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Effect of Leading- and Trailing-Edge Flaps on Clipped Delta Wings With and Without Wing Camber at Supersonic Speeds

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Summary

An experimental investigation of the aerodynamic characteristics of thin, moderately swept fighter wings has been conducted to evaluate the effect of camber and twist on the effectiveness of leading- and trailing-edge flaps at supersonic speeds in the Langley Unitary Plan Wind Tunnel. The study geometry consisted of a generic fuselage with camber typical of advanced fighter designs without inlets, canopy, or vertical tail. The model was tested with two wing configurations—an uncambered (flat) wing and a cambered and twisted wing. Each wing had an identical clipped delta planform with an inboard leading edge swept back 65° and an outboard leading edge swept back 50°. The trailing edge was swept forward 25°. The leading-edge flaps were deflected −4°, −2° (cambered wing only), 0°, 5°, 10°, and 15°, and the trailing-edge flaps were deflected −30°, −20°, −10°, 0°, and 10°. Experimental testing was conducted at Mach numbers of 1.60, 1.80, 2.00, and 2.16 for an angle-of-attack range of −4° to 20°.

The addition of wing camber and twist had a significant effect on the longitudinal aerodynamic characteristics. Without leading- or trailing-edge flap deflections, the uncambered wing had a lower minimum drag and a lower drag due to lift at low lift coefficient than the cambered wing. Camber and twist also decreased the lift and increased the zero-lift pitching-moment coefficient ($C_{m,o}$), but it had no significant effect on lift-curve slope or stability level.

Leading-edge flap deflection typically increased drag. The increment in drag per degree of leading-edge flap deflection increased as the deflection angle increased and was higher for the cambered wing than for the uncambered wing. However, at the higher lift conditions tested, the data showed that a drag reduction occurred when leading-edge flaps were deflected 5° on the uncambered wing.

The trailing-edge flap effectiveness for pitching moment and minimum drag were smaller for the cambered wing than for the uncambered wing. Despite the reduced pitch-control effectiveness, the shift in $C_{m,o}$ caused by the addition of camber and twist resulted in smaller flap deflections required to trim. The net result was a lower drag coefficient at trimmed condition on the cambered wing than on the uncambered wing for lift coefficients greater than 0.1.

Introduction

Today's military combat aircraft must satisfy a wide range of requirements and perform a variety of roles efficiently over an extensive flight envelope. The number of design points (i.e., the spread in Mach number and lift) makes the choice of wing shape and size for a combat aircraft less clear than for a civil transport, and inevitably a compromise is evolved.

One of those design compromises is the use of wing camber and twist for reducing cruise drag. A wing camber design based upon a subsonic design point is typically quite different from the camber surface based on supersonic design criteria. The subsonic-based camber surface has significantly greater curvature than the supersonic design. At subsonic speeds lift can be produced more efficiently and drag may be reduced by spreading the upper surface suction more evenly over the cambered wing (ref. 1). However, at the supersonic cruise point (low lift), a significant drag penalty due to wing camber usually occurs (ref. 2). The disadvantage of camber at high speed/low lift may be offset by the performance benefit achieved at both low speed and high speed/high lift as well as a possible reduced trim-drag penalty at supersonic speed. The disadvantage of extreme camber at supersonic speed may also be reduced by using leading-edge flaps deflected upward to reduce wing camber at certain conditions.

Wings that achieve variable camber by utilizing leading- and trailing-edge devices are being considered for high-performance aircraft to meet the severe aerodynamic requirement of efficient cruise across a broad Mach number range as well as increased high-angle-of-attack maneuverability. The primary purposes of leading- and trailing-edge devices are both to improve the lift-drag ratio by controlling the flow on the wing upper surface so that drag is minimized by maintaining attached-flow conditions and to control the pitching moment over a range of lift conditions. Leading- and trailing-edge flaps are typically utilized on production aircraft, primarily at subsonic and transonic speeds, to decrease drag due to lift and thus increase the maximum lift-drag ratio (refs. 3 and 4). However, previous studies conducted on uncambered wings indicate that aerodynamic performance benefits can also be obtained by employing leading-edge flaps at supersonic speeds (refs. 5 and 6).

A cooperative wing design program has been established between NASA and General Dynamics. The purpose of this program is to evaluate at supersonic speeds the effect of camber as well as the effectiveness of leading- and trailing-edge flaps on moderately swept fighter wings designed to meet a broad spectrum of performance goals. In support of this program, an experimental investigation of the aerodynamic performance of leading- and trailing-edge flaps on two wings (an uncambered wing and a cambered wing with both having the same planform and airfoil thickness distribution) has been conducted in the Langley Unitary Plan Wind Tunnel at Mach numbers from 1.60 to 2.16. This paper presents the results of the investigation of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds.

Symbols and Abbreviations

All longitudinal aerodynamic coefficients are referenced to the stability axis system. The moment reference center is located 21.13 in. from the nose, which corresponds to 35 percent of the wing mean aerodynamic chord.

BL	butt line
b	wing span, 24.86 in.
C_D	drag coefficient, Drag/qS
$C_{D,\mathrm{min}}$	minimum drag coefficient
$C_{D,\mathrm{trim}}$	drag coefficient at trimmed condition
ΔC_D	change in drag coefficient from value for minimum drag
$\Delta C_D/\Delta C_L{}^2$	drag polar shape factor
$\Delta C_{D,\mathrm{min}}/\lvert\delta_{\mathrm{LE}}\rvert$	leading-edge flap-effectiveness parameter on minimum drag
$\Delta C_{D,\mathrm{min}}/\lvert\delta_{\mathrm{TE}}\rvert$	trailing-edge flap-effectiveness parameter on minimum drag
C_L	lift coefficient, Lift/qS
ΔC_L	change in lift coefficient from value for minimum drag
$\Delta C_{L\lvert\alpha=0}/\lvert\delta_{\mathrm{TE}}\rvert$	trailing-edge flap-effectiveness parameter on lift at $\alpha = 0°$
$\partial C_L/\partial\alpha$	lift-curve slope at $\alpha = 0°$
C_m	pitching-moment coefficient, Pitching moment/$qS\bar{c}$
$C_{m,o}$	zero-lift pitching-moment coefficient
$\Delta C_{m,o}/\lvert\delta_{\mathrm{TE}}\rvert$	trailing-edge flap-effectiveness parameter on zero-lift pitching moment
$\partial C_m/\partial C_L$	longitudinal stability at $\alpha = 0°$
c	local chord length, in.
$\bar{c}$	reference chord, 15.747 in.
FS	fuselage station
L/D	lift-drag ratio
M	free-stream Mach number
MRC	moment reference center
q	dynamic pressure, psi
S	wing reference area, 2.25 ft^2
t	airfoil thickness, in.
x_c	streamwise distance from leading edge of local chord, in.
x/l	fraction of wing length from wing leading edge at exposed root chord (length of exposed root chord, 22.29 in.)
y	lateral distance from model centerline, in.
z	vertical distance, positive up, in.
α	angle of attack, deg
δ_{LE}	streamwise leading-edge flap deflection, positive when leading edge is down, deg
δ_{TE}	streamwise trailing-edge flap deflection, positive when trailing edge is down, deg
$\delta_{\mathrm{TE,trim}}$	streamwise trailing-edge flap deflection needed for trim, deg

Model Description

The model, shown installed in the Langley Unitary Plan Wind Tunnel (UPWT) in figure 1, has a generic fuselage without inlets, canopy, or vertical tail. The model can be tested with two wing configurations—an uncambered wing and a cambered wing. Both wings are configured with the same planform (fig. 2(a)) and airfoil thickness distribution (table I). The maximum thickness is 4.5 percent of the local chord located at 40 percent. The wing airfoil definition is an NACA 64A004.5 section from the leading edge to the 40 percent chord line and a biconvex section from the 40 percent chord line to 100 percent of the chord length, as shown in figure 2(b). Table II contains the dimensionless surface ordinates for the cambered wing. The wings have a clipped double-delta planform with the leading edge swept back 65° and the outboard leading edge swept back 50°. The trailing edge is swept forward 25°.

The wings were designed for typical advanced fighter performance requirements. By using linear theory methodology as described in reference 7, the cambered wing was derived for optimal transonic maneuver performance and efficient supersonic cruise with minimum trim-drag requirement. Its broad spectrum of performance goals includes sustained transonic and supersonic maneuver performance while minimizing acceleration penalties. The multipoint design criteria for the cambered wing were achieved by designing a series of wing camber surfaces for different lift and Mach number conditions and then by evaluating the designs over the flight envelope. In order to meet the performance goals, a wing camber based upon a lift coefficient of 0.10 and a Mach number of 1.5 was selected. It should be noted that the selection was based upon an overall mission performance criterion and not upon aerodynamic performance at specific flight conditions.

Test Description

The tests were conducted in the low Mach number test section of the Langley UPWT, which is a variable-pressure, continuous-flow facility (ref. 8) at Mach numbers of 1.60, 1.80, 2.00, and 2.16 and stagnation pressures of 454.8, 455.5, 448.5, and 438.8 psf, respectively. The Reynolds number was 2.0×10^6 per foot and the stagnation temperature was held constant at 125°F throughout the test. The tunnel dew point was held sufficiently low to prevent any significant condensation effects.

Transition-inducing strips consisting of No. 60 grit were located 1.2 in. aft of the fuselage nose and 0.4 in. aft (streamwise) on both the upper and lower wing surfaces of the wing leading edge. To ensure fully turbulent boundary-layer flow over most of the model at all test conditions, the grit size and location were selected according to the methods discussed in references 9 to 11.

An internally mounted, six-component, strain-gauge balance was used to measure model forces and moments. Based on the manufacturer's stated accuracy for the balance used, C_D, C_L, and C_m are estimated to be accurate to within ±0.0004, ±0.0035, and ±0.0006, respectively, or 0.5 percent of full scale. Repeat points taken for this test indicate that C_D, C_L, and C_m generally repeated within 0.0001, 0.0015, and 0.0001, respectively. The model angle of attack ranged from −4° to 20°. The leading-edge flaps were tested for deflections of 0° to 15° in increments of 5° for both wings and additionally for deflections of −4° and −2° for the cambered wing. The trailing-edge flaps were tested from −30° to 10° in 10° increments.

The angles of attack were corrected for tunnel flow angularity and for model support sting and balance deflections resulting from aerodynamic loads on the model. Chamber pressures were measured continuously throughout the test by means of tubes within the balance chamber routed along the sting to pressure transducers located outside the tunnel. These pressures were used to correct the force data to a condition that would exist if free-stream static pressure acted within the fuselage cavity.

Experimental Results

As indicated earlier, the purpose of this study was to evaluate the effect of camber as well as the effectiveness of leading- and trailing-edge flaps at supersonic speeds. The longitudinal aerodynamic characteristics of both wings with no flap deflections will be discussed first. This will be followed by a discussion of the effectiveness of the leading- and trailing-edge flap deflections on both wings. A complete listing of the force and moment data is presented in appendix A.

Aerodynamic Characteristics With No Flap Deflection

The longitudinal aerodynamic characteristics for the uncambered and cambered wings with no leading- and trailing-edge flap deflections at the four test Mach numbers are shown in figure 3. The drag data for $M = 1.60$ show that the cambered wing has higher drag than the uncambered wing for low lift coefficients ($C_L < 0.2$). (See fig. 3(a).) At about $C_L = 0.2$ a crossover in the drag occurs, and at higher lift coefficients the cambered wing has lower drag. The maximum L/D is higher for the cambered wing than for the uncambered wing and this occurs at $C_L = 0.25$. The pitching-moment and lift data for $M = 1.60$ are shown in figure 3(a). The data show that both wings have about the same lift-curve slope and stability level and that the variation in C_L and C_m remains essentially linear throughout the test angle-of-attack range. The addition of camber and twist to the wing results in an increase in the zero-lift pitching moment, and for a given angle of attack this results in a decrease in lift for the cambered wing.

As the Mach number increases, the minimum C_L at which improved aerodynamic performance results from the camber increases and the magnitude of this increment decreases. At $M = 2.16$ a crossover occurs at $C_L = 0.35$, and this results in only a slight improvement compared with that of the uncambered wing. Camber continues to provide a positive $C_{m,o}$ shift and a negative C_L shift.

To further evaluate the effect of camber, the aerodynamic characteristics are presented as a function of Mach number in figure 4. Figure 4(a) shows a comparison of the minimum drag ($C_{D,\mathrm{min}}$) and polar shape factor ($\Delta C_D/\Delta C_L{}^2$) over the range of Mach numbers tested for both wings. Note that the polar shape factor is an assessment of the drag due to lift referenced from its minimum drag value to its drag values at $\Delta C_L = 0.1$. The data show that both the cambered wing and the uncambered wing have nearly constant minimum drag over the entire Mach number range. As previously shown, the uncambered wing shows better performance, lower minimum drag values, and lower drag due to lift at low lift compared with that of the cambered wing.

The longitudinal stability level ($\partial C_m/\partial C_L$) and lift-curve slope ($\partial C_L/\partial \alpha$) of the uncambered and cambered wings as a function of Mach number are presented in figure 4(b). The data show that both wings are more stable at the lower Mach numbers than at the higher Mach numbers, and that the cambered wing is slightly more stable than the uncambered wing. The change in lift-curve slope with Mach number is similar for both wings, as can be seen in figure 4(b).

Vapor screen, tufts, and oil flow visualization data were obtained with the uncambered wing. Tufts and oil flow data were used to examine the flow characteristics on the upper wing surface. The flow direction is determined by the alignment of the tufts or the streaking of the oil. The vapor screen data were used to obtain information on the shape and location of vortices and shocks in the flow field above the wing. The vapor screen photographs were taken of the upper surface of the left wing panel at wing locations of 30 percent and 60 percent of the exposed root chord at a Mach number of 1.60 with the camera behind the model looking upstream.

Tufts on the uncambered wing at $M = 1.60$ with no leading- or trailing-edge flap deflections at angles of attack of 0°, 4°, 8°, and 12° are shown in figure 5. Figure 6 shows vapor screen photographs for the uncambered wing without a leading- or trailing-edge flap deflection at angles of attack of 4°, 8°, and 12°. At an angle of attack of 0°, attached flow over the wing is observed in the tuft photograph as indicated by the smooth streamwise alignment of the tufts. As the angle of attack increases to 4°, the flow accelerates about the leading edge as indicated by the slight inboard alignment of the tufts along the leading edge. With further increases in angle of attack, the acceleration about the leading edge or crossflow recompresses as it turns streamwise. This causes a crossflow shock. This shock can be seen by the outward alignment of the tufts on the center portion of the wing at $\alpha = 8°$. The shock can also be seen in the vapor screen photographs in figure 6 by the shading discontinuity on the center portion of the wing at $\alpha = 8°$. Further increases in lift result in shock-induced separation of the boundary layer and the formation of a small separation bubble, which may be seen as a small dark region on the wing upper surface near the shock. The dark circular region on the inboard portion of the wing at $\alpha = 12°$ is the leading-edge vortex that forms at the inboard leading edge and propagates streamwise close to the fuselage.

Leading-Edge Flap Deflection

The effect on drag of deflecting the leading-edge flaps of the uncambered and cambered wings is shown in figures 7 and 8, respectively. Deflecting the leading-edge flaps at supersonic speeds normally does not provide a benefit in performance; however, the data show that a drag reduction occurs for the uncambered wing when the leading-edge flaps are deflected 5° at the higher lift conditions obtained for this test at all Mach numbers tested (fig. 7). The assumption was made that deflecting the leading edge of the cambered wing upward (negative) might provide a drag reduction at low lift by eliminating some of the drag due to camber. However, the data in figure 8 show that the upward leading-edge deflection did not provide any significant drag reduction.

As was shown in figure 3, the aerodynamic characteristics of the uncambered and cambered wings are quite similar with the primary differences being lower drag at low lift for the uncambered wing and an increase in $C_{m,o}$ for the cambered wing. Based upon these differences, it was decided that appropriate figures of merit for assessing leading- and trailing-edge flap effectiveness were the increments in drag, lift, and pitching moment per degree of flap deflection (flap-effectiveness parameters). This method of presentation should allow for a direct comparison between the uncambered and cambered wings. All flap-effectiveness data will be presented as the change in the particular aerodynamic coefficient from the undeflected case divided by the absolute value of the deflection angle.

Figure 9 shows the effectiveness on drag of the leading-edge flap deflection over the Mach number range at $C_{D,\min}$. No significant variation in the drag increment with Mach number is observed; however, the penalty in drag per degree of flap deflection is considerably higher as the leading-edge flap deflection increases. Drag per unit of leading-edge flap deflection is higher for the cambered wing than for the uncambered wing at each deflection.

Trailing-Edge Flap Deflection

The effect of trailing-edge flap deflection on lift, pitching moment, and drag for both wings is shown in figures 10–12. The main purpose of trailing-edge flaps for this class of configuration is to affect the pitching moment to obtain trim conditions. As can be seen from figure 10, negative increments in flap deflection have a large effect on the pitching-moment curve in the positive direction to produce trim. This benefit, however, always results in an increase in drag for constant lift. (See figs. 11 and 12.)

The trailing-edge flap-effectiveness parameters for the uncambered and cambered wings over the Mach number range are shown in figure 13. The drag penalty decreases slightly as Mach number increases with constant trailing-edge deflection. The data for both wings show that a nonlinearly increasing drag increment occurs per degree of flap deflection with increasing deflection. The cambered-wing data show a lower drag penalty per degree of flap deflection for both the -10° and -20° deflections when compared with that of the uncambered wing. For a trailing-edge deflection of -30°, both wings have comparable drag increments.

The effect of trailing-edge flap deflection on lift at $\alpha = 0^\circ$ is presented in figure 13(b). In general, a loss in lift results from trailing-edge flap deflection. The uncambered- and cambered-wing data of figure 13(b) show a reduction in lift loss with increasing Mach number.

The change in the zero-lift pitching moment for the trailing-edge flap deflection is shown in figure 13(c). The flap effectiveness is smaller for the cambered wing than for the uncambered wing. For both wings, the effectiveness decreases with increasing (more negative) flap-deflection angle; i.e., a trailing-edge flap deflection of -10° has a higher effectiveness on pitching moment per degree of deflection than either a -20° or -30° deflection for both wings. This difference, however, is not as significant for the cambered wing as for the uncambered wing. The data show that the increment due to flap deflection becomes smaller with increasing Mach number for both wings.

Figure 14 presents oil flow and tuft photographs of the upper surface of the uncambered wing with a trailing-edge flap deflection of -30° at $M = 1.60$ and angles of attack of 4°, 8°, and 12°. The data are presented here to show the reader the effect on the flow resulting from a large trailing-edge flap deflection, but a detailed discussion of the flow characteristics is not within the scope of this paper. The data show a strong shock and shock-induced separation forward of the trailing-edge flap. Forward of the shock, the flow is attached and well behaved at an angle of attack of 4°. As angle of attack increases, the flow characteristics over the wing become very complex. Additional flow visualization data are included in appendix B.

Trimmed Drag Data

Trimmed drag polars for the cambered and uncambered wings are shown in figure 15 with no leading-edge flap deflection. The figures also show the trailing-edge flap deflections needed for trim. (The data were trimmed about the longitudinal location of the 35-percent mean aerodynamic chord.) As anticipated during wing design, the cambered wing needs a smaller trailing-edge flap deflection than the uncambered wing because of the positive shift in the pitching moment even though the pitching-moment effectiveness parameters were smaller for the cambered wing. The net result is a lower trim-drag penalty for the cambered wing. The cambered-wing data show lower drag for all lift coefficients greater than 0.1.

Concluding Remarks

An experimental investigation has been conducted at supersonic speeds to evaluate the effect of camber and twist and the aerodynamic effectiveness of leading- and trailing-edge flaps on both an uncambered wing and a cambered wing. The study geometry consisted of a $65^\circ/50^\circ$ clipped double-delta wing with a trailing edge swept forward 25°. Both wings were attached to the same generic fuselage, and both were configured with leading- and trailing-edge flaps of identical planform. Experimental testing was conducted in the low Mach number test section of the Langley Unitary Plan Wind Tunnel at Mach numbers of 1.60, 1.80, 2.00, and 2.16 for an angle-of-attack range of -4° to 20°.

The addition of wing camber and twist had a significant effect on the longitudinal aerodynamic characteristics. Without leading- or trailing-edge flap deflections, the uncambered wing had a lower minimum drag and a lower drag due to lift at low lift coefficient than the cambered wing. Camber and twist also decreased the lift and increased the zero-lift pitching-moment coefficient ($C_{m,o}$), but they had no significant effect on lift-curve slope or stability level.

Leading-edge flap deflection typically increased drag. The increment in drag per degree of leading-edge flap deflection increased as the deflection angle increased and was higher for the cambered wing than for the uncambered wing. However, at the higher lift conditions tested, the data showed that a drag reduction occurred when leading-edge flaps were deflected 5° for the uncambered wing.

The trailing-edge flap effectiveness for pitching moment and minimum drag was smaller for the cambered wing than for the uncambered wing. Despite the reduced pitch-control effectiveness, the shift in $C_{m,o}$ caused by the addition of camber and twist resulted in smaller flap deflections required to trim. The net result was a lower drag coefficient at trimmed condition for lift on the cambered wing than on the uncambered wing for lift coefficients greater than 0.1.

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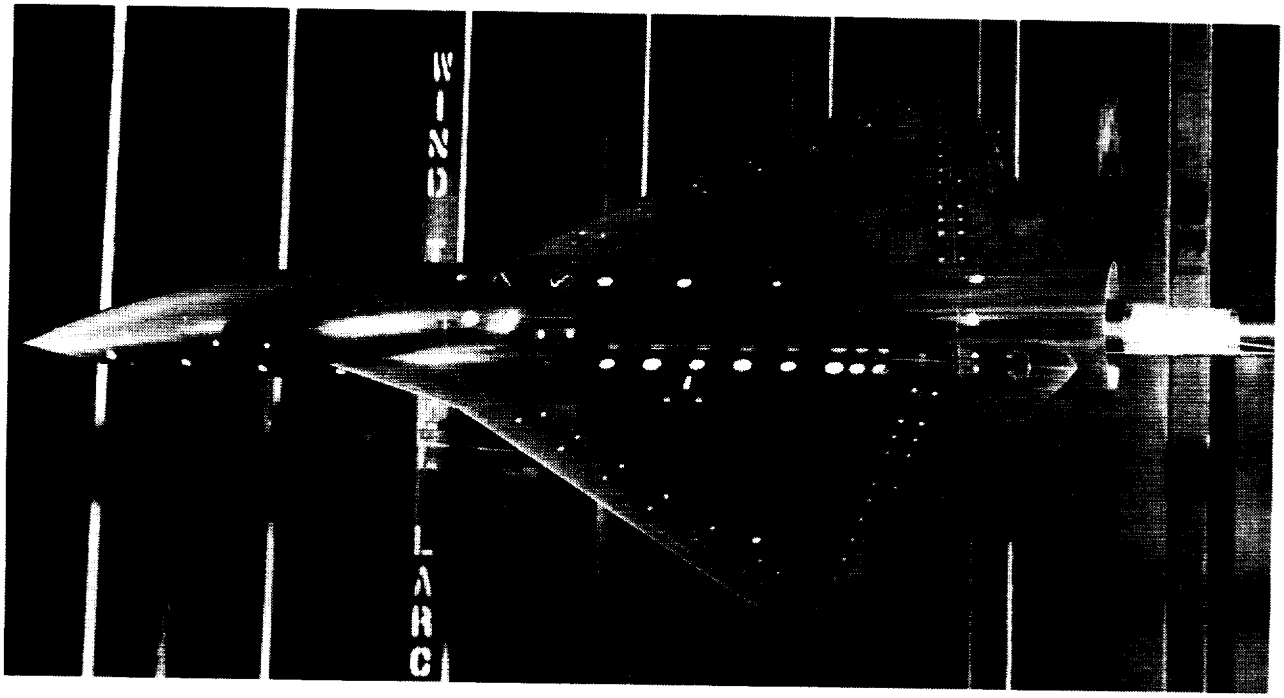
Table I. Half-Thickness Ordinates for Uncambered and Cambered Wings

x_c/c	$\frac{t}{2}/c$	x_c/c	$\frac{t}{2}/c$
0.00	0.0000	40.00	2.2500
.50	.3703	45.00	2.2120
.75	.4485	50.00	2.1240
1.25	.5663	55.00	1.9970
2.50	.7691	60.00	1.8370
5.00	1.0546	65.00	1.6520
7.50	1.2703	70.00	1.4420
10.00	1.4459	75.00	1.2130
15.00	1.7232	80.00	.9730
20.00	1.9293	85.00	.7320
25.00	2.0799	90.00	.4910
30.00	2.1814	95.00	.2510
35.00	2.2379	100.00	.0100

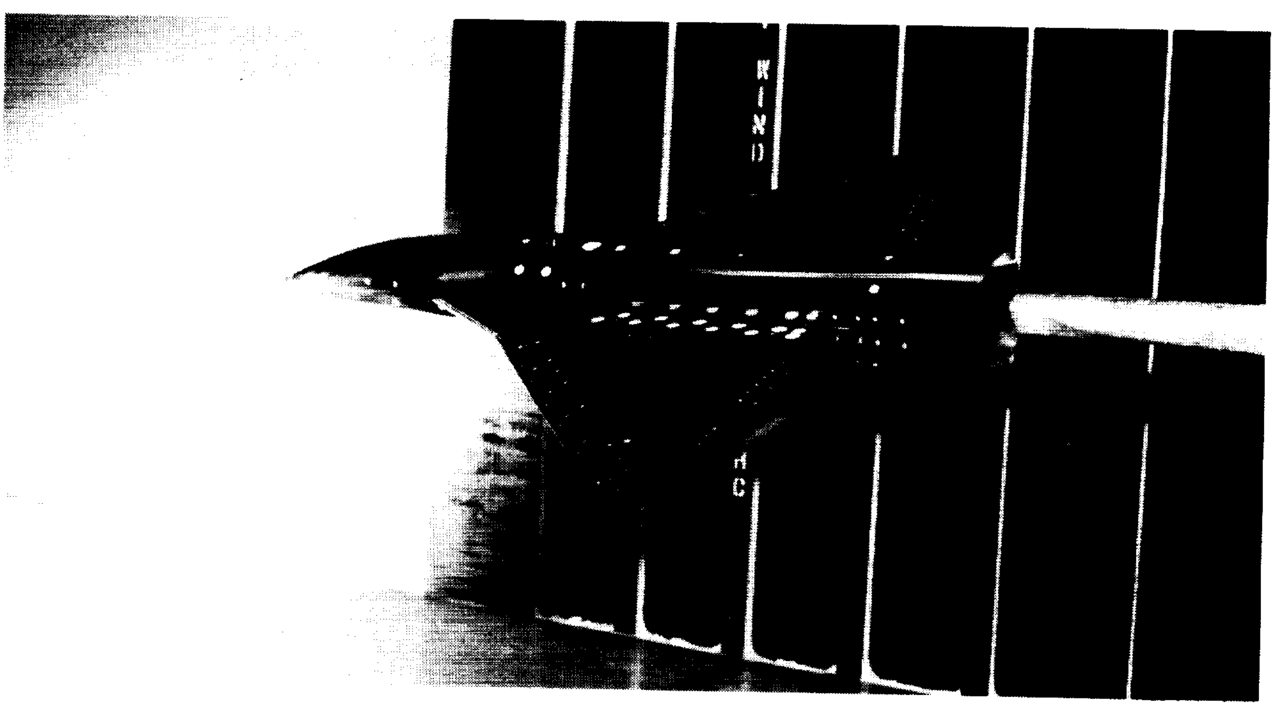
Table II. Surface Ordinates for Cambered Wing

x_c/c	Values of z/c for $2y/b$ of				
	0.2321	0.4000	0.6000	0.8000	0.9996
0.0000	−0.004976	−0.009075	−0.015460	−0.026828	−0.098765
.0010	−.004879	−.008952	−.015313	−.026662	−.098570
.0020	−.004782	−.008829	−.015166	−.026497	−.098374
.0030	−.004685	−.008705	−.015019	−.026332	−.098179
.0040	−.004588	−.008583	−.014873	−.026166	−.097984
.0050	−.004491	−.008460	−.014726	−.026001	−.097789
.0075	−.004251	−.008153	−.014359	−.025588	−.097301
.0250	−.002638	−.006064	−.011841	−.022744	−.093908
.0500	−.000824	−.003453	−.008549	−.018966	−.089214
.7500	.000108	−.001513	−.005804	−.015703	−.084792
.1000	.000477	.000008	−.003397	−.012765	−.080552
.1500	.000739	.002740	.001164	−.007173	−.072251
.2000	.000350	.005001	.005276	−.002092	−.064139
.2500	−.000378	.006983	.009057	.002590	−.056168
.3000	−.001257	.008794	.012589	.006911	−.048306
.3500	−.002165	.010506	.015900	.010903	−.040545
.4000	−.003034	.012127	.019002	.014584	−.032833
.4500	−.003852	.013699	.021923	.017966	−.028312
.5000	−.004601	.015190	.024665	.021047	−.017840
.5500	−.005319	.016602	.027206	.023839	−.010459
.6000	−.006038	.017913	.029558	.026340	−.003167
.6500	−.006806	.019095	.031719	.028542	−.004024
.7000	−.007645	.020126	.033671	.030463	−.011106
.7500	−.008603	.020998	.035412	.032085	−.018097
.8000	−.009682	.021709	.036954	.033416	−.024969
.8500	−.010860	.022251	.038275	.034438	−.031740
.9000	−.012099	.022662	.039287	.035196	−.038392
.9500	−.013317	.022974	.040308	.035601	−.044933
1.0000	−.014376	.023235	.041050	.035722	−.051355



L-88-3628

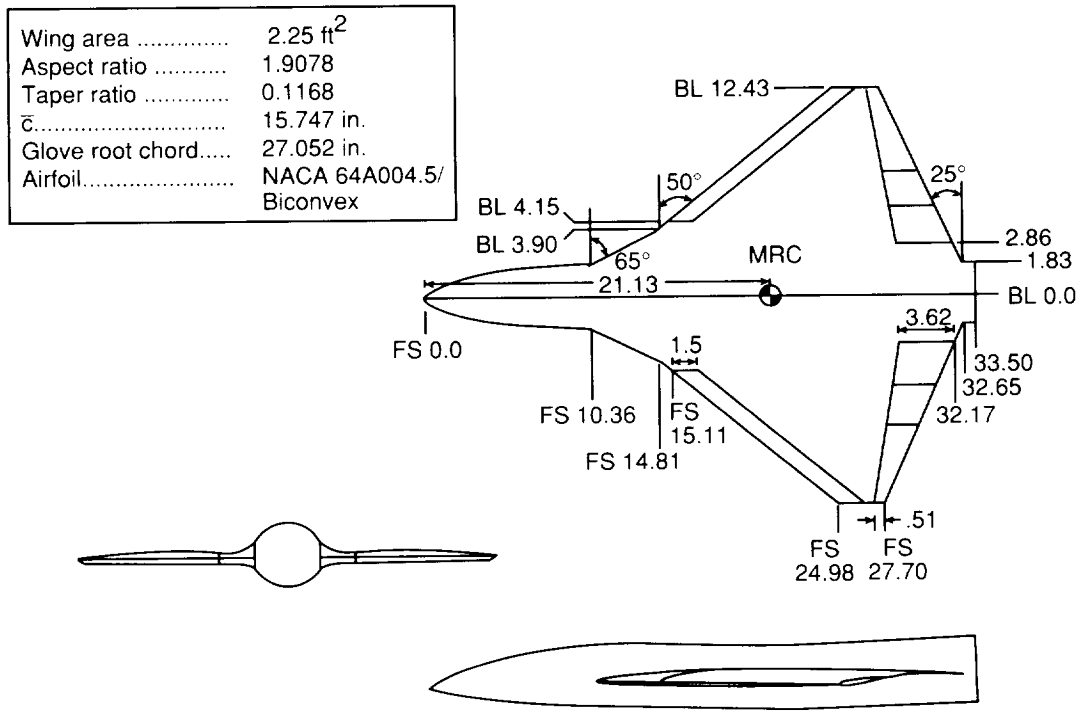
(a) Uncambered wing.



L-88-03670

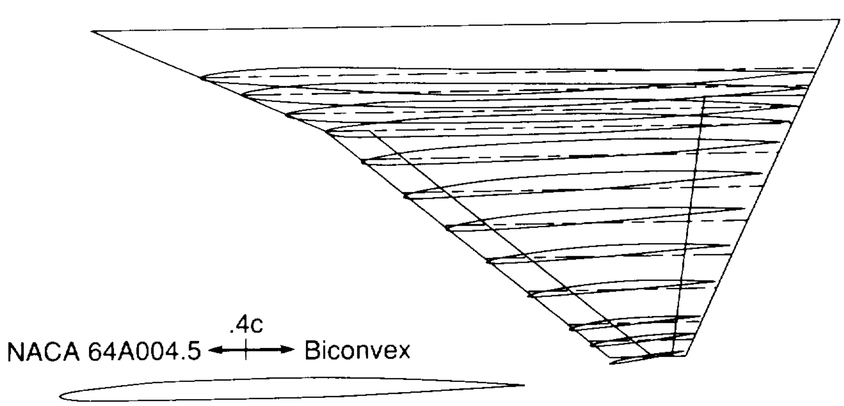
(b) Cambered wing.

Figure 1. Generic fighter models installed in the Langley Unitary Plan Wind Tunnel.



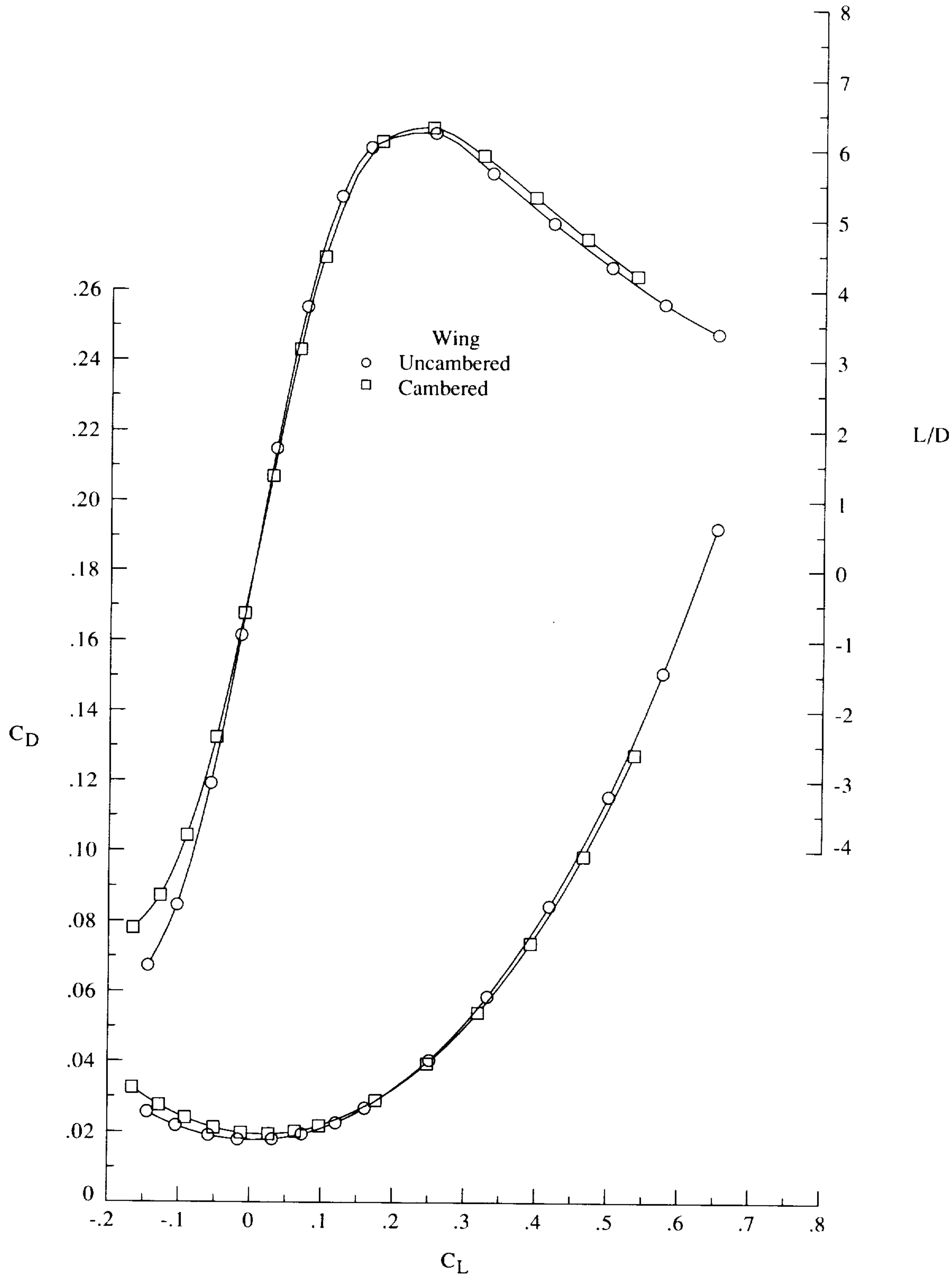
(a) Three-view sketch.

Figure 2. Generic fighter model and wing. All dimensions are given in inches unless otherwise indicated.



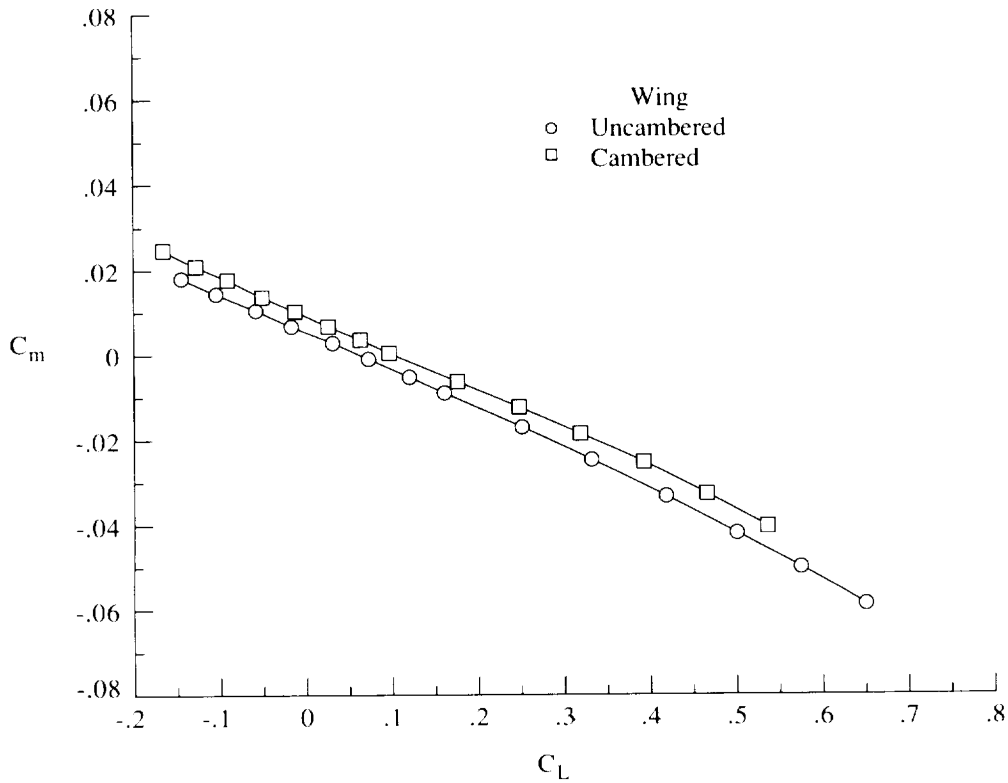
(b) Planform drawing with airfoil sections and definition.

