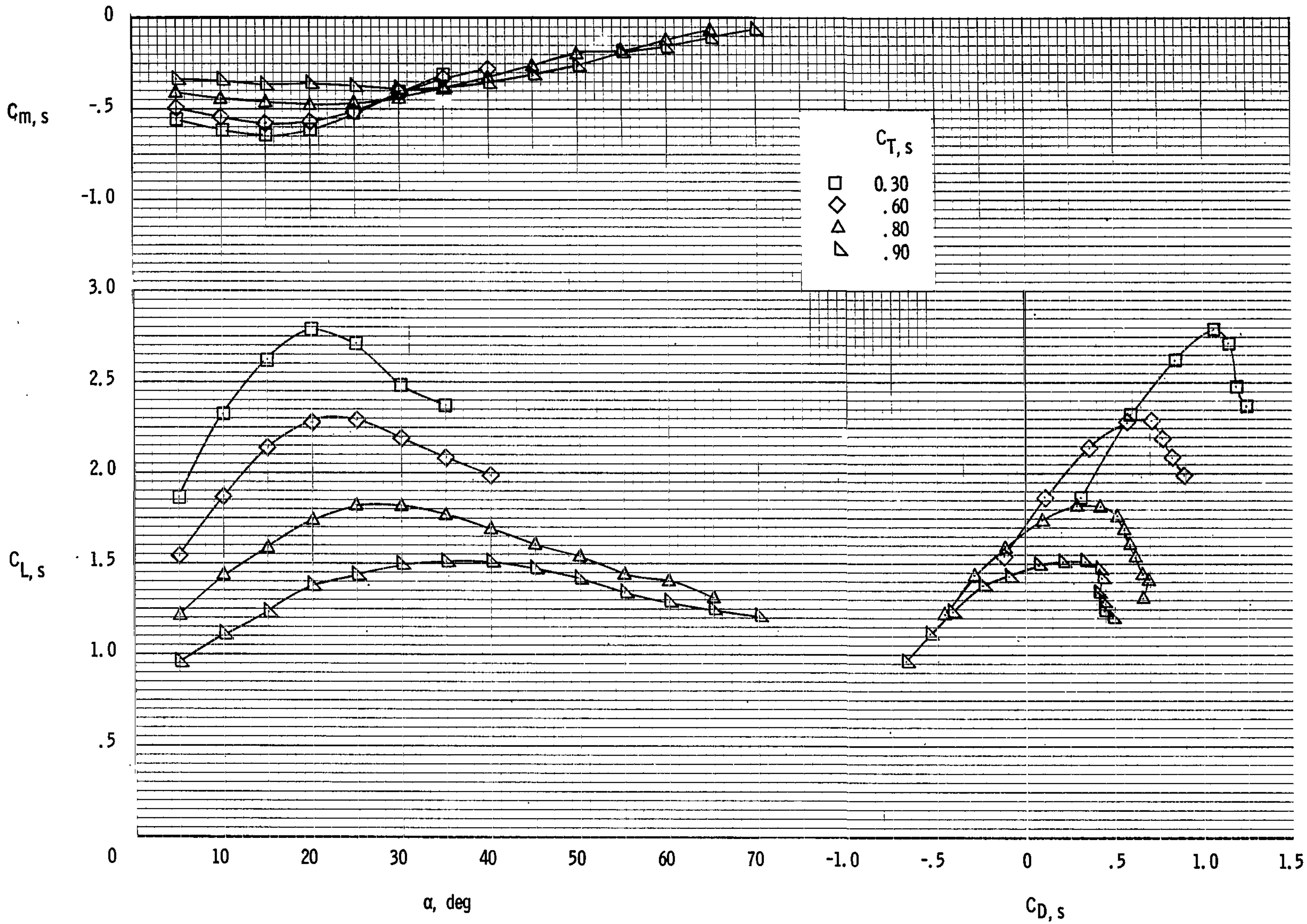
(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4516

Figure 19.- Continued.



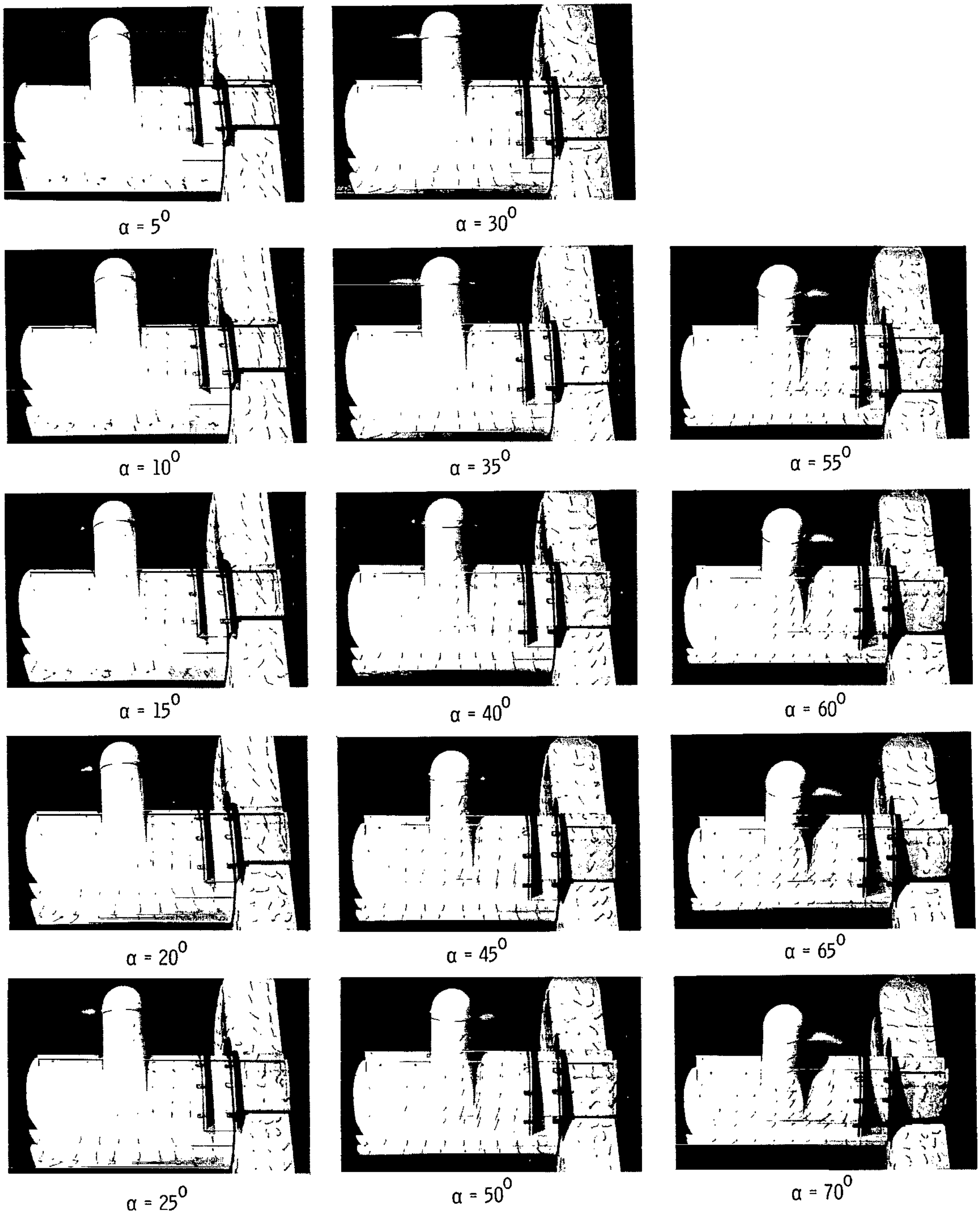
(e) Flow characteristics; $C_{T,s} = 0.30$. L-66-4517

Figure 19.- Concluded.



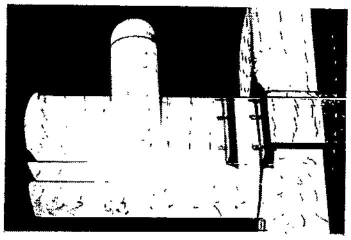
(a) Aerodynamic characteristics.

Figure 20.- Aerodynamic and flow characteristics of the wing with propeller rotation up at the tip. Full-span slat on; fences on; $\delta_f = 60^0$.

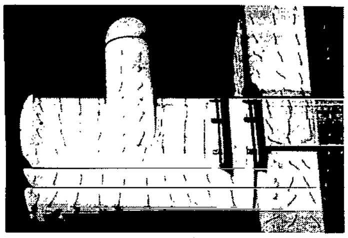


(b) Flow characteristics; $C_{T,s} = 0.90$. L-66-4518

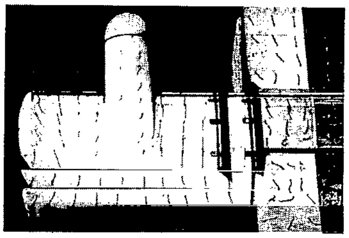
Figure 20.- Continued.