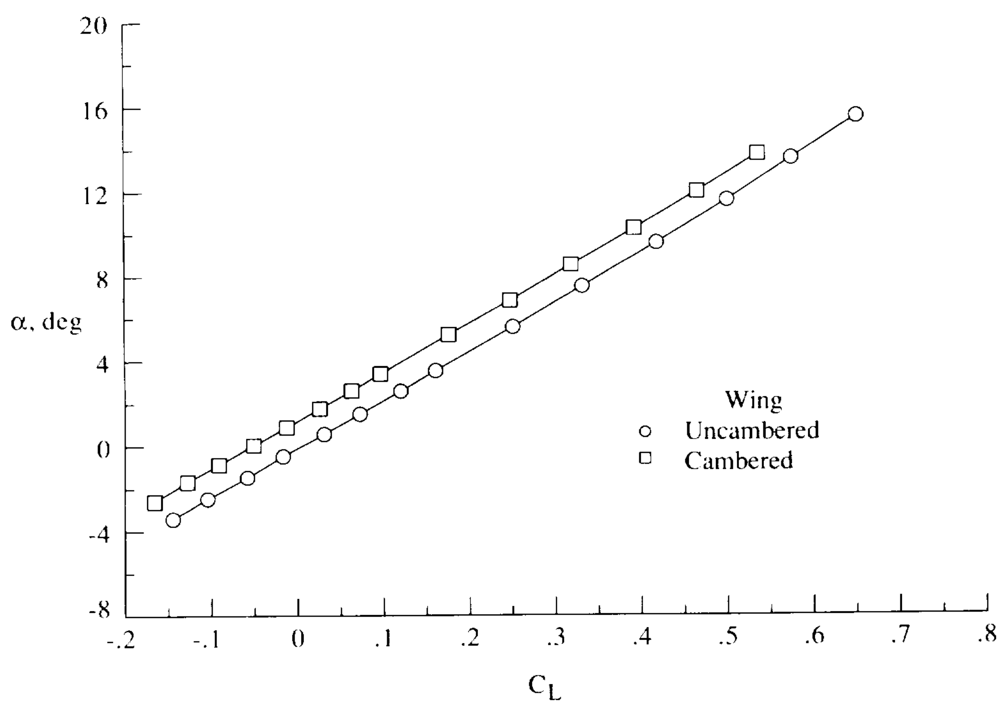
Figure 2. Concluded.



(a) Lift, drag, and pitching-moment characteristics at $M = 1.60$.

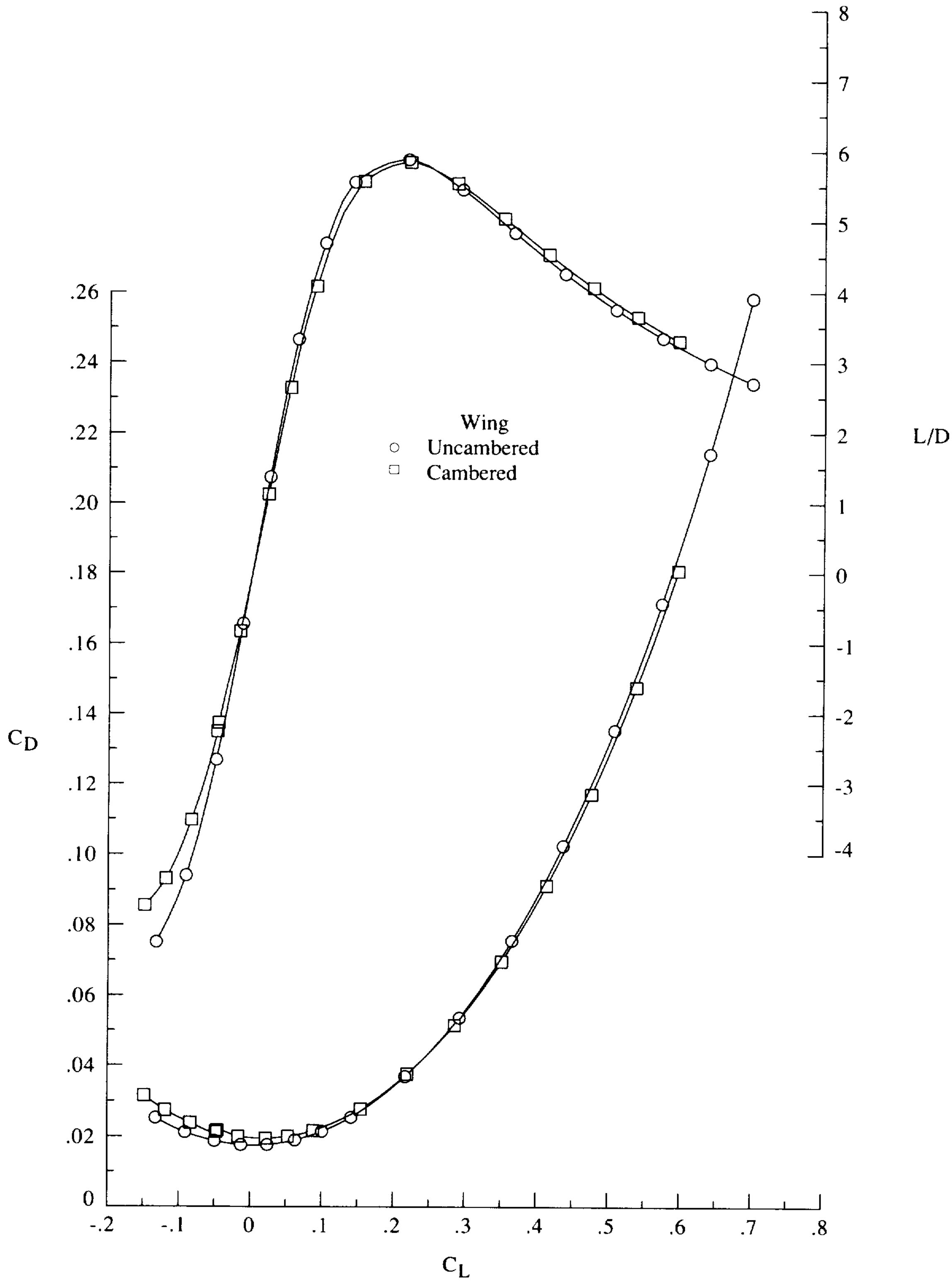
Figure 3. Longitudinal aerodynamic characteristics of cambered and uncambered wings with $\delta_{LE} = 0°$ and $\delta_{TE} = 0°$.





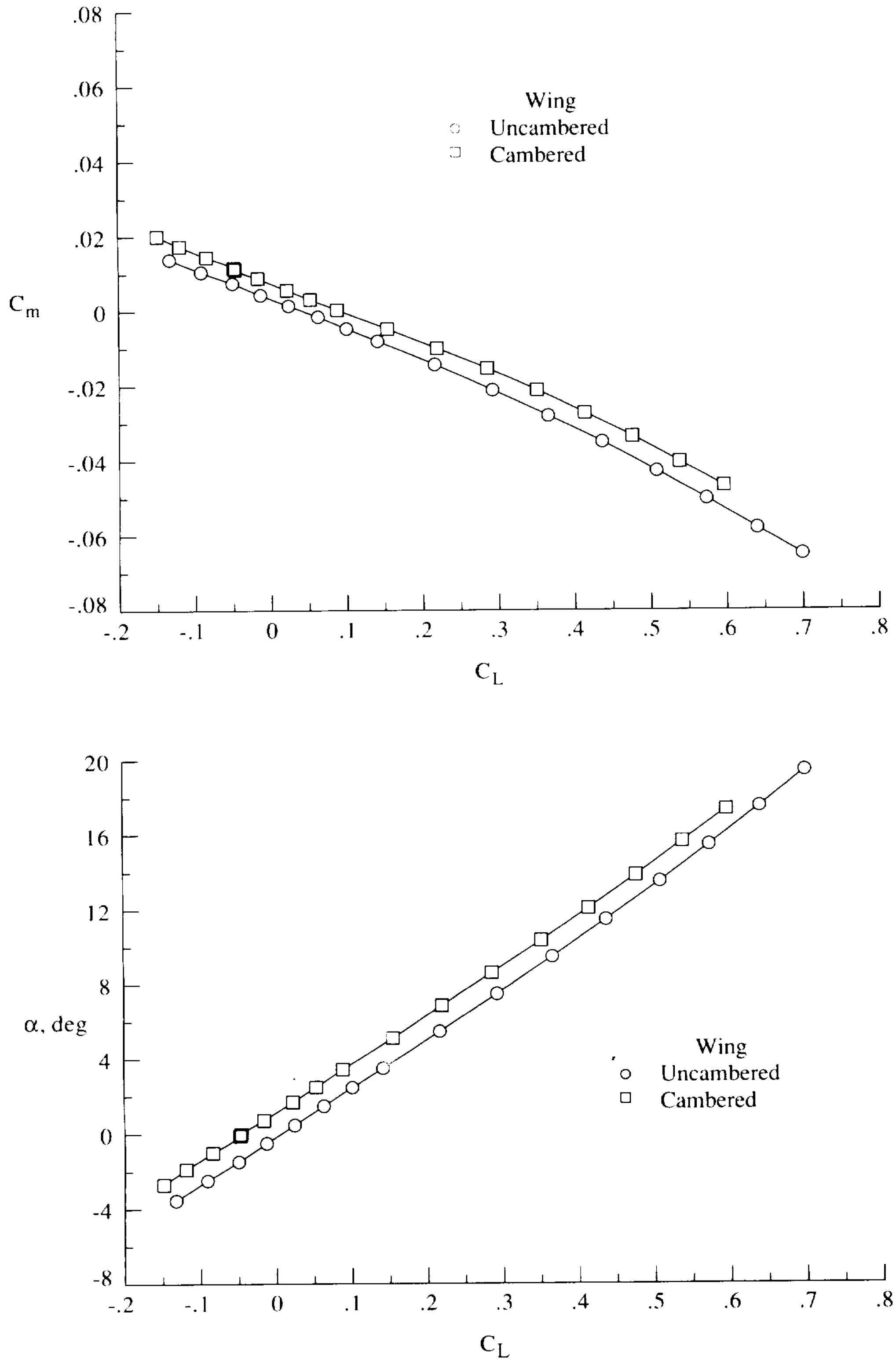
(a) Concluded.

Figure 3. Continued.



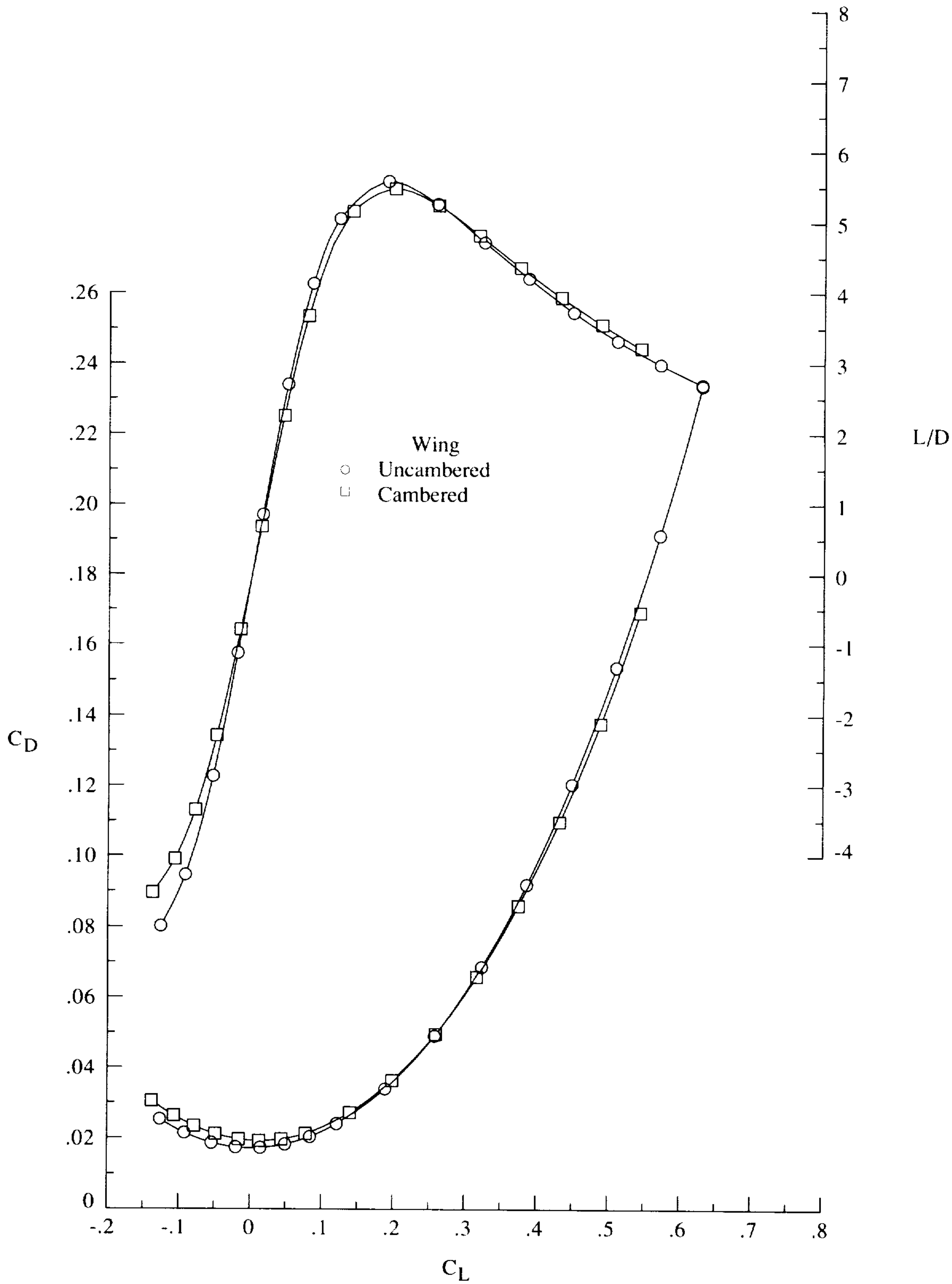
(b) Lift, drag, and pitching-moment characteristics at $M = 1.80$.

Figure 3. Continued.



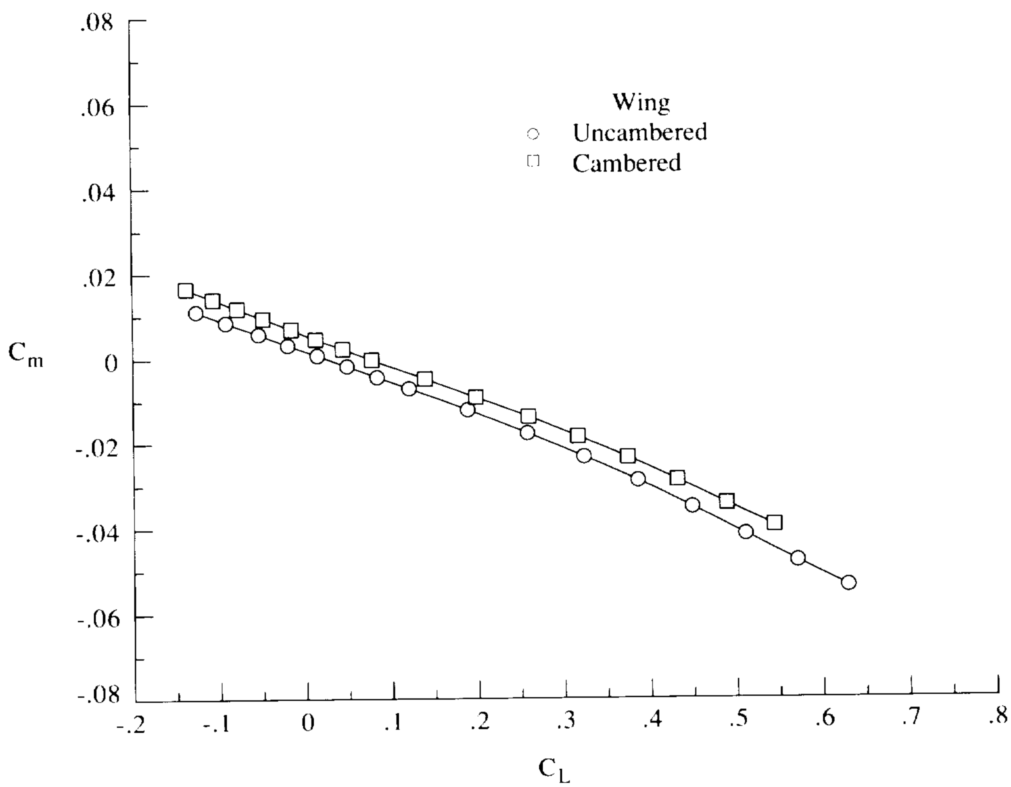
(b) Concluded.

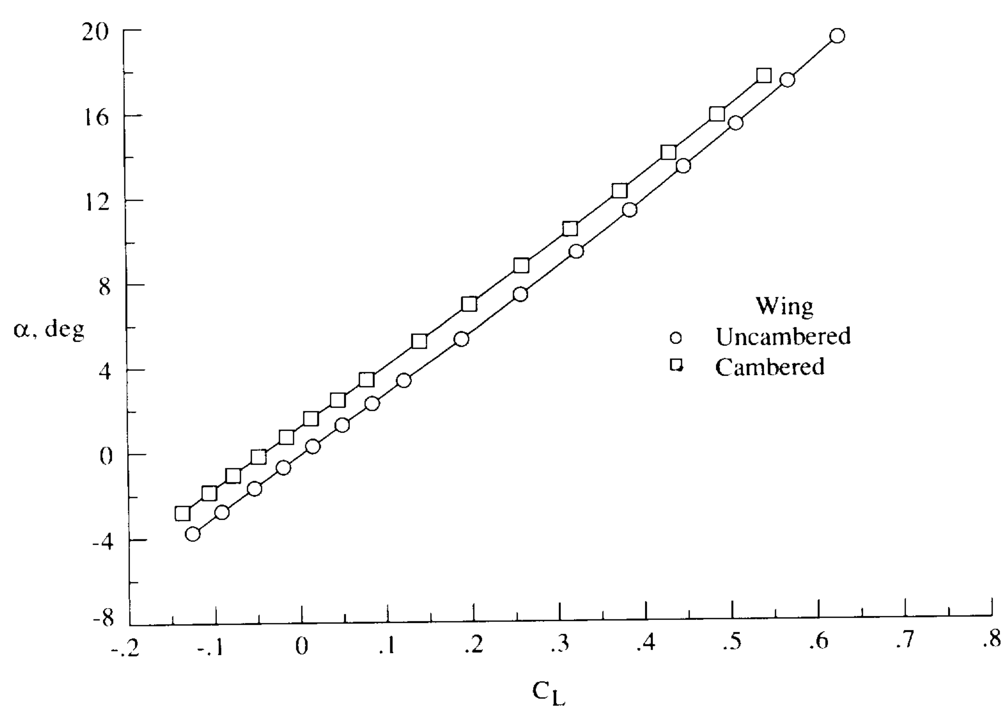
Figure 3. Continued.



(c) Lift, drag, and pitching-moment characteristics at $M = 2.00$.

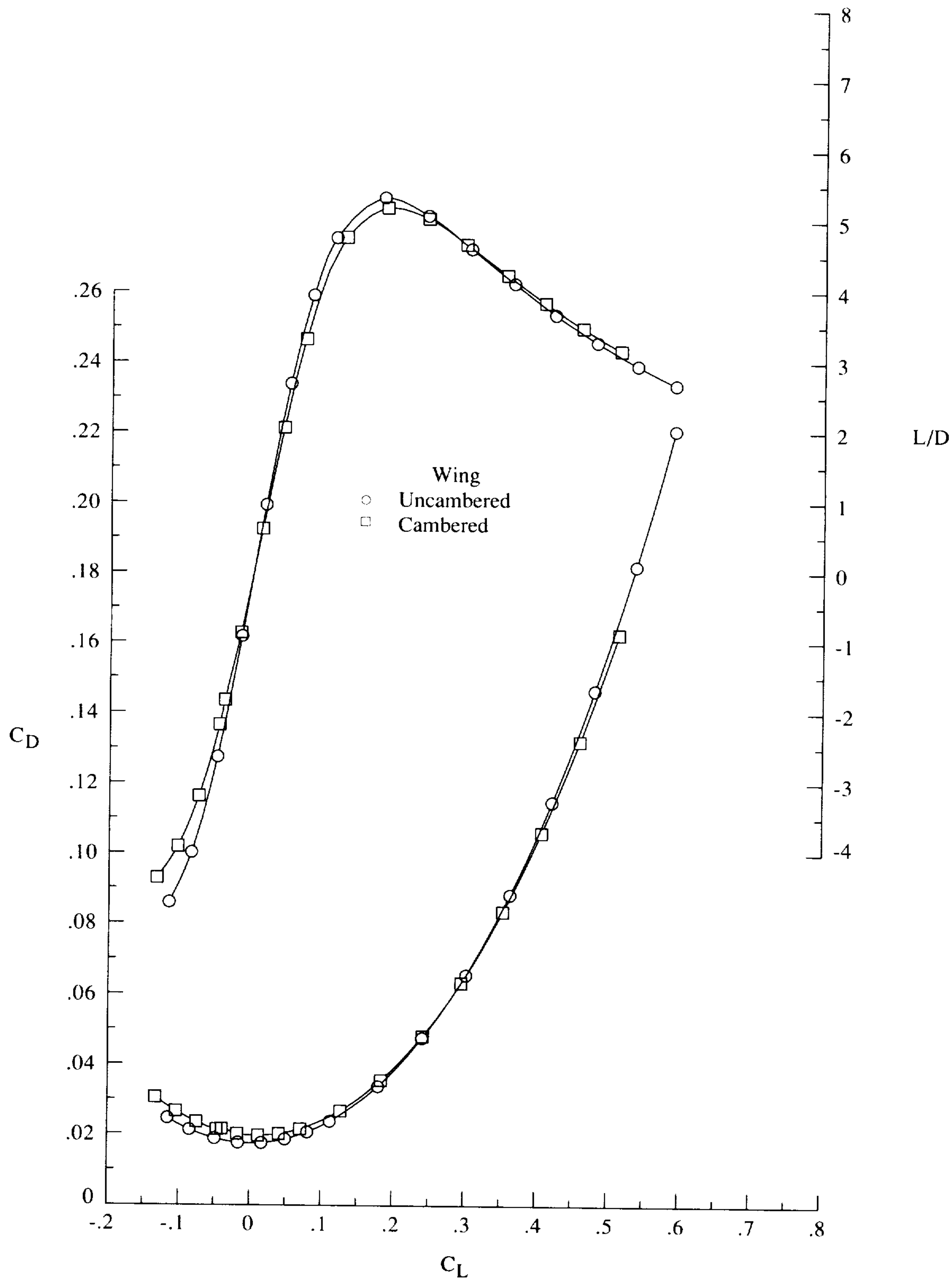
Figure 3. Continued.





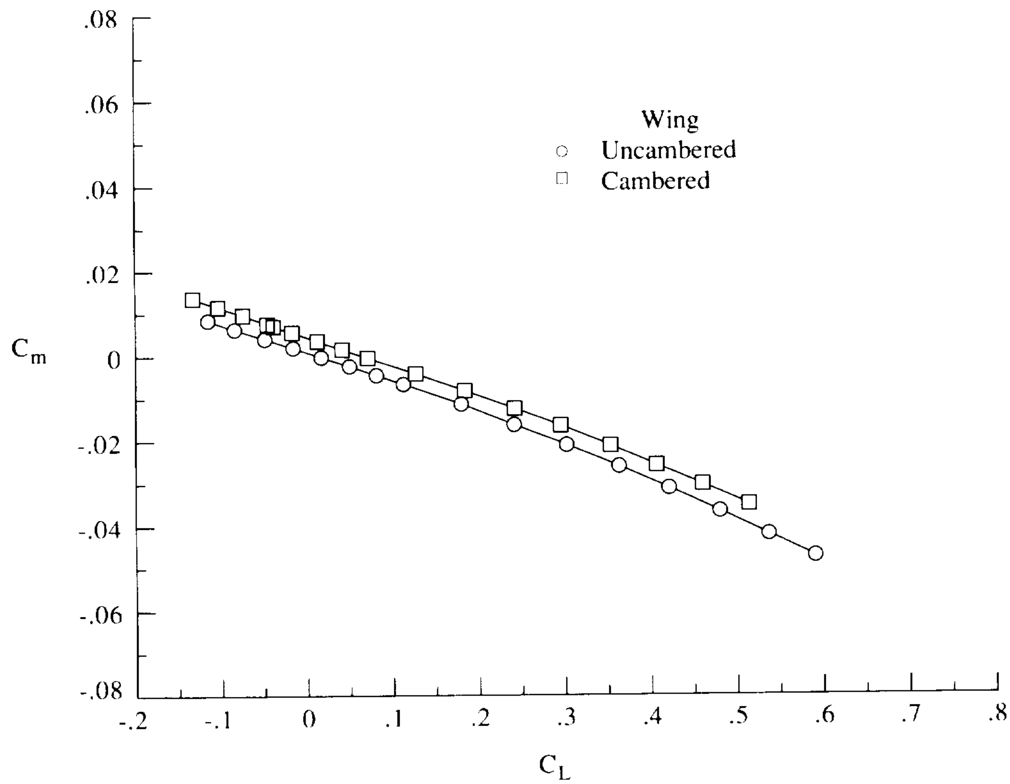
(c) Concluded.

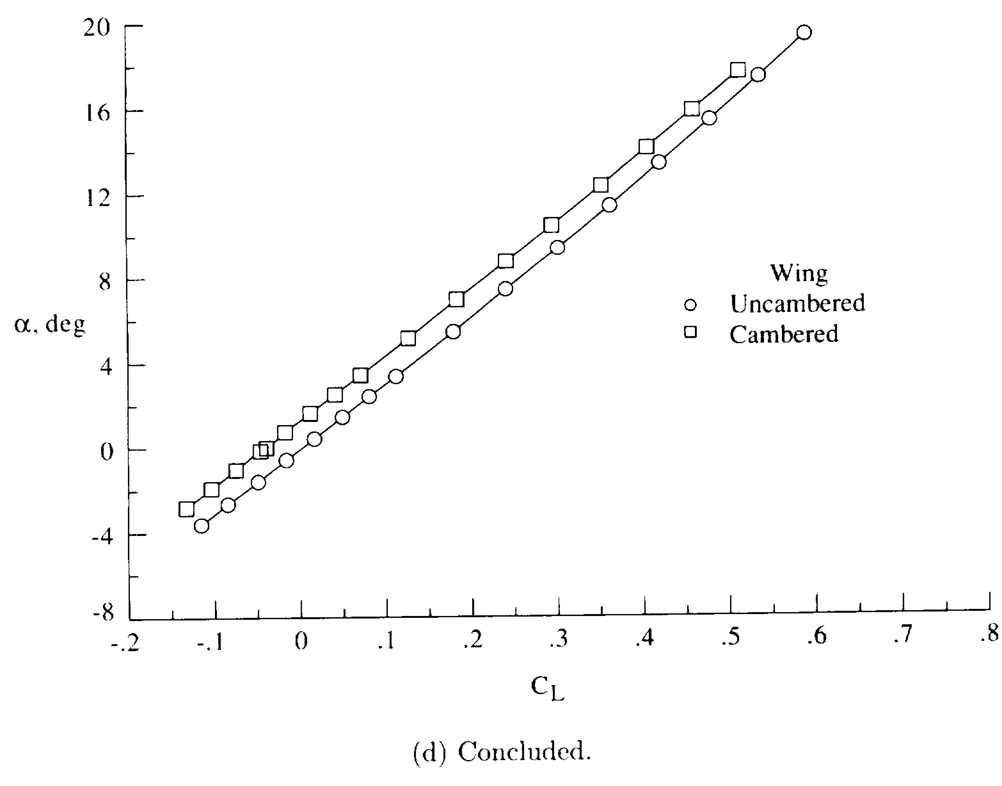
Figure 3. Continued.



(d) Lift, drag, and pitching-moment characteristics at $M = 2.16$.

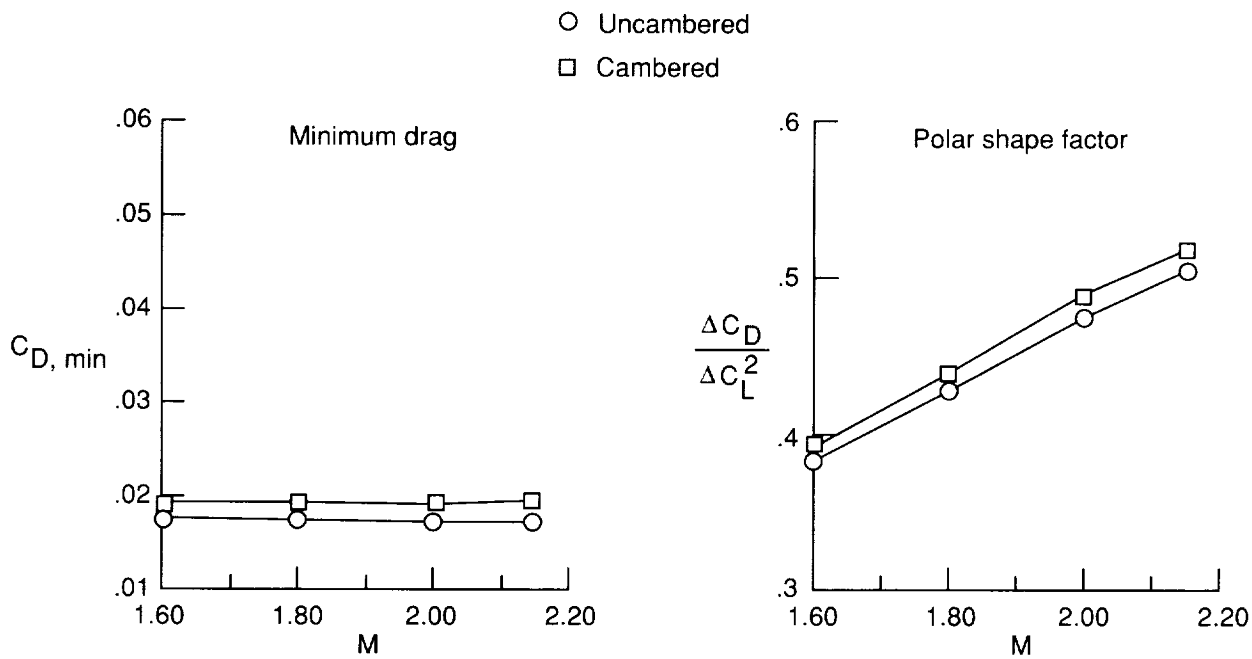
Figure 3. Continued.



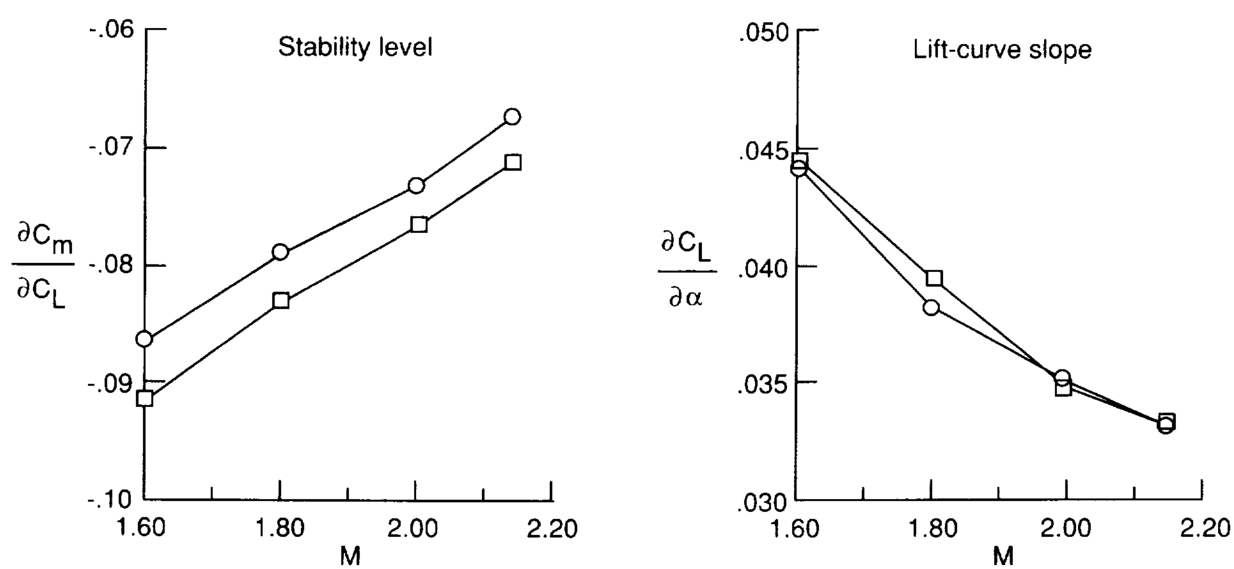


(d) Concluded.

Figure 3. Concluded.



(a) Drag characteristics.



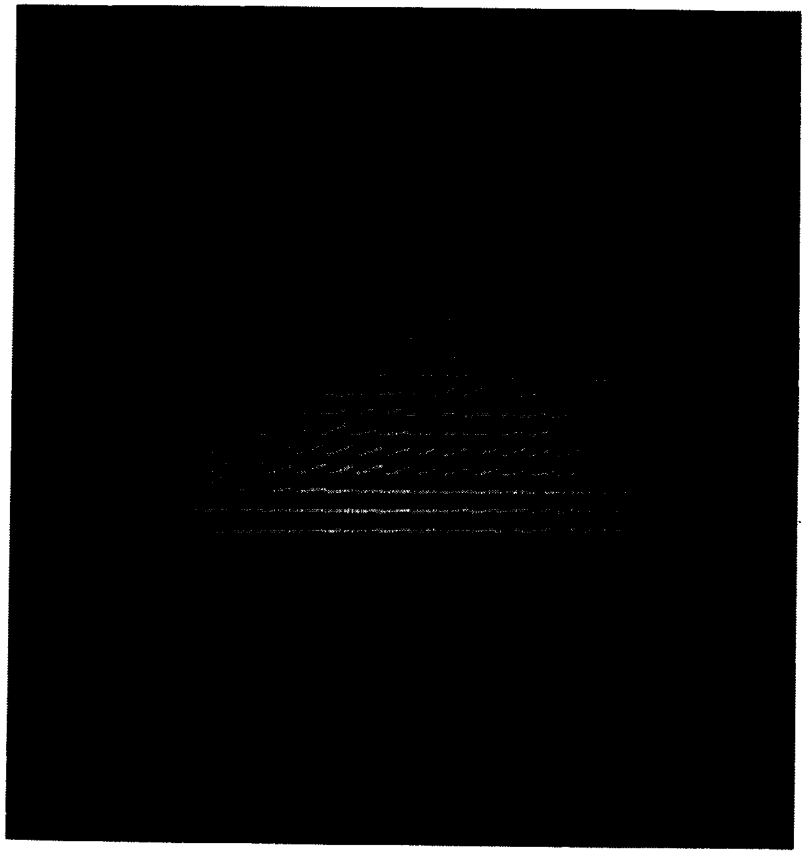
(b) Stability level and lift-curve slope of uncambered and cambered wings.

Figure 4. Summary plots with $\delta_{LE} = 0°$ and $\delta_{TE} = 0°$.

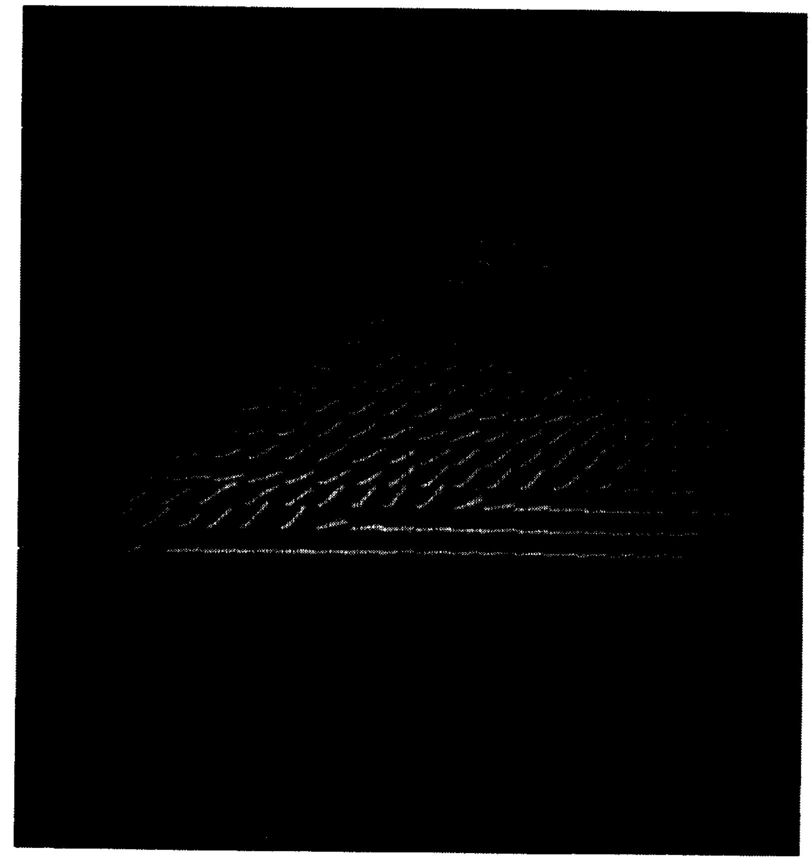
(a) $\alpha = 0^\circ$.

(b) $\alpha = 4^\circ$.

Figure 5. Tufts on uncambered wing with $\delta_{\mathrm{LE}} = 0^\circ$ and $\delta_{\mathrm{TE}} = 0^\circ$ at $M = 1.60$.

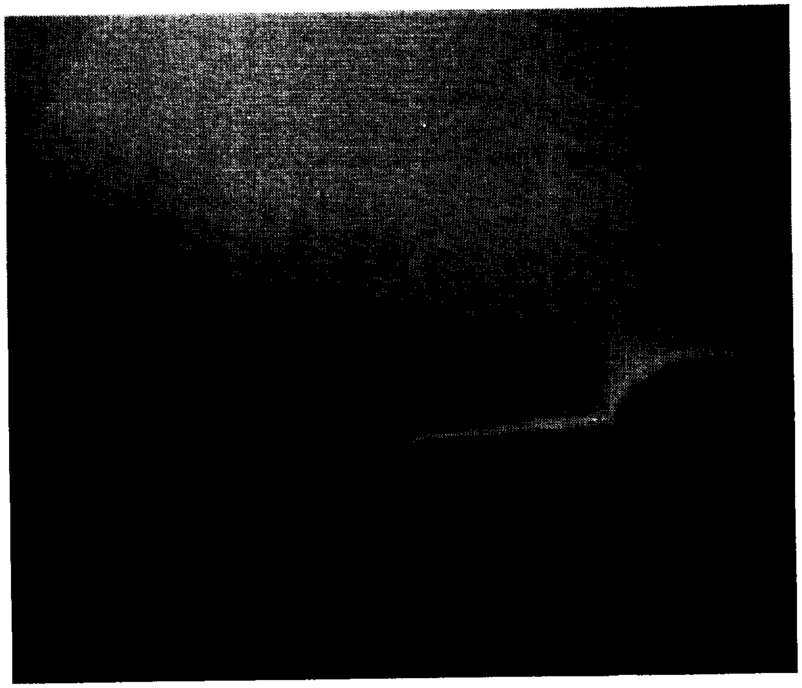


(c) $\alpha = 8°$.

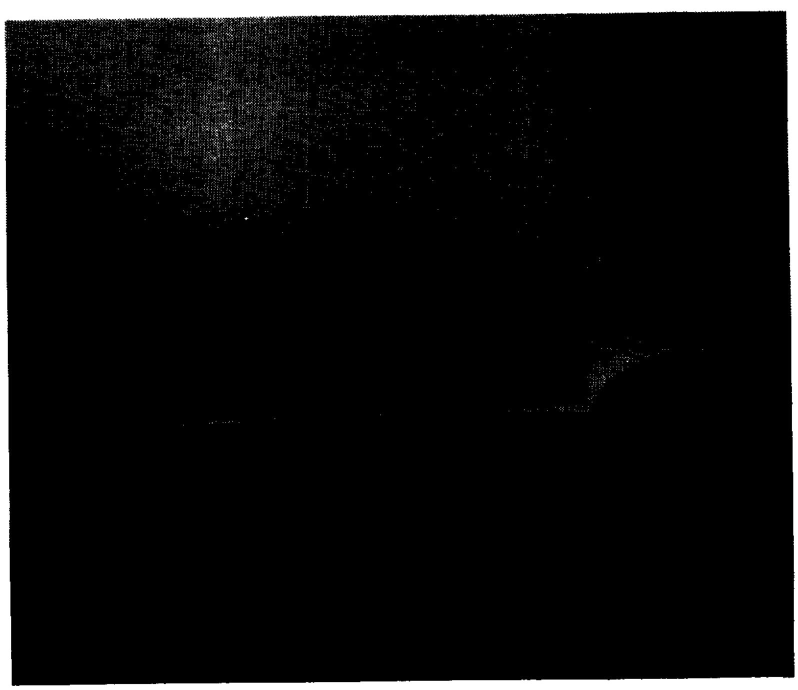


(d) $\alpha = 12°$.

Figure 5. Concluded.



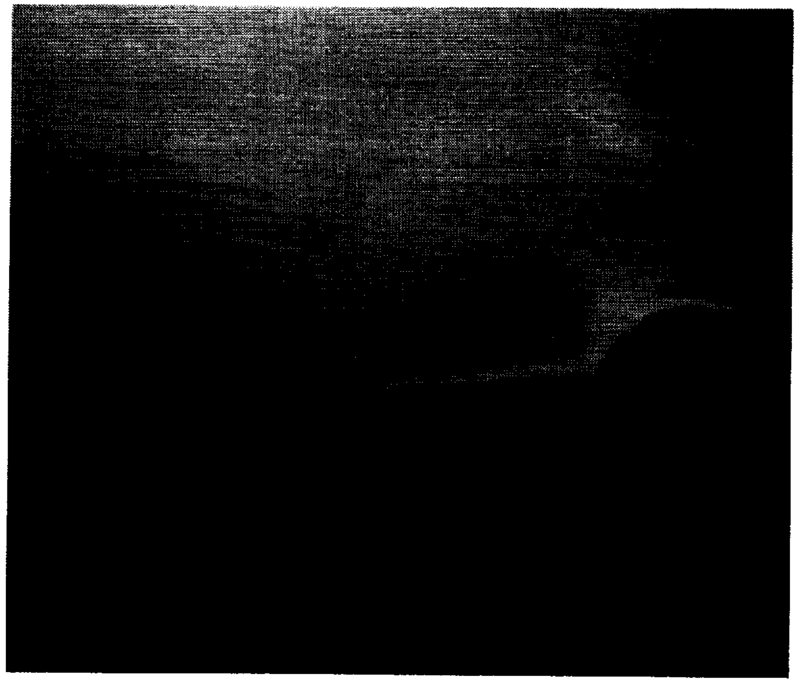
x/l = 0.30



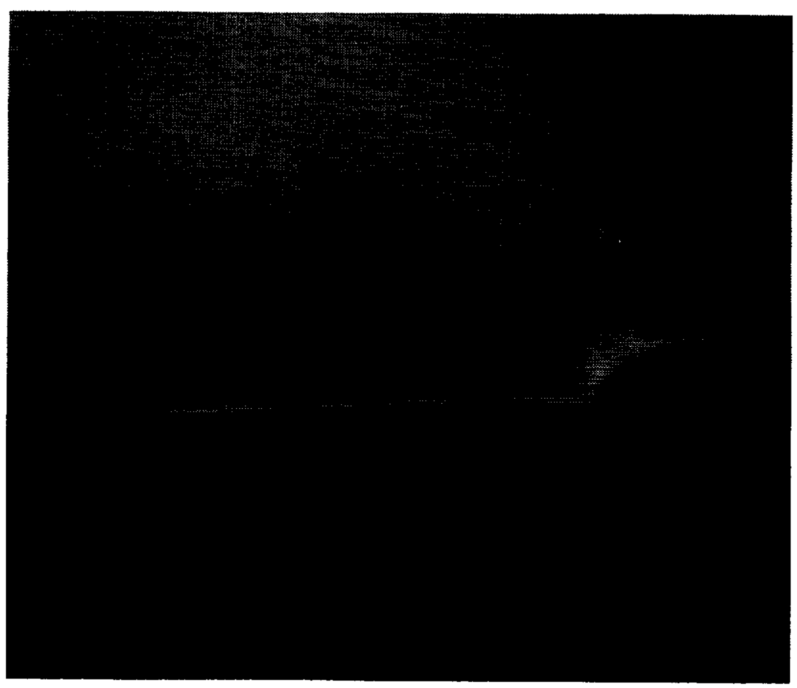
x/l = 0.90

(a) $\alpha = 4°$.

Figure 6. Vapor screen flow visualization for uncambered wing with $\delta_{LE} = 0°$ and $\delta_{TE} = 0°$ at $M = 1.60$.



x/l = 0.30

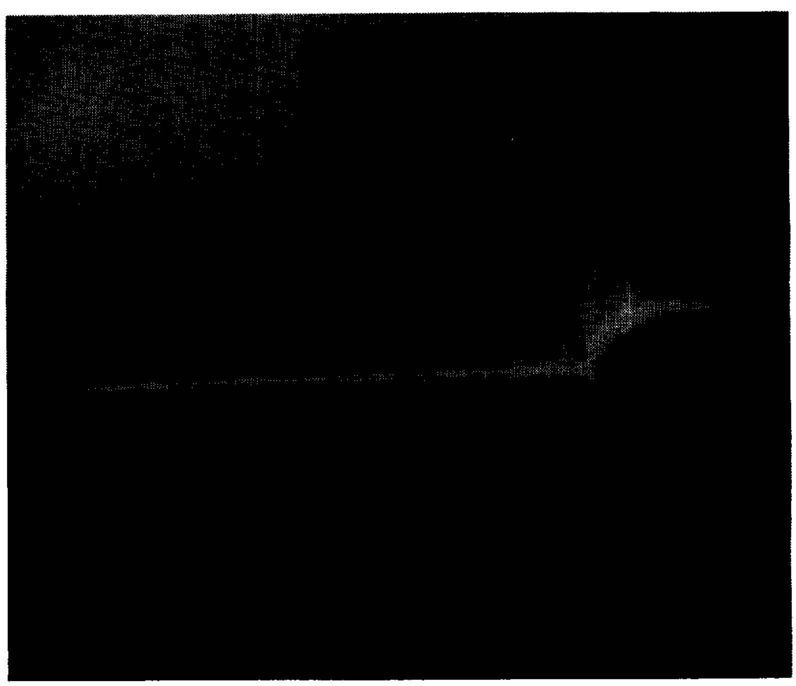


x/l = 0.90

(b) $\alpha = 8°$.

Figure 6. Continued.

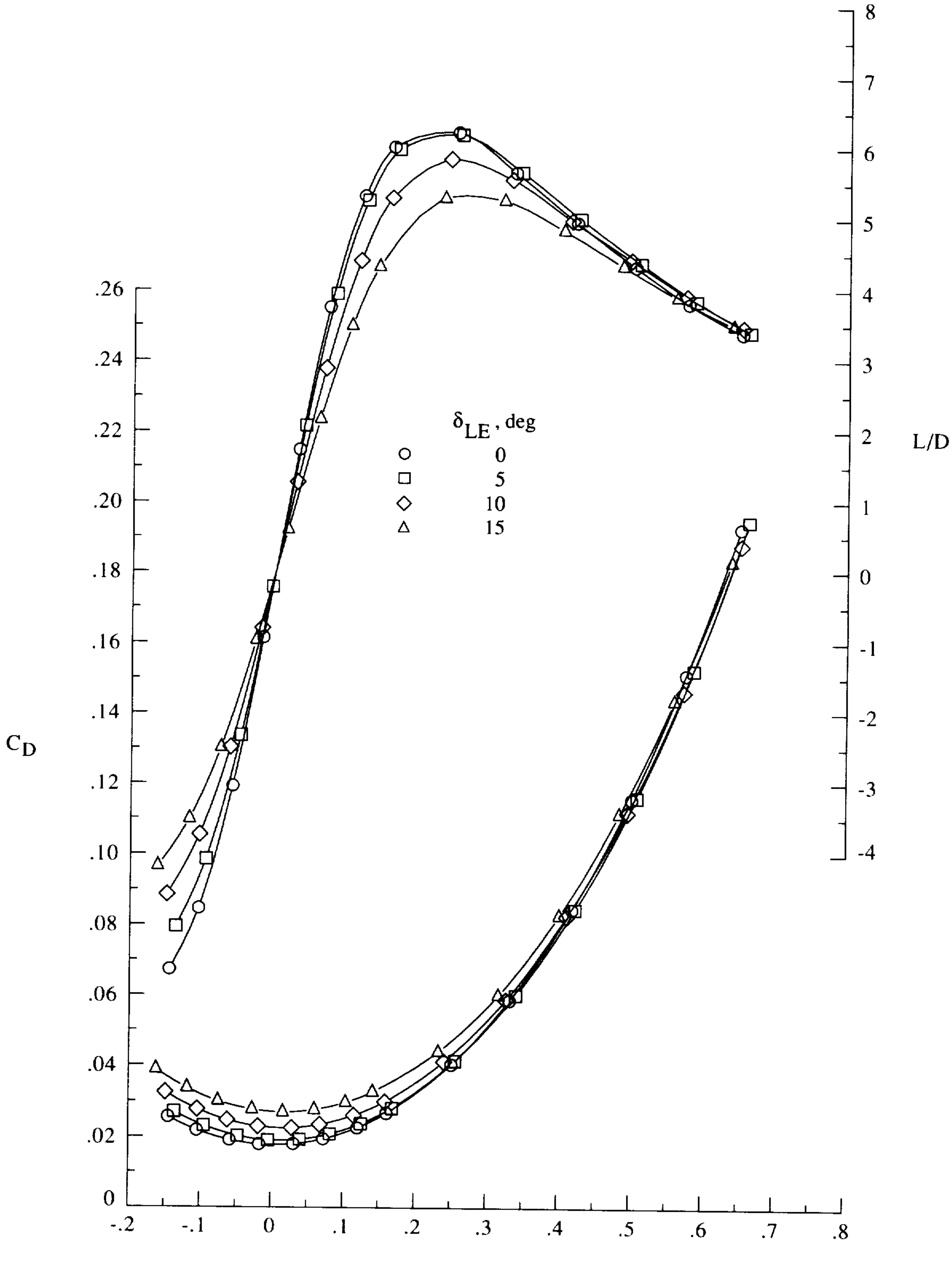
x/*l* = 0.30



x/*l* = 0.90

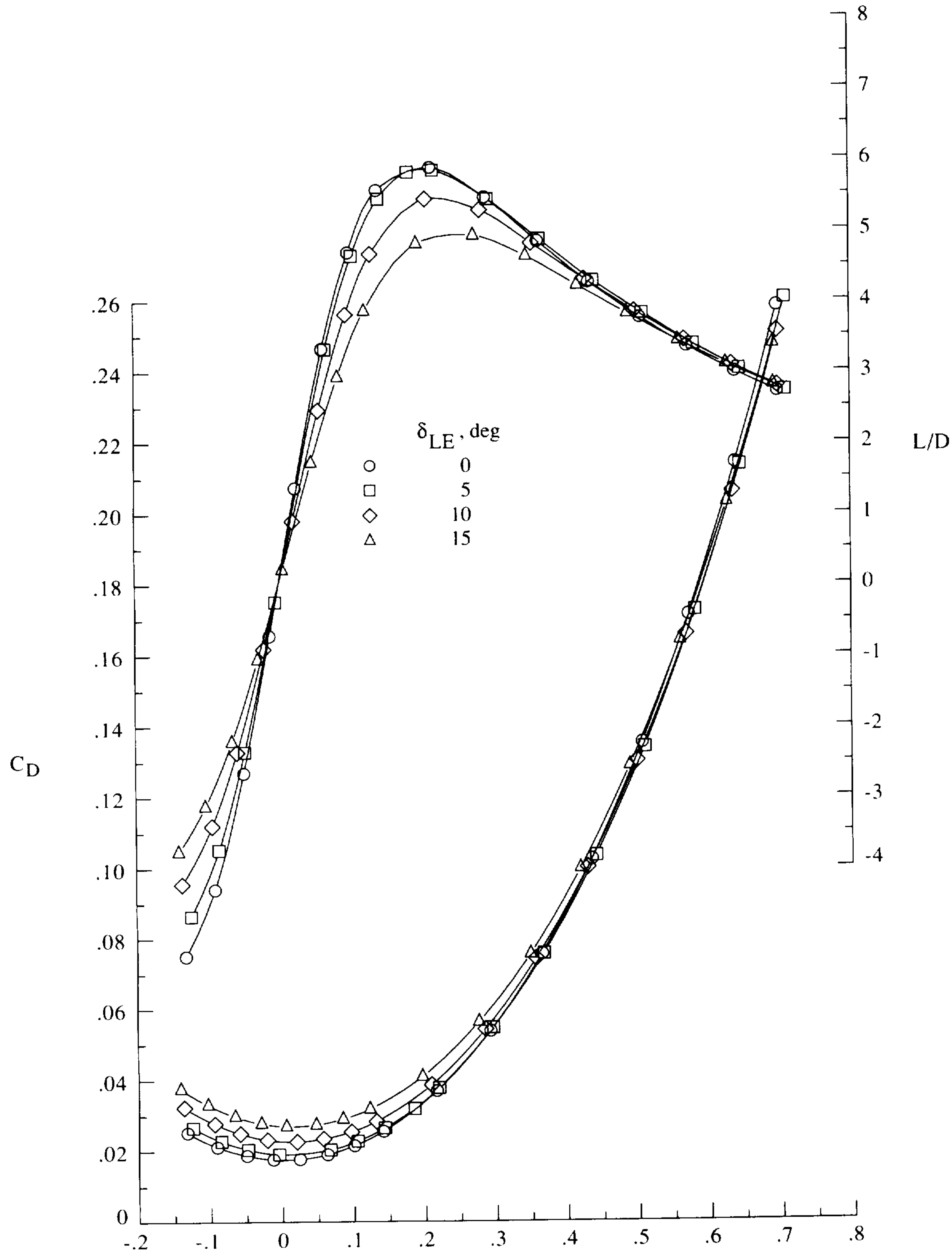
(c) $\alpha = 12°$.

Figure 6. Concluded.



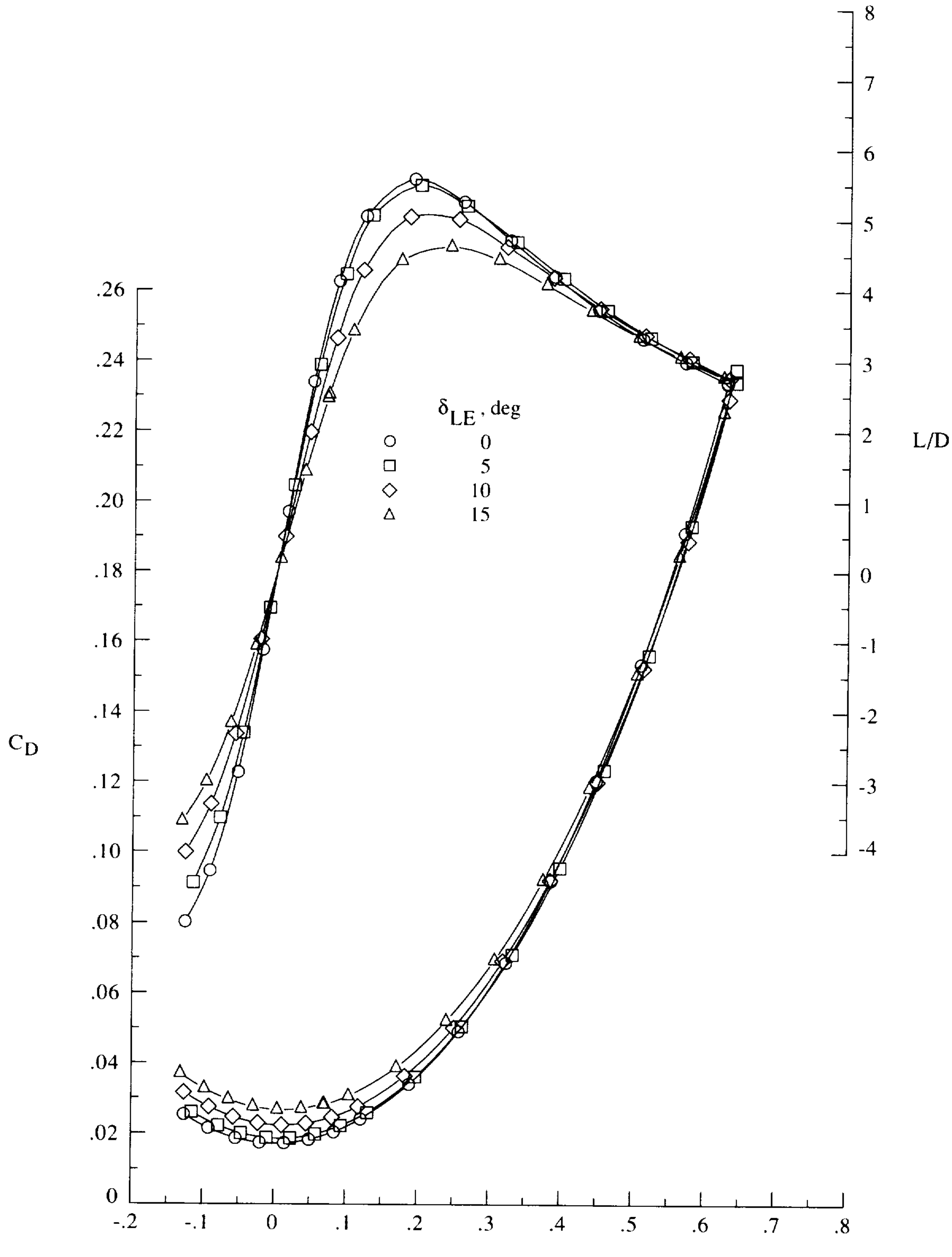
(a) $M = 1.60$.

Figure 7. Effect on drag of leading-edge flap deflection on uncambered wing with $\delta_{TE} = 0°$.



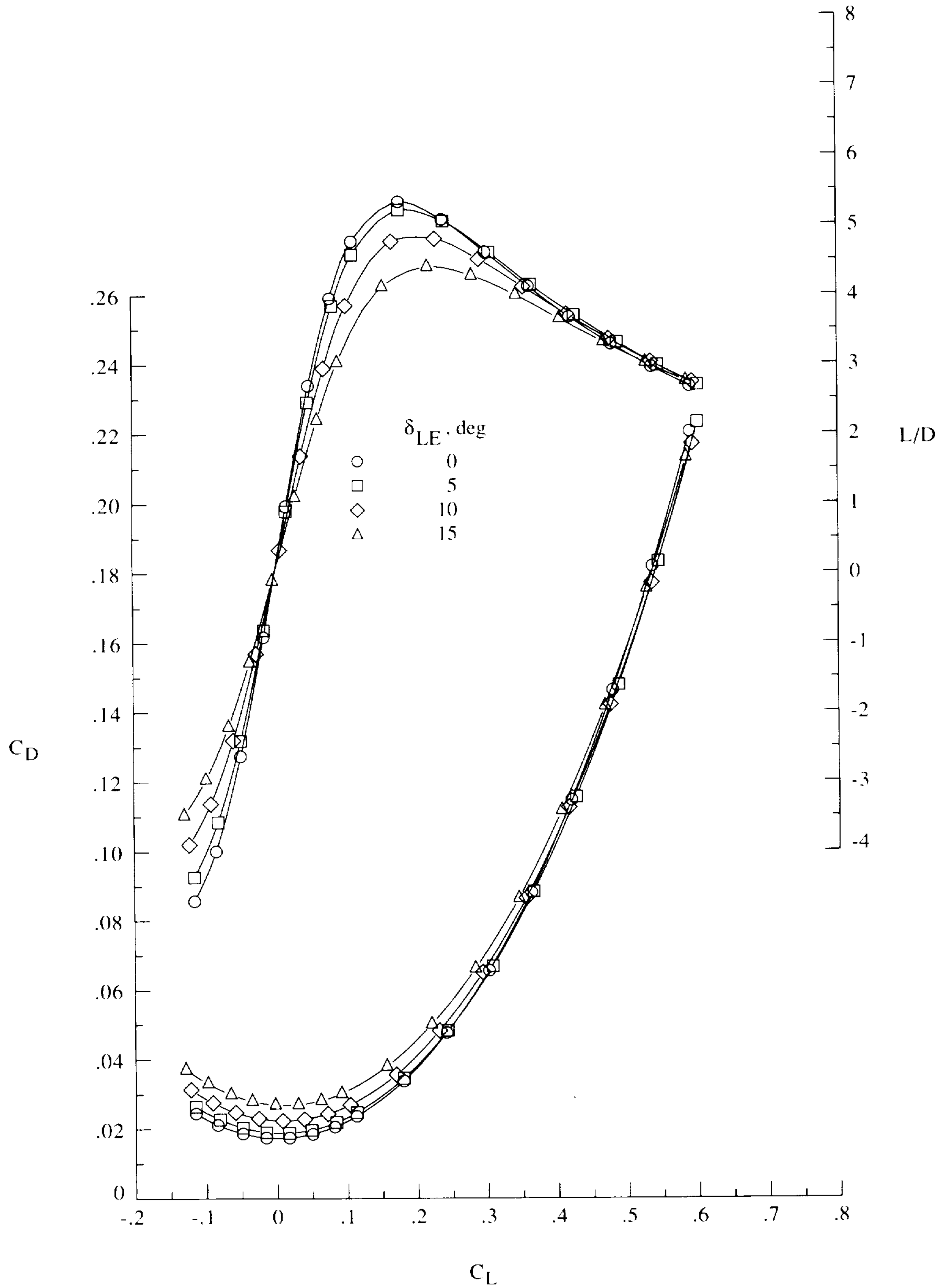
(b) $M = 1.80$.

Figure 7. Continued.



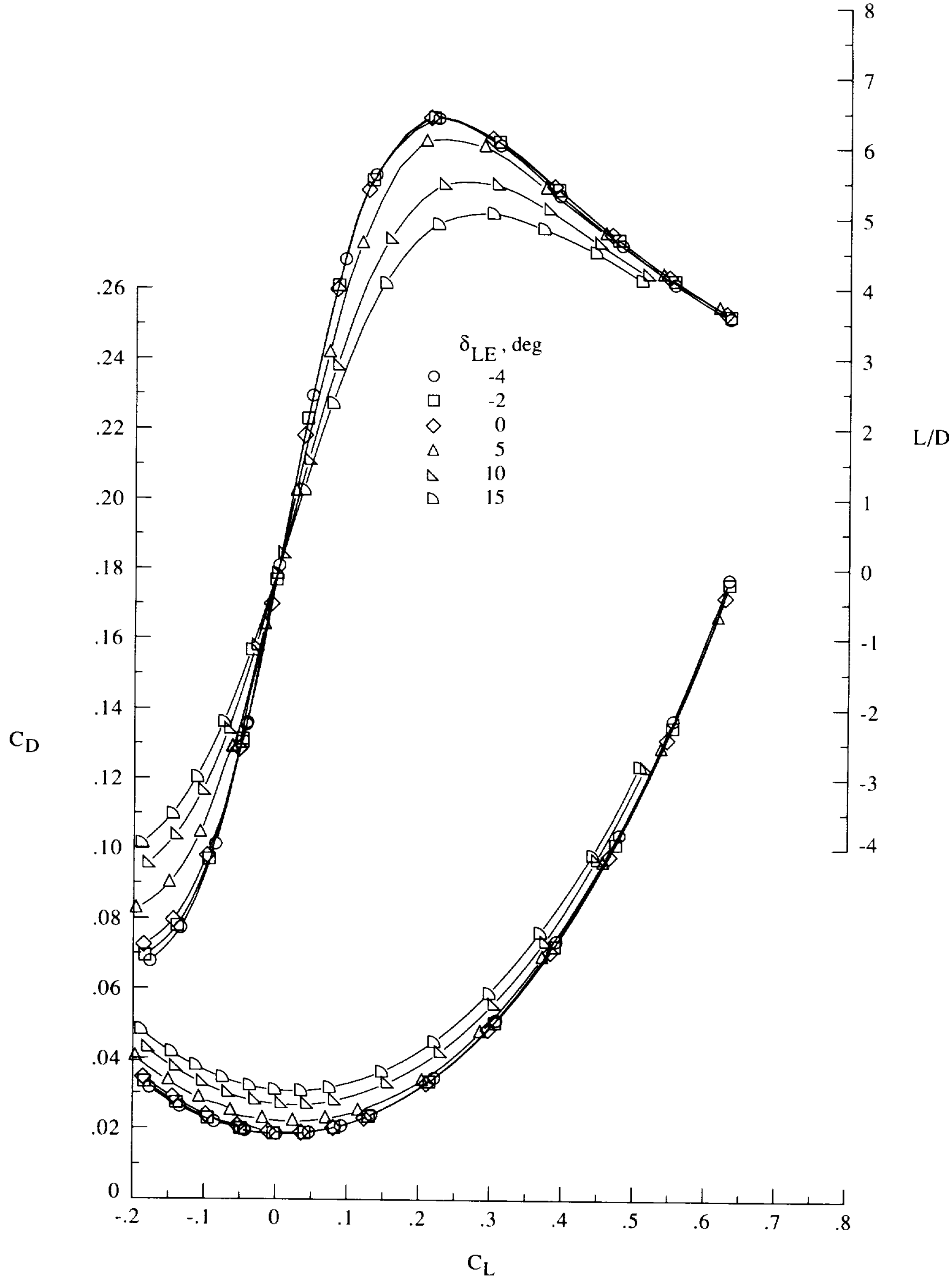
(c) $M = 2.00$.

Figure 7. Continued.



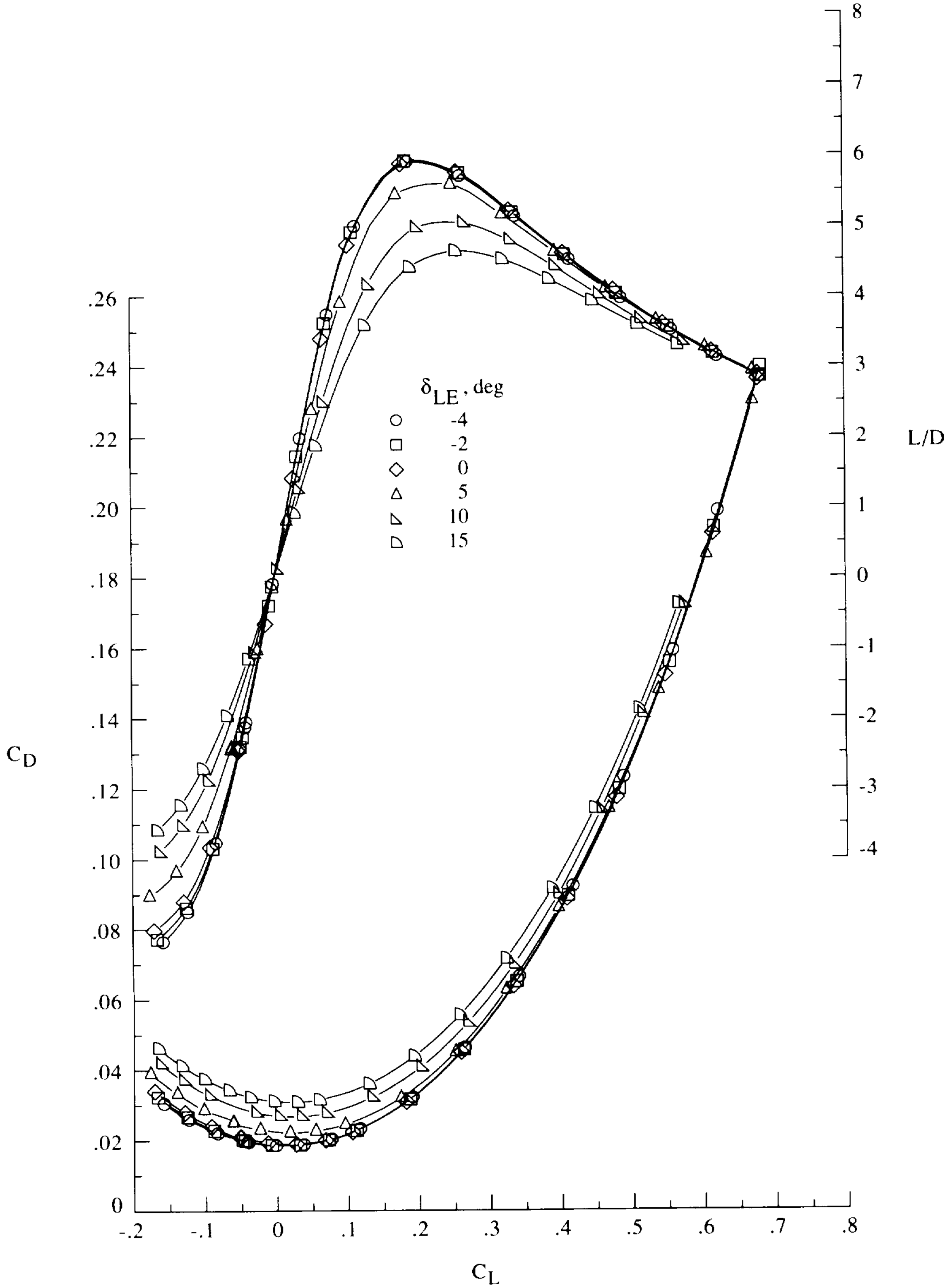
(d) $M = 2.16$.

Figure 7. Concluded.



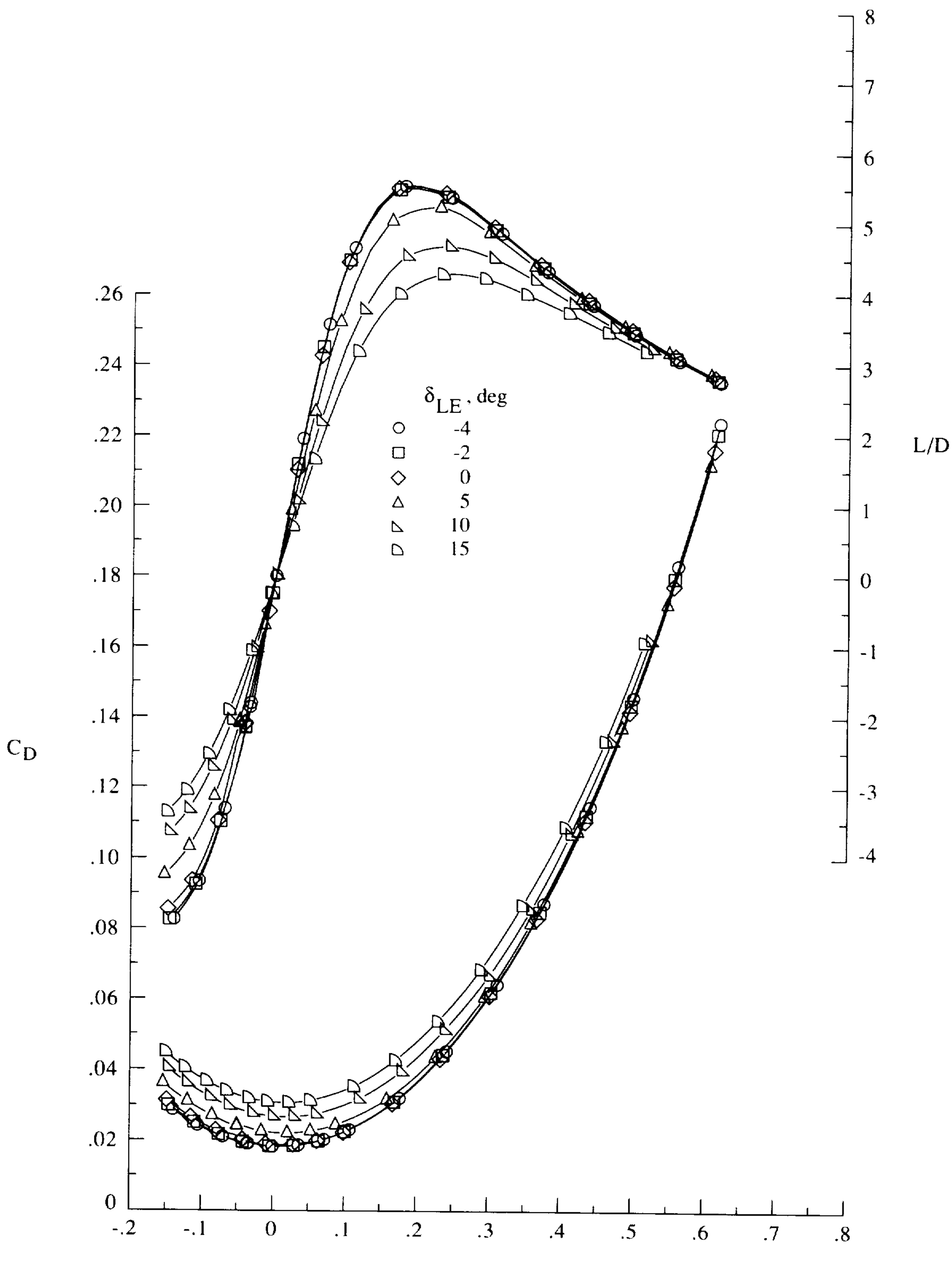
(a) $M = 1.60$.

Figure 8. Effect on drag of leading-edge flap deflection on cambered wing with $\delta_{TE} = 0°$.



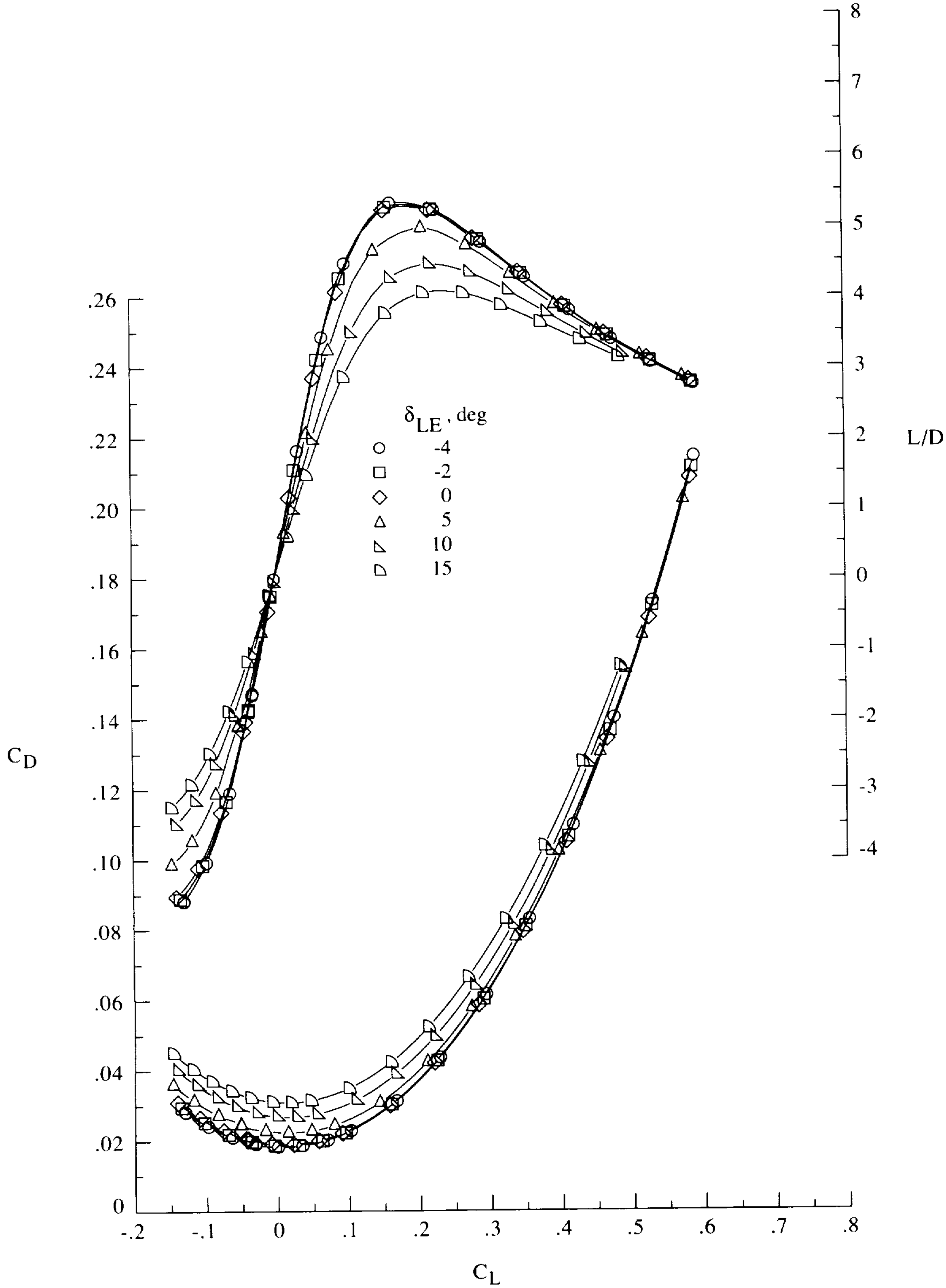
(b) $M = 1.80$.

Figure 8. Continued.



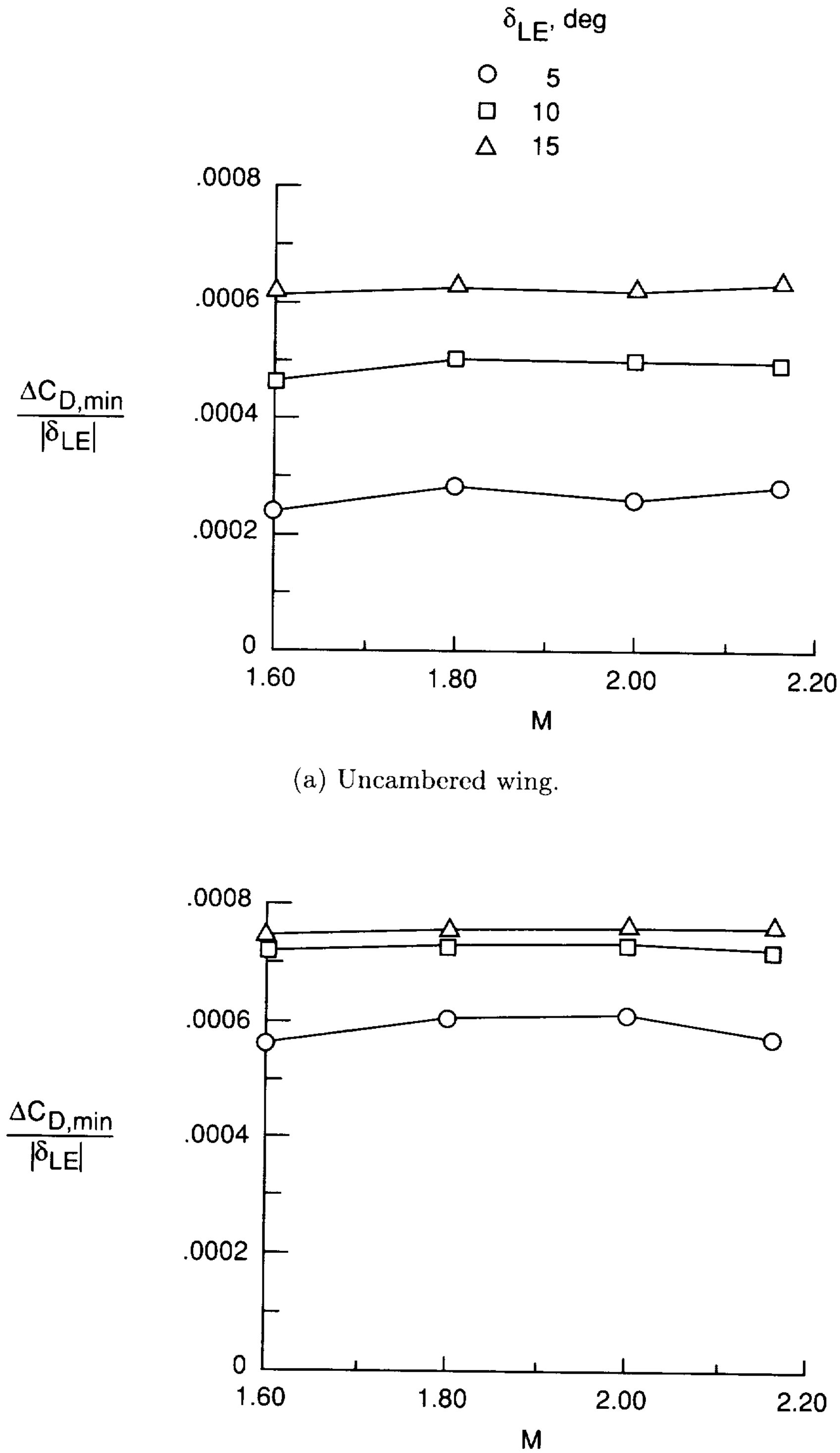
(c) $M = 2.00$.