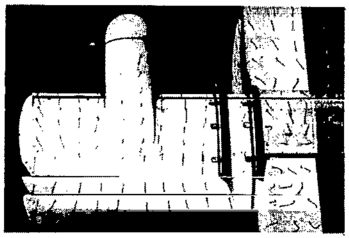
$\alpha = 5^0$



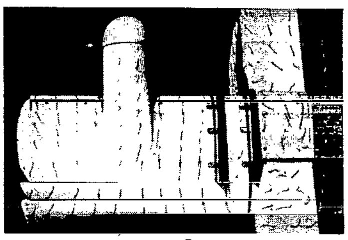
$\alpha = 10^0$



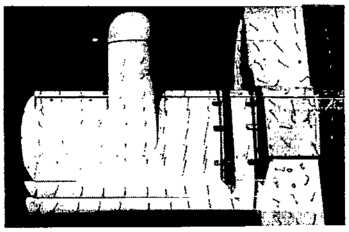
$\alpha = 15^0$



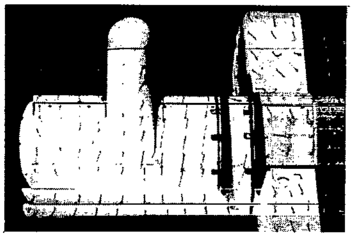
$\alpha = 20^0$



$\alpha = 25^0$



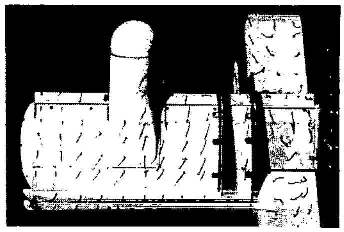
$\alpha = 30^0$



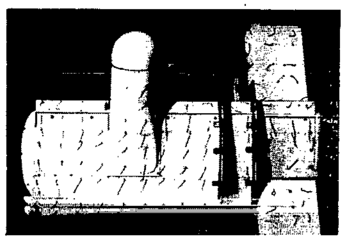
$\alpha = 35^0$

$\alpha = 40^0$

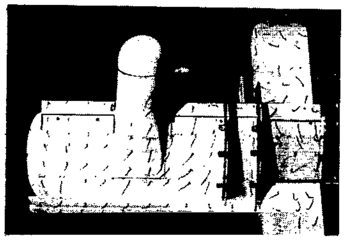
$\alpha = 45^0$



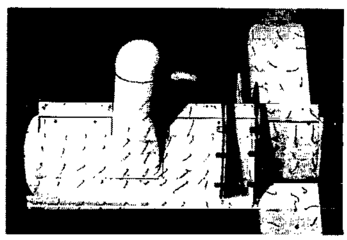
$\alpha = 50^0$



$\alpha = 55^0$



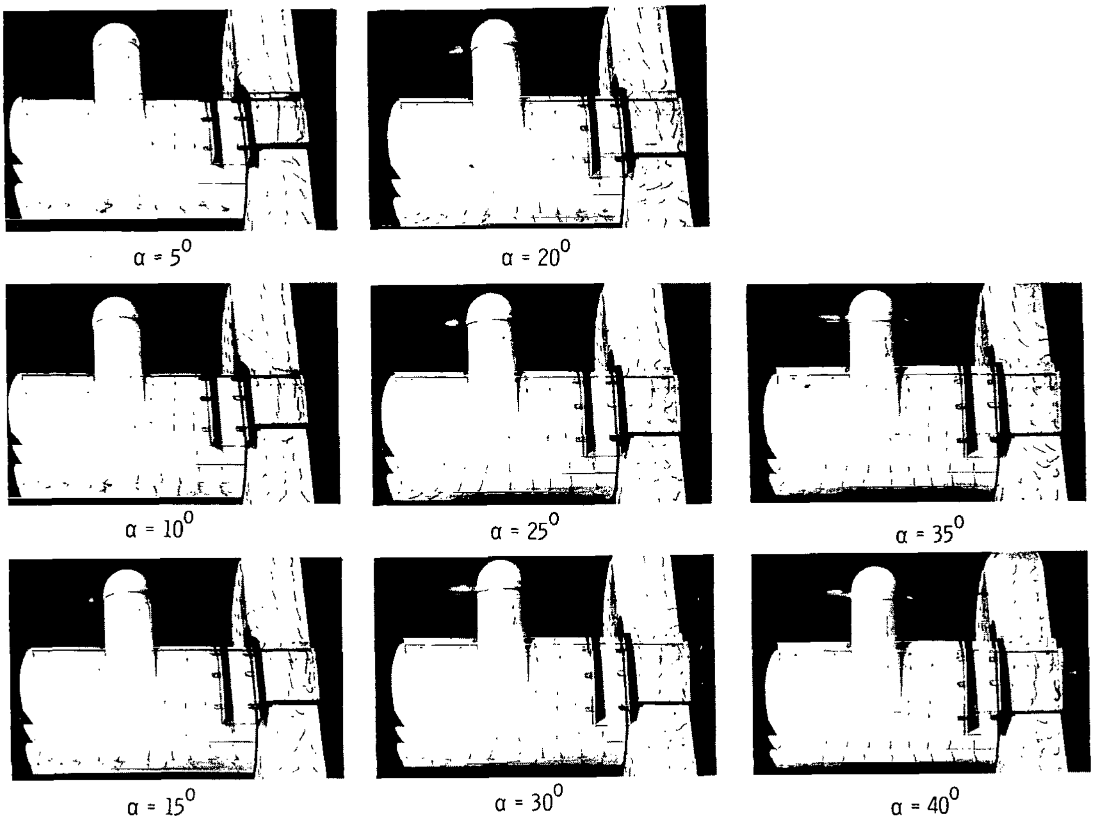
$\alpha = 60^0$



$\alpha = 65^0$

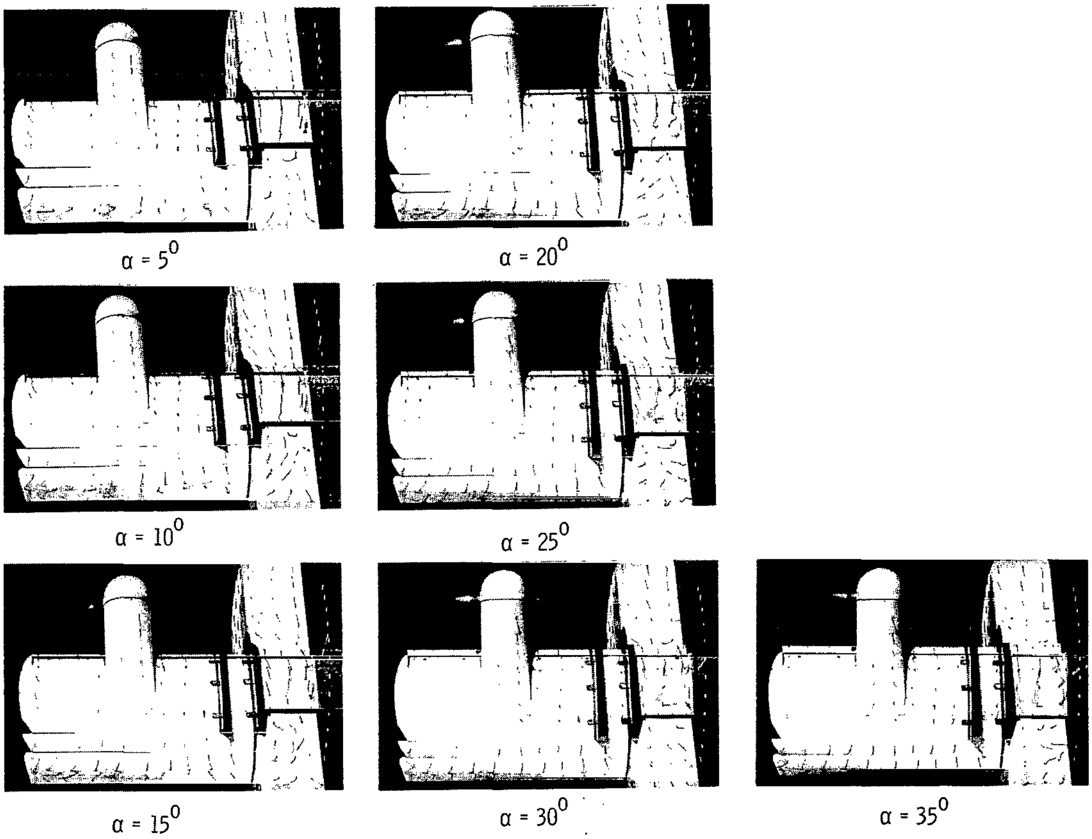
(c) Flow characteristics; $C_{T,s} = 0.80$. L-66-4519

Figure 20.- Continued.