Figure 8. Continued.



(d) $M = 2.16$.

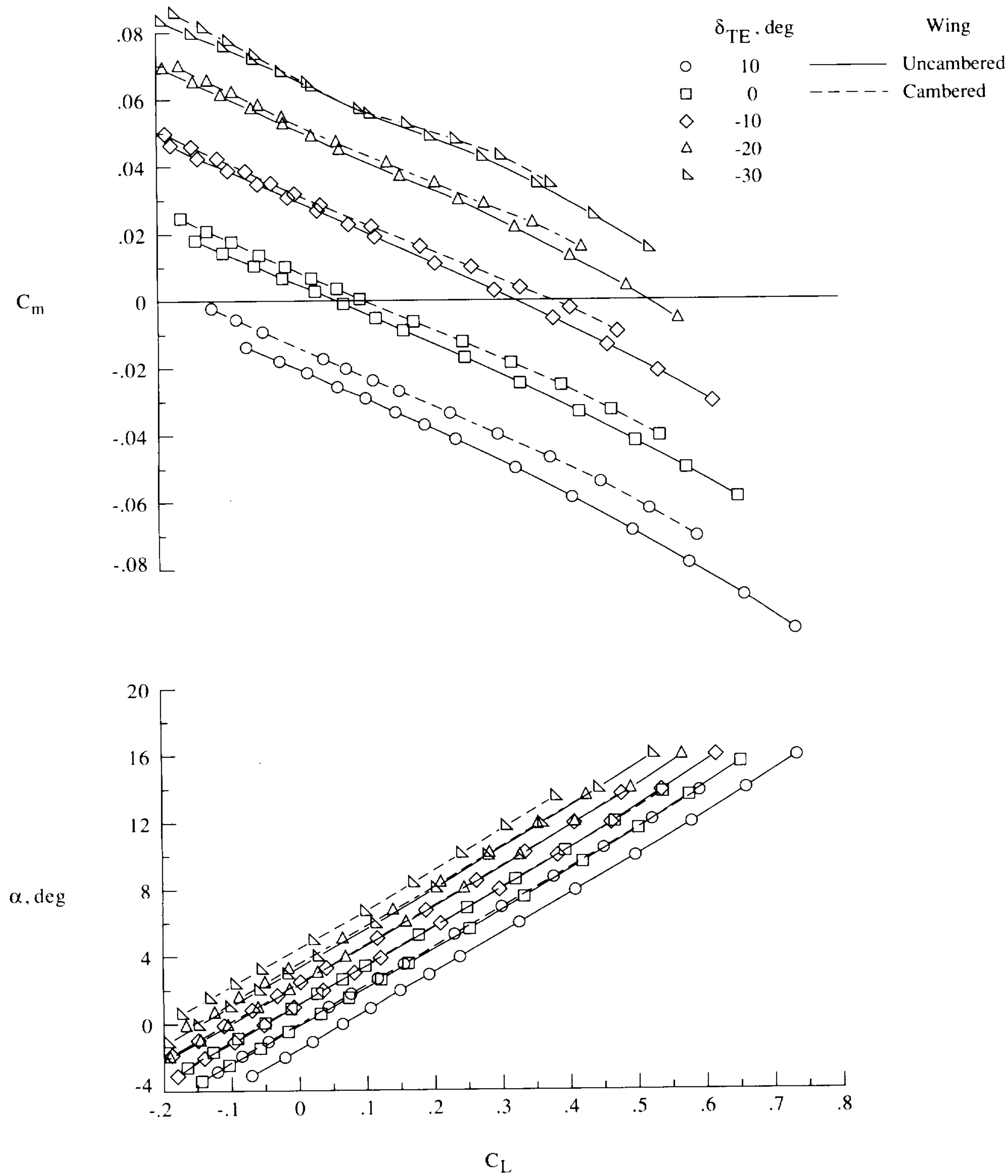
Figure 8. Concluded.



(a) Uncambered wing.

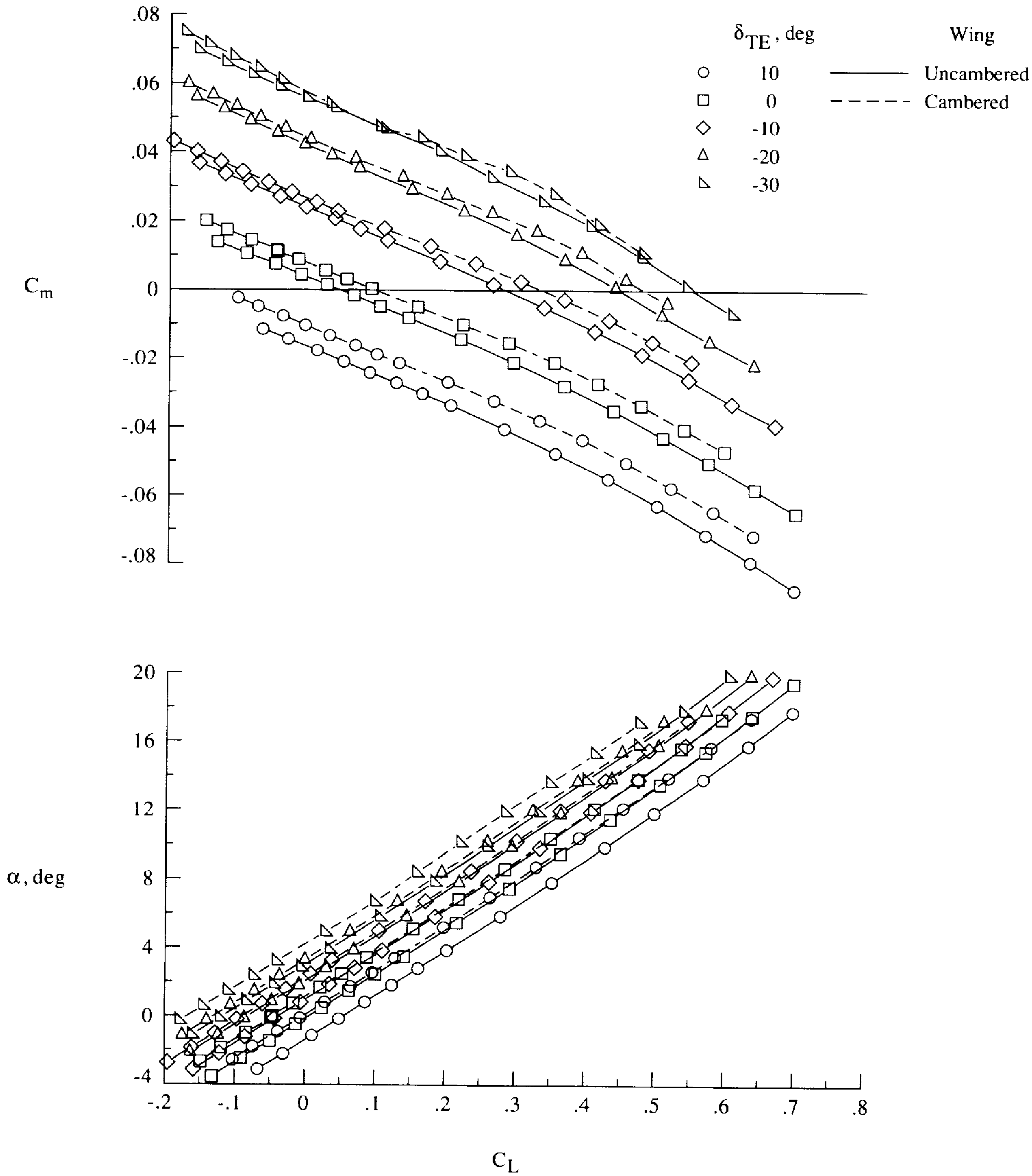
(b) Cambered wing.

Figure 9. Leading-edge flap-effectiveness parameters on minimum drag with $\delta_{TE} = 0°$.



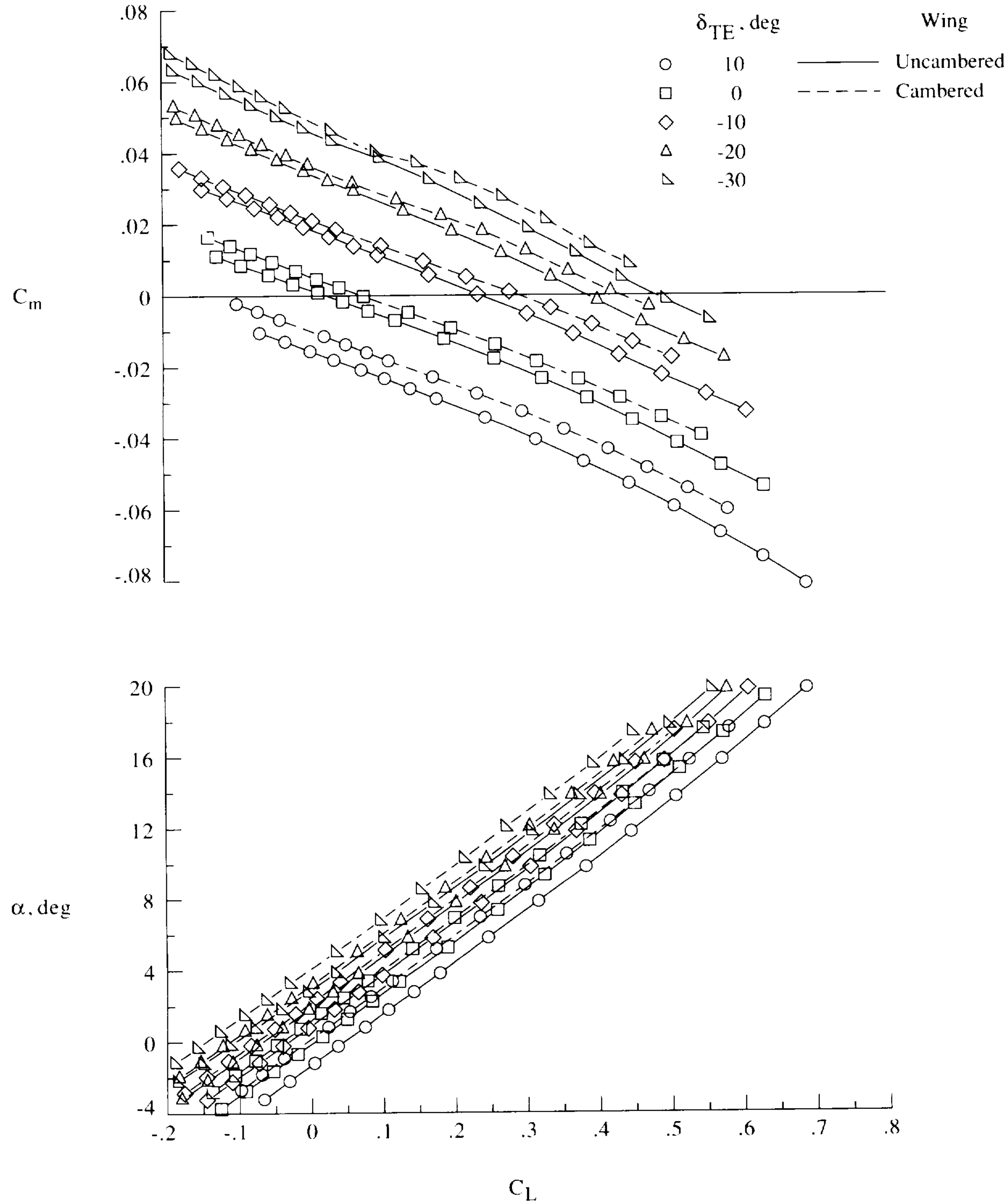
(a) $M = 1.60$.

Figure 10. Effect of trailing-edge flap deflection on lift and pitching-moment characteristics at $\delta_{LE} = 0°$.



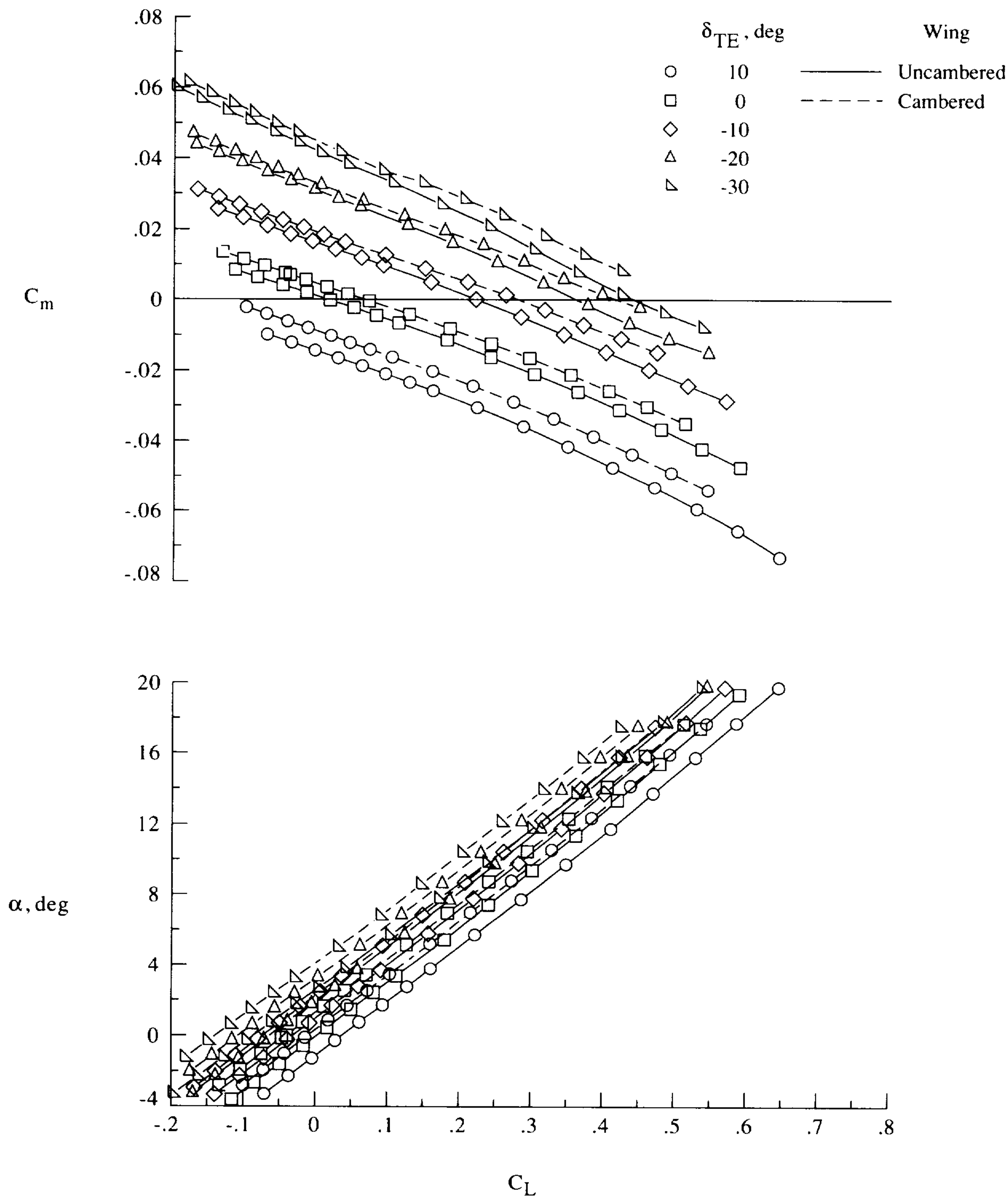
(b) $M = 1.80$.

Figure 10. Continued.



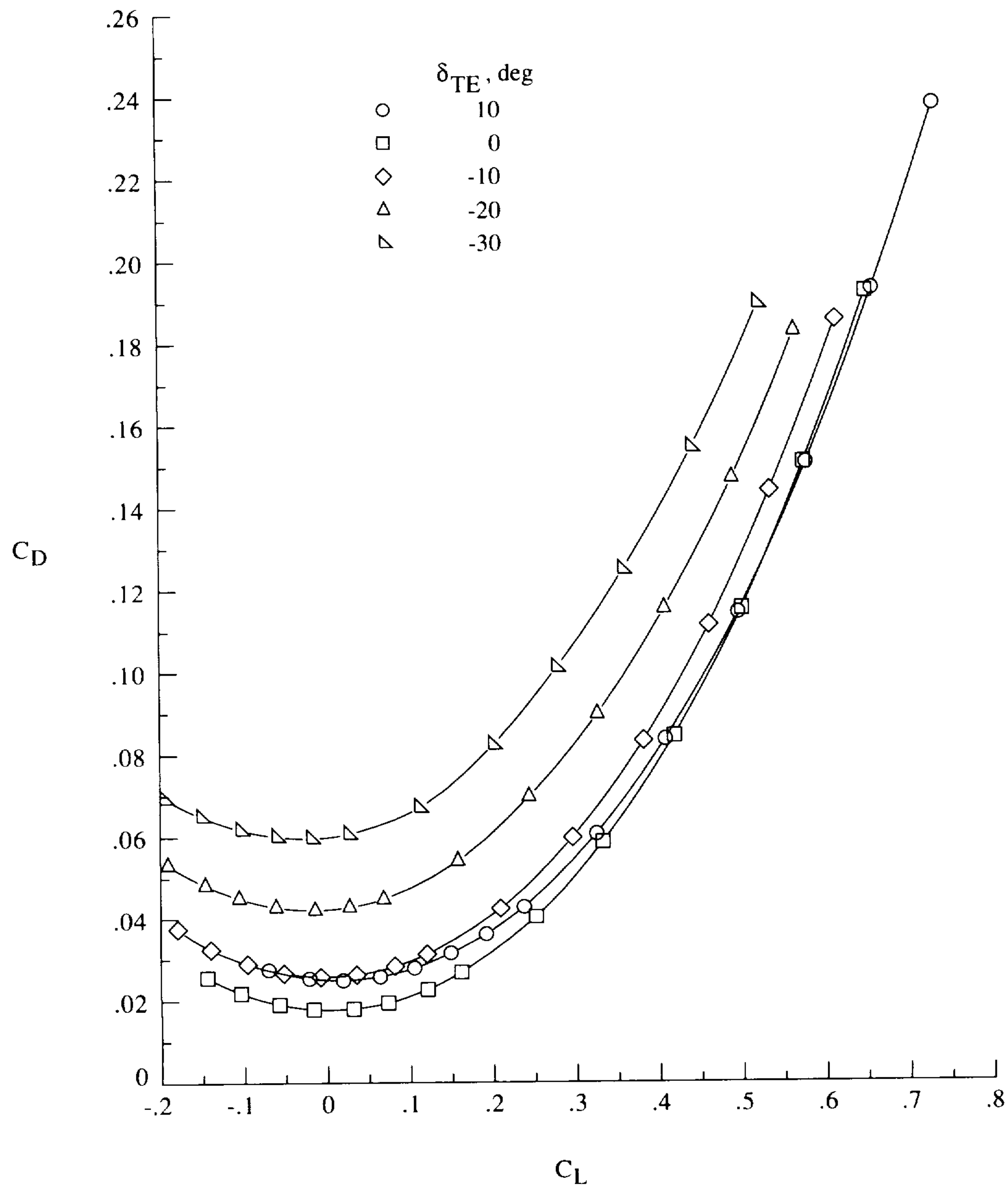
(c) $M = 2.00$.

Figure 10. Continued.



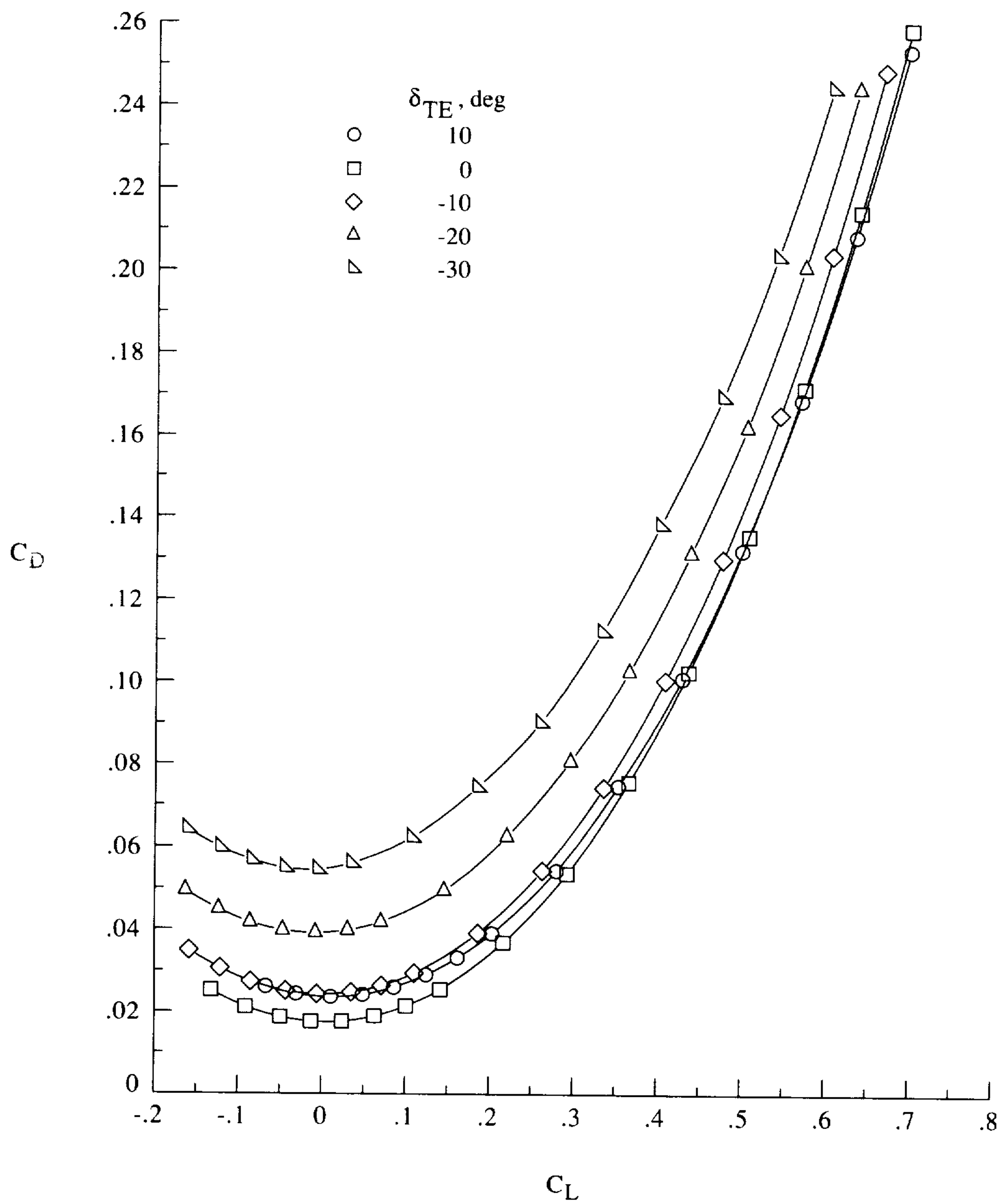
(d) $M = 2.16$.

Figure 10. Concluded.



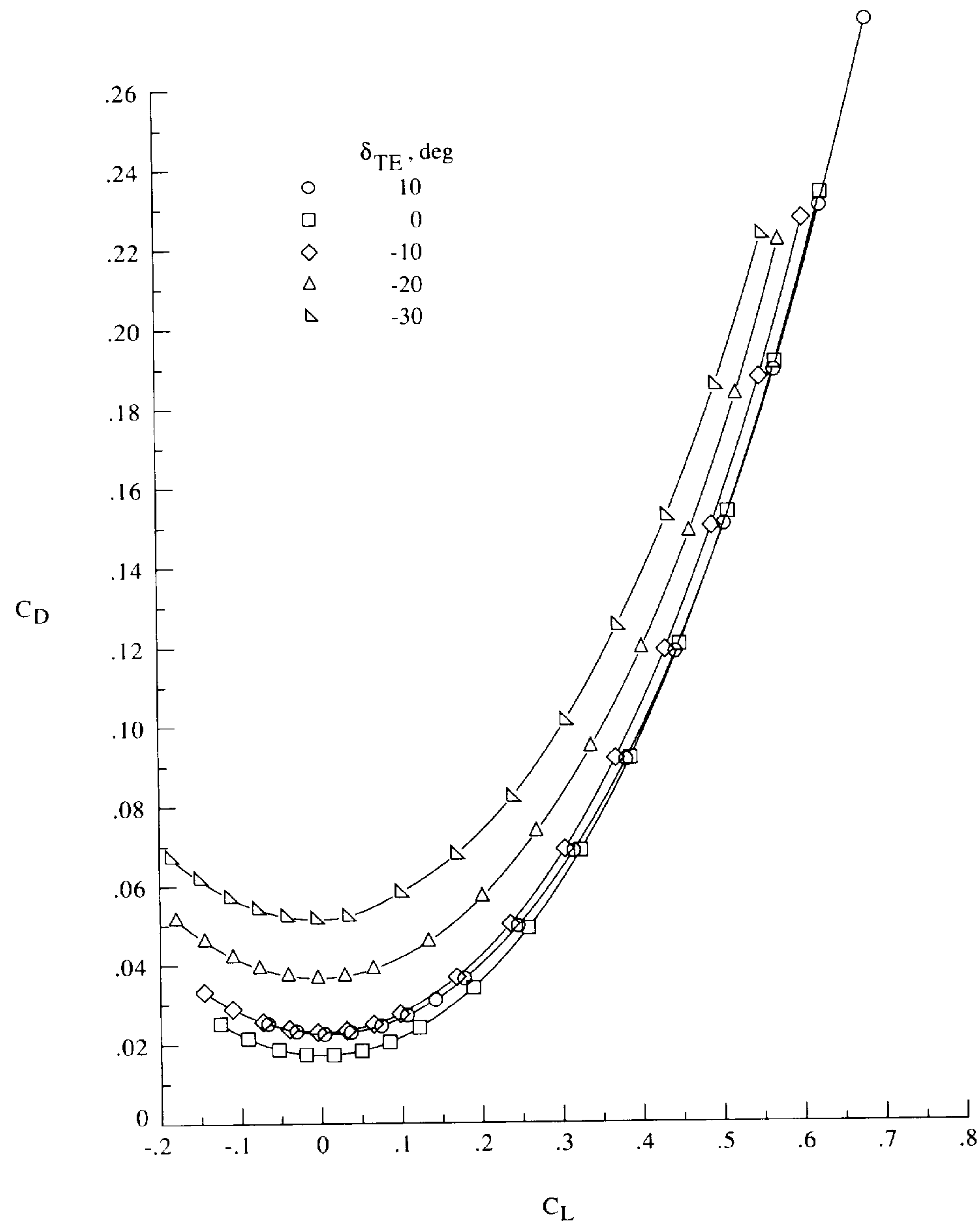
(a) $M = 1.60$.

Figure 11. Effect of trailing-edge flap deflection on drag of uncambered wing.



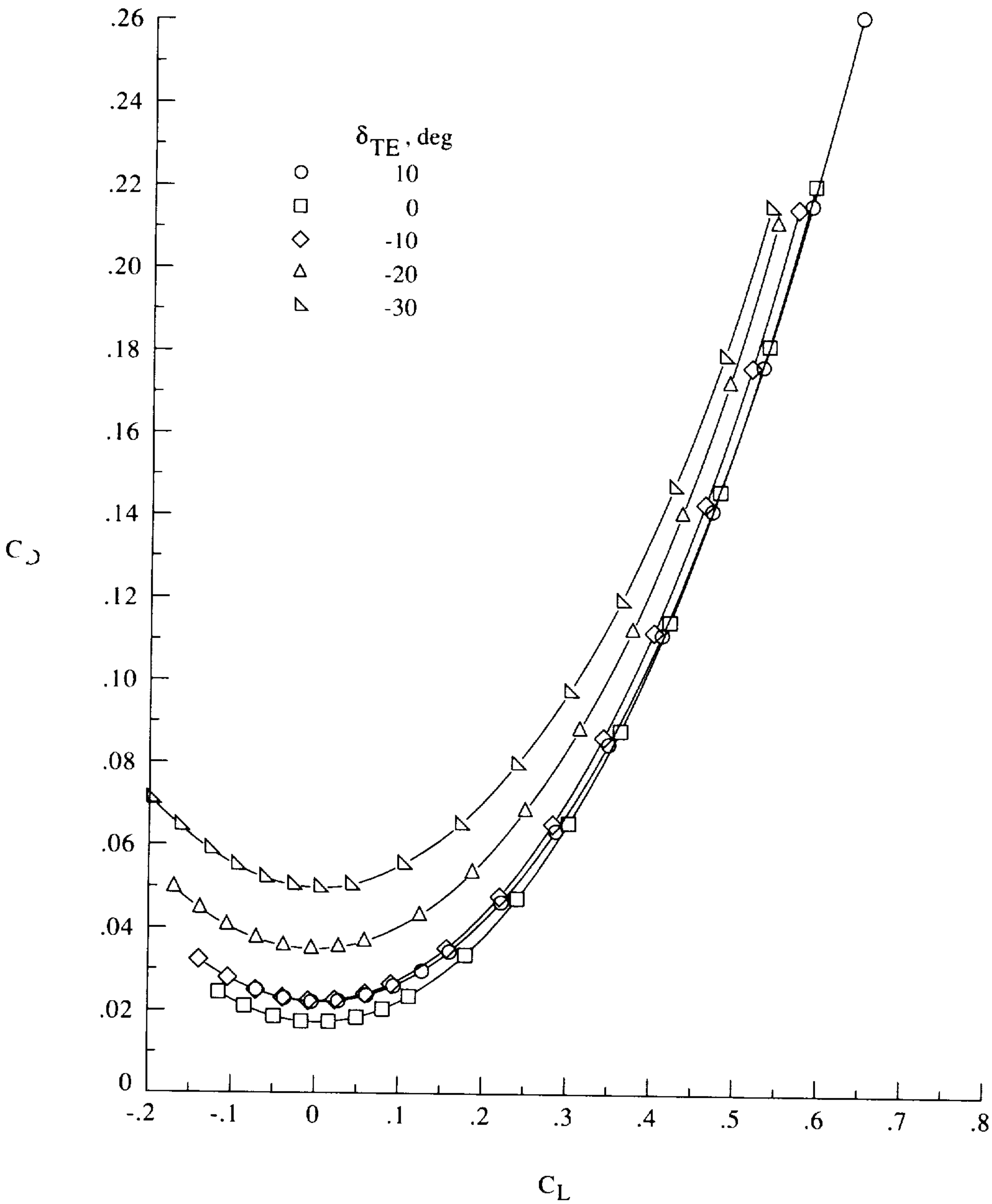
(b) $M = 1.80$.

Figure 11. Continued.



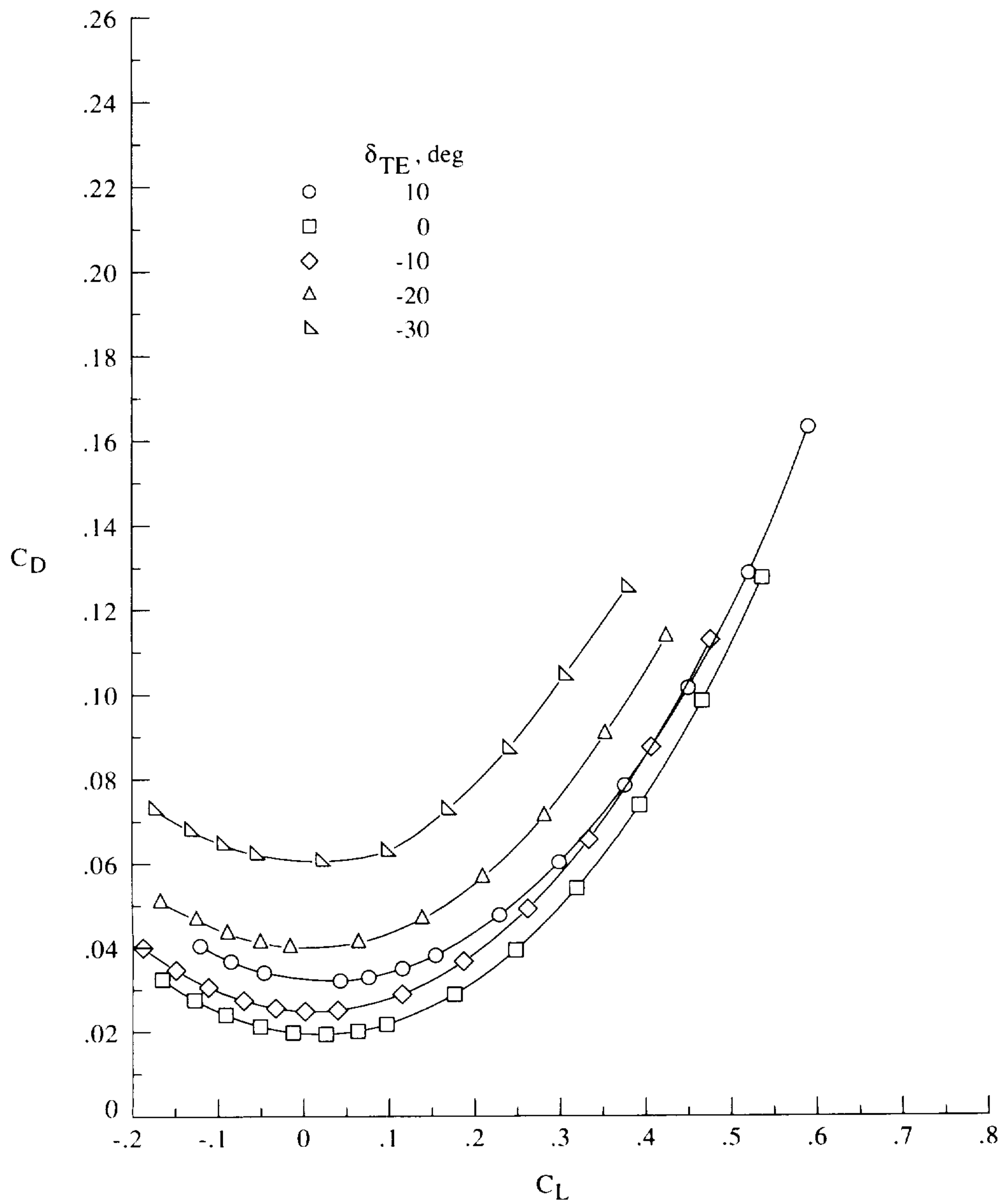
(c) $M = 2.00$.

Figure 11. Continued.



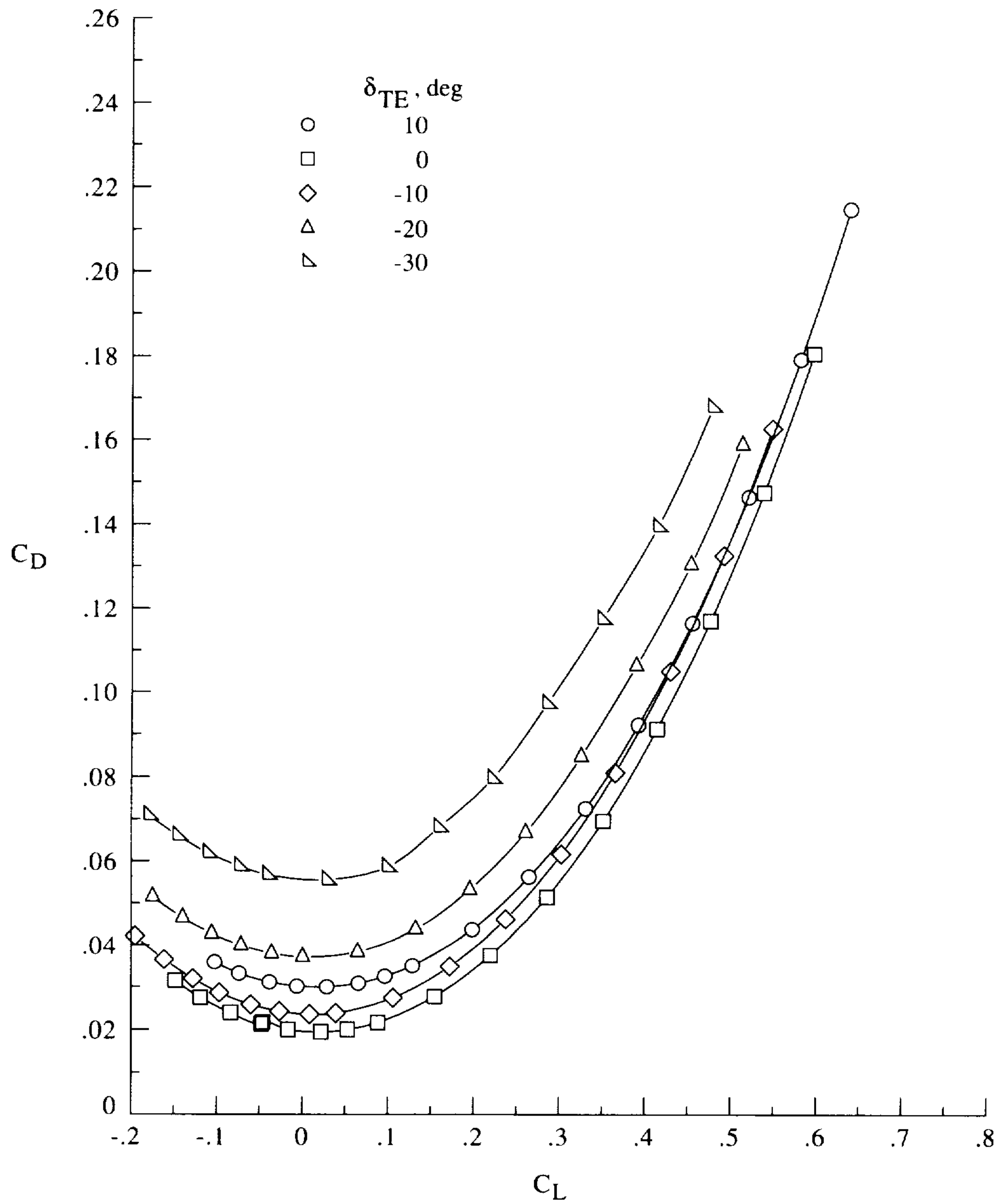
(d) $M = 2.16$.

Figure 11. Concluded.



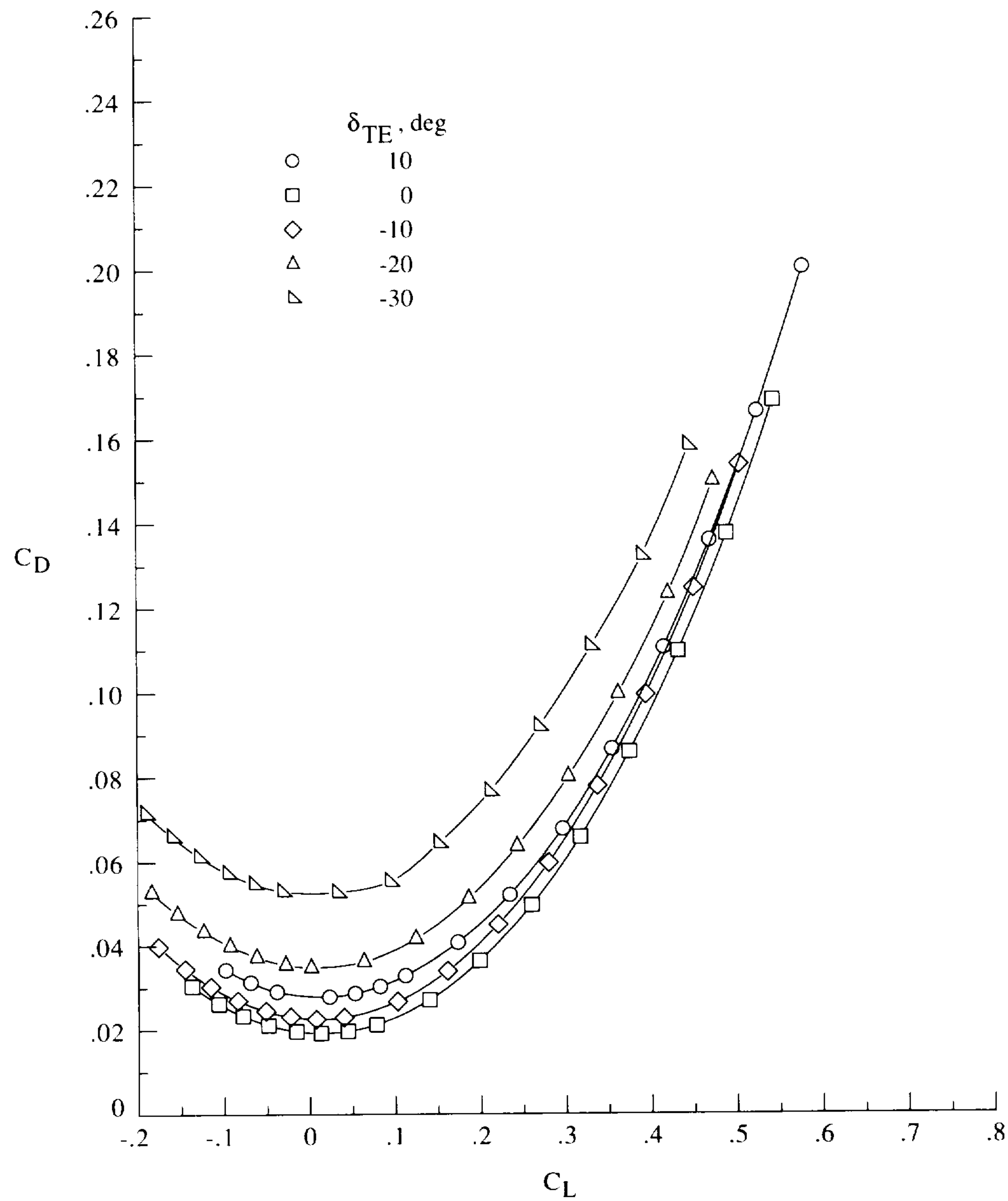
(a) $M = 1.60$.

Figure 12. Effect of trailing-edge flap deflection on drag of cambered wing.



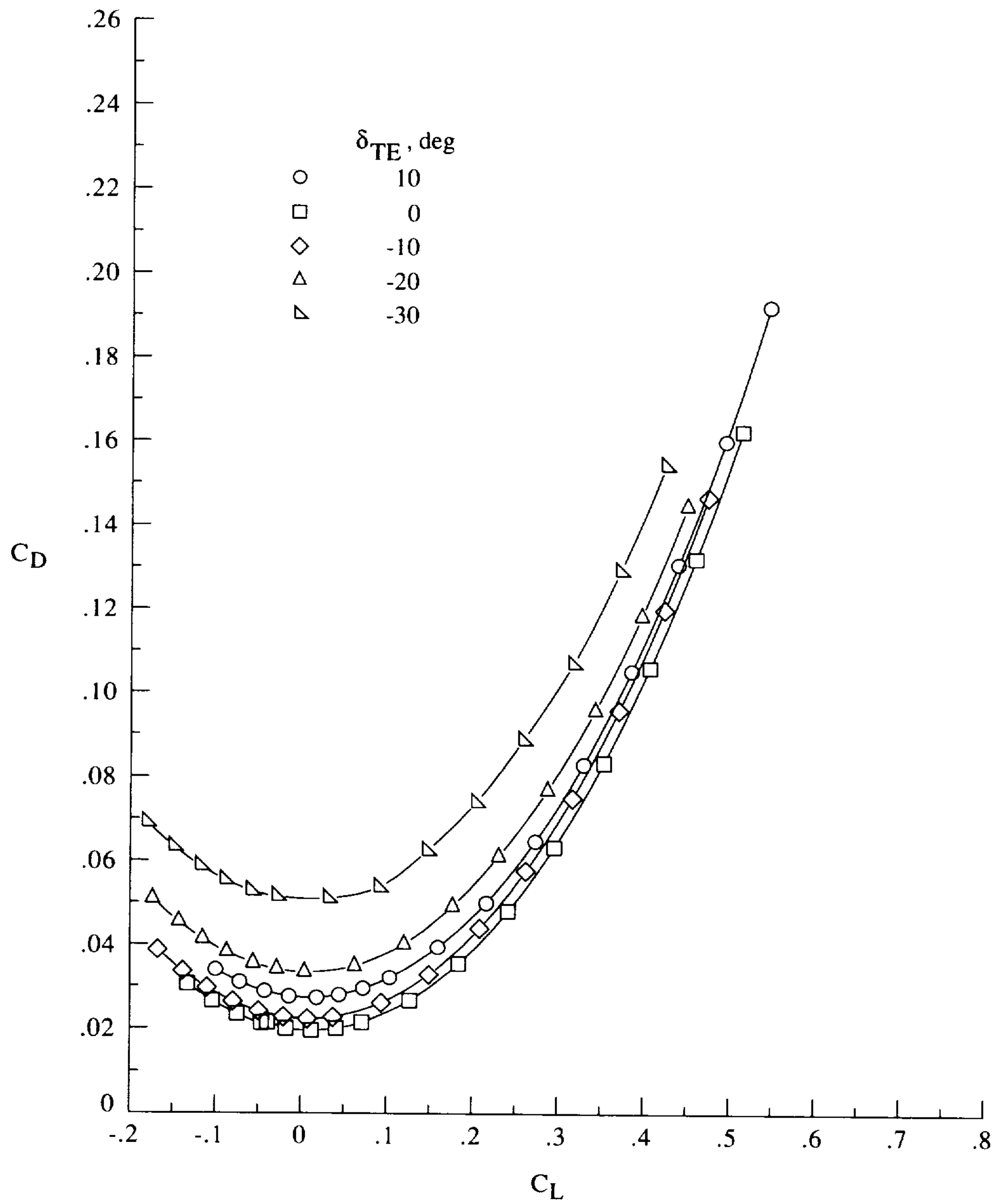
(b) $M = 1.80$.

Figure 12. Continued.



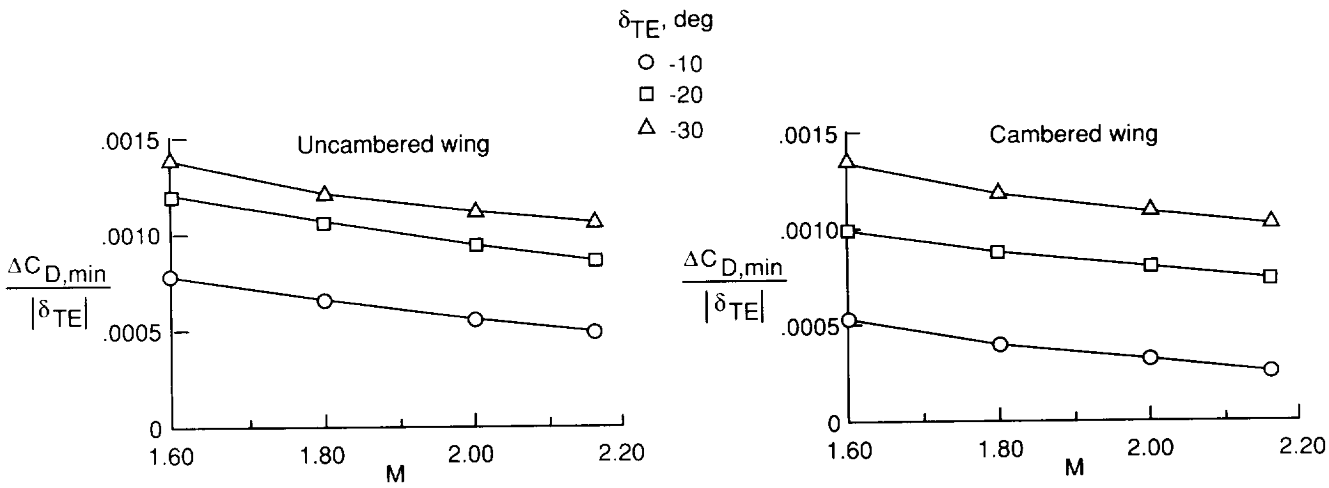
(c) $M = 2.00$.

Figure 12. Continued.

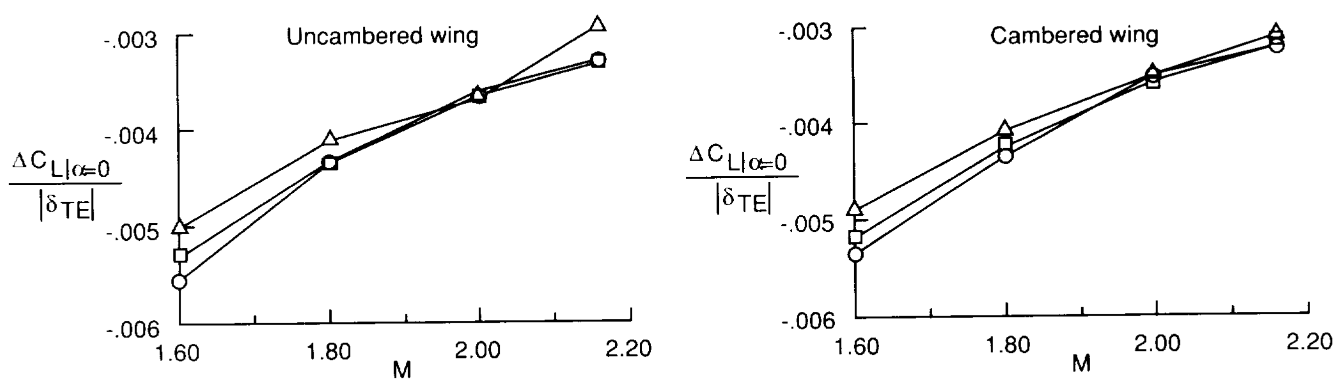


(d) $M = 2.16$.

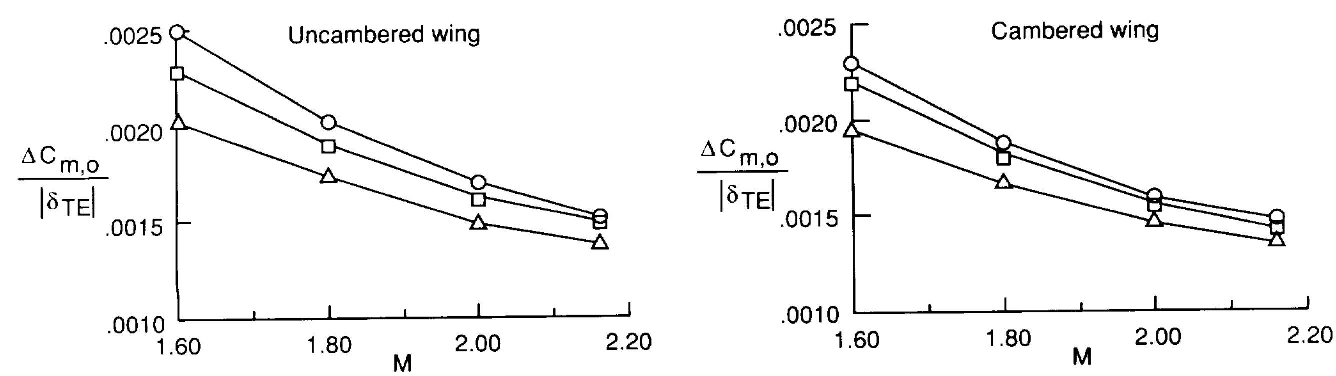
Figure 12. Concluded.



(a) Minimum drag.

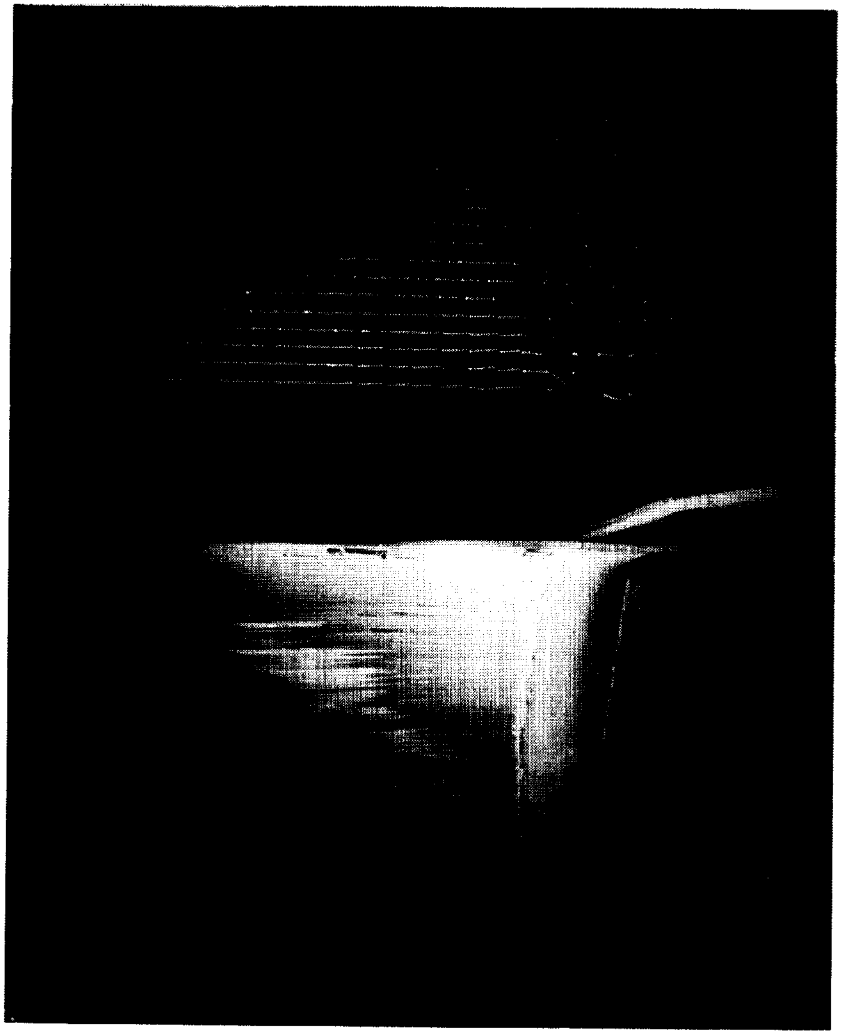


(b) Lift.

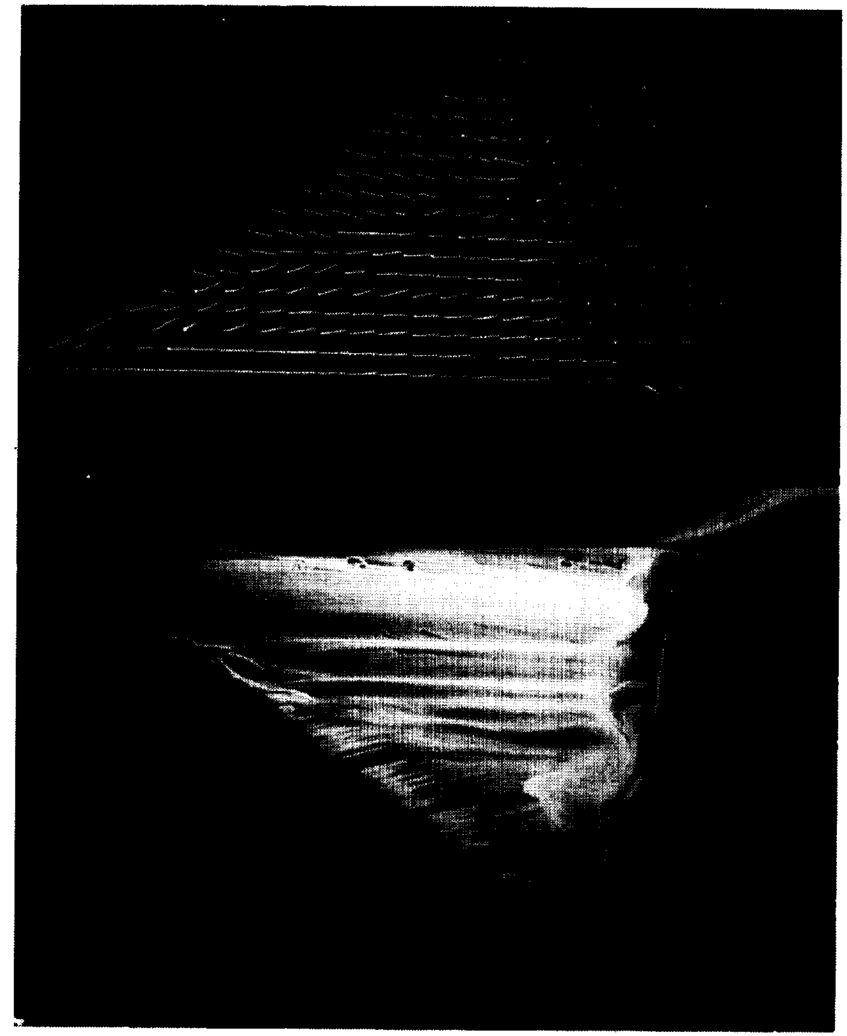


(c) Zero-lift pitching moment.

Figure 13. Trailing-edge flap-effectiveness parameters with $\delta_{LE} = 0°$.

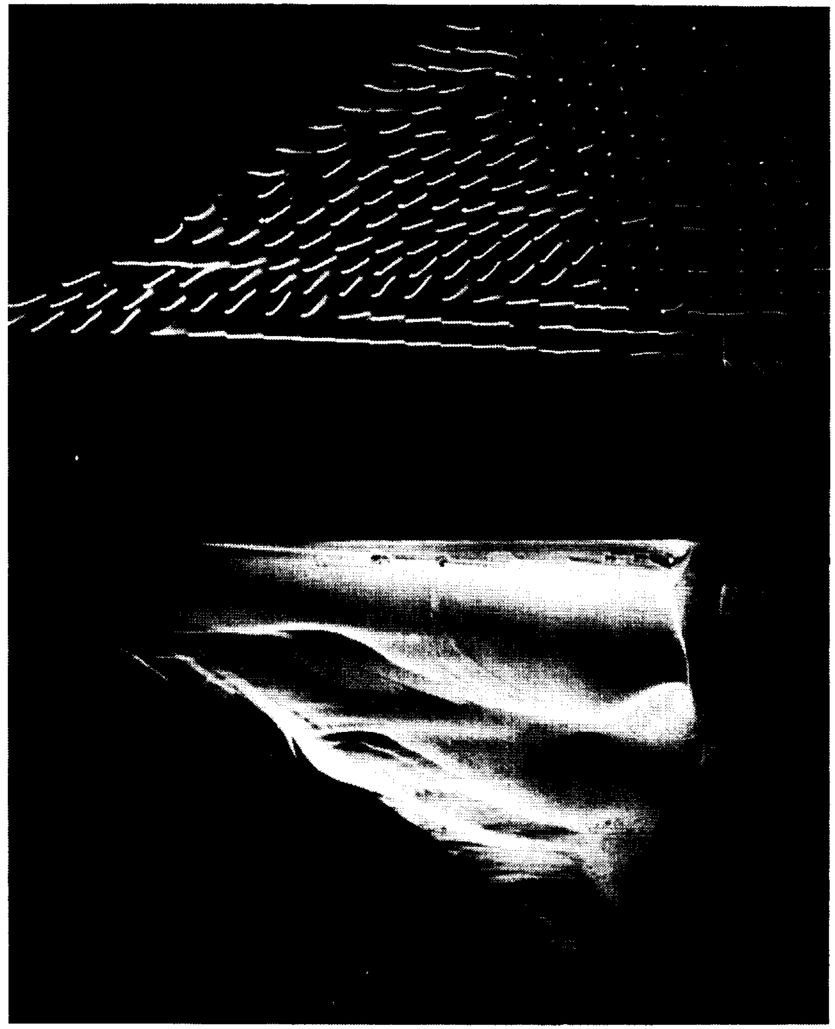


(a) $\alpha = 4°$.



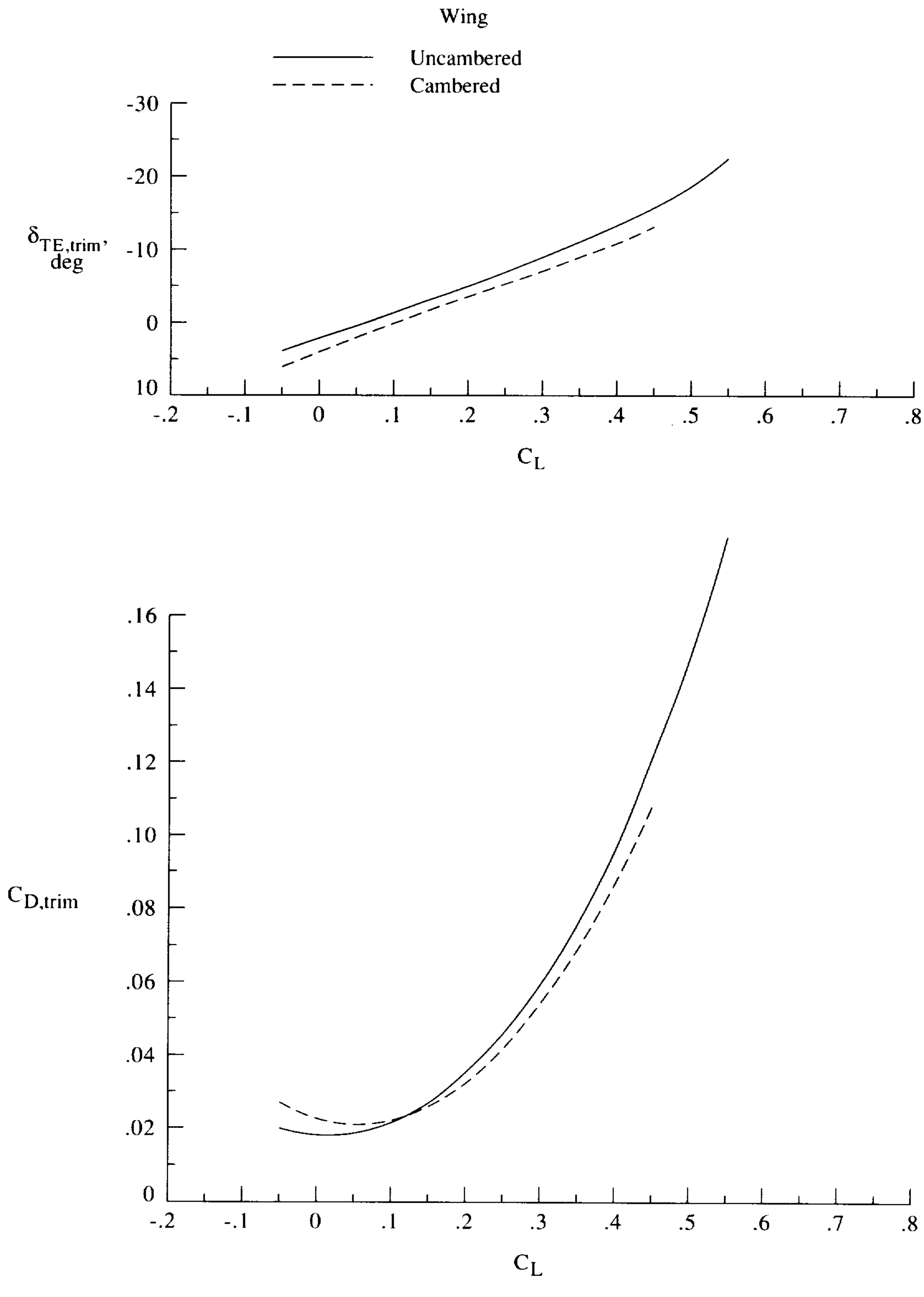
(b) $\alpha = 8°$.

Figure 14. Oil flow and tufts on upper surface of uncambered wing with $\delta_{LE} = 0°$ and $\delta_{TE} = -30°$ at $M = 1.60$.



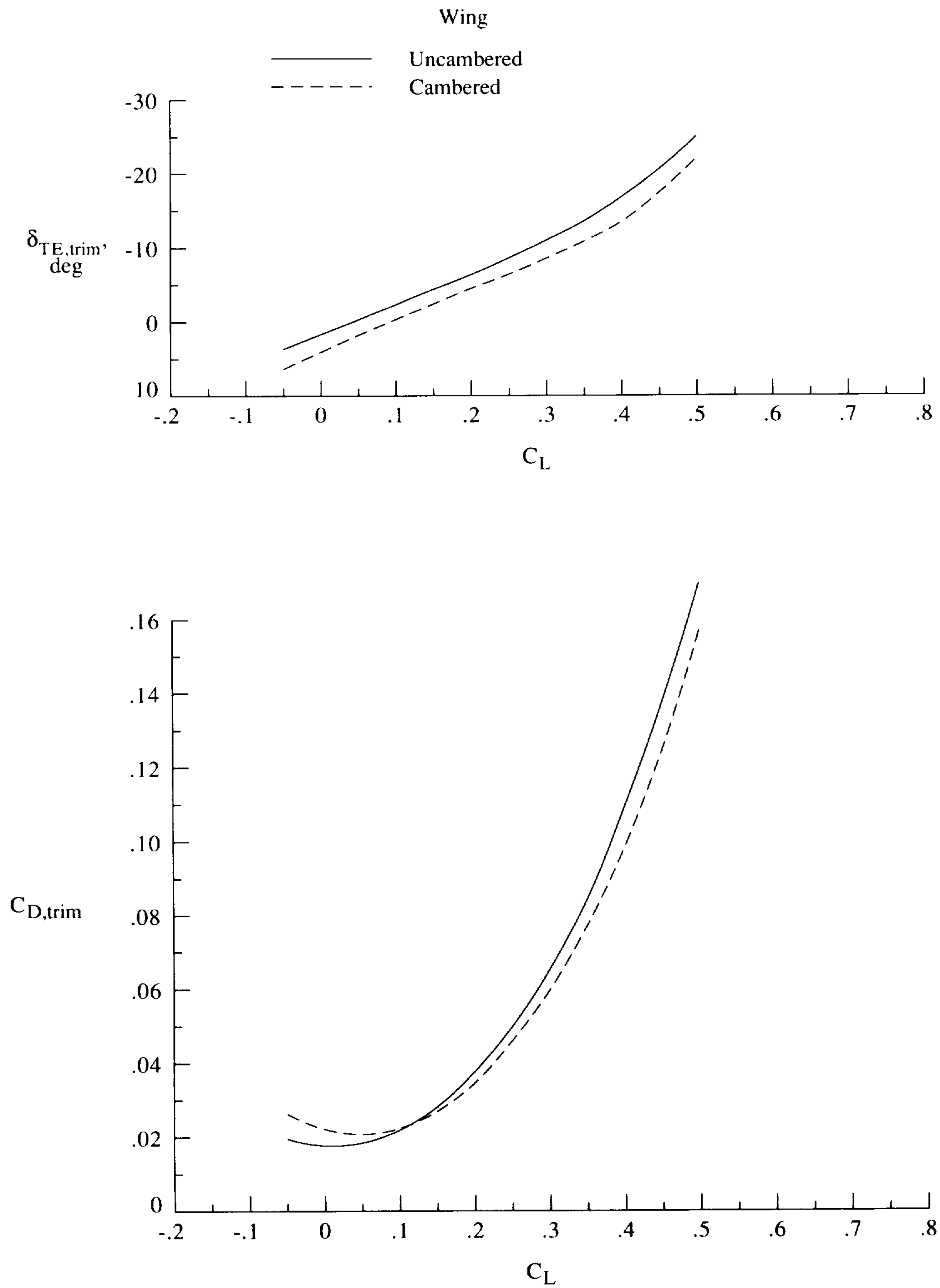
(c) $\alpha = 12^{\circ}$.

Figure 14. Concluded.



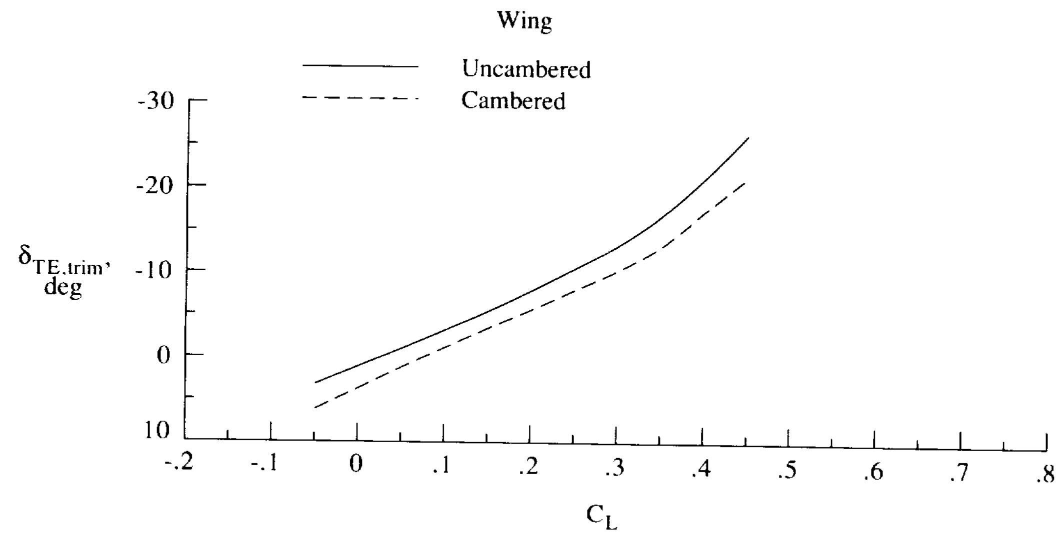
(a) $M = 1.60$.

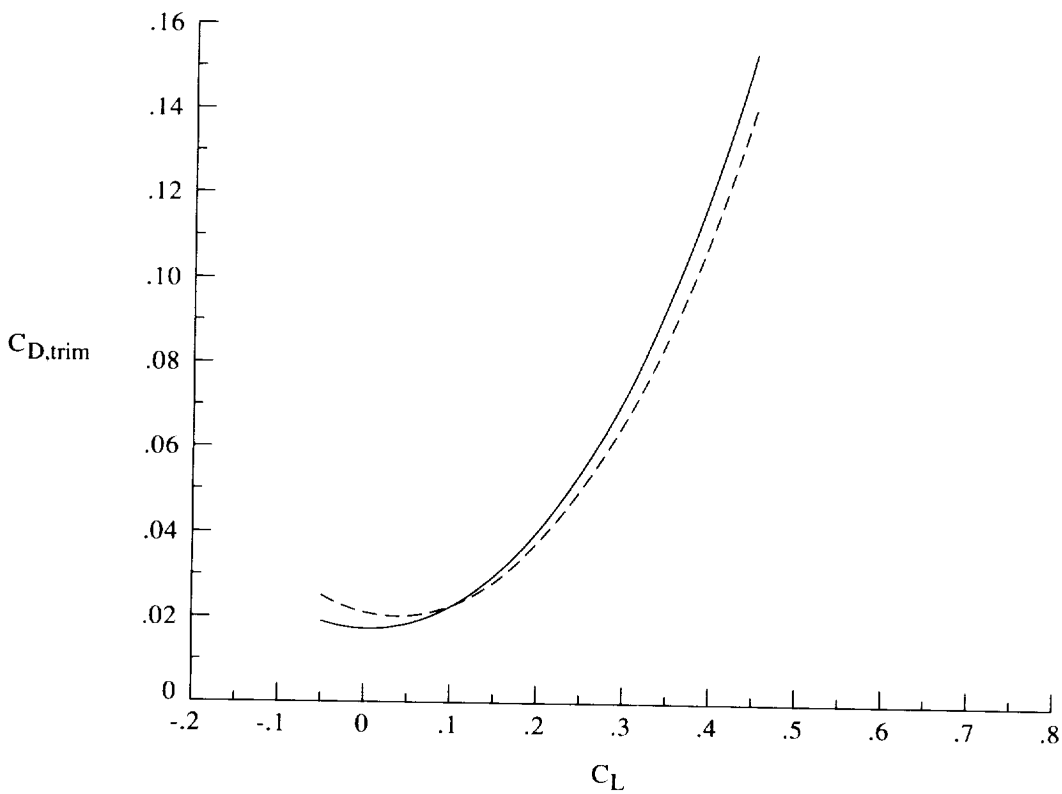
Figure 15. Trimmed drag polars and trailing-edge deflections with $\delta_{LE} = 0°$.



(b) $M = 1.80$.

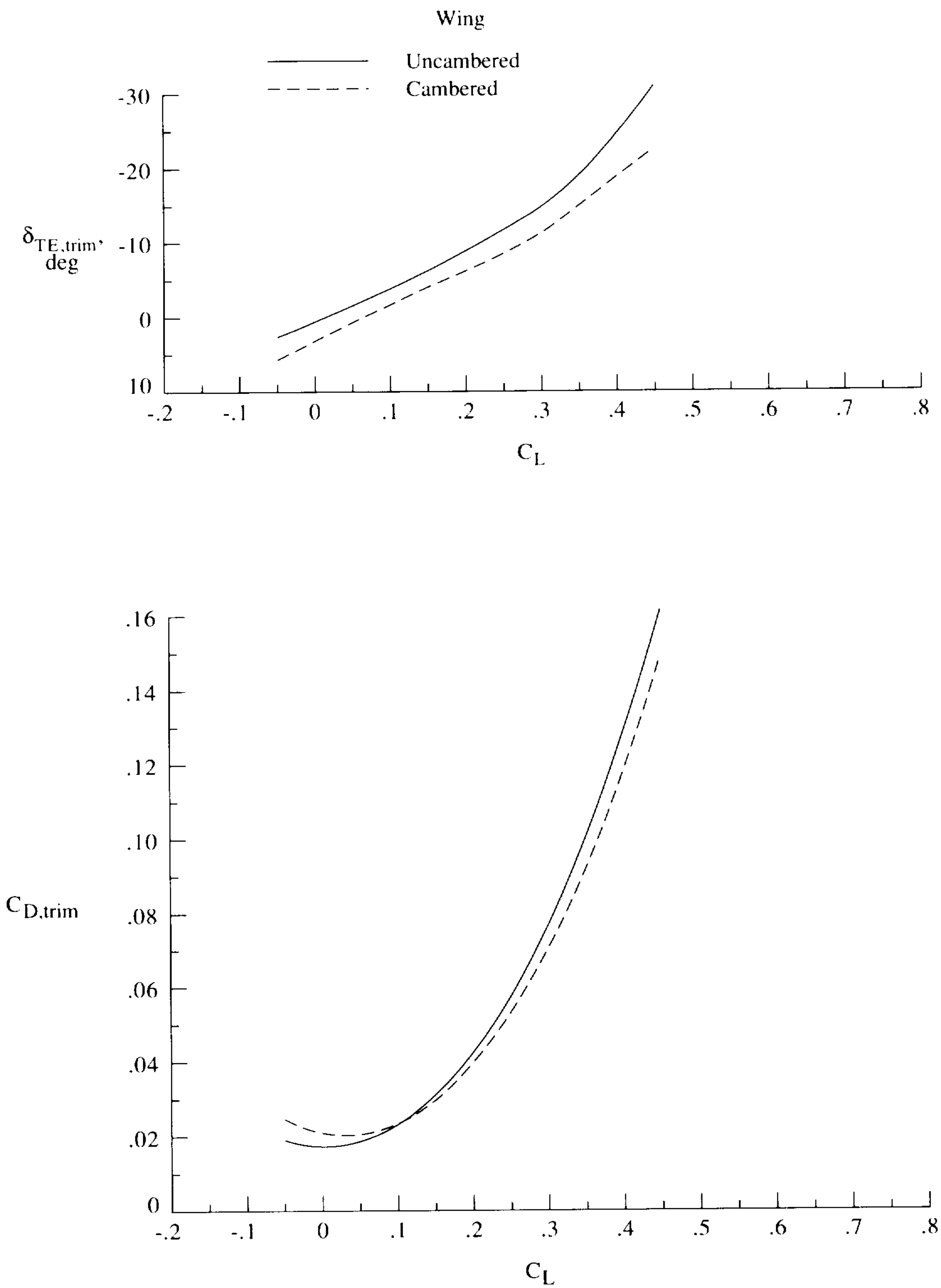
Figure 15. Continued.





(c) $M = 2.00$.

Figure 15. Continued.



(d) $M = 2.16$.

Figure 15. Concluded.