(d) Flow characteristics; $C_{T,s} = 0.60$. L-66-4520

Figure 20.- Continued.



(e) Flow characteristics; $C_{T,s} = 0.30$. L-66-4521

Figure 20.- Concluded.

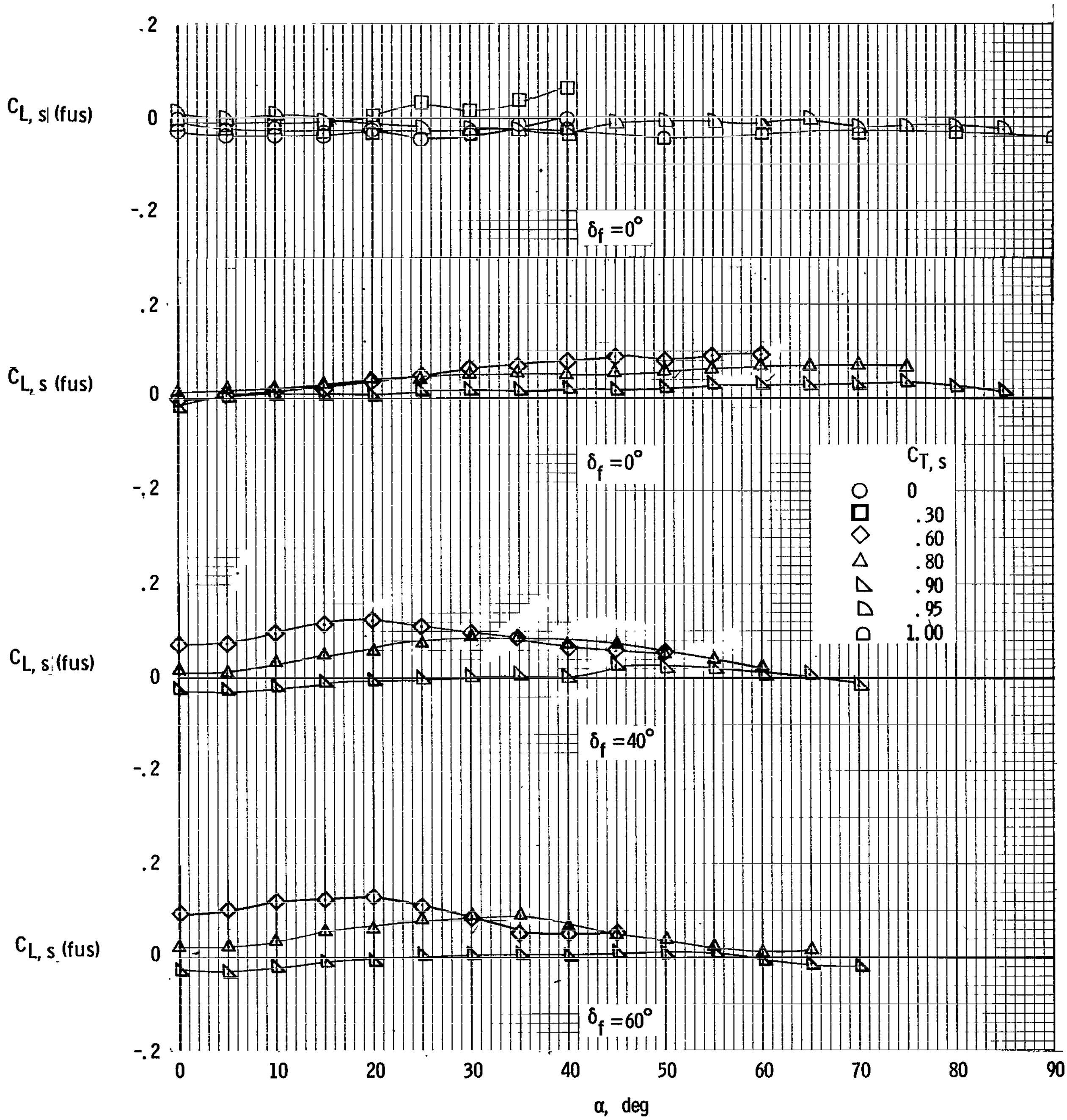


Figure 21.- Fuselage lift coefficients. Basic leading edge; propeller rotation down at tip.

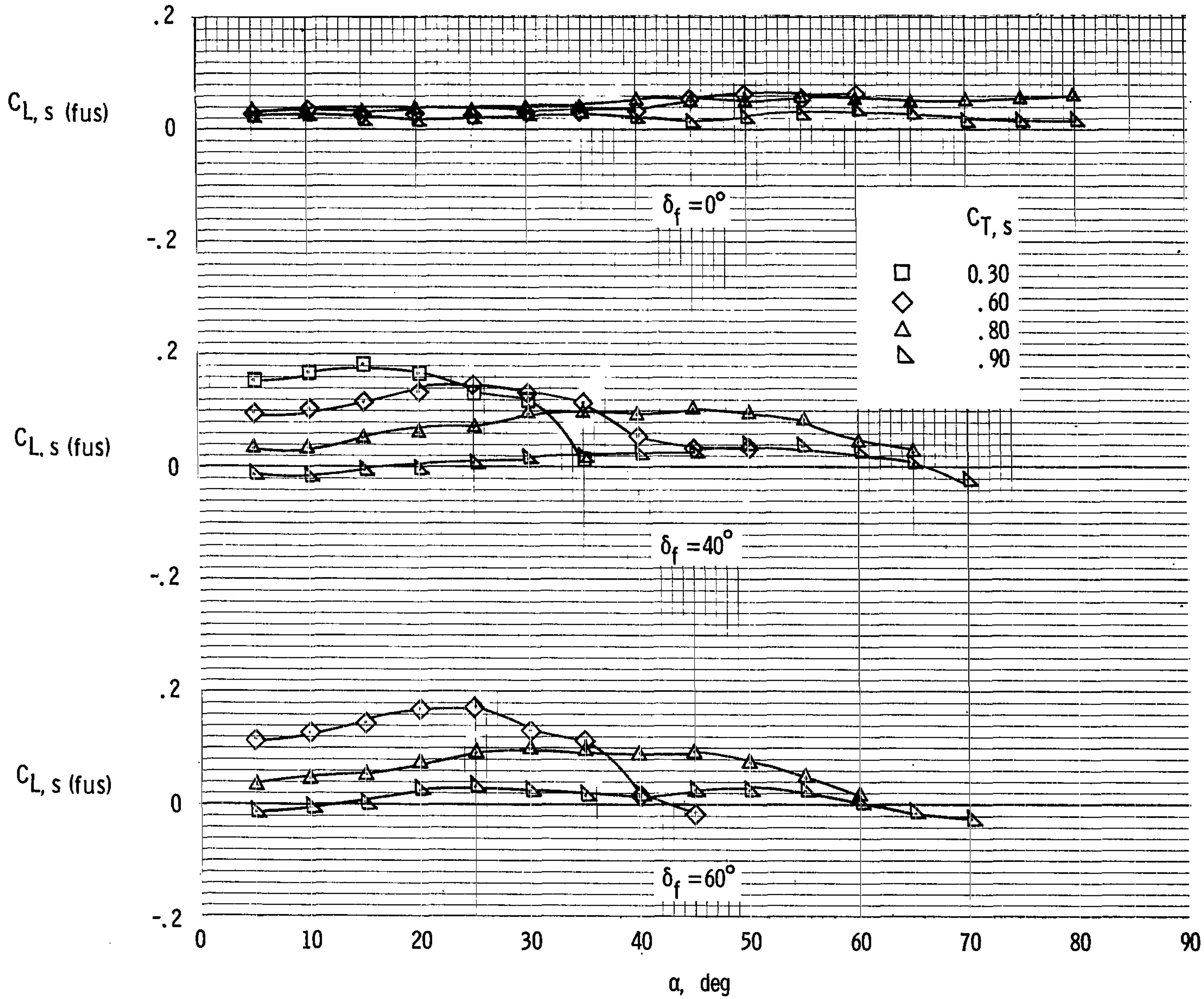


Figure 22.- Fuselage lift coefficients. Inboard slat; fences on; propeller rotation down at tip.