Appendix A

Run Log and Data Listing

Appendix A presents a complete listing of the force and moment data. The computer symbols used are listed below, and table AI gives a run log for the subsequent data listing.

alpha angle of attack, deg

CA axial-force coefficient, Axial force/qS

CD drag coefficient, Drag/qS

CL lift coefficient, Lift/qS

CM pitching-moment coefficient, Pitching moment/$qS\bar{c}$

CN normal-force coefficient, Normal force/qS

Table AI. Run Log for Data Listing

Streamwise flap deflection		Tunnel run at Mach numbers of—			
δ_{LE}, deg	δ_{TE}, deg	1.60	1.80	2.00	2.16
Uncambered wing					
0	0	215	220	222	224
5	↓	65	69	70	71
10	↓	75	79	80	81
15	↓	85	89	90	91
0	10	15	19	20	21
↓	−10	45	49	50	51
↓	−20	35	39	40	41
↓	−30	25	29	30	31
Cambered wing					
−4	0	221	230	223	225
−2	↓	226	227	228	229
0	↓	161	166	169	170
5	↓	143	147	148	149
10	↓	153	154	155	156
15	↓	157	158	159	160
0	10	109	111	112	113
↓	−10	123	127	128	129
↓	−20	119	120	121	122
↓	−30	115	116	117	118

RUN	alpha	CL	CD	CM	L/D	CN	CA
15.0	−3.09	−0.0707	0.02745	−0.01375	−2.58	−0.0721	0.0236
15.0	−2.02	−0.0217	0.02537	−0.01797	−0.86	−0.0226	0.0246
15.0	−1.09	0.0190	0.02491	−0.02144	0.76	0.0185	0.0253
15.0	−0.03	0.0634	0.02577	−0.02570	2.46	0.0634	0.0258
15.0	0.89	0.1047	0.02781	−0.02910	3.76	0.1051	0.0262
15.0	1.94	0.1485	0.03144	−0.03333	4.72	0.1495	0.0264
15.0	2.87	0.1912	0.03609	−0.03707	5.30	0.1927	0.0265
15.0	3.92	0.2368	0.04284	−0.04136	5.53	0.2392	0.0266
15.0	5.96	0.3244	0.06062	−0.04993	5.35	0.3289	0.0266
15.0	7.89	0.4074	0.08361	−0.05877	4.87	0.4150	0.0269
15.0	9.94	0.4956	0.11454	−0.06878	4.33	0.5079	0.0273
15.0	11.96	0.5781	0.15079	−0.07846	3.83	0.5968	0.0277
15.0	13.98	0.6580	0.19306	−0.08807	3.41	0.6852	0.0283
15.0	15.89	0.7326	0.23796	−0.09826	3.08	0.7698	0.0283

RUN	alpha	CL	CD	CM	L/D	CN	CA
19.0	−3.12	−0.0670	0.02615	−0.01153	−2.56	−0.0684	0.0225
19.0	−2.22	−0.0307	0.02437	−0.01436	−1.26	−0.0316	0.0232
19.0	−1.14	0.0107	0.02363	−0.01774	0.45	0.0102	0.0238
19.0	−0.15	0.0489	0.02419	−0.02095	2.02	0.0488	0.0243
19.0	0.84	0.0861	0.02600	−0.02417	3.31	0.0865	0.0247
19.0	1.83	0.1244	0.02900	−0.02715	4.29	0.1253	0.0250
19.0	2.80	0.1618	0.03312	−0.03026	4.89	0.1632	0.0252
19.0	3.85	0.2029	0.03903	−0.03355	5.20	0.2051	0.0253
19.0	5.84	0.2795	0.05431	−0.04045	5.15	0.2836	0.0256
19.0	7.83	0.3529	0.07460	−0.04752	4.73	0.3598	0.0258
19.0	9.86	0.4288	0.10082	−0.05510	4.25	0.4397	0.0259
19.0	11.85	0.4994	0.13181	−0.06279	3.79	0.5159	0.0265
19.0	13.85	0.5696	0.16844	−0.07128	3.38	0.5933	0.0272
19.0	15.80	0.6340	0.20813	−0.07921	3.05	0.6668	0.0276
19.0	17.79	0.6974	0.25311	−0.08741	2.76	0.7414	0.0280

RUN	alpha	CL	CD	CM	L/D	CN	CA
20.0	−3.22	−0.0665	0.02518	−0.01042	−2.64	−0.0678	0.0214
20.0	−2.21	−0.0312	0.02323	−0.01289	−1.34	−0.0321	0.0220
20.0	−1.19	0.0036	0.02251	−0.01559	0.16	0.0031	0.0226
20.0	−0.25	0.0363	0.02291	−0.01803	1.58	0.0362	0.0231
20.0	0.82	0.0741	0.02454	−0.02079	3.02	0.0744	0.0235
20.0	1.79	0.1065	0.02710	−0.02323	3.93	0.1073	0.0238
20.0	2.79	0.1417	0.03092	−0.02606	4.58	0.1431	0.0240
20.0	3.84	0.1781	0.03621	−0.02894	4.92	0.1801	0.0242
20.0	5.81	0.2451	0.04962	−0.03430	4.94	0.2489	0.0246
20.0	7.84	0.3147	0.06849	−0.04045	4.59	0.3211	0.0249
20.0	9.82	0.3806	0.09136	−0.04674	4.17	0.3906	0.0251
20.0	11.77	0.4432	0.11855	−0.05290	3.74	0.4581	0.0256
20.0	13.74	0.5051	0.15053	−0.05936	3.36	0.5264	0.0263
20.0	15.81	0.5688	0.18904	−0.06672	3.01	0.5988	0.0269
20.0	17.80	0.6275	0.23017	−0.07360	2.73	0.6678	0.0273
20.0	19.80	0.6864	0.27688	−0.08114	2.48	0.7396	0.0280

RUN	alpha	CL	CD	CM	L/D	CN	CA
21.0	−3.29	−0.0705	0.02510	−0.00988	−2.81	−0.0718	0.0210
21.0	−2.27	−0.0367	0.02306	−0.01209	−1.59	−0.0376	0.0216
21.0	−1.27	−0.0040	0.02221	−0.01431	−0.18	−0.0045	0.0221
21.0	−0.28	0.0281	0.02243	−0.01648	1.25	0.0280	0.0226
21.0	0.74	0.0616	0.02382	−0.01870	2.58	0.0619	0.0230
21.0	1.70	0.0940	0.02613	−0.02100	3.60	0.0947	0.0233
21.0	2.75	0.1279	0.02975	−0.02340	4.30	0.1292	0.0236
21.0	3.78	0.1605	0.03447	−0.02581	4.66	0.1624	0.0238
21.0	5.72	0.2220	0.04653	−0.03056	4.77	0.2255	0.0242
21.0	7.72	0.2867	0.06357	−0.03593	4.51	0.2926	0.0245
21.0	9.72	0.3489	0.08481	−0.04157	4.11	0.3582	0.0247
21.0	11.73	0.4114	0.11135	−0.04750	3.70	0.4255	0.0254
21.0	13.73	0.4702	0.14143	−0.05322	3.32	0.4903	0.0258
21.0	15.73	0.5294	0.17663	−0.05943	3.00	0.5575	0.0265
21.0	17.70	0.5864	0.21565	−0.06568	2.72	0.6242	0.0271

RUN	alpha	CL	CD	CM	L/D	CN	CA
25.0	−3.12	−0.2834	0.08360	0.09205	−3.39	−0.2875	0.0680
25.0	−1.96	−0.2299	0.07451	0.08667	−3.09	−0.2323	0.0666
25.0	−1.12	−0.1940	0.06940	0.08337	−2.79	−0.1953	0.0656
25.0	−0.09	−0.1501	0.06492	0.07937	−2.31	−0.1502	0.0647
25.0	0.97	−0.1032	0.06169	0.07554	−1.67	−0.1021	0.0634
25.0	1.95	−0.0601	0.06007	0.07166	−1.00	−0.0580	0.0621
25.0	2.89	−0.0182	0.05965	0.06796	−0.31	−0.0152	0.0605
25.0	3.94	0.0265	0.06068	0.06356	0.44	0.0306	0.0587
25.0	5.89	0.1121	0.06708	0.05544	1.67	0.1184	0.0552
25.0	8.01	0.2011	0.08234	0.04869	2.44	0.2106	0.0535
25.0	9.93	0.2778	0.10112	0.04250	2.75	0.2910	0.0517
25.0	11.88	0.3580	0.12485	0.03447	2.87	0.3761	0.0485
25.0	13.93	0.4410	0.15444	0.02507	2.86	0.4652	0.0437
25.0	15.96	0.5215	0.18945	0.01518	2.75	0.5535	0.0387

RUN	alpha	CL	CD	CM	L/D	CN	CA
29.0	−3.25	−0.2466	0.07791	0.07769	−3.17	−0.2506	0.0638
29.0	−2.25	−0.2064	0.07057	0.07381	−2.92	−0.2090	0.0624
29.0	−1.13	−0.1611	0.06411	0.06980	−2.51	−0.1623	0.0609
29.0	−0.12	−0.1215	0.05974	0.06609	−2.03	−0.1216	0.0595
29.0	0.85	−0.0839	0.05678	0.06265	−1.48	−0.0830	0.0580
29.0	1.85	−0.0447	0.05494	0.05914	−0.81	−0.0429	0.0564
29.0	2.85	−0.0056	0.05454	0.05583	−0.10	−0.0029	0.0547
29.0	3.89	0.0348	0.05609	0.05286	0.62	0.0385	0.0536
29.0	5.79	0.1067	0.06224	0.04669	1.71	0.1125	0.0512
29.0	7.84	0.1850	0.07433	0.04028	2.49	0.1934	0.0484
29.0	9.85	0.2597	0.09013	0.03267	2.88	0.2713	0.0444
29.0	11.87	0.3332	0.11226	0.02569	2.97	0.3492	0.0413
29.0	13.80	0.4019	0.13796	0.01860	2.91	0.4232	0.0381
29.0	15.85	0.4755	0.16914	0.00947	2.81	0.5036	0.0328
29.0	17.78	0.5409	0.20325	0.00111	2.66	0.5771	0.0283
29.0	19.85	0.6062	0.24405	−0.00686	2.48	0.6531	0.0237

RUN	alpha	CL	CD	CM	L/D	CN	CA
30.0	−3.19	−0.2209	0.07349	0.06608	−3.01	−0.2246	0.0611
30.0	−2.24	−0.1868	0.06713	0.06301	−2.78	−0.1893	0.0598
30.0	−1.25	−0.1513	0.06171	0.05991	−2.45	−0.1526	0.0584
30.0	−0.20	−0.1136	0.05712	0.05642	−1.99	−0.1138	0.0567
30.0	0.75	−0.0788	0.05413	0.05326	−1.46	−0.0781	0.0551
30.0	1.76	−0.0432	0.05220	0.05007	−0.83	−0.0415	0.0535
30.0	2.76	−0.0063	0.05154	0.04684	−0.12	−0.0038	0.0518
30.0	3.84	0.0332	0.05218	0.04337	0.64	0.0366	0.0498
30.0	5.77	0.0990	0.05815	0.03847	1.70	0.1044	0.0479
30.0	7.73	0.1683	0.06764	0.03240	2.49	0.1758	0.0444
30.0	9.80	0.2385	0.08202	0.02539	2.91	0.2490	0.0402
30.0	11.78	0.3048	0.10107	0.01866	3.02	0.3190	0.0367
30.0	13.78	0.3704	0.12498	0.01183	2.96	0.3895	0.0331
30.0	15.72	0.4331	0.15229	0.00490	2.84	0.4582	0.0292
30.0	17.76	0.4949	0.18522	−0.00142	2.67	0.5278	0.0254
30.0	19.78	0.5541	0.22304	−0.00700	2.48	0.5969	0.0224

RUN	alpha	CL	CD	CM	L/D	CN	CA
31.0	−3.31	−0.1976	0.07088	0.06009	−2.79	−0.2014	0.0594
31.0	−2.31	−0.1633	0.06440	0.05686	−2.54	−0.1658	0.0578
31.0	−1.23	−0.1273	0.05883	0.05354	−2.16	−0.1285	0.0561
31.0	−0.29	−0.0954	0.05505	0.05076	−1.73	−0.0956	0.0546
31.0	0.71	−0.0613	0.05211	0.04754	−1.18	−0.0606	0.0529
31.0	1.72	−0.0276	0.05039	0.04456	−0.55	−0.0261	0.0512
31.0	2.66	0.0040	0.04982	0.04160	0.08	0.0063	0.0496
31.0	3.76	0.0416	0.05046	0.03827	0.82	0.0448	0.0476
31.0	5.67	0.1040	0.05549	0.03307	1.87	0.1089	0.0450
31.0	7.74	0.1719	0.06499	0.02690	2.65	0.1791	0.0412
31.0	9.79	0.2390	0.07979	0.02088	3.00	0.2491	0.0380
31.0	11.73	0.3013	0.09742	0.01424	3.09	0.3149	0.0341
31.0	13.68	0.3625	0.11939	0.00773	3.04	0.3805	0.0303
31.0	15.74	0.4241	0.14708	0.00152	2.88	0.4481	0.0266
31.0	17.73	0.4830	0.17897	−0.00374	2.70	0.5145	0.0234

RUN	alpha	CL	CD	CM	L/D	CN	CA
35.0	−3.14	−0.2389	0.06029	0.07387	−3.96	−0.2418	0.0471
35.0	−2.02	−0.1910	0.05321	0.06909	−3.59	−0.1927	0.0465
35.0	−1.03	−0.1463	0.04832	0.06484	−3.03	−0.1471	0.0457
35.0	−0.13	−0.1057	0.04512	0.06105	−2.34	−0.1058	0.0449
35.0	0.91	−0.0613	0.04287	0.05700	−1.43	−0.0606	0.0438
35.0	1.96	−0.0143	0.04216	0.05250	−0.34	−0.0128	0.0426
35.0	2.97	0.0271	0.04291	0.04882	0.63	0.0293	0.0414
35.0	3.90	0.0682	0.04488	0.04471	1.52	0.0711	0.0401
35.0	5.97	0.1577	0.05407	0.03678	2.92	0.1625	0.0374
35.0	7.97	0.2436	0.06967	0.02968	3.50	0.2510	0.0352
35.0	9.93	0.3260	0.08965	0.02147	3.64	0.3366	0.0321
35.0	11.94	0.4069	0.11545	0.01287	3.52	0.4220	0.0288
35.0	13.92	0.4891	0.14703	0.00378	3.33	0.5102	0.0250
35.0	15.90	0.5643	0.18276	−0.00589	3.09	0.5928	0.0212

RUN	alpha	CL	CD	CM	L/D	CN	CA
39.0	−2.15	−0.1636	0.04939	0.05597	−3.31	−0.1653	0.0432
39.0	−1.14	−0.1239	0.04487	0.05250	−2.76	−0.1248	0.0424
39.0	−0.15	−0.0864	0.04168	0.04914	−2.07	−0.0865	0.0415
39.0	0.86	−0.0474	0.03975	0.04561	−1.19	−0.0468	0.0405
39.0	1.82	−0.0083	0.03918	0.04220	−0.21	−0.0071	0.0394
39.0	2.83	0.0301	0.03979	0.03910	0.76	0.0320	0.0382
39.0	3.86	0.0699	0.04178	0.03546	1.67	0.0725	0.0370
39.0	5.83	0.1452	0.04949	0.02916	2.93	0.1495	0.0345
39.0	7.82	0.2200	0.06247	0.02280	3.52	0.2265	0.0319
39.0	9.87	0.2956	0.08068	0.01576	3.66	0.3051	0.0288
39.0	11.77	0.3653	0.10248	0.00865	3.56	0.3785	0.0258
39.0	13.86	0.4381	0.13112	0.00066	3.34	0.4568	0.0224
39.0	15.77	0.5049	0.16187	−0.00733	3.12	0.5299	0.0185
39.0	17.86	0.5734	0.20069	−0.01510	2.86	0.6073	0.0152
39.0	19.88	0.6375	0.24387	−0.02198	2.61	0.6824	0.0126

RUN	alpha	CL	CD	CM	L/D	CN	CA
40.0	−3.19	−0.1801	0.05146	0.04945	−3.50	−0.1827	0.0413
40.0	−2.20	−0.1446	0.04606	0.04642	−3.14	−0.1463	0.0405
40.0	−1.19	−0.1095	0.04190	0.04343	−2.61	−0.1103	0.0396
40.0	−0.24	−0.0765	0.03908	0.04074	−1.96	−0.0767	0.0388
40.0	0.76	−0.0408	0.03720	0.03779	−1.10	−0.0403	0.0377
40.0	1.79	−0.0041	0.03650	0.03472	−0.11	−0.0029	0.0366
40.0	2.76	0.0294	0.03702	0.03204	0.79	0.0312	0.0356
40.0	3.78	0.0650	0.03875	0.02921	1.68	0.0674	0.0344
40.0	5.78	0.1337	0.04565	0.02351	2.93	0.1376	0.0320
40.0	7.76	0.2006	0.05699	0.01786	3.52	0.2065	0.0294
40.0	9.78	0.2686	0.07324	0.01179	3.67	0.2771	0.0266
40.0	11.82	0.3370	0.09443	0.00512	3.57	0.3492	0.0234
40.0	13.80	0.4010	0.11933	−0.00154	3.36	0.4179	0.0202
40.0	15.75	0.4617	0.14842	−0.00770	3.11	0.4847	0.0175
40.0	17.77	0.5207	0.18288	−0.01300	2.85	0.5516	0.0152
40.0	19.75	0.5756	0.22132	−0.01771	2.60	0.6166	0.0138

RUN	alpha	CL	CD	CM	L/D	CN	CA
41.0	−3.26	−0.1698	0.04970	0.04387	−3.42	−0.1723	0.0400
41.0	−2.28	−0.1385	0.04465	0.04145	−3.10	−0.1402	0.0391
41.0	−1.30	−0.1062	0.04060	0.03888	−2.62	−0.1071	0.0382
41.0	−0.25	−0.0710	0.03747	0.03608	−1.90	−0.0712	0.0372
41.0	0.76	−0.0384	0.03568	0.03363	−1.08	−0.0379	0.0362
41.0	1.76	−0.0049	0.03495	0.03110	−0.14	−0.0038	0.0351
41.0	2.74	0.0276	0.03539	0.02861	0.78	0.0292	0.0340
41.0	3.71	0.0585	0.03681	0.02624	1.59	0.0608	0.0330
41.0	5.75	0.1244	0.04325	0.02110	2.88	0.1281	0.0306
41.0	7.68	0.1870	0.05356	0.01602	3.49	0.1925	0.0281
41.0	9.70	0.2497	0.06843	0.01054	3.65	0.2577	0.0254
41.0	11.75	0.3138	0.08828	0.00454	3.55	0.3252	0.0225
41.0	13.76	0.3760	0.11235	−0.00160	3.35	0.3920	0.0197
41.0	15.75	0.4342	0.14044	−0.00691	3.09	0.4560	0.0173
41.0	17.69	0.4895	0.17235	−0.01125	2.84	0.5188	0.0154
41.0	19.77	0.5451	0.21111	−0.01509	2.58	0.5844	0.0142

RUN	alpha	CL	CD	CM	L/D	CN	CA
45.0	−3.10	−0.1797	0.03749	0.04637	−4.79	−0.1815	0.0277
45.0	−2.04	−0.1401	0.03244	0.04242	−4.32	−0.1412	0.0274
45.0	−1.08	−0.0960	0.02888	0.03878	−3.32	−0.0965	0.0271
45.0	−0.07	−0.0523	0.02661	0.03472	−1.96	−0.0523	0.0266
45.0	0.97	−0.0080	0.02572	0.03077	−0.31	−0.0076	0.0258
45.0	1.96	0.0352	0.02621	0.02691	1.34	0.0360	0.0250
45.0	2.99	0.0813	0.02828	0.02280	2.88	0.0827	0.0240
45.0	3.87	0.1199	0.03119	0.01915	3.85	0.1218	0.0230
45.0	5.93	0.2087	0.04243	0.01105	4.92	0.2120	0.0206
45.0	7.95	0.2956	0.05972	0.00290	4.95	0.3010	0.0183
45.0	9.98	0.3814	0.08329	−0.00550	4.58	0.3901	0.0160
45.0	11.94	0.4605	0.11153	−0.01343	4.13	0.4736	0.0138
45.0	13.86	0.5343	0.14416	−0.02114	3.71	0.5533	0.0119
45.0	15.95	0.6141	0.18558	−0.03027	3.31	0.6414	0.0097

RUN	alpha	CL	CD	CM	L/D	CN	CA
49.0	−3.14	−0.1588	0.03485	0.03676	−4.56	−0.1604	0.0261
49.0	−2.20	−0.1216	0.03055	0.03364	−3.98	−0.1227	0.0259
49.0	−1.24	−0.0852	0.02735	0.03065	−3.11	−0.0857	0.0255
49.0	−0.16	−0.0433	0.02509	0.02721	−1.73	−0.0434	0.0250
49.0	0.81	−0.0059	0.02432	0.02411	−0.24	−0.0056	0.0244
49.0	1.87	0.0351	0.02477	0.02077	1.42	0.0359	0.0236
49.0	2.82	0.0712	0.02639	0.01774	2.70	0.0724	0.0228
49.0	3.83	0.1103	0.02937	0.01443	3.76	0.1120	0.0219
49.0	5.82	0.1860	0.03909	0.00826	4.76	0.1890	0.0200
49.0	7.85	0.2626	0.05433	0.00156	4.83	0.2676	0.0180
49.0	9.81	0.3356	0.07419	−0.00501	4.52	0.3434	0.0159
49.0	11.89	0.4085	0.10034	−0.01189	4.07	0.4204	0.0141
49.0	13.81	0.4763	0.12979	−0.01867	3.67	0.4935	0.0124
49.0	15.82	0.5438	0.16495	−0.02606	3.30	0.5682	0.0104
49.0	17.79	0.6058	0.20356	−0.03297	2.98	0.6391	0.0087
49.0	19.79	0.6684	0.24818	−0.03919	2.69	0.7130	0.0072

RUN	alpha	CL	CD	CM	L/D	CN	CA
50.0	−3.23	−0.1455	0.03312	0.02985	−4.39	−0.1472	0.0249
50.0	−2.24	−0.1103	0.02886	0.02727	−3.82	−0.1114	0.0245
50.0	−1.18	−0.0728	0.02562	0.02450	−2.84	−0.0733	0.0241
50.0	−0.23	−0.0399	0.02384	0.02199	−1.68	−0.0400	0.0237
50.0	0.77	−0.0048	0.02303	0.01918	−0.21	−0.0045	0.0231
50.0	1.82	0.0312	0.02343	0.01652	1.33	0.0319	0.0224
50.0	2.80	0.0649	0.02496	0.01387	2.60	0.0661	0.0218
50.0	3.74	0.0980	0.02749	0.01137	3.56	0.0995	0.0210
50.0	5.80	0.1685	0.03665	0.00583	4.60	0.1713	0.0194
50.0	7.76	0.2357	0.05009	0.00031	4.70	0.2403	0.0178
50.0	9.83	0.3039	0.06898	−0.00522	4.41	0.3112	0.0160
50.0	11.83	0.3676	0.09176	−0.01091	4.01	0.3786	0.0145
50.0	13.82	0.4304	0.11911	−0.01680	3.61	0.4464	0.0129
50.0	15.76	0.4895	0.15005	−0.02237	3.26	0.5118	0.0115
50.0	17.83	0.5503	0.18740	−0.02773	2.94	0.5812	0.0099
50.0	19.79	0.6053	0.22712	−0.03265	2.67	0.6465	0.0088

RUN	alpha	CL	CD	CM	L/D	CN	CA
51.0	−3.32	−0.1394	0.03238	0.02571	−4.31	−0.1410	0.0243
51.0	−2.26	−0.1045	0.02800	0.02334	−3.73	−0.1055	0.0238
51.0	−1.25	−0.0709	0.02502	0.02106	−2.83	−0.0714	0.0235
51.0	−0.24	−0.0387	0.02319	0.01867	−1.67	−0.0388	0.0230
51.0	0.68	−0.0080	0.02246	0.01663	−0.35	−0.0077	0.0225
51.0	1.67	0.0238	0.02269	0.01431	1.05	0.0245	0.0220
51.0	2.77	0.0601	0.02421	0.01191	2.48	0.0612	0.0213
51.0	3.70	0.0909	0.02659	0.00974	3.42	0.0924	0.0207
51.0	5.77	0.1571	0.03526	0.00492	4.45	0.1598	0.0193
51.0	7.76	0.2199	0.04793	0.00002	4.59	0.2243	0.0178
51.0	9.78	0.2828	0.06522	−0.00490	4.34	0.2898	0.0162
51.0	11.75	0.3426	0.08642	−0.00982	3.96	0.3531	0.0148
51.0	13.72	0.4017	0.11198	−0.01478	3.59	0.4168	0.0135
51.0	15.77	0.4618	0.14302	−0.01980	3.23	0.4833	0.0121
51.0	17.74	0.5162	0.17633	−0.02424	2.93	0.5454	0.0107
51.0	19.72	0.5702	0.21476	−0.02861	2.65	0.6092	0.0098
51.0	−0.25	−0.0382	0.02325	0.01889	−1.64	−0.0383	0.0231

RUN	alpha	CL	CD	CM	L/D	CN	CA
65.0	−3.07	−0.1359	0.02703	0.01517	−5.03	−0.1372	0.0197
65.0	−2.13	−0.0943	0.02315	0.01110	−4.07	−0.0950	0.0196
65.0	−1.07	−0.0470	0.02028	0.00660	−2.32	−0.0473	0.0194
65.0	−0.03	−0.0041	0.01904	0.00245	−0.22	−0.0041	0.0190
65.0	0.96	0.0401	0.01928	−0.00149	2.08	0.0405	0.0186
65.0	1.95	0.0823	0.02085	−0.00501	3.95	0.0830	0.0180
65.0	2.94	0.1255	0.02381	−0.00875	5.27	0.1265	0.0173
65.0	3.97	0.1689	0.02820	−0.01237	5.99	0.1704	0.0164
65.0	6.00	0.2565	0.04141	−0.01988	6.19	0.2594	0.0144
65.0	7.97	0.3406	0.06009	−0.02727	5.67	0.3456	0.0123
65.0	9.93	0.4228	0.08444	−0.03538	5.01	0.4310	0.0103
65.0	11.97	0.5078	0.11599	−0.04376	4.38	0.5208	0.0082
65.0	13.94	0.5857	0.15225	−0.05186	3.85	0.6051	0.0066
65.0	15.96	0.6616	0.19444	−0.06035	3.40	0.6896	0.0050

RUN	alpha	CL	CD	CM	L/D	CN	CA
69.0	−3.16	−0.1245	0.02662	0.01152	−4.68	−0.1258	0.0197
69.0	−2.14	−0.0851	0.02277	0.00833	−3.74	−0.0859	0.0196
69.0	−1.22	−0.0481	0.02043	0.00517	−2.36	−0.0486	0.0194
69.0	−0.08	−0.0046	0.01902	0.00142	−0.24	−0.0046	0.0190
69.0	1.82	0.0674	0.02030	−0.00452	3.32	0.0680	0.0182
69.0	2.77	0.1054	0.02271	−0.00736	4.64	0.1063	0.0176
69.0	3.77	0.1436	0.02641	−0.01046	5.44	0.1451	0.0169
69.0	4.84	0.1852	0.03185	−0.01357	5.81	0.1872	0.0161
69.0	5.77	0.2201	0.03769	−0.01634	5.84	0.2228	0.0154
69.0	7.83	0.2962	0.05457	−0.02269	5.43	0.3009	0.0137
69.0	9.78	0.3680	0.07563	−0.02902	4.87	0.3755	0.0120
69.0	11.85	0.4425	0.10338	−0.03607	4.28	0.4543	0.0103
69.0	13.75	0.5111	0.13397	−0.04291	3.81	0.5283	0.0086
69.0	15.85	0.5821	0.17256	−0.05058	3.37	0.6071	0.0070
69.0	17.81	0.6460	0.21346	−0.05758	3.03	0.6803	0.0057
69.0	19.83	0.7097	0.26053	−0.06437	2.72	0.7560	0.0044

RUN	alpha	CL	CD	CM	L/D	CN	CA
70.0	−3.19	−0.1151	0.02593	0.00863	−4.44	−0.1164	0.0195
70.0	−2.15	−0.0779	0.02219	0.00584	−3.51	−0.0787	0.0192
70.0	−1.21	−0.0461	0.02003	0.00335	−2.30	−0.0465	0.0191
70.0	−0.17	−0.0099	0.01877	0.00052	−0.53	−0.0099	0.0187
70.0	0.75	0.0230	0.01867	−0.00198	1.23	0.0232	0.0184
70.0	1.78	0.0582	0.01980	−0.00457	2.94	0.0588	0.0180
70.0	2.82	0.0938	0.02216	−0.00717	4.23	0.0948	0.0175
70.0	3.87	0.1308	0.02581	−0.00990	5.07	0.1322	0.0169
70.0	5.84	0.1978	0.03604	−0.01495	5.49	0.2004	0.0157
70.0	7.78	0.2627	0.05051	−0.01993	5.20	0.2671	0.0145
70.0	9.84	0.3328	0.07094	−0.02550	4.69	0.3400	0.0130
70.0	11.85	0.3985	0.09545	−0.03107	4.18	0.4096	0.0116
70.0	13.82	0.4596	0.12342	−0.03682	3.72	0.4758	0.0100
70.0	15.79	0.5209	0.15609	−0.04249	3.34	0.5437	0.0085
70.0	17.75	0.5796	0.19312	−0.04836	3.00	0.6109	0.0072
70.0	19.84	0.6409	0.23775	−0.05465	2.70	0.6836	0.0061

RUN	alpha	CL	CD	CM	L/D	CN	CA
71.0	−3.32	−0.1155	0.02645	0.00648	−4.37	−0.1168	0.0197
71.0	−2.28	−0.0814	0.02275	0.00418	−3.58	−0.0823	0.0195
71.0	−1.28	−0.0490	0.02035	0.00192	−2.41	−0.0494	0.0192
71.0	−0.26	−0.0156	0.01902	−0.00048	−0.82	−0.0157	0.0189
71.0	0.71	0.0167	0.01880	−0.00249	0.89	0.0170	0.0186
71.0	1.67	0.0482	0.01965	−0.00467	2.45	0.0488	0.0182
71.0	2.75	0.0838	0.02184	−0.00696	3.84	0.0847	0.0178
71.0	3.68	0.1129	0.02469	−0.00894	4.57	0.1142	0.0174
71.0	5.75	0.1799	0.03451	−0.01350	5.21	0.1824	0.0163
71.0	7.72	0.2428	0.04809	−0.01790	5.05	0.2471	0.0150
71.0	9.76	0.3073	0.06676	−0.02280	4.60	0.3141	0.0137
71.0	11.70	0.3659	0.08838	−0.02775	4.14	0.3762	0.0124
71.0	13.71	0.4271	0.11544	−0.03280	3.70	0.4423	0.0109
71.0	15.76	0.4882	0.14774	−0.03803	3.30	0.5099	0.0096
71.0	17.74	0.5450	0.18317	−0.04312	2.98	0.5749	0.0084
71.0	19.71	0.6013	0.22315	−0.04850	2.69	0.6414	0.0073

RUN	alpha	CL	CD	CM	L/D	CN	CA
75.0	−3.03	−0.1485	0.03248	0.01490	−4.57	−0.1500	0.0246
75.0	−2.03	−0.1036	0.02777	0.01028	−3.73	−0.1045	0.0241
75.0	−1.08	−0.0615	0.02476	0.00623	−2.48	−0.0619	0.0236
75.0	−0.09	−0.0183	0.02296	0.00203	−0.80	−0.0183	0.0229
75.0	0.98	0.0288	0.02254	−0.00233	1.28	0.0292	0.0220
75.0	1.90	0.0680	0.02354	−0.00625	2.89	0.0688	0.0213
75.0	2.97	0.1155	0.02616	−0.01043	4.42	0.1167	0.0201
75.0	3.99	0.1590	0.02997	−0.01454	5.30	0.1607	0.0188
75.0	5.90	0.2409	0.04115	−0.02138	5.85	0.2438	0.0162
75.0	7.89	0.3271	0.05879	−0.02823	5.56	0.3321	0.0133
75.0	9.95	0.4108	0.08246	−0.03561	4.98	0.4188	0.0102
75.0	11.94	0.4943	0.11164	−0.04377	4.43	0.5067	0.0070
75.0	13.92	0.5722	0.14602	−0.05166	3.92	0.5905	0.0041
75.0	15.96	0.6512	0.18756	−0.06019	3.47	0.6776	0.0012

RUN	alpha	CL	CD	CM	L/D	CN	CA
79.0	−3.23	−0.1367	0.03240	0.01113	−4.22	−0.1384	0.0247
79.0	−2.15	−0.0943	0.02772	0.00737	−3.40	−0.0953	0.0242
79.0	−1.21	−0.0589	0.02495	0.00422	−2.36	−0.0594	0.0237
79.0	−0.21	−0.0210	0.02311	0.00082	−0.91	−0.0211	0.0230
79.0	0.85	0.0204	0.02259	−0.00273	0.90	0.0207	0.0223
79.0	1.84	0.0575	0.02339	−0.00593	2.46	0.0582	0.0215
79.0	2.83	0.0966	0.02535	−0.00905	3.81	0.0977	0.0205
79.0	3.77	0.1318	0.02825	−0.01195	4.67	0.1334	0.0195
79.0	5.82	0.2094	0.03853	−0.01799	5.43	0.2122	0.0171
79.0	7.82	0.2853	0.05410	−0.02378	5.27	0.2900	0.0148
79.0	9.79	0.3569	0.07421	−0.02959	4.81	0.3643	0.0124
79.0	11.83	0.4304	0.10005	−0.03629	4.30	0.4417	0.0097
79.0	13.80	0.5002	0.13012	−0.04298	3.84	0.5168	0.0071
79.0	15.81	0.5696	0.16586	−0.05052	3.43	0.5933	0.0044
79.0	17.80	0.6354	0.20610	−0.05752	3.08	0.6680	0.0019
79.0	19.78	0.6989	0.25101	−0.06415	2.78	0.7426	−0.0003

RUN	alpha	CL	CD	CM	L/D	CN	CA
80.0	−3.25	−0.1262	0.03150	0.00805	−4.01	−0.1278	0.0243
80.0	−2.22	−0.0909	0.02741	0.00523	−3.32	−0.0919	0.0239
80.0	−1.24	−0.0569	0.02460	0.00245	−2.31	−0.0575	0.0234
80.0	−0.24	−0.0223	0.02286	−0.00027	−0.98	−0.0224	0.0228
80.0	0.73	0.0110	0.02229	−0.00294	0.49	0.0113	0.0222
80.0	1.76	0.0452	0.02280	−0.00558	1.98	0.0459	0.0214
80.0	2.78	0.0814	0.02451	−0.00827	3.32	0.0825	0.0205
80.0	3.81	0.1179	0.02752	−0.01097	4.29	0.1195	0.0196
80.0	5.73	0.1830	0.03628	−0.01586	5.04	0.1857	0.0178
80.0	7.73	0.2513	0.05015	−0.02084	5.01	0.2558	0.0159
80.0	9.82	0.3193	0.06915	−0.02620	4.62	0.3264	0.0137
80.0	11.77	0.3847	0.09192	−0.03136	4.19	0.3954	0.0115
80.0	13.82	0.4499	0.12001	−0.03719	3.75	0.4656	0.0091
80.0	15.83	0.5134	0.15245	−0.04274	3.37	0.5355	0.0066
80.0	17.79	0.5749	0.18873	−0.04864	3.05	0.6050	0.0041
80.0	19.76	0.6312	0.22917	−0.05447	2.75	0.6715	0.0022

RUN	alpha	CL	CD	CM	L/D	CN	CA
81.0	−3.29	−0.1224	0.03139	0.00641	−3.90	−0.1240	0.0243
81.0	−2.32	−0.0915	0.02758	0.00404	−3.32	−0.0925	0.0239
81.0	−1.29	−0.0594	0.02475	0.00170	−2.40	−0.0599	0.0234
81.0	−0.30	−0.0266	0.02301	−0.00066	−1.16	−0.0268	0.0229
81.0	0.77	0.0074	0.02235	−0.00305	0.33	0.0077	0.0223
81.0	1.74	0.0383	0.02279	−0.00544	1.68	0.0390	0.0216
81.0	2.77	0.0715	0.02434	−0.00766	2.94	0.0726	0.0209
81.0	3.76	0.1034	0.02691	−0.00993	3.84	0.1049	0.0201
81.0	5.77	0.1692	0.03554	−0.01441	4.76	0.1719	0.0183
81.0	7.74	0.2309	0.04812	−0.01891	4.80	0.2353	0.0166
81.0	9.71	0.2929	0.06499	−0.02343	4.51	0.2996	0.0146
81.0	11.71	0.3554	0.08647	−0.02815	4.11	0.3656	0.0125
81.0	13.71	0.4168	0.11237	−0.03304	3.71	0.4316	0.0104
81.0	15.68	0.4761	0.14204	−0.03810	3.35	0.4967	0.0081
81.0	17.69	0.5353	0.17700	−0.04305	3.02	0.5638	0.0060
81.0	19.72	0.5938	0.21698	−0.04860	2.74	0.6322	0.0039

RUN	alpha	CL	CD	CM	L/D	CN	CA
85.0	−3.12	−0.1618	0.03876	0.01532	−4.17	−0.1637	0.0299
85.0	−2.11	−0.1181	0.03362	0.01092	−3.51	−0.1192	0.0293
85.0	−1.12	−0.0748	0.03003	0.00642	−2.49	−0.0754	0.0286
85.0	−0.09	−0.0268	0.02774	0.00167	−0.97	−0.0269	0.0277
85.0	0.95	0.0162	0.02697	−0.00255	0.60	0.0166	0.0267
85.0	1.99	0.0602	0.02767	−0.00697	2.17	0.0611	0.0256
85.0	2.96	0.1038	0.02974	−0.01107	3.49	0.1052	0.0243
85.0	3.86	0.1416	0.03270	−0.01483	4.33	0.1435	0.0231
85.0	5.93	0.2328	0.04392	−0.02305	5.30	0.2361	0.0196
85.0	7.89	0.3161	0.06004	−0.03041	5.27	0.3214	0.0161
85.0	9.91	0.4001	0.08265	−0.03730	4.84	0.4083	0.0125
85.0	11.96	0.4829	0.11128	−0.04469	4.34	0.4955	0.0088
85.0	13.90	0.5587	0.14346	−0.05225	3.89	0.5768	0.0050
85.0	15.92	0.6379	0.18280	−0.06047	3.49	0.6636	0.0008

RUN	alpha	CL	CD	CM	L/D	CN	CA
89.0	−3.14	−0.1414	0.03757	0.01080	−3.76	−0.1433	0.0298
89.0	−2.16	−0.1036	0.03308	0.00732	−3.13	−0.1047	0.0291
89.0	−1.15	−0.0659	0.02978	0.00384	−2.21	−0.0665	0.0284
89.0	−0.15	−0.0293	0.02774	0.00064	−1.06	−0.0294	0.0277
89.0	0.79	0.0056	0.02692	−0.00271	0.21	0.0060	0.0268
89.0	1.89	0.0472	0.02736	−0.00615	1.72	0.0481	0.0258
89.0	2.89	0.0848	0.02897	−0.00953	2.93	0.0861	0.0247
89.0	3.85	0.1227	0.03180	−0.01262	3.86	0.1246	0.0235
89.0	5.76	0.1964	0.04084	−0.01870	4.81	0.1995	0.0209
89.0	7.86	0.2762	0.05615	−0.02517	4.92	0.2813	0.0178
89.0	9.85	0.3492	0.07544	−0.03142	4.63	0.3570	0.0146
89.0	11.82	0.4202	0.09971	−0.03743	4.21	0.4317	0.0115
89.0	13.78	0.4899	0.12863	−0.04380	3.81	0.5065	0.0082
89.0	15.85	0.5609	0.16401	−0.05091	3.42	0.5844	0.0046
89.0	17.83	0.6274	0.20297	−0.05779	3.09	0.6594	0.0011
89.0	19.82	0.6933	0.24743	−0.06459	2.80	0.7361	−0.0023

RUN	alpha	CL	CD	CM	L/D	CN	CA
90.0	−3.21	−0.1314	0.03688	0.00767	−3.56	−0.1333	0.0295
90.0	−2.19	−0.0977	0.03256	0.00495	−3.00	−0.0988	0.0288
90.0	−1.18	−0.0639	0.02949	0.00201	−2.17	−0.0645	0.0282
90.0	−0.16	−0.0293	0.02745	−0.00072	−1.07	−0.0294	0.0274
90.0	0.85	0.0047	0.02662	−0.00346	0.18	0.0051	0.0266
90.0	1.84	0.0384	0.02688	−0.00612	1.43	0.0392	0.0256
90.0	2.76	0.0692	0.02809	−0.00873	2.46	0.0705	0.0247
90.0	2.80	0.0707	0.02811	−0.00882	2.52	0.0720	0.0246
90.0	3.77	0.1044	0.03054	−0.01140	3.42	0.1062	0.0236
90.0	5.74	0.1712	0.03872	−0.01658	4.42	0.1742	0.0214
90.0	7.79	0.2406	0.05208	−0.02202	4.62	0.2454	0.0190
90.0	9.75	0.3077	0.06939	−0.02717	4.43	0.3150	0.0163
90.0	11.79	0.3749	0.09191	−0.03239	4.08	0.3857	0.0134
90.0	13.76	0.4387	0.11824	−0.03782	3.71	0.4543	0.0105
90.0	15.85	0.5042	0.15071	−0.04345	3.35	0.5262	0.0072
90.0	17.77	0.5625	0.18442	−0.04885	3.05	0.5920	0.0039
90.0	19.79	0.6235	0.22541	−0.05450	2.77	0.6630	0.0010

RUN	alpha	CL	CD	CM	L/D	CN	CA
91.0	−3.29	−0.1293	0.03715	0.00592	−3.48	−0.1312	0.0297
91.0	−2.31	−0.0982	0.03311	0.00352	−2.97	−0.0995	0.0291
91.0	−1.26	−0.0660	0.02995	0.00095	−2.20	−0.0667	0.0285
91.0	−0.32	−0.0359	0.02799	−0.00119	−1.28	−0.0360	0.0278
91.0	0.73	−0.0030	0.02693	−0.00348	−0.11	−0.0026	0.0270
91.0	1.78	0.0295	0.02699	−0.00589	1.09	0.0303	0.0260
91.0	2.77	0.0619	0.02816	−0.00828	2.20	0.0632	0.0251
91.0	3.72	0.0911	0.03016	−0.01028	3.02	0.0929	0.0242
91.0	5.76	0.1558	0.03790	−0.01505	4.11	0.1588	0.0221
91.0	7.75	0.2198	0.04996	−0.01965	4.40	0.2245	0.0199
91.0	9.73	0.2824	0.06609	−0.02444	4.27	0.2895	0.0174
91.0	11.70	0.3448	0.08637	−0.02913	3.99	0.3552	0.0146
91.0	13.72	0.4065	0.11154	−0.03398	3.64	0.4213	0.0120
91.0	15.77	0.4683	0.14160	−0.03884	3.31	0.4892	0.0090
91.0	17.78	0.5279	0.17533	−0.04385	3.01	0.5562	0.0058
91.0	19.72	0.5851	0.21298	−0.04893	2.75	0.6226	0.0031

RUN	alpha	CL	CD	CM	L/D	CN	CA
109.0	−2.86	−0.1212	0.04038	−0.00222	−3.00	−0.1231	0.0343
109.0	−1.93	−0.0852	0.03668	−0.00560	−2.32	−0.0864	0.0338
109.0	−1.07	−0.0462	0.03406	−0.00920	−1.36	−0.0468	0.0332
109.0	0.98	0.0429	0.03213	−0.01726	1.34	0.0435	0.0314
109.0	1.75	0.0761	0.03294	−0.02022	2.31	0.0771	0.0306
109.0	2.65	0.1156	0.03501	−0.02376	3.30	0.1171	0.0296
109.0	3.49	0.1543	0.03809	−0.02699	4.05	0.1563	0.0286
109.0	5.27	0.2290	0.04766	−0.03360	4.81	0.2324	0.0264
109.0	6.90	0.2987	0.06023	−0.03995	4.96	0.3038	0.0239
109.0	8.67	0.3753	0.07840	−0.04688	4.79	0.3829	0.0209
109.0	10.42	0.4492	0.10144	−0.05410	4.43	0.4601	0.0185
109.0	12.12	0.5203	0.12870	−0.06222	4.04	0.5358	0.0166
109.0	13.82	0.5898	0.16317	−0.07046	3.61	0.6117	0.0176

RUN	alpha	CL	CD	CM	L/D	CN	CA
111.0	−2.58	−0.1026	0.03592	−0.00238	−2.86	−0.1041	0.0312
111.0	−1.81	−0.0740	0.03323	−0.00481	−2.23	−0.0750	0.0309
111.0	−0.92	−0.0384	0.03114	−0.00759	−1.23	−0.0389	0.0305
111.0	−0.11	−0.0064	0.03016	−0.01031	−0.21	−0.0064	0.0302
111.0	0.82	0.0286	0.03002	−0.01332	0.95	0.0290	0.0296
111.0	1.74	0.0654	0.03088	−0.01619	2.12	0.0663	0.0289
111.0	2.57	0.0963	0.03256	−0.01886	2.96	0.0976	0.0282
111.0	3.39	0.1286	0.03510	−0.02134	3.66	0.1304	0.0274
111.0	5.20	0.1982	0.04378	−0.02689	4.53	0.2014	0.0256
111.0	6.96	0.2645	0.05628	−0.03228	4.70	0.2694	0.0238
111.0	8.72	0.3302	0.07257	−0.03793	4.55	0.3374	0.0217
111.0	10.41	0.3917	0.09216	−0.04348	4.25	0.4019	0.0199
111.0	12.11	0.4546	0.11650	−0.05024	3.90	0.4690	0.0185
111.0	13.92	0.5197	0.14649	−0.05761	3.55	0.5397	0.0171
111.0	15.72	0.5804	0.17926	−0.06450	3.24	0.6072	0.0153
111.0	17.40	0.6381	0.21481	−0.07144	2.97	0.6732	0.0141

RUN	alpha	CL	CD	CM	L/D	CN	CA
112.0	−2.68	−0.0983	0.03431	−0.00222	−2.87	−0.0998	0.0297
112.0	−1.82	−0.0691	0.03133	−0.00442	−2.20	−0.0700	0.0291
112.0	−0.93	−0.0385	0.02914	−0.00674	−1.32	−0.0390	0.0285
112.0	0.82	0.0230	0.02792	−0.01137	0.82	0.0234	0.0276
112.0	1.69	0.0529	0.02874	−0.01371	1.84	0.0537	0.0272
112.0	2.53	0.0821	0.03035	−0.01600	2.71	0.0834	0.0267
112.0	3.40	0.1119	0.03285	−0.01830	3.41	0.1137	0.0262
112.0	5.18	0.1732	0.04065	−0.02282	4.26	0.1762	0.0248
112.0	6.96	0.2340	0.05208	−0.02747	4.49	0.2386	0.0233
112.0	8.77	0.2961	0.06776	−0.03251	4.37	0.3029	0.0218
112.0	10.53	0.3539	0.08662	−0.03761	4.09	0.3638	0.0205
112.0	12.35	0.4145	0.11061	−0.04321	3.75	0.4286	0.0194
112.0	14.03	0.4683	0.13608	−0.04857	3.44	0.4873	0.0185
112.0	15.79	0.5239	0.16648	−0.05429	3.15	0.5494	0.0176
112.0	17.59	0.5785	0.20063	−0.06019	2.88	0.6121	0.0164

RUN	alpha	CL	CD	CM	L/D	CN	CA
113.0	−2.80	−0.0999	0.03397	−0.00219	−2.94	−0.1014	0.0291
113.0	−1.93	−0.0717	0.03100	−0.00407	−2.31	−0.0727	0.0286
113.0	−1.01	−0.0425	0.02879	−0.00616	−1.48	−0.0430	0.0280
113.0	−0.12	−0.0139	0.02757	−0.00799	−0.50	−0.0140	0.0275
113.0	0.85	0.0183	0.02724	−0.01018	0.67	0.0188	0.0270
113.0	1.67	0.0445	0.02793	−0.01216	1.59	0.0453	0.0266
113.0	2.52	0.0725	0.02947	−0.01408	2.46	0.0737	0.0263
113.0	3.47	0.1035	0.03210	−0.01623	3.22	0.1052	0.0258
113.0	5.20	0.1596	0.03939	−0.02024	4.05	0.1625	0.0248
113.0	6.97	0.2159	0.05001	−0.02442	4.32	0.2203	0.0234
113.0	8.78	0.2729	0.06463	−0.02893	4.22	0.2796	0.0222
113.0	10.55	0.3290	0.08287	−0.03367	3.97	0.3386	0.0212
113.0	12.35	0.3846	0.10502	−0.03872	3.66	0.3981	0.0203
113.0	14.13	0.4386	0.13055	−0.04371	3.36	0.4572	0.0195
113.0	15.92	0.4934	0.15984	−0.04900	3.09	0.5183	0.0184
113.0	17.68	0.5447	0.19188	−0.05405	2.84	0.5773	0.0173

RUN	alpha	CL	CD	CM	L/D	CN	CA
115.0	−2.80	−0.3260	0.10166	0.10238	−3.21	−0.3305	0.0856
115.0	−2.00	−0.2892	0.09315	0.09819	−3.10	−0.2922	0.0830
115.0	−1.09	−0.2493	0.08489	0.09371	−2.94	−0.2509	0.0801
115.0	−0.23	−0.2096	0.07809	0.08955	−2.68	−0.2099	0.0772
115.0	0.58	−0.1746	0.07290	0.08570	−2.40	−0.1739	0.0746
115.0	1.49	−0.1326	0.06785	0.08131	−1.95	−0.1307	0.0713
115.0	2.32	−0.0950	0.06455	0.07737	−1.47	−0.0923	0.0684
115.0	3.19	−0.0564	0.06217	0.07309	−0.91	−0.0529	0.0652
115.0	4.91	0.0204	0.06056	0.06472	0.34	0.0255	0.0586
115.0	6.63	0.0969	0.06290	0.05682	1.54	0.1035	0.0513
115.0	8.33	0.1676	0.07271	0.05254	2.31	0.1764	0.0476
115.0	10.05	0.2391	0.08703	0.04781	2.75	0.2506	0.0440
115.0	11.70	0.3048	0.10438	0.04289	2.92	0.3196	0.0404
115.0	13.46	0.3779	0.12519	0.03456	3.02	0.3967	0.0338

RUN	alpha	CL	CD	CM	L/D	CN	CA
116.0	−3.01	−0.2858	0.09287	0.08543	−3.08	−0.2903	0.0777
116.0	−2.08	−0.2497	0.08431	0.08187	−2.96	−0.2526	0.0752
116.0	−1.21	−0.2151	0.07716	0.07836	−2.79	−0.2167	0.0726
116.0	−0.29	−0.1795	0.07085	0.07483	−2.53	−0.1799	0.0699
116.0	0.55	−0.1455	0.06598	0.07145	−2.21	−0.1449	0.0674
116.0	1.44	−0.1103	0.06187	0.06790	−1.78	−0.1088	0.0646
116.0	2.32	−0.0738	0.05876	0.06450	−1.26	−0.0714	0.0617
116.0	3.18	−0.0409	0.05669	0.06107	−0.72	−0.0377	0.0589
116.0	4.90	0.0284	0.05553	0.05408	0.51	0.0330	0.0529
116.0	6.68	0.0989	0.05856	0.04730	1.69	0.1051	0.0467
116.0	8.38	0.1593	0.06811	0.04421	2.34	0.1676	0.0442
116.0	10.10	0.2218	0.07965	0.03892	2.79	0.2324	0.0395
116.0	11.87	0.2857	0.09727	0.03444	2.94	0.2996	0.0364
116.0	13.61	0.3498	0.11743	0.02790	2.98	0.3676	0.0318
116.0	15.34	0.4142	0.13952	0.01909	2.97	0.4364	0.0250
116.0	17.13	0.4778	0.16786	0.01077	2.85	0.5060	0.0197

RUN	alpha	CL	CD	CM	L/D	CN	CA
117.0	−2.94	−0.2505	0.08509	0.07378	−2.94	−0.2545	0.0721
117.0	−2.09	−0.2221	0.07824	0.07079	−2.84	−0.2248	0.0701
117.0	−1.19	−0.1899	0.07150	0.06775	−2.66	−0.1914	0.0675
117.0	−0.34	−0.1593	0.06600	0.06485	−2.41	−0.1597	0.0650
117.0	0.55	−0.1280	0.06119	0.06169	−2.09	−0.1275	0.0624
117.0	1.47	−0.0948	0.05729	0.05841	−1.66	−0.0933	0.0597
117.0	2.32	−0.0642	0.05471	0.05557	−1.17	−0.0620	0.0573
117.0	3.25	−0.0311	0.05298	0.05234	−0.59	−0.0280	0.0547
117.0	5.00	0.0329	0.05272	0.04617	0.62	0.0373	0.0497
117.0	6.74	0.0946	0.05532	0.04020	1.71	0.1005	0.0438
117.0	8.48	0.1514	0.06442	0.03716	2.35	0.1593	0.0414
117.0	10.28	0.2114	0.07657	0.03257	2.76	0.2217	0.0376
117.0	12.02	0.2693	0.09200	0.02753	2.93	0.2825	0.0339
117.0	13.80	0.3297	0.11085	0.02114	2.97	0.3466	0.0290
117.0	15.57	0.3894	0.13239	0.01423	2.94	0.4107	0.0230
117.0	17.35	0.4444	0.15836	0.00870	2.81	0.4714	0.0187

RUN	alpha	CL	CD	CM	L/D	CN	CA
118.0	−3.02	−0.2391	0.08289	0.06723	−2.88	−0.2431	0.0702
118.0	−2.08	−0.2083	0.07517	0.06422	−2.77	−0.2109	0.0676
118.0	−1.26	−0.1807	0.06912	0.06152	−2.61	−0.1822	0.0651
118.0	−0.32	−0.1494	0.06329	0.05855	−2.36	−0.1497	0.0625
118.0	0.58	−0.1183	0.05870	0.05571	−2.02	−0.1177	0.0599
118.0	1.45	−0.0894	0.05535	0.05295	−1.62	−0.0880	0.0576
118.0	2.36	−0.0588	0.05282	0.05008	−1.11	−0.0566	0.0552
118.0	3.23	−0.0288	0.05148	0.04738	−0.56	−0.0259	0.0530
118.0	5.00	0.0311	0.05101	0.04189	0.61	0.0354	0.0481
118.0	6.77	0.0904	0.05367	0.03653	1.68	0.0961	0.0426
118.0	8.55	0.1467	0.06241	0.03309	2.35	0.1543	0.0399
118.0	10.37	0.2036	0.07398	0.02848	2.75	0.2136	0.0361
118.0	12.11	0.2584	0.08860	0.02394	2.92	0.2712	0.0324
118.0	13.90	0.3164	0.10677	0.01818	2.96	0.3328	0.0276
118.0	15.67	0.3712	0.12902	0.01281	2.88	0.3922	0.0240
118.0	17.46	0.4238	0.15406	0.00814	2.75	0.4505	0.0199

RUN	alpha	CL	CD	CM	L/D	CN	CA
119.0	−2.78	−0.2792	0.07015	0.08152	−3.98	−0.2822	0.0565
119.0	−1.90	−0.2426	0.06259	0.07757	−3.88	−0.2445	0.0545
119.0	−1.03	−0.2043	0.05611	0.07352	−3.64	−0.2053	0.0524
119.0	−0.17	−0.1673	0.05077	0.06967	−3.29	−0.1674	0.0503
119.0	0.61	−0.1253	0.04656	0.06534	−2.69	−0.1248	0.0479
119.0	1.52	−0.0892	0.04328	0.06189	−2.06	−0.0880	0.0456
119.0	2.38	−0.0506	0.04113	0.05798	−1.23	−0.0488	0.0432
119.0	3.20	−0.0157	0.04003	0.05443	−0.39	−0.0134	0.0408
119.0	5.00	0.0642	0.04110	0.04703	1.56	0.0675	0.0354
119.0	6.70	0.1387	0.04674	0.04076	2.97	0.1432	0.0302
119.0	8.33	0.2093	0.05656	0.03481	3.70	0.2153	0.0256
119.0	10.09	0.2813	0.07118	0.02858	3.95	0.2894	0.0208
119.0	11.81	0.3523	0.09049	0.02292	3.89	0.3633	0.0165
119.0	13.52	0.4236	0.11344	0.01555	3.73	0.4384	0.0113

RUN	alpha	CL	CD	CM	L/D	CN	CA
120.0	−2.85	−0.2400	0.06375	0.06610	−3.77	−0.2429	0.0517
120.0	−2.01	−0.2094	0.05733	0.06311	−3.65	−0.2113	0.0499
120.0	−1.16	−0.1753	0.05151	0.05991	−3.40	−0.1763	0.0479
120.0	−0.28	−0.1402	0.04658	0.05663	−3.01	−0.1404	0.0459
120.0	0.61	−0.1062	0.04274	0.05339	−2.48	−0.1057	0.0439
120.0	1.46	−0.0720	0.03998	0.05011	−1.80	−0.0710	0.0418
120.0	2.35	−0.0362	0.03804	0.04698	−0.95	−0.0346	0.0395
120.0	3.29	0.0000	0.03719	0.04372	0.00	0.0021	0.0371
120.0	4.93	0.0643	0.03840	0.03822	1.67	0.0674	0.0327
120.0	6.70	0.1320	0.04386	0.03286	3.01	0.1363	0.0282
120.0	8.41	0.1952	0.05323	0.02771	3.67	0.2009	0.0241
120.0	10.14	0.2603	0.06681	0.02245	3.90	0.2680	0.019[illegible]
120.0	11.95	0.3250	0.08484	0.01699	3.83	0.3355	0.015[illegible]
120.0	13.71	0.3894	0.10633	0.01070	3.66	0.4035	0.0110
120.0	15.44	0.4528	0.13044	0.00302	3.47	0.4712	0.0052
120.0	17.18	0.5124	0.15892	−0.00375	3.22	0.5364	0.0005

RUN	alpha	CL	CD	CM	L/D	CN	CA
121.0	−2.92	−0.2164	0.05951	0.05602	−3.64	−0.2191	0.0484
121.0	−1.99	−0.1836	0.05277	0.05291	−3.48	−0.1853	0.0464
121.0	−1.14	−0.1538	0.04758	0.05033	−3.23	−0.1547	0.0445
121.0	−0.27	−0.1233	0.04325	0.04753	−2.85	−0.1235	0.0427
121.0	0.59	−0.0929	0.03985	0.04481	−2.33	−0.0925	0.0408
121.0	1.47	−0.0618	0.03724	0.04201	−1.66	−0.0608	0.0388
121.0	2.40	−0.0280	0.03545	0.03910	−0.79	−0.0265	0.0366
121.0	3.23	0.0018	0.03480	0.03657	0.05	0.0038	0.0346
121.0	5.00	0.0636	0.03613	0.03143	1.76	0.0665	0.0304
121.0	6.77	0.1243	0.04151	0.02675	2.99	0.1283	0.0266
121.0	8.57	0.1860	0.05119	0.02224	3.63	0.1916	0.0229
121.0	10.28	0.2428	0.06363	0.01795	3.82	0.2503	0.0193
121.0	12.07	0.3029	0.08006	0.01243	3.78	0.3129	0.0149
121.0	13.83	0.3612	0.09962	0.00672	3.63	0.3746	0.0104
121.0	15.64	0.4196	0.12332	0.00111	3.40	0.4373	0.0057
121.0	17.38	0.4724	0.14998	−0.00324	3.15	0.4956	0.0020

RUN	alpha	CL	CD	CM	L/D	CN	CA
122.0	−2.99	−0.2060	0.05753	0.04979	−3.58	−0.2087	0.0467
122.0	−2.04	−0.1741	0.05086	0.04704	−3.42	−0.1758	0.0446
122.0	−1.13	−0.1433	0.04545	0.04445	−3.15	−0.1442	0.0426
122.0	−0.26	−0.1154	0.04137	0.04197	−2.79	−0.1156	0.0408
122.0	0.58	−0.0872	0.03819	0.03980	−2.28	−0.0868	0.0391
122.0	1.53	−0.0563	0.03556	0.03710	−1.58	−0.0553	0.0370
122.0	2.34	−0.0286	0.03413	0.03500	−0.84	−0.0272	0.0353
122.0	3.30	0.0037	0.03339	0.03246	0.11	0.0056	0.0331
122.0	5.07	0.0622	0.03486	0.02796	1.78	0.0650	0.0292
122.0	6.85	0.1199	0.04016	0.02366	2.99	0.1238	0.0256
122.0	8.61	0.1764	0.04923	0.01959	3.58	0.1818	0.0223
122.0	10.35	0.2301	0.06108	0.01553	3.77	0.2374	0.0188
122.0	12.15	0.2869	0.07684	0.01077	3.73	0.2967	0.0147
122.0	13.91	0.3423	0.09556	0.00582	3.58	0.3552	0.0105
122.0	15.70	0.3962	0.11822	0.00149	3.35	0.4134	0.0066
122.0	17.49	0.4488	0.14448	−0.00226	3.11	0.4715	0.0029

RUN	alpha	CL	CD	CM	L/D	CN	CA
123.0	−2.69	−0.2243	0.04596	0.05341	−4.88	−0.2262	0.0354
123.0	−1.86	−0.1879	0.03994	0.04988	−4.70	−0.1891	0.0338
123.0	−0.97	−0.1494	0.03465	0.04596	−4.31	−0.1499	0.0321
123.0	−0.10	−0.1113	0.03058	0.04237	−3.64	−0.1114	0.0304
123.0	0.81	−0.0699	0.02742	0.03858	−2.55	−0.0695	0.0284
123.0	1.66	−0.0326	0.02559	0.03501	−1.27	−0.0318	0.0265
123.0	2.45	0.0019	0.02488	0.03185	0.08	0.0030	0.0248
123.0	3.29	0.0400	0.02512	0.02855	1.59	0.0414	0.0228
123.0	5.05	0.1153	0.02895	0.02216	3.98	0.1174	0.0187
123.0	6.72	0.1871	0.03669	0.01627	5.10	0.1901	0.0146
123.0	8.46	0.2620	0.04914	0.01000	5.33	0.2664	0.0101
123.0	10.16	0.3333	0.06566	0.00376	5.08	0.3397	0.0059
123.0	11.93	0.4061	0.08742	−0.00236	4.65	0.4154	0.0016
123.0	13.64	0.4755	0.11276	−0.00942	4.22	0.4886	−0.0026

RUN	alpha	CL	CD	CM	L/D	CN	CA
127.0	−2.76	−0.1957	0.04217	0.04313	−4.64	−0.1975	0.0327
127.0	−1.88	−0.1616	0.03654	0.04008	−4.42	−0.1627	0.0312
127.0	−1.03	−0.1280	0.03200	0.03714	−4.00	−0.1286	0.0297
127.0	−0.20	−0.0970	0.02861	0.03441	−3.39	−0.0971	0.0283
127.0	0.71	−0.0603	0.02581	0.03131	−2.34	−0.0600	0.0266
127.0	1.56	−0.0268	0.02422	0.02848	−1.11	−0.0261	0.0249
127.0	2.47	0.0086	0.02353	0.02555	0.36	0.0095	0.0231
127.0	3.28	0.0391	0.02380	0.02291	1.64	0.0404	0.0215
127.0	5.00	0.1059	0.02743	0.01788	3.86	0.1079	0.0181
127.0	6.74	0.1721	0.03492	0.01276	4.93	0.1750	0.0145
127.0	8.47	0.2373	0.04625	0.00772	5.13	0.2415	0.0108
127.0	10.21	0.3021	0.06166	0.00252	4.90	0.3083	0.0071
127.0	11.98	0.3649	0.08102	−0.00271	4.50	0.3737	0.0036
127.0	13.77	0.4290	0.10498	−0.00865	4.09	0.4417	−0.0001
127.0	15.54	0.4912	0.13255	−0.01506	3.71	0.5088	−0.0039
127.0	17.26	0.5476	0.16271	−0.02092	3.37	0.5712	−0.0071

RUN	alpha	CL	CD	CM	L/D	CN	CA
128.0	−2.86	−0.1764	0.03972	0.03577	−4.44	−0.1782	0.0309
128.0	−1.96	−0.1455	0.03448	0.03308	−4.22	−0.1466	0.0295
128.0	−1.08	−0.1156	0.03031	0.03062	−3.81	−0.1161	0.0281
128.0	−0.20	−0.0842	0.02700	0.02824	−3.12	−0.0843	0.0267
128.0	0.72	−0.0513	0.02453	0.02560	−2.09	−0.0510	0.0252
128.0	1.56	−0.0224	0.02317	0.02326	−0.97	−0.0218	0.0238
128.0	2.41	0.0075	0.02261	0.02092	0.33	0.0085	0.0223
128.0	3.35	0.0402	0.02302	0.01844	1.74	0.0414	0.0206
128.0	5.13	0.1025	0.02677	0.01395	3.83	0.1045	0.0175
128.0	6.85	0.1612	0.03395	0.00963	4.75	0.1641	0.0145
128.0	8.61	0.2204	0.04494	0.00525	4.90	0.2247	0.0114
128.0	10.39	0.2797	0.05974	0.00102	4.68	0.2859	0.0083
128.0	12.16	0.3368	0.07784	−0.00352	4.33	0.3456	0.0052
128.0	13.91	0.3935	0.09948	−0.00816	3.96	0.4058	0.0020
128.0	15.66	0.4495	0.12475	−0.01316	3.60	0.4665	−0.0012
128.0	17.47	0.5032	0.15391	−0.01745	3.27	0.5262	−0.0043

RUN	alpha	CL	CD	CM	L/D	CN	CA
129.0	−2.94	−0.1678	0.03872	0.03115	−4.33	−0.1695	0.0301
129.0	−2.02	−0.1383	0.03359	0.02903	−4.12	−0.1394	0.0287
129.0	−1.13	−0.1099	0.02961	0.02697	−3.71	−0.1104	0.0274
129.0	−0.20	−0.0796	0.02636	0.02479	−3.02	−0.0797	0.0261
129.0	0.69	−0.0495	0.02408	0.02263	−2.06	−0.0492	0.0247
129.0	1.59	−0.0205	0.02270	0.02058	−0.90	−0.0198	0.0233
129.0	2.44	0.0075	0.02222	0.01850	0.34	0.0084	0.0219
129.0	3.36	0.0374	0.02262	0.01638	1.65	0.0387	0.0204
129.0	5.08	0.0936	0.02603	0.01267	3.60	0.0956	0.0176
129.0	6.82	0.1492	0.03282	0.00882	4.55	0.1520	0.0149
129.0	8.69	0.2083	0.04392	0.00497	4.74	0.2126	0.0119
129.0	10.43	0.2619	0.05755	0.00129	4.55	0.2679	0.0092
129.0	12.22	0.3161	0.07491	−0.00291	4.22	0.3248	0.0063
129.0	13.98	0.3701	0.09559	−0.00715	3.87	0.3822	0.0033
129.0	15.75	0.4227	0.11971	−0.01099	3.53	0.4393	0.0005
129.0	17.49	0.4731	0.14654	−0.01483	3.23	0.4953	−0.0024

RUN	alpha	CL	CD	CM	L/D	CN	CA
143.0	−2.58	−0.1765	0.03751	0.02445	−4.71	−0.1780	0.0295
143.0	−1.65	−0.1370	0.03194	0.02052	−4.29	−0.1379	0.0280
143.0	−0.76	−0.0967	0.02776	0.01660	−3.48	−0.0971	0.0265
143.0	0.08	−0.0608	0.02494	0.01305	−2.44	−0.0608	0.0250
143.0	0.90	−0.0253	0.02315	0.00940	−1.09	−0.0249	0.0235
143.0	1.80	0.0132	0.02227	0.00581	0.59	0.0139	0.0218
143.0	2.60	0.0497	0.02250	0.00247	2.21	0.0507	0.0202
143.0	3.49	0.0892	0.02381	−0.00119	3.75	0.0904	0.0183
143.0	5.22	0.1648	0.02944	−0.00816	5.60	0.1668	0.0143
143.0	6.92	0.2396	0.03938	−0.01450	6.08	0.2426	0.0102
143.0	8.67	0.3110	0.05384	−0.02046	5.78	0.3156	0.0064
143.0	10.39	0.3825	0.07270	−0.02672	5.26	0.3894	0.0025
143.0	12.07	0.4513	0.09530	−0.03310	4.74	0.4612	−0.0012
143.0	13.84	0.5232	0.12349	−0.04032	4.24	0.5376	−0.0053

RUN	alpha	CL	CD	CM	L/D	CN	CA
147.0	−2.65	−0.1558	0.03619	0.01945	−4.30	−0.1573	0.0289
147.0	−1.80	−0.1234	0.03159	0.01660	−3.91	−0.1244	0.0277
147.0	−0.92	−0.0899	0.02789	0.01341	−3.22	−0.0903	0.0264
147.0	−0.04	−0.0561	0.02514	0.01054	−2.23	−0.0561	0.0251
147.0	0.81	−0.0234	0.02338	0.00755	−1.00	−0.0231	0.0237
147.0	1.68	0.0093	0.02254	0.00465	0.41	0.0100	0.0223
147.0	2.55	0.0425	0.02269	0.00174	1.87	0.0435	0.0208
147.0	3.46	0.0777	0.02387	−0.00109	3.25	0.0790	0.0191
147.0	5.21	0.1449	0.02892	−0.00668	5.01	0.1469	0.0157
147.0	6.94	0.2118	0.03793	−0.01204	5.58	0.2148	0.0121
147.0	8.65	0.2757	0.05082	−0.01706	5.42	0.2802	0.0088
147.0	10.42	0.3399	0.06816	−0.02238	4.99	0.3466	0.0056
147.0	12.18	0.4035	0.08943	−0.02805	4.51	0.4133	0.0022
147.0	13.84	0.4637	0.11317	−0.03390	4.10	0.4773	−0.0011
147.0	15.65	0.5252	0.14219	−0.04025	3.69	0.5441	−0.0047
147.0	17.39	0.5855	0.17486	−0.04677	3.35	0.6110	−0.0082

RUN	alpha	CL	CD	CM	L/D	CN	CA
148.0	−2.79	−0.1453	0.03534	0.01587	−4.11	−0.1468	0.0282
148.0	−1.86	−0.1139	0.03075	0.01317	−3.70	−0.1148	0.0270
148.0	−1.01	−0.0850	0.02745	0.01090	−3.10	−0.0854	0.0260
148.0	−0.07	−0.0531	0.02477	0.00836	−2.14	−0.0531	0.0247
148.0	0.84	−0.0229	0.02309	0.00574	−0.99	−0.0226	0.0234
148.0	1.72	0.0076	0.02238	0.00338	0.34	0.0082	0.0221
148.0	2.55	0.0366	0.02249	0.00114	1.63	0.0376	0.0208
148.0	3.48	0.0688	0.02356	−0.00140	2.92	0.0701	0.0193
148.0	5.24	0.1296	0.02838	−0.00615	4.57	0.1316	0.0164
148.0	6.98	0.1899	0.03672	−0.01058	5.17	0.1929	0.0134
148.0	8.72	0.2488	0.04874	−0.01520	5.10	0.2533	0.0105
148.0	10.48	0.3069	0.06462	−0.01964	4.75	0.3136	0.0077
148.0	12.26	0.3647	0.08419	−0.02436	4.33	0.3743	0.0048
148.0	14.02	0.4213	0.10699	−0.02926	3.94	0.4347	0.0017
148.0	15.83	0.4789	0.13419	−0.03423	3.57	0.4974	−0.0015
148.0	17.60	0.5339	0.16432	−0.03948	3.25	0.5586	−0.0048

RUN	alpha	CL	CD	CM	L/D	CN	CA
149.0	−2.80	−0.1397	0.03501	0.01351	−3.99	−0.1412	0.0281
149.0	−1.86	−0.1097	0.03051	0.01123	−3.60	−0.1107	0.0269
149.0	−0.98	−0.0823	0.02729	0.00926	−3.02	−0.0827	0.0259
149.0	−0.11	−0.0542	0.02489	0.00721	−2.18	−0.0542	0.0248
149.0	0.79	−0.0254	0.02325	0.00521	−1.09	−0.0251	0.0236
149.0	1.65	0.0023	0.02249	0.00309	0.10	0.0030	0.0224
149.0	2.54	0.0302	0.02256	0.00107	1.34	0.0312	0.0212
149.0	3.49	0.0616	0.02357	−0.00112	2.61	0.0629	0.0198
149.0	5.23	0.1173	0.02801	−0.00511	4.19	0.1194	0.0172
149.0	6.98	0.1728	0.03569	−0.00917	4.84	0.1759	0.0144
149.0	8.75	0.2298	0.04723	−0.01325	4.87	0.2344	0.0117
149.0	10.58	0.2870	0.06267	−0.01756	4.58	0.2937	0.0089
149.0	12.32	0.3406	0.08078	−0.02178	4.22	0.3499	0.0062
149.0	14.13	0.3954	0.10303	−0.02610	3.84	0.4086	0.0034
149.0	15.91	0.4492	0.12836	−0.03052	3.50	0.4672	0.0003
149.0	17.64	0.5006	0.15629	−0.03484	3.20	0.5245	−0.0027

RUN	alpha	CL	CD	CM	L/D	CN	CA
153.0	−2.50	−0.1817	0.04289	0.02428	−4.24	−0.1834	0.0349
153.0	−1.62	−0.1430	0.03736	0.02055	−3.83	−0.1440	0.0333
153.0	−0.73	−0.1050	0.03297	0.01637	−3.19	−0.1054	0.0316
153.0	0.12	−0.0691	0.02990	0.01288	−2.31	−0.0690	0.0301
153.0	0.96	−0.0313	0.02780	0.00912	−1.12	−0.0308	0.0283
153.0	1.82	0.0053	0.02677	0.00558	0.20	0.0062	0.0266
153.0	2.63	0.0411	0.02670	0.00207	1.54	0.0423	0.0248
153.0	3.55	0.0800	0.02773	−0.00156	2.88	0.0816	0.0227
153.0	5.26	0.1535	0.03271	−0.00855	4.69	0.1558	0.0185
153.0	6.92	0.2277	0.04170	−0.01524	5.46	0.2310	0.0139
153.0	8.66	0.3023	0.05537	−0.02182	5.46	0.3072	0.0092
153.0	10.38	0.3745	0.07324	−0.02823	5.11	0.3815	0.0045
153.0	12.15	0.4462	0.09640	−0.03476	4.63	0.4565	0.0003
153.0	13.86	0.5139	0.12286	−0.04138	4.18	0.5284	−0.0039

RUN	alpha	CL	CD	CM	L/D	CN	CA
154.0	−2.66	−0.1629	0.04179	0.01937	−3.90	−0.1647	0.0342
154.0	−1.81	−0.1308	0.03705	0.01652	−3.53	−0.1319	0.0329
154.0	−0.85	−0.0946	0.03276	0.01327	−2.89	−0.0951	0.0314
154.0	0.89	−0.0300	0.02790	0.00710	−1.07	−0.0295	0.0284
154.0	1.77	0.0030	0.02689	0.00436	0.11	0.0039	0.0268
154.0	2.62	0.0337	0.02683	0.00163	1.26	0.0349	0.0253
154.0	3.50	0.0688	0.02769	−0.00131	2.48	0.0703	0.0234
154.0	5.21	0.1333	0.03213	−0.00680	4.15	0.1357	0.0199
154.0	6.96	0.2018	0.04065	−0.01236	4.96	0.2053	0.0159
154.0	8.75	0.2681	0.05326	−0.01783	5.03	0.2731	0.0119
154.0	10.49	0.3329	0.06959	−0.02356	4.78	0.3400	0.0078
154.0	12.22	0.3956	0.08972	−0.02903	4.41	0.4057	0.0040
154.0	13.96	0.4569	0.11389	−0.03484	4.01	0.4709	0.0003
154.0	15.70	0.5150	0.14098	−0.04063	3.65	0.5339	−0.0036
154.0	17.43	0.5743	0.17218	−0.04666	3.34	0.5995	−0.0077

RUN	alpha	CL	CD	CM	L/D	CN	CA
155.0	−2.69	−0.1469	0.04039	0.01531	−3.64	−0.1487	0.0335
155.0	−1.86	−0.1203	0.03618	0.01304	−3.32	−0.1214	0.0323
155.0	−0.90	−0.0877	0.03224	0.01046	−2.72	−0.0882	0.0309
155.0	−0.07	−0.0613	0.02972	0.00802	−2.06	−0.0613	0.0297
155.0	0.88	−0.0284	0.02771	0.00535	−1.02	−0.0280	0.0281
155.0	1.73	0.0001	0.02677	0.00307	0.00	0.0009	0.0268
155.0	2.58	0.0288	0.02665	0.00079	1.08	0.0300	0.0253
155.0	3.51	0.0602	0.02745	−0.00164	2.19	0.0618	0.0237
155.0	5.29	0.1199	0.03174	−0.00639	3.78	0.1224	0.0205
155.0	7.04	0.1795	0.03950	−0.01102	4.55	0.1830	0.0172
155.0	8.81	0.2394	0.05112	−0.01573	4.68	0.2444	0.0138
155.0	10.59	0.3006	0.06660	−0.02062	4.51	0.3077	0.0102
155.0	12.35	0.3587	0.08531	−0.02549	4.21	0.3687	0.0066
155.0	14.04	0.4128	0.10666	−0.02996	3.87	0.4263	0.0033
155.0	15.85	0.4702	0.13319	−0.03493	3.53	0.4887	−0.0003
155.0	17.62	0.5230	0.16183	−0.03930	3.23	0.5475	−0.0041

RUN	alpha	CL	CD	CM	L/D	CN	CA
156.0	−2.77	−0.1408	0.04021	0.01287	−3.50	−0.1425	0.0334
156.0	−1.86	−0.1133	0.03584	0.01065	−3.16	−0.1144	0.0322
156.0	−0.96	−0.0855	0.03234	0.00863	−2.64	−0.0860	0.0309
156.0	−0.09	−0.0583	0.02977	0.00657	−1.96	−0.0584	0.0297
156.0	0.82	−0.0301	0.02793	0.00451	−1.08	−0.0297	0.0284
156.0	1.73	−0.0017	0.02698	0.00250	−0.06	−0.0009	0.0270
156.0	2.62	0.0262	0.02682	0.00049	0.98	0.0274	0.0256
156.0	3.51	0.0544	0.02756	−0.00143	1.97	0.0560	0.0242
156.0	5.29	0.1097	0.03150	−0.00554	3.48	0.1121	0.0213
156.0	7.08	0.1657	0.03890	−0.00949	4.26	0.1692	0.0182
156.0	8.81	0.2209	0.04955	−0.01378	4.46	0.2259	0.0151
156.0	10.60	0.2773	0.06392	−0.01806	4.34	0.2844	0.0118
156.0	12.34	0.3311	0.08113	−0.02246	4.08	0.3408	0.0085
156.0	14.11	0.3853	0.10218	−0.02664	3.77	0.3985	0.0052
156.0	15.93	0.4396	0.12726	−0.03095	3.45	0.4577	0.0017
156.0	17.65	0.4898	0.15407	−0.03478	3.18	0.5134	−0.0017

RUN	alpha	CL	CD	CM	L/D	CN	CA
157.0	−2.53	−0.1899	0.04819	0.02490	−3.94	−0.1918	0.0398
157.0	−1.54	−0.1472	0.04186	0.02049	−3.52	−0.1483	0.0379
157.0	−0.77	−0.1134	0.03794	0.01709	−2.99	−0.1139	0.0364
157.0	0.12	−0.0758	0.03446	0.01307	−2.20	−0.0757	0.0346
157.0	0.99	−0.0379	0.03208	0.00922	−1.18	−0.0374	0.0327
157.0	1.87	−0.0026	0.03089	0.00564	−0.09	−0.0016	0.0310
157.0	2.65	0.0342	0.03063	0.00182	1.12	0.0356	0.0290
157.0	3.62	0.0740	0.03153	−0.00203	2.35	0.0758	0.0268
157.0	5.27	0.1469	0.03613	−0.00905	4.07	0.1496	0.0225
157.0	6.98	0.2201	0.04483	−0.01601	4.91	0.2239	0.0178
157.0	8.76	0.2969	0.05866	−0.02282	5.06	0.3024	0.0127
157.0	10.46	0.3681	0.07600	−0.02959	4.84	0.3758	0.0079
157.0	12.14	0.4410	0.09789	−0.03679	4.51	0.4517	0.0029
157.0	13.87	0.5061	0.12333	−0.04294	4.10	0.5209	−0.0016

RUN	alpha	CL	CD	CM	L/D	CN	CA
158.0	−2.59	−0.1657	0.04625	0.01963	−3.58	−0.1676	0.0387
158.0	−1.70	−0.1331	0.04123	0.01644	−3.23	−0.1343	0.0373
158.0	−0.87	−0.1014	0.03742	0.01351	−2.71	−0.1020	0.0359
158.0	0.06	−0.0673	0.03424	0.01025	−1.97	−0.0673	0.0343
158.0	0.90	−0.0372	0.03225	0.00732	−1.15	−0.0367	0.0328
158.0	1.74	−0.0043	0.03109	0.00442	−0.14	−0.0034	0.0312
158.0	2.63	0.0284	0.03086	0.00148	0.92	0.0298	0.0295
158.0	3.48	0.0591	0.03150	−0.00135	1.88	0.0609	0.0279
158.0	5.33	0.1288	0.03595	−0.00737	3.58	0.1316	0.0238
158.0	7.02	0.1929	0.04378	−0.01292	4.41	0.1968	0.0199
158.0	8.73	0.2571	0.05548	−0.01839	4.63	0.2625	0.0158
158.0	10.46	0.3224	0.07138	−0.02415	4.52	0.3300	0.0117
158.0	12.25	0.3874	0.09155	−0.03021	4.23	0.3980	0.0073
158.0	13.95	0.4476	0.11420	−0.03614	3.92	0.4619	0.0029
158.0	15.77	0.5104	0.14241	−0.04217	3.58	0.5299	−0.0017
158.0	17.48	0.5665	0.17225	−0.04775	3.29	0.5921	−0.0059

RUN	alpha	CL	CD	CM	L/D	CN	CA
159.0	−2.65	−0.1505	0.04479	0.01562	−3.36	−0.1524	0.0378
159.0	−1.80	−0.1236	0.04047	0.01316	−3.05	−0.1248	0.0366
159.0	−0.88	−0.0931	0.03668	0.01055	−2.54	−0.0936	0.0352
159.0	−0.04	−0.0651	0.03397	0.00812	−1.92	−0.0651	0.0339
159.0	0.89	−0.0340	0.03191	0.00552	−1.07	−0.0335	0.0324
159.0	1.73	−0.0079	0.03096	0.00319	−0.25	−0.0069	0.0312
159.0	2.62	0.0216	0.03067	0.00079	0.70	0.0230	0.0297
159.0	3.51	0.0519	0.03127	−0.00174	1.66	0.0538	0.0280
159.0	5.31	0.1123	0.03520	−0.00658	3.19	0.1150	0.0247
159.0	7.04	0.1704	0.04251	−0.01122	4.01	0.1743	0.0213
159.0	8.80	0.2295	0.05350	−0.01610	4.29	0.2350	0.0178
159.0	10.57	0.2890	0.06831	−0.02093	4.23	0.2966	0.0141
159.0	12.37	0.3466	0.08656	−0.02587	4.00	0.3571	0.0103
159.0	14.15	0.4060	0.10869	−0.03106	3.74	0.4203	0.0061
159.0	15.88	0.4609	0.13314	−0.03587	3.46	0.4798	0.0019
159.0	17.64	0.5140	0.16120	−0.04034	3.19	0.5387	−0.0022