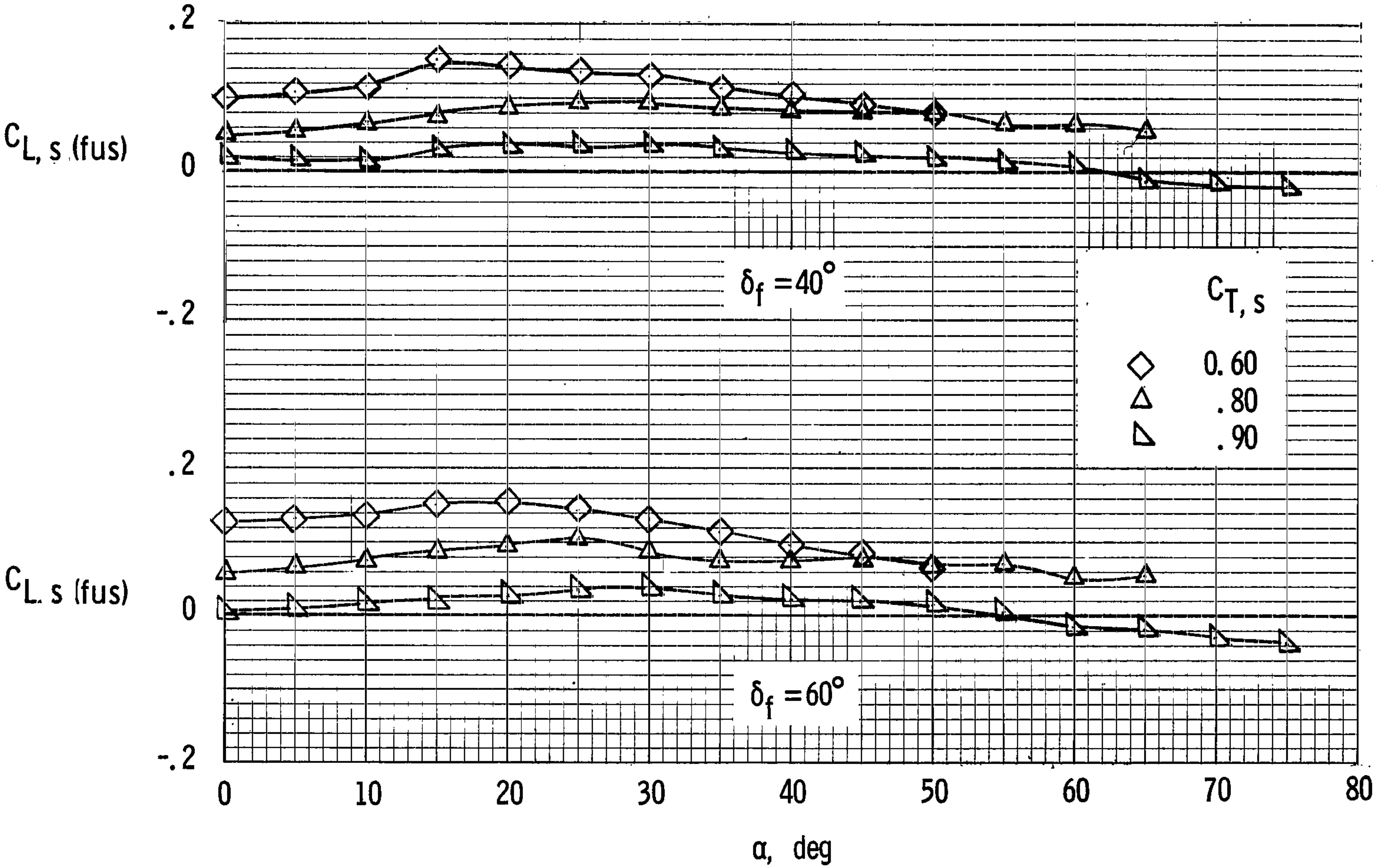


Figure 23.- Fuselage lift coefficients. Basic leading edge; propeller rotation up at tip.

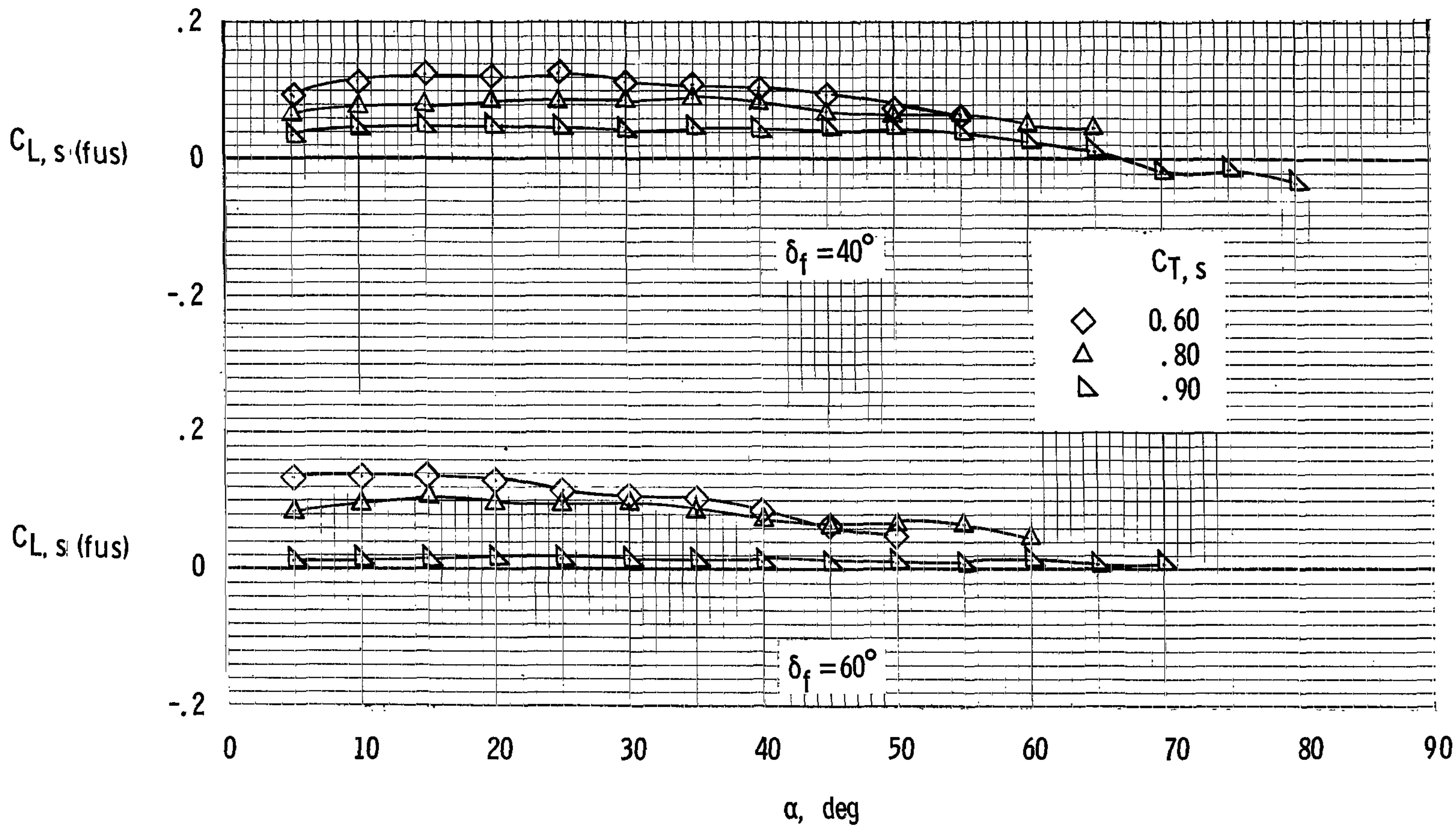


Figure 24.- Fuselage lift coefficients. Inboard slat; propeller rotation up at tip.

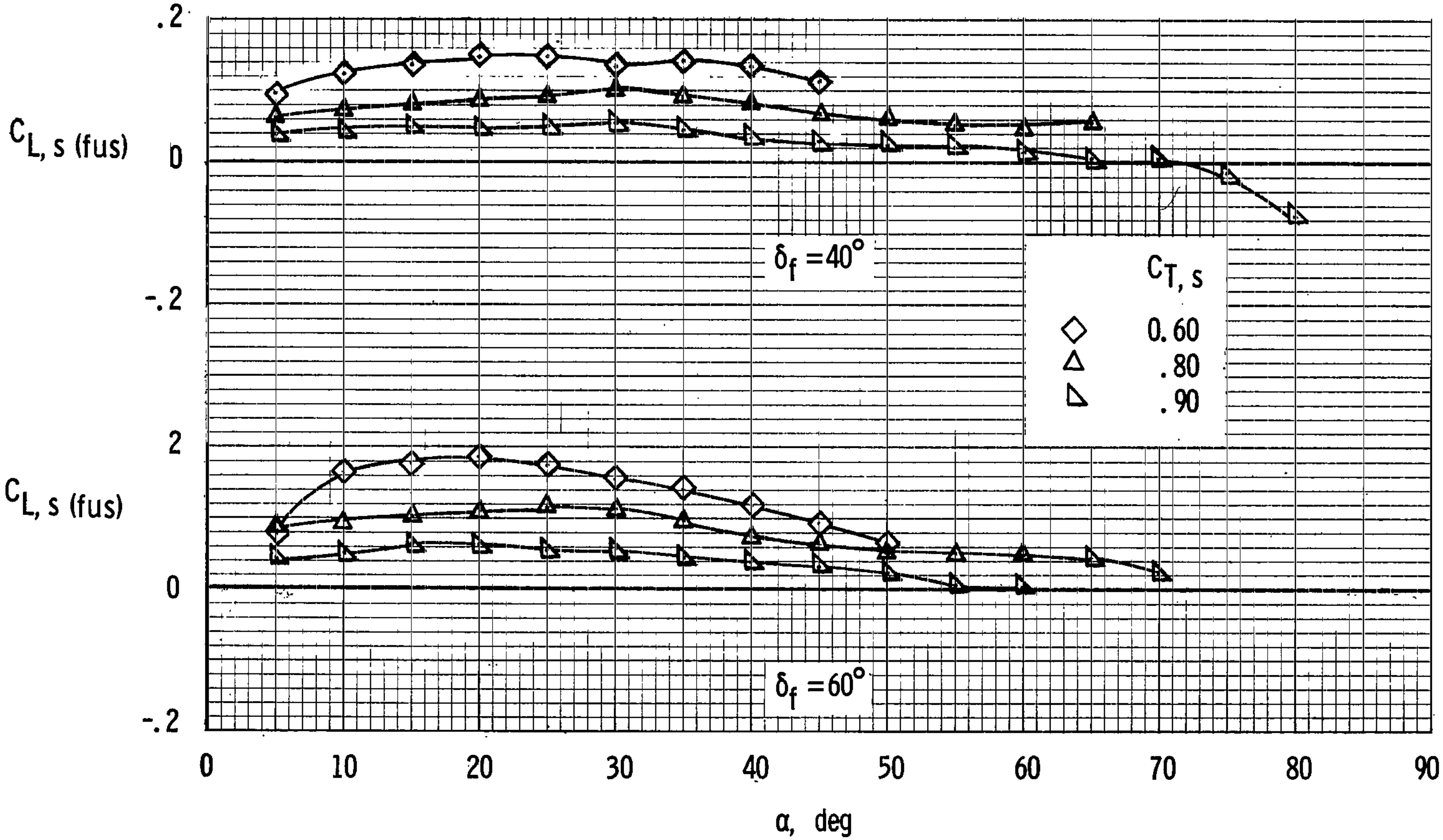


Figure 25.- Fuselage lift coefficients. Inboard slat; fences on; propeller rotation up at tip.

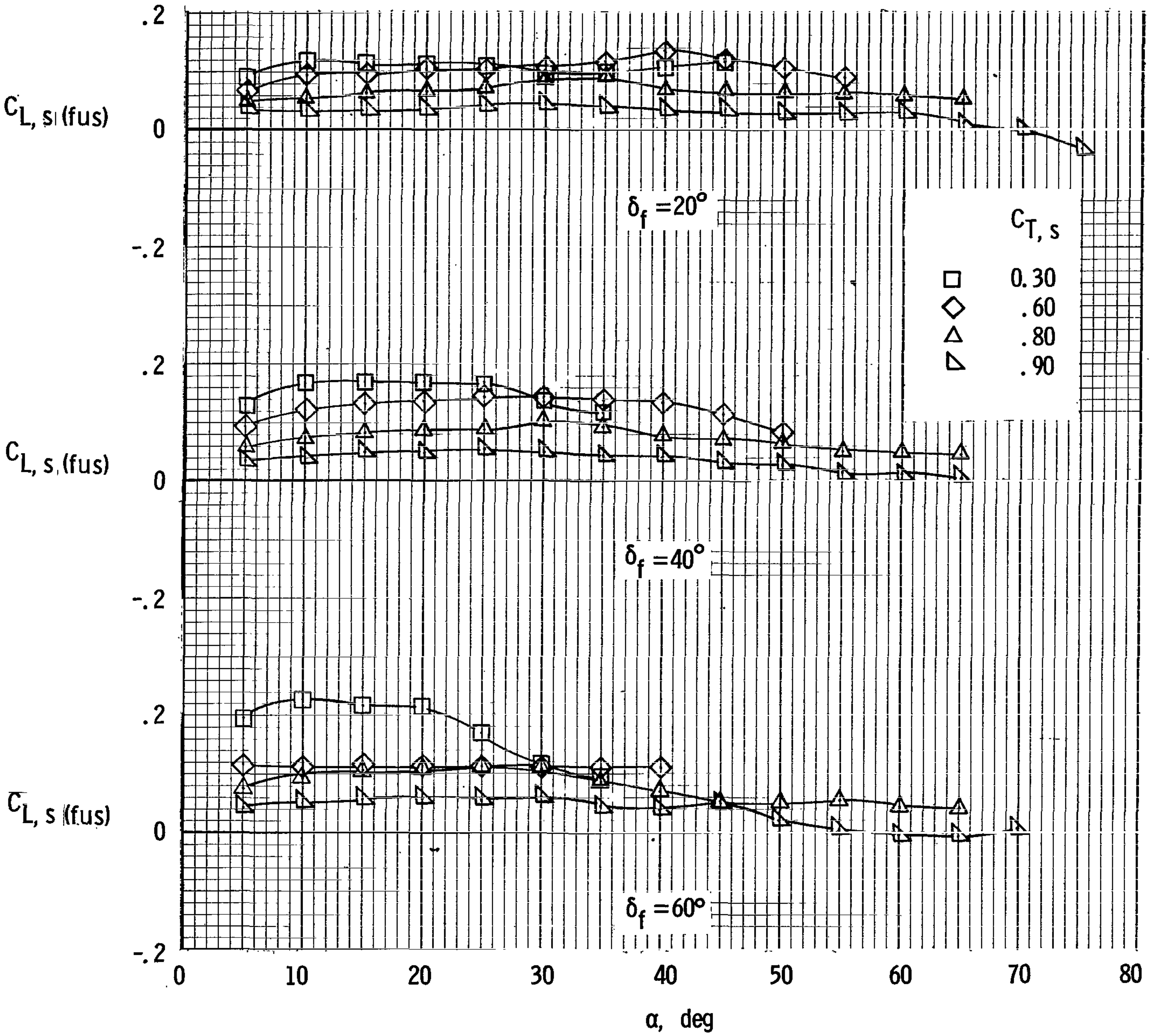
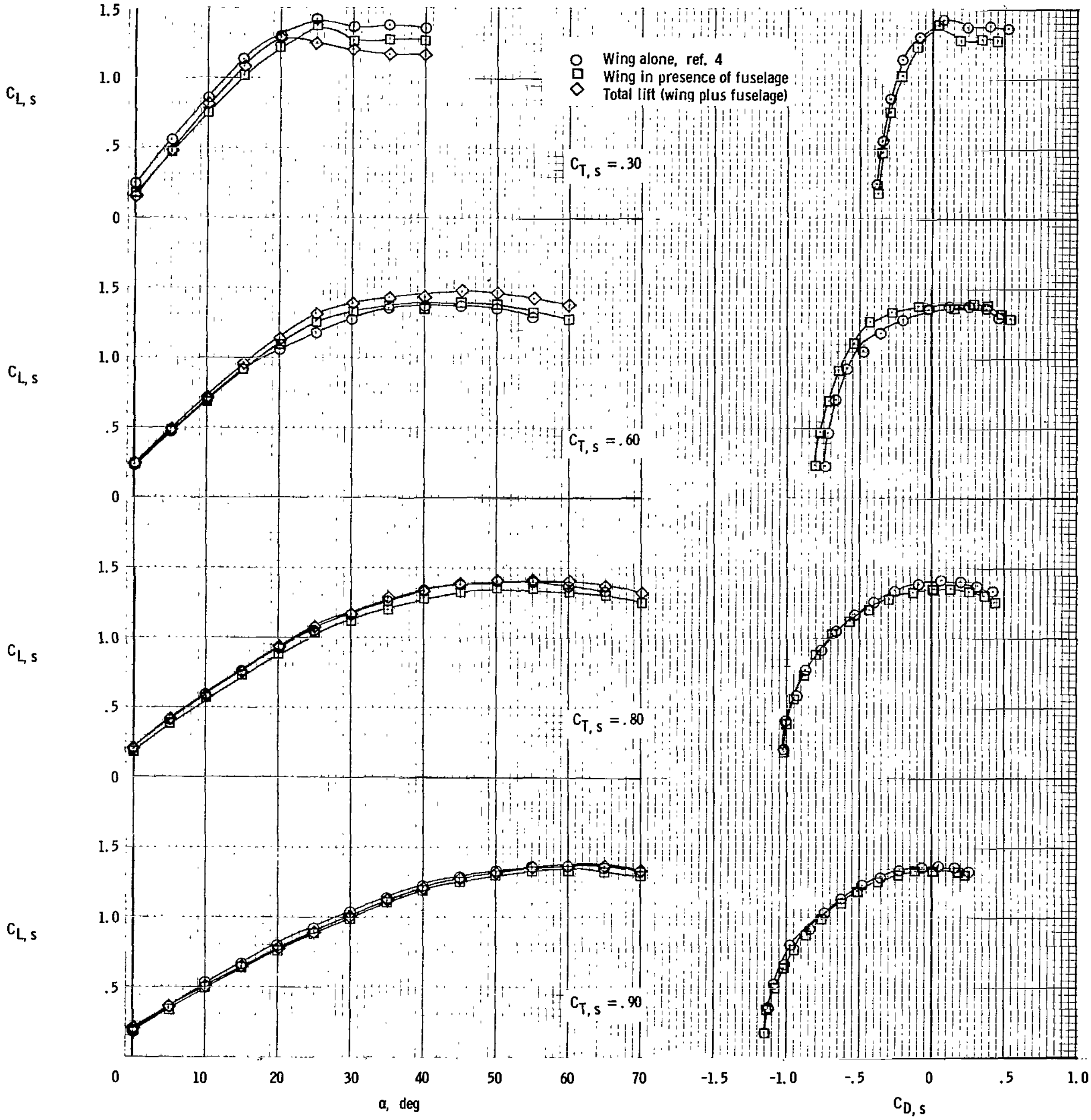
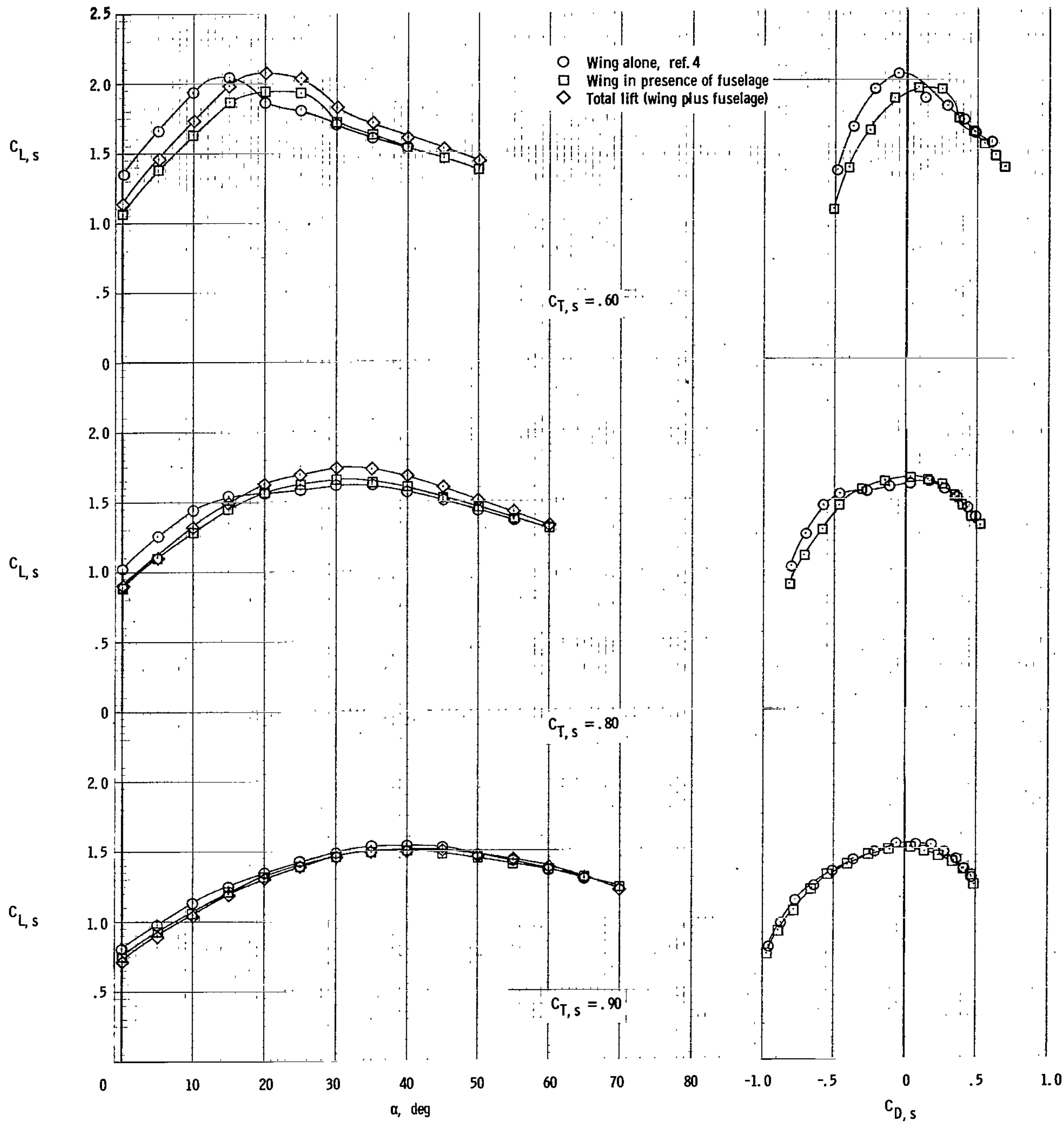


Figure 26.- Fuselage lift coefficients. Full-span slat; fences on; propeller rotation up at tip.



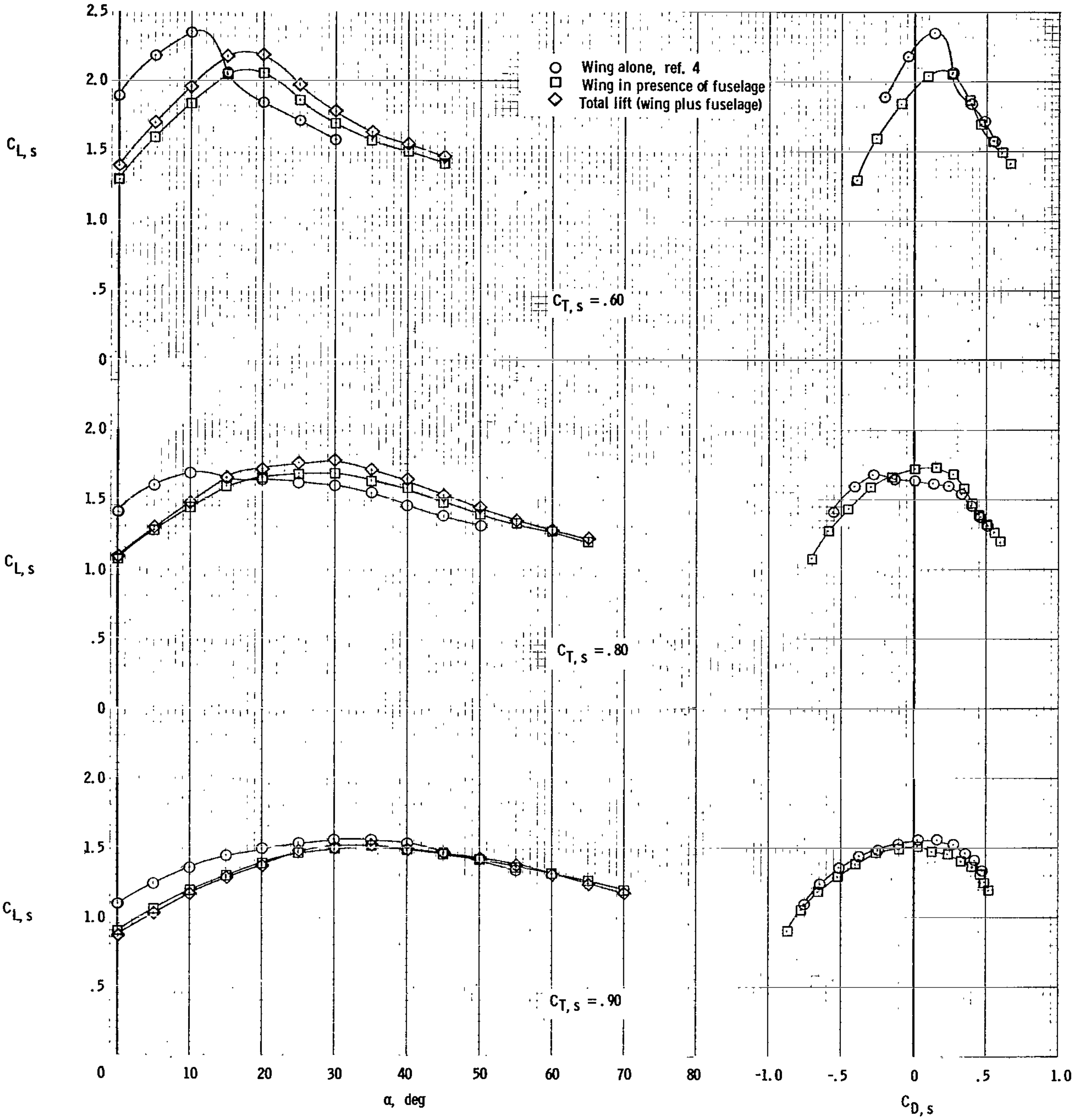
(a) $\delta_f = 0^o$.

Figure 27.- Comparison of lift characteristics of wing (in presence of fuselage), wing plus fuselage, and wing alone (ref. 4). Basic leading edge; propeller rotation down at tip.



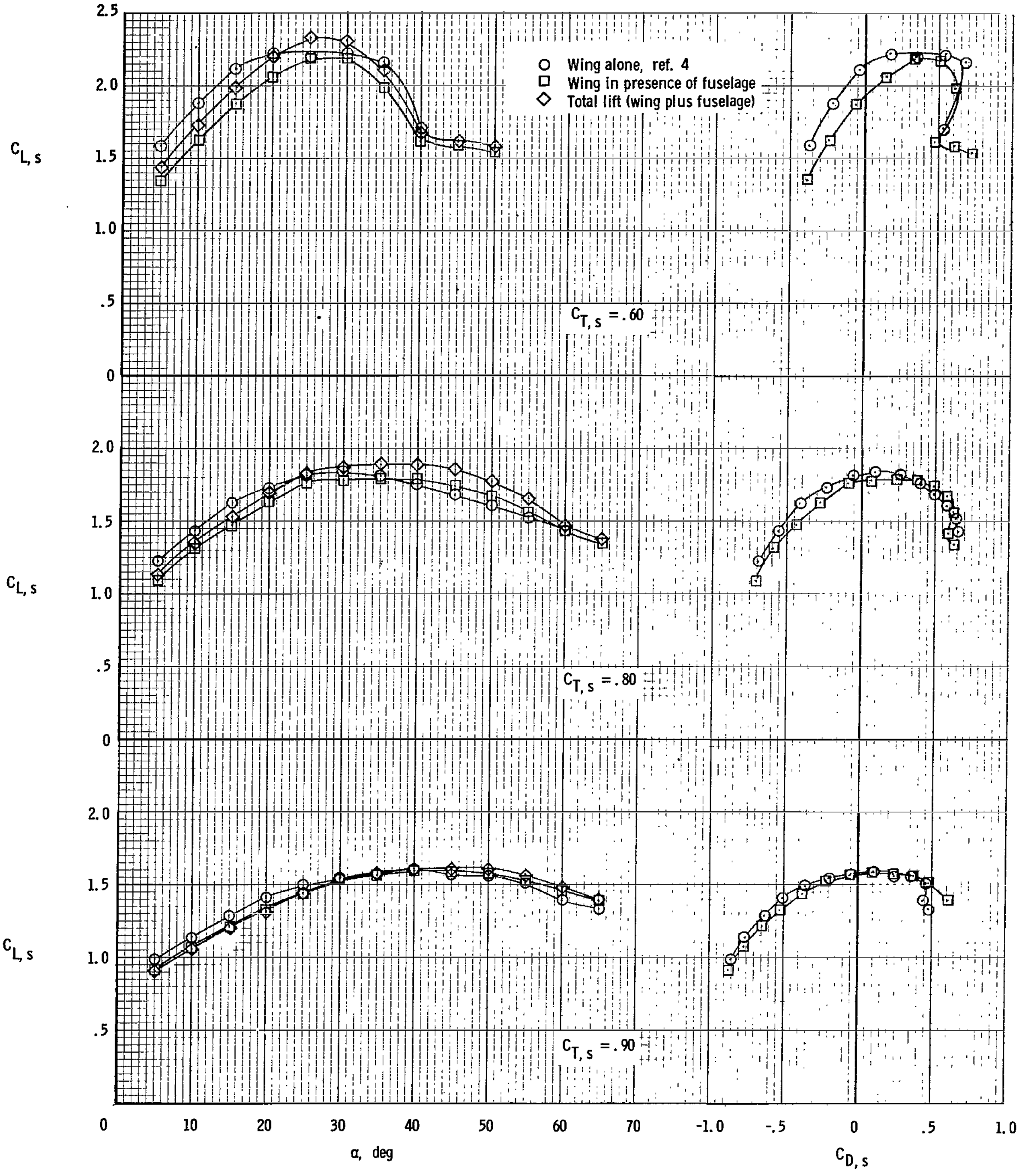
(b) $\delta_f = 40^{\circ}$.

Figure 27.- Continued.



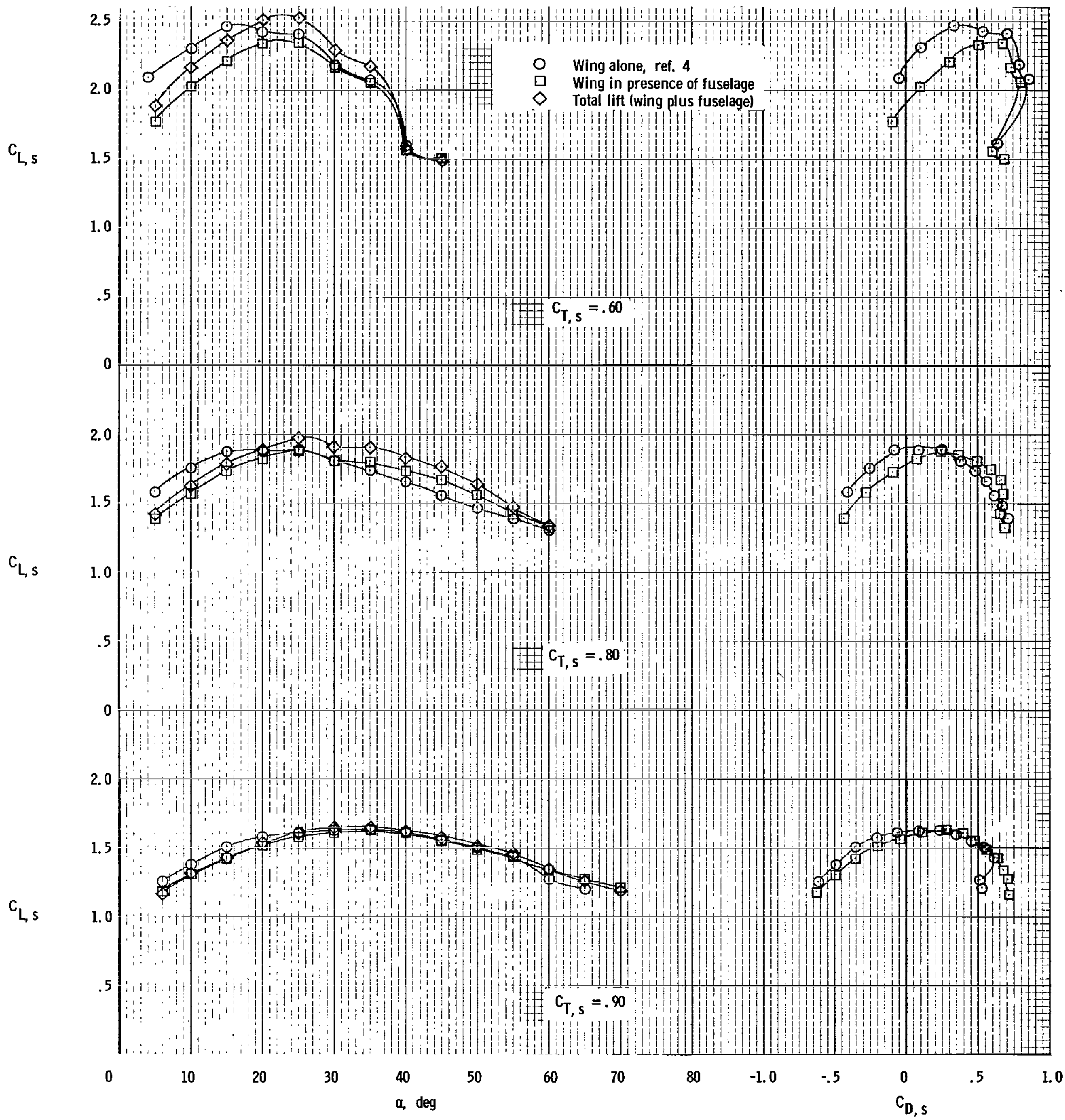
(c) $\delta_f = 60^0$.

Figure 27.- Concluded.



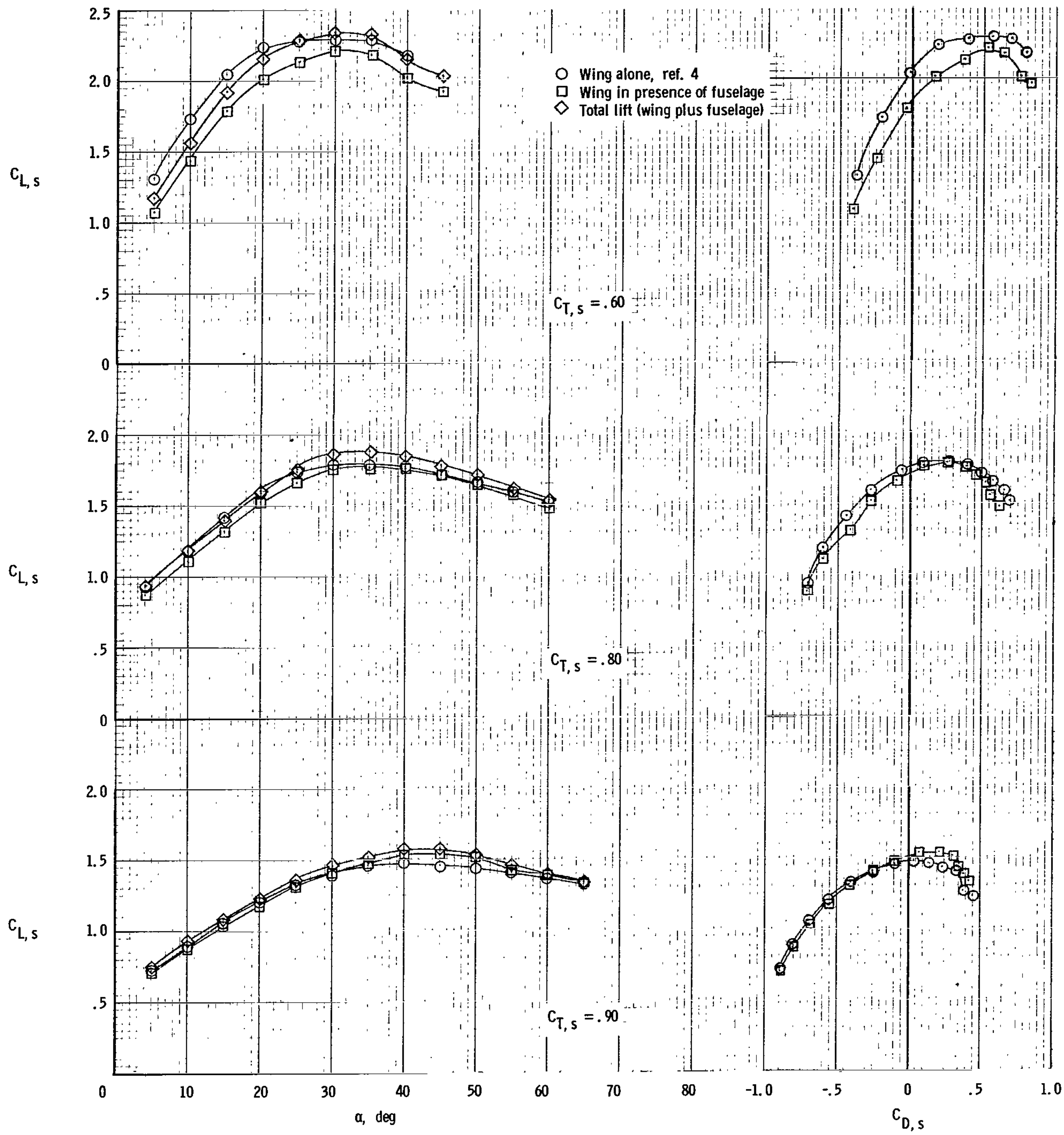
(a) $\delta_f = 40^0$.

Figure 28.- Comparison of lift characteristics of wing (in presence of fuselage), wing plus fuselage, and wing alone (ref. 4). Inboard slat; fences on; propeller rotation down at tip.



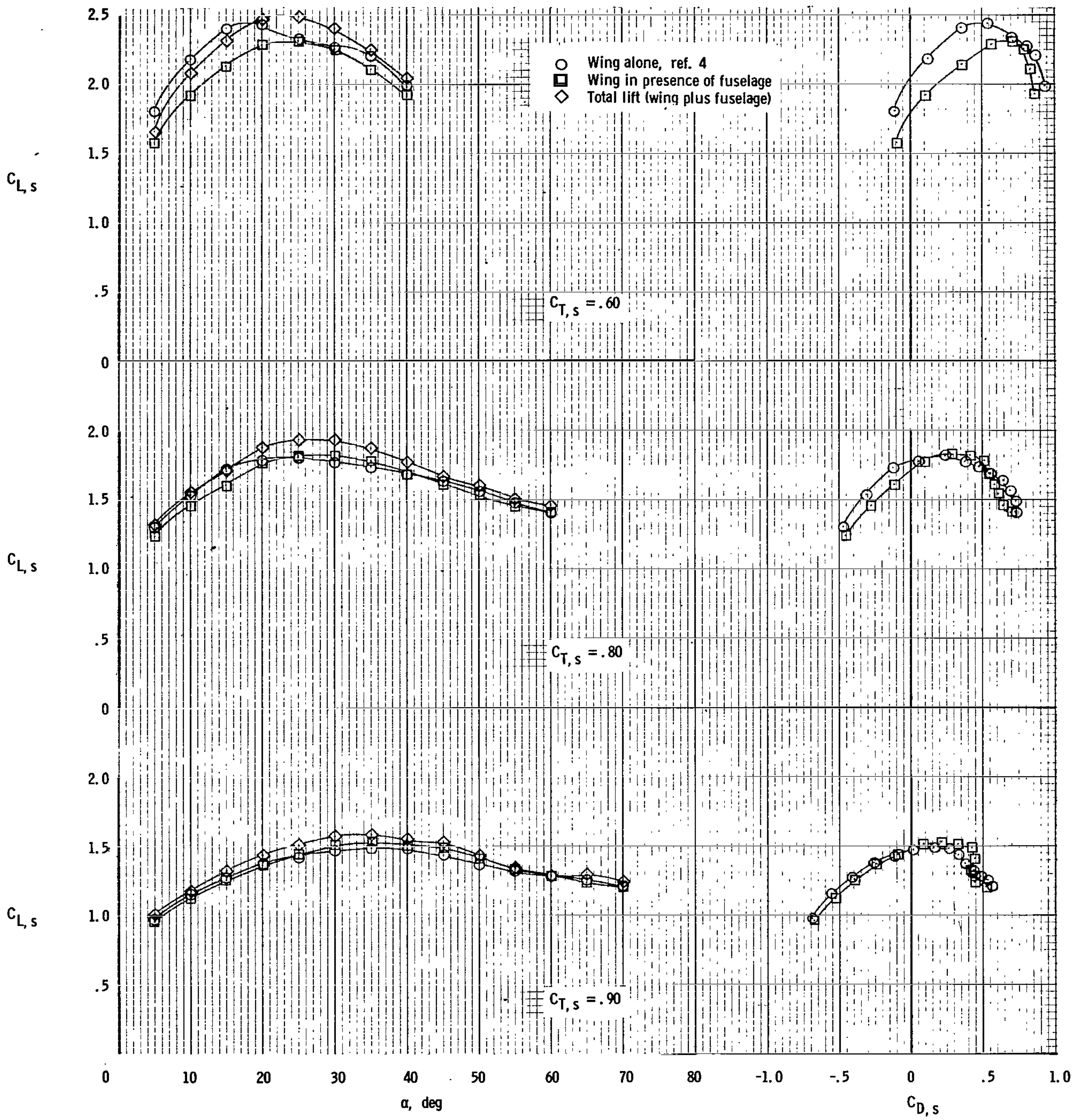
(b) $\delta_f = 60^0$.

Figure 28.- Concluded.



(a) $\delta_f = 40^0$.

Figure 29.- Comparison of lift characteristics of wing (in presence of fuselage), wing plus fuselage, and wing alone (ref. 4). Inboard slat; fences on; propeller rotation up at tip.



(b) $\delta_f = 60^0$.

Figure 29.- Concluded.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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