RUN	alpha	CL	CD	CM	L/D	CN	CA
160.0	−2.76	−0.1464	0.04502	0.01297	−3.25	−0.1484	0.0379
160.0	−1.85	−0.1185	0.04047	0.01080	−2.93	−0.1197	0.0366
160.0	−0.99	−0.0922	0.03702	0.00875	−2.49	−0.0928	0.0354
160.0	−0.10	−0.0649	0.03424	0.00661	−1.90	−0.0649	0.0341
160.0	0.80	−0.0382	0.03234	0.00455	−1.18	−0.0377	0.0329
160.0	1.75	−0.0076	0.03115	0.00236	−0.24	−0.0067	0.0314
160.0	2.62	0.0185	0.03095	0.00040	0.60	0.0199	0.0301
160.0	3.53	0.0462	0.03147	−0.00172	1.47	0.0481	0.0286
160.0	5.26	0.0997	0.03490	−0.00575	2.86	0.1025	0.0256
160.0	7.14	0.1591	0.04227	−0.01014	3.76	0.1631	0.0222
160.0	8.86	0.2121	0.05233	−0.01428	4.05	0.2177	0.0191
160.0	10.64	0.2685	0.06634	−0.01866	4.05	0.2762	0.0156
160.0	12.37	0.3212	0.08287	−0.02301	3.88	0.3315	0.0121
160.0	14.17	0.3767	0.10378	−0.02748	3.63	0.3907	0.0084
160.0	15.94	0.4310	0.12758	−0.03187	3.38	0.4495	0.0043
160.0	17.73	0.4847	0.15497	−0.03624	3.13	0.5089	0.0000

RUN	alpha	CL	CD	CM	L/D	CN	CA
161.0	−2.60	−0.1655	0.03246	0.02467	−5.10	−0.1668	0.0249
161.0	−1.68	−0.1276	0.02753	0.02091	−4.63	−0.1283	0.0238
161.0	−0.87	−0.0910	0.02403	0.01773	−3.79	−0.0914	0.0227
161.0	0.05	−0.0506	0.02125	0.01369	−2.38	−0.0506	0.0213
161.0	0.90	−0.0123	0.01980	0.01029	−0.62	−0.0120	0.0200
161.0	1.77	0.0262	0.01944	0.00670	1.35	0.0268	0.0186
161.0	2.61	0.0635	0.02016	0.00354	3.15	0.0644	0.0172
161.0	3.40	0.0972	0.02177	0.00044	4.47	0.0983	0.0160
161.0	5.23	0.1764	0.02890	−0.00628	6.11	0.1784	0.0127
161.0	6.85	0.2480	0.03934	−0.01232	6.30	0.2509	0.0095
161.0	8.54	0.3191	0.05402	−0.01860	5.91	0.3236	0.0060
161.0	10.26	0.3925	0.07374	−0.02528	5.32	0.3994	0.0027
161.0	12.00	0.4655	0.09841	−0.03276	4.73	0.4758	−0.0006
161.0	13.76	0.5360	0.12753	−0.04039	4.20	0.5509	−0.0036

RUN	alpha	CL	CD	CM	L/D	CN	CA
166.0	−2.70	−0.1487	0.03150	0.02011	−4.72	−0.1500	0.0245
166.0	−1.88	−0.1191	0.02744	0.01742	−4.34	−0.1200	0.0235
166.0	−1.00	−0.0839	0.02387	0.01447	−3.52	−0.0843	0.0224
166.0	−0.10	−0.0481	0.02133	0.01157	−2.25	−0.0481	0.0212
166.0	0.73	−0.0165	0.01997	0.00885	−0.83	−0.0163	0.0202
166.0	1.69	0.0219	0.01946	0.00565	1.12	0.0225	0.0188
166.0	2.48	0.0528	0.01999	0.00313	2.64	0.0536	0.0177
166.0	3.42	0.0883	0.02165	0.00036	4.08	0.0895	0.0163
166.0	5.11	0.1545	0.02773	−0.00484	5.57	0.1564	0.0138
166.0	6.86	0.2195	0.03758	−0.01005	5.84	0.2224	0.0111
166.0	8.60	0.2855	0.05150	−0.01541	5.54	0.2900	0.0082
166.0	10.35	0.3509	0.06960	−0.02117	5.04	0.3577	0.0054
166.0	12.08	0.4135	0.09122	−0.02723	4.53	0.4234	0.0027
166.0	13.83	0.4758	0.11704	−0.03354	4.07	0.4900	−0.0001
166.0	15.65	0.5377	0.14753	−0.04039	3.64	0.5576	−0.0030
166.0	17.36	0.5958	0.18059	−0.04680	3.30	0.6226	−0.0054
166.0	0.00	−0.0462	0.02169	0.01120	−2.13	−0.0462	0.0217

RUN	alpha	CL	CD	CM	L/D	CN	CA
169.0	−2.78	−0.1376	0.03044	0.01647	−4.52	−0.1390	0.0237
169.0	−1.85	−0.1064	0.02629	0.01398	−4.05	−0.1072	0.0228
169.0	−1.04	−0.0782	0.02338	0.01178	−3.34	−0.0786	0.0220
169.0	−0.18	−0.0484	0.02115	0.00948	−2.29	−0.0484	0.0210
169.0	0.73	−0.0156	0.01969	0.00694	−0.79	−0.0153	0.0199
169.0	1.60	0.0130	0.01926	0.00460	0.68	0.0136	0.0189
169.0	2.47	0.0444	0.01973	0.00231	2.25	0.0452	0.0178
169.0	3.41	0.0781	0.02126	−0.00022	3.67	0.0792	0.0166
169.0	5.19	0.1400	0.02714	−0.00475	5.16	0.1418	0.0144
169.0	6.92	0.1988	0.03632	−0.00918	5.47	0.2017	0.0121
169.0	8.71	0.2596	0.04957	−0.01378	5.24	0.2641	0.0097
169.0	10.43	0.3167	0.06582	−0.01853	4.81	0.3234	0.0074
169.0	12.19	0.3743	0.08594	−0.02346	4.36	0.3840	0.0050
169.0	13.95	0.4315	0.10970	−0.02873	3.93	0.4452	0.0024
169.0	15.75	0.4884	0.13758	−0.03423	3.55	0.5074	−0.0001
169.0	17.54	0.5432	0.16906	−0.03942	3.21	0.5689	−0.0025

RUN	alpha	CL	CD	CM	L/D	CN	CA
170.0	−2.81	−0.1329	0.03049	0.01360	−4.36	−0.1343	0.0239
170.0	−1.91	−0.1037	0.02652	0.01153	−3.91	−0.1045	0.0230
170.0	−1.02	−0.0747	0.02343	0.00965	−3.19	−0.0751	0.0221
170.0	−0.14	−0.0463	0.02128	0.00760	−2.17	−0.0463	0.0212
170.0	0.74	−0.0173	0.01996	0.00562	−0.87	−0.0170	0.0202
170.0	1.63	0.0121	0.01954	0.00357	0.62	0.0126	0.0192
170.0	2.52	0.0412	0.02002	0.00157	2.06	0.0420	0.0182
170.0	3.42	0.0711	0.02140	−0.00044	3.32	0.0722	0.0171
170.0	5.14	0.1270	0.02663	−0.00418	4.77	0.1289	0.0152
170.0	6.94	0.1838	0.03545	−0.00823	5.18	0.1867	0.0130
170.0	8.73	0.2415	0.04799	−0.01244	5.03	0.2460	0.0108
170.0	10.45	0.2951	0.06320	−0.01649	4.67	0.3017	0.0086
170.0	12.30	0.3527	0.08327	−0.02122	4.24	0.3623	0.0062
170.0	14.08	0.4061	0.10582	−0.02580	3.84	0.4196	0.0039
170.0	15.84	0.4592	0.13190	−0.03030	3.48	0.4777	0.0016
170.0	17.64	0.5130	0.16223	−0.03506	3.16	0.5381	−0.0009
170.0	0.00	−0.0391	0.02142	0.00701	−1.83	−0.0391	0.0214

RUN	alpha	CL	CD	CM	L/D	CN	CA
215.0	−3.41	−0.1444	0.02563	0.01808	−5.64	−0.1457	0.0170
215.0	−2.47	−0.1041	0.02183	0.01439	−4.77	−0.1049	0.0173
215.0	−1.47	−0.0580	0.01911	0.01049	−3.04	−0.0585	0.0176
215.0	−0.48	−0.0166	0.01790	0.00668	−0.93	−0.0168	0.0178
215.0	0.58	0.0314	0.01802	0.00278	1.74	0.0315	0.0177
215.0	1.52	0.0730	0.01943	−0.00096	3.76	0.0735	0.0175
215.0	2.59	0.1206	0.02262	−0.00521	5.33	0.1215	0.0171
215.0	3.54	0.1612	0.02678	−0.00892	6.02	0.1626	0.0168
215.0	5.59	0.2513	0.04036	−0.01701	6.23	0.2540	0.0157
215.0	7.52	0.3320	0.05865	−0.02472	5.66	0.3369	0.0147
215.0	9.59	0.4183	0.08447	−0.03331	4.95	0.4265	0.0136
215.0	11.60	0.5002	0.11552	−0.04195	4.33	0.5132	0.0126
215.0	13.57	0.5749	0.15094	−0.05000	3.81	0.5943	0.0119
215.0	15.53	0.6503	0.19235	−0.05878	3.38	0.6780	0.0112

RUN	alpha	CL	CD	CM	L/D	CN	CA
220.0	−3.55	−0.1324	0.02525	0.01389	−5.24	−0.1337	0.0170
220.0	−2.48	−0.0910	0.02118	0.01054	−4.30	−0.0918	0.0172
220.0	−1.48	−0.0497	0.01872	0.00753	−2.66	−0.0502	0.0174
220.0	−0.49	−0.0126	0.01760	0.00437	−0.72	−0.0128	0.0175
220.0	0.47	0.0242	0.01764	0.00147	1.37	0.0243	0.0174
220.0	1.48	0.0630	0.01895	−0.00155	3.32	0.0635	0.0173
220.0	2.45	0.1006	0.02144	−0.00473	4.69	0.1014	0.0171
220.0	3.48	0.1414	0.02544	−0.00810	5.56	0.1427	0.0168
220.0	5.46	0.2165	0.03683	−0.01434	5.88	0.2190	0.0160
220.0	7.47	0.2923	0.05360	−0.02115	5.45	0.2968	0.0152
220.0	9.48	0.3654	0.07552	−0.02802	4.84	0.3729	0.0143
220.0	11.48	0.4363	0.10238	−0.03503	4.26	0.4479	0.0135
220.0	13.51	0.5075	0.13527	−0.04284	3.75	0.5250	0.0129
220.0	15.46	0.5728	0.17128	−0.05019	3.34	0.5977	0.0124
220.0	17.53	0.6394	0.21410	−0.05802	2.99	0.6742	0.0116
220.0	19.45	0.6988	0.25828	−0.06496	2.71	0.7449	0.0109

RUN	alpha	CL	CD	CM	L/D	CN	CA
221.0	−2.95	−0.1767	0.03150	0.02688	−5.61	−0.1781	0.0224
221.0	−2.00	−0.1342	0.02615	0.02313	−5.13	−0.1351	0.0215
221.0	−0.91	−0.0862	0.02186	0.01863	−3.95	−0.0866	0.0205
221.0	0.06	−0.0429	0.01948	0.01497	−2.20	−0.0428	0.0195
221.0	1.07	0.0007	0.01850	0.01117	0.04	0.0011	0.0185
221.0	2.12	0.0466	0.01891	0.00707	2.46	0.0473	0.0172
221.0	3.10	0.0916	0.02074	0.00307	4.41	0.0925	0.0158
221.0	4.08	0.1337	0.02383	−0.00075	5.61	0.1350	0.0142
221.0	6.08	0.2213	0.03449	−0.00845	6.42	0.2237	0.0109
221.0	8.04	0.3078	0.05104	−0.01621	6.03	0.3119	0.0075
221.0	10.05	0.3915	0.07367	−0.02446	5.31	0.3983	0.0043
221.0	12.10	0.4789	0.10385	−0.03334	4.61	0.4901	0.0012
221.0	14.01	0.5537	0.13665	−0.04192	4.05	0.5703	−0.0014
221.0	15.99	0.6313	0.17682	−0.05092	3.57	0.6556	−0.0040
221.0	0.01	−0.0438	0.01962	0.01528	−2.23	−0.0438	0.0196

RUN	alpha	CL	CD	CM	L/D	CN	CA
222.0	−3.75	−0.1260	0.02526	0.01112	−4.99	−0.1274	0.0170
222.0	−2.75	−0.0917	0.02146	0.00850	−4.27	−0.0926	0.0170
222.0	−1.66	−0.0535	0.01869	0.00582	−2.86	−0.0540	0.0171
222.0	−0.69	−0.0196	0.01747	0.00322	−1.12	−0.0198	0.0172
222.0	0.28	0.0148	0.01734	0.00082	0.85	0.0148	0.0173
222.0	1.27	0.0494	0.01832	−0.00171	2.70	0.0498	0.0172
222.0	2.28	0.0843	0.02041	−0.00433	4.13	0.0850	0.0170
222.0	3.36	0.1215	0.02405	−0.00701	5.05	0.1227	0.0169
222.0	5.27	0.1891	0.03392	−0.01214	5.57	0.1914	0.0164
222.0	7.35	0.2581	0.04910	−0.01770	5.26	0.2623	0.0157
222.0	9.36	0.3236	0.06864	−0.02327	4.71	0.3305	0.0151
222.0	11.29	0.3859	0.09184	−0.02883	4.20	0.3964	0.0145
222.0	13.31	0.4485	0.12045	−0.03505	3.72	0.4642	0.0139
222.0	15.32	0.5100	0.15359	−0.04151	3.32	0.5325	0.0134
222.0	17.33	0.5703	0.19109	−0.04782	2.98	0.6013	0.0126
222.0	19.35	0.6289	0.23355	−0.05376	2.69	0.6708	0.0120

RUN	alpha	CL	CD	CM	L/D	CN	CA
223.0	−2.95	−0.1396	0.02868	0.01764	−4.87	−0.1409	0.0215
223.0	−1.95	−0.1048	0.02422	0.01487	−4.33	−0.1055	0.0206
223.0	−0.95	−0.0695	0.02098	0.01227	−3.31	−0.0698	0.0198
223.0	0.03	−0.0354	0.01900	0.00991	−1.86	−0.0354	0.0190
223.0	1.04	−0.0001	0.01817	0.00719	−0.01	0.0002	0.0182
223.0	2.06	0.0363	0.01859	0.00461	1.95	0.0370	0.0173
223.0	3.08	0.0721	0.02020	0.00191	3.57	0.0731	0.0163
223.0	4.11	0.1074	0.02304	−0.00055	4.66	0.1088	0.0153
223.0	6.12	0.1772	0.03202	−0.00583	5.54	0.1796	0.0130
223.0	8.04	0.2423	0.04510	−0.01090	5.37	0.2463	0.0107
223.0	10.11	0.3125	0.06418	−0.01685	4.87	0.3189	0.0083
223.0	12.09	0.3772	0.08715	−0.02273	4.33	0.3871	0.0062
223.0	14.05	0.4407	0.11444	−0.02885	3.85	0.4553	0.0040
223.0	16.01	0.5000	0.14560	−0.03470	3.43	0.5208	0.0021
223.0	18.07	0.5612	0.18295	−0.04094	3.07	0.5903	−0.0001
223.0	20.03	0.6194	0.22366	−0.04716	2.77	0.6585	−0.0021
223.0	0.07	−0.0343	0.01901	0.00993	−1.81	−0.0343	0.0191

RUN	alpha	CL	CD	CM	L/D	CN	CA
224.0	−3.60	−0.1154	0.02451	0.00843	−4.71	−0.1167	0.0172
224.0	−2.65	−0.0845	0.02115	0.00631	−3.99	−0.0853	0.0172
224.0	−1.59	−0.0491	0.01866	0.00409	−2.63	−0.0496	0.0173
224.0	−0.57	−0.0160	0.01747	0.00197	−0.92	−0.0162	0.0173
224.0	0.43	0.0168	0.01743	−0.00024	0.97	0.0170	0.0173
224.0	1.44	0.0498	0.01850	−0.00236	2.69	0.0503	0.0172
224.0	2.41	0.0811	0.02054	−0.00452	3.95	0.0819	0.0171
224.0	3.36	0.1125	0.02363	−0.00666	4.76	0.1137	0.0170
224.0	5.43	0.1797	0.03371	−0.01138	5.33	0.1821	0.0166
224.0	7.41	0.2410	0.04749	−0.01628	5.07	0.2451	0.0160
224.0	9.37	0.3018	0.06549	−0.02106	4.61	0.3085	0.0155
224.0	11.36	0.3626	0.08808	−0.02607	4.12	0.3729	0.0149
224.0	13.34	0.4205	0.11457	−0.03120	3.67	0.4356	0.0144
224.0	15.38	0.4794	0.14618	−0.03667	3.28	0.5009	0.0138
224.0	17.41	0.5363	0.18170	−0.04216	2.95	0.5661	0.0129
224.0	19.36	0.5902	0.22045	−0.04739	2.68	0.6299	0.0124

RUN	alpha	CL	CD	CM	L/D	CN	CA
225.0	−2.97	−0.1299	0.02829	0.01446	−4.59	−0.1312	0.0215
225.0	−2.96	−0.1295	0.02823	0.01431	−4.59	−0.1307	0.0215
225.0	−2.00	−0.0976	0.02418	0.01231	−4.04	−0.0984	0.0208
225.0	−0.98	−0.0642	0.02106	0.01005	−3.05	−0.0645	0.0200
225.0	0.00	−0.0313	0.01913	0.00792	−1.63	−0.0313	0.0191
225.0	0.94	−0.0002	0.01838	0.00582	−0.01	0.0001	0.0184
225.0	1.96	0.0339	0.01869	0.00357	1.82	0.0346	0.0175
225.0	3.05	0.0697	0.02032	0.00120	3.43	0.0706	0.0166
225.0	4.04	0.1025	0.02293	−0.00105	4.47	0.1039	0.0156
225.0	6.03	0.1672	0.03134	−0.00559	5.33	0.1696	0.0136
225.0	7.95	0.2287	0.04368	−0.01022	5.23	0.2325	0.0116
225.0	10.03	0.2939	0.06155	−0.01549	4.77	0.3001	0.0094
225.0	12.01	0.3550	0.08306	−0.02078	4.27	0.3646	0.0074
225.0	14.03	0.4176	0.10984	−0.02624	3.80	0.4317	0.0053
225.0	16.04	0.4758	0.14027	−0.03148	3.39	0.4960	0.0033
225.0	17.94	0.5308	0.17341	−0.03682	3.06	0.5584	0.0015
225.0	20.02	0.5901	0.21451	−0.04253	2.75	0.6278	−0.0004
225.0	−0.04	−0.0319	0.01928	0.00804	−1.66	−0.0320	0.0193

RUN	alpha	CL	CD	CM	L/D	CN	CA
226.0	−2.98	−0.1840	0.03329	0.02688	−5.53	−0.1855	0.0237
226.0	−1.97	−0.1390	0.02725	0.02257	−5.10	−0.1398	0.0225
226.0	−0.97	−0.0952	0.02287	0.01853	−4.16	−0.0955	0.0213
226.0	0.05	−0.0495	0.01993	0.01449	−2.48	−0.0495	0.0200
226.0	1.08	−0.0030	0.01859	0.01017	−0.16	−0.0027	0.0186
226.0	2.06	0.0401	0.01878	0.00649	2.14	0.0408	0.0173
226.0	3.02	0.0819	0.02027	0.00267	4.04	0.0829	0.0159
226.0	4.06	0.1299	0.02345	−0.00143	5.54	0.1312	0.0142
226.0	6.03	0.2149	0.03341	−0.00881	6.43	0.2173	0.0106
226.0	8.09	0.3062	0.05033	−0.01686	6.08	0.3102	0.0067
226.0	10.04	0.3895	0.07216	−0.02451	5.40	0.3961	0.0031
226.0	12.06	0.4741	0.10111	−0.03297	4.69	0.4848	−0.0002
226.0	14.02	0.5527	0.13463	−0.04171	4.11	0.5688	−0.0033
226.0	16.06	0.6320	0.17550	−0.05072	3.60	0.6558	−0.0062
226.0	0.04	−0.0488	0.02001	0.01446	−2.44	−0.0488	0.0200

RUN	alpha	CL	CD	CM	L/D	CN	CA
227.0	−3.12	−0.1663	0.03235	0.02185	−5.14	−0.1679	0.0233
227.0	−2.08	−0.1253	0.02671	0.01829	−4.69	−0.1262	0.0222
227.0	−1.11	−0.0878	0.02283	0.01528	−3.85	−0.0882	0.0211
227.0	−0.05	−0.0453	0.01997	0.01163	−2.27	−0.0453	0.0199
227.0	0.94	−0.0074	0.01868	0.00852	−0.40	−0.0071	0.0188
227.0	1.92	0.0322	0.01867	0.00546	1.73	0.0328	0.0176
227.0	2.96	0.0726	0.02008	0.00210	3.61	0.0735	0.0163
227.0	3.96	0.1117	0.02278	−0.00103	4.91	0.1130	0.0150
227.0	5.93	0.1873	0.03162	−0.00701	5.92	0.1895	0.0121
227.0	7.92	0.2631	0.04575	−0.01319	5.75	0.2669	0.0091
227.0	9.90	0.3374	0.06505	−0.01976	5.19	0.3435	0.0061
227.0	11.89	0.4101	0.08960	−0.02685	4.58	0.4198	0.0032
227.0	13.90	0.4826	0.11986	−0.03452	4.03	0.4973	0.0004
227.0	15.96	0.5539	0.15585	−0.04203	3.55	0.5754	−0.0024
227.0	17.89	0.6167	0.19412	−0.04907	3.18	0.6465	−0.0047
227.0	19.92	0.6828	0.23975	−0.05631	2.85	0.7236	−0.0072
227.0	−0.11	−0.0484	0.02016	0.01196	−2.40	−0.0485	0.0201

RUN	alpha	CL	CD	CM	L/D	CN	CA
228.0	−2.97	−0.1459	0.02995	0.01765	−4.87	−0.1473	0.0224
228.0	−1.92	−0.1096	0.02505	0.01480	−4.37	−0.1104	0.0214
228.0	−0.92	−0.0755	0.02163	0.01211	−3.49	−0.0758	0.0204
228.0	0.03	−0.0416	0.01942	0.00960	−2.14	−0.0415	0.0194
228.0	1.08	−0.0046	0.01827	0.00686	−0.25	−0.0042	0.0184
228.0	2.04	0.0293	0.01840	0.00442	1.59	0.0299	0.0174
228.0	3.06	0.0642	0.01975	0.00157	3.25	0.0652	0.0163
228.0	4.09	0.1005	0.02239	−0.00108	4.49	0.1019	0.0152
228.0	6.10	0.1698	0.03097	−0.00624	5.48	0.1722	0.0128
228.0	8.08	0.2373	0.04407	−0.01136	5.39	0.2412	0.0103
228.0	10.06	0.3041	0.06186	−0.01678	4.92	0.3102	0.0078
228.0	12.06	0.3714	0.08473	−0.02284	4.38	0.3809	0.0052
228.0	14.08	0.4351	0.11195	−0.02903	3.89	0.4493	0.0028
228.0	16.04	0.4967	0.14338	−0.03493	3.46	0.5170	0.0005
228.0	18.04	0.5567	0.17939	−0.04077	3.10	0.5849	−0.0019
228.0	20.06	0.6160	0.22057	−0.04682	2.79	0.6543	−0.0041
228.0	0.04	−0.0419	0.01952	0.00967	−2.15	−0.0419	0.0196

RUN	alpha	CL	CD	CM	L/D	CN	CA
229.0	−2.97	−0.1347	0.02957	0.01400	−4.56	−0.1361	0.0226
229.0	−2.00	−0.1030	0.02527	0.01191	−4.08	−0.1039	0.0217
229.0	−0.98	−0.0693	0.02189	0.00975	−3.17	−0.0697	0.0207
229.0	−0.01	−0.0374	0.01976	0.00762	−1.89	−0.0374	0.0197
229.0	0.98	−0.0048	0.01872	0.00530	−0.26	−0.0045	0.0188
229.0	1.97	0.0290	0.01878	0.00314	1.54	0.0296	0.0178
229.0	3.00	0.0622	0.02000	0.00092	3.11	0.0632	0.0167
229.0	3.99	0.0952	0.02235	−0.00126	4.26	0.0965	0.0157
229.0	5.97	0.1601	0.03033	−0.00575	5.28	0.1624	0.0135
229.0	7.98	0.2247	0.04282	−0.01043	5.25	0.2285	0.0112
229.0	10.03	0.2902	0.06030	−0.01544	4.81	0.2963	0.0088
229.0	11.98	0.3501	0.08099	−0.02048	4.32	0.3593	0.0066
229.0	13.97	0.4111	0.10659	−0.02593	3.86	0.4247	0.0042
229.0	15.96	0.4702	0.13657	−0.03109	3.44	0.4897	0.0020
229.0	18.02	0.5300	0.17209	−0.03658	3.08	0.5572	−0.0003
229.0	20.03	0.5869	0.21142	−0.04202	2.78	0.6238	−0.0024
229.0	−0.01	−0.0370	0.01984	0.00766	−1.87	−0.0370	0.0198

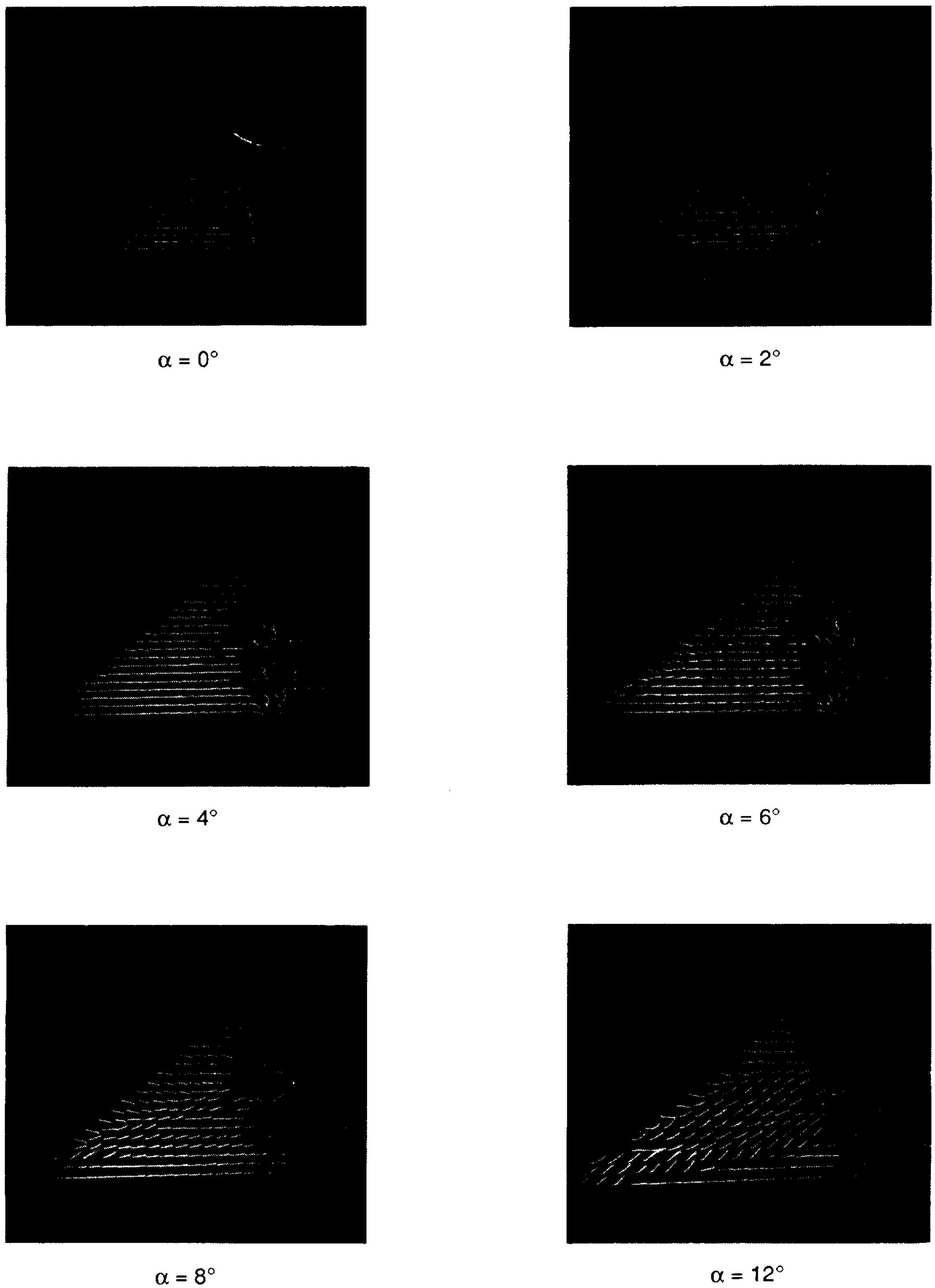
RUN	alpha	CL	CD	CM	L/D	CN	CA
230.0	−3.04	−0.1581	0.03054	0.02185	−5.18	−0.1595	0.0221
230.0	−2.13	−0.1234	0.02597	0.01907	−4.75	−0.1243	0.0214
230.0	−1.13	−0.0833	0.02210	0.01589	−3.77	−0.0837	0.0205
230.0	−0.02	−0.0401	0.01951	0.01228	−2.05	−0.0401	0.0195
230.0	0.97	−0.0016	0.01857	0.00911	−0.09	−0.0013	0.0186
230.0	1.95	0.0375	0.01889	0.00603	1.98	0.0381	0.0176
230.0	2.96	0.0765	0.02045	0.00294	3.74	0.0774	0.0165
230.0	3.98	0.1164	0.02331	−0.00039	4.99	0.1177	0.0152
230.0	5.90	0.1905	0.03224	−0.00652	5.91	0.1928	0.0125
230.0	7.86	0.2643	0.04630	−0.01276	5.71	0.2682	0.0097
230.0	9.89	0.3408	0.06642	−0.01958	5.13	0.3471	0.0069
230.0	11.92	0.4165	0.09233	−0.02711	4.51	0.4266	0.0043
230.0	13.95	0.4887	0.12334	−0.03494	3.96	0.5040	0.0019
230.0	15.97	0.5588	0.15923	−0.04243	3.51	0.5810	−0.0007
230.0	17.95	0.6224	0.19879	−0.04962	3.13	0.6533	−0.0027
230.0	−0.08	−0.0417	0.01965	0.01248	−2.12	−0.0418	0.0196

Appendix B

Flow Visualization Data

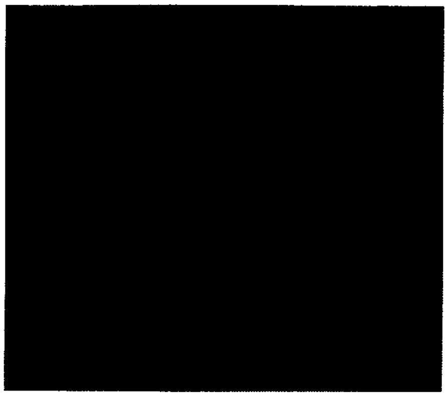
Appendix B presents additional flow visualization data. Tuft photographs of the uncambered wing are presented for $\alpha = 0°, 2°, 4°, 6°, 8°$, and $12°$ in figures B1–B4 for $M = 1.60$, 1.80, 2.00, and 2.16 with $\delta_{LE} = 0°$ and $\delta_{TE} = -30°, -10°, 0°$, and $10°$.

Oil flow and tuft photographs of the uncambered wing are presented for $\alpha = 0°, 4°, 8°$, and $12°$ in figures B5 and B6 for $M = 1.60$ and 2.16 with $\delta_{LE} = 0°$ and $5°$ and $\delta_{TE} = 0°$ and $-30°$.



(a) $M = 1.60$.

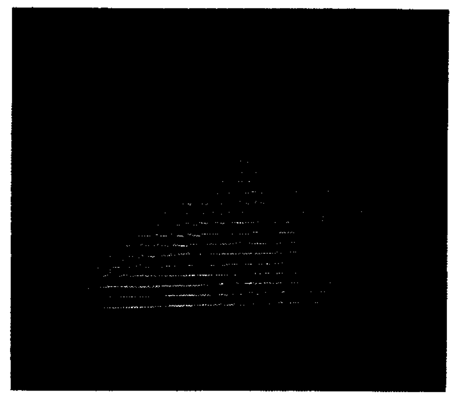
Figure B1. Tuft photographs of uncambered wing at $\alpha = 0°, 2°, 4°, 6°, 8°$, and $12°$ with $\delta_{LE} = 0°$ and $\delta_{TE} = -30°$.



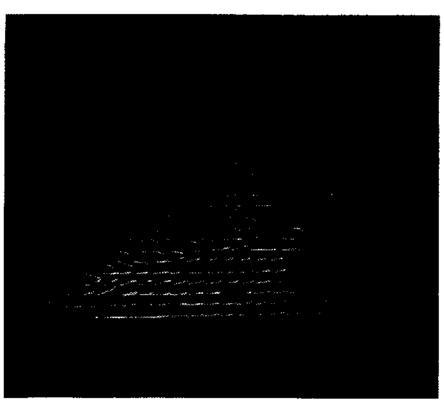
$\alpha = 0°$

$\alpha = 2°$

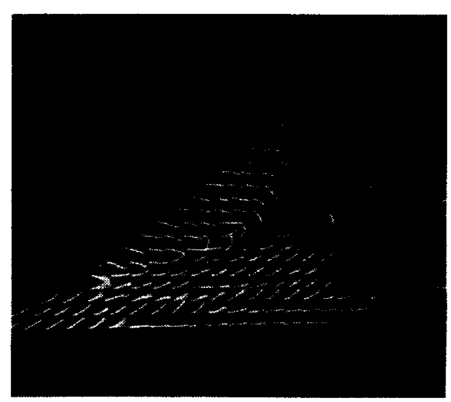
$\alpha = 4°$



$\alpha = 6°$



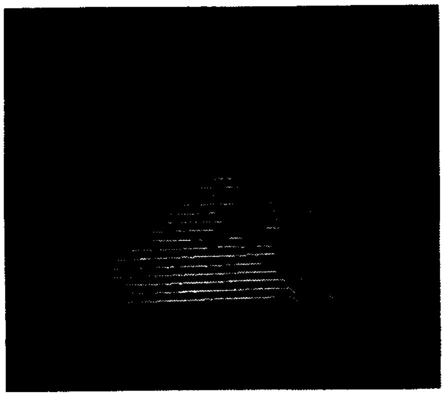
$\alpha = 8°$



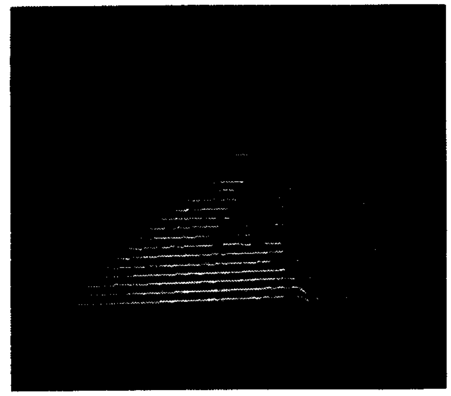
$\alpha = 12°$

(b) $M = 1.80$.

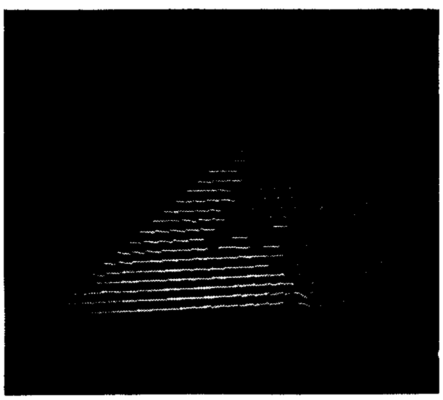
Figure B1. Continued.



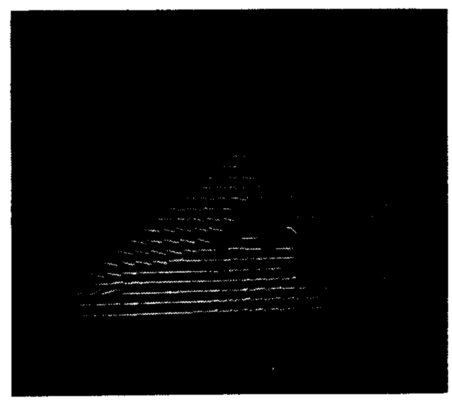
α = 0°



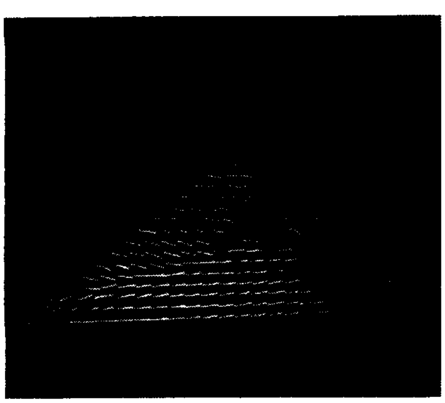
α = 2°



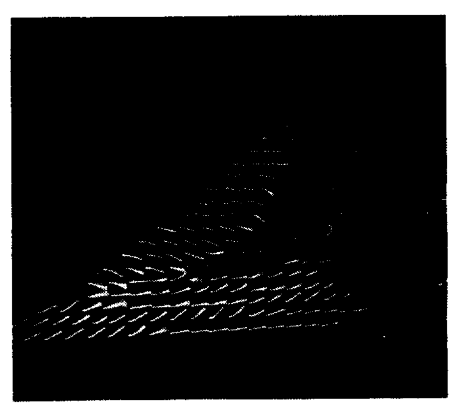
α = 4°



α = 6°



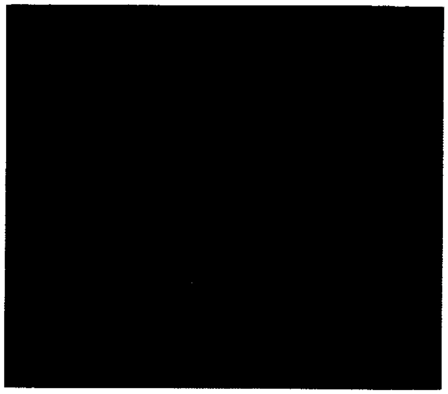
α = 8°



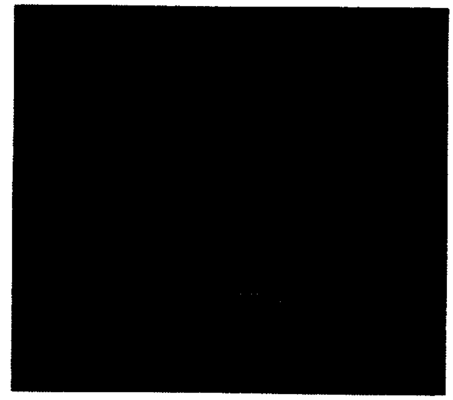
α = 12°

(c) $M = 2.00$.

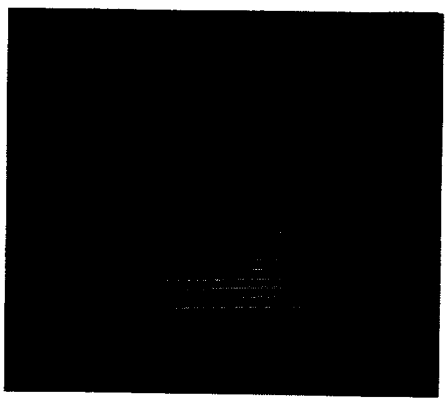
Figure B1. Continued.



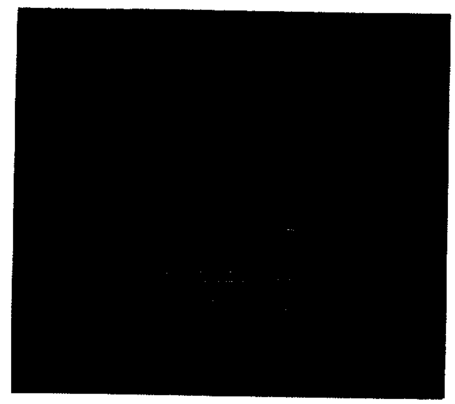
α = 0°



α = 2°

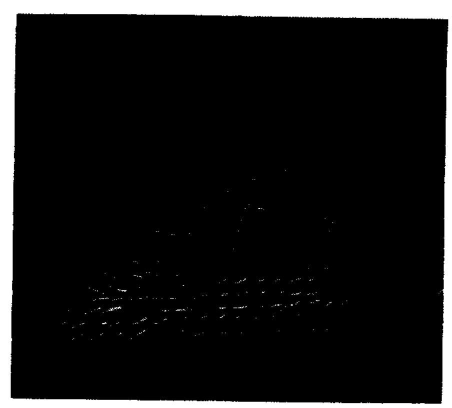


α = 4°



α = 6°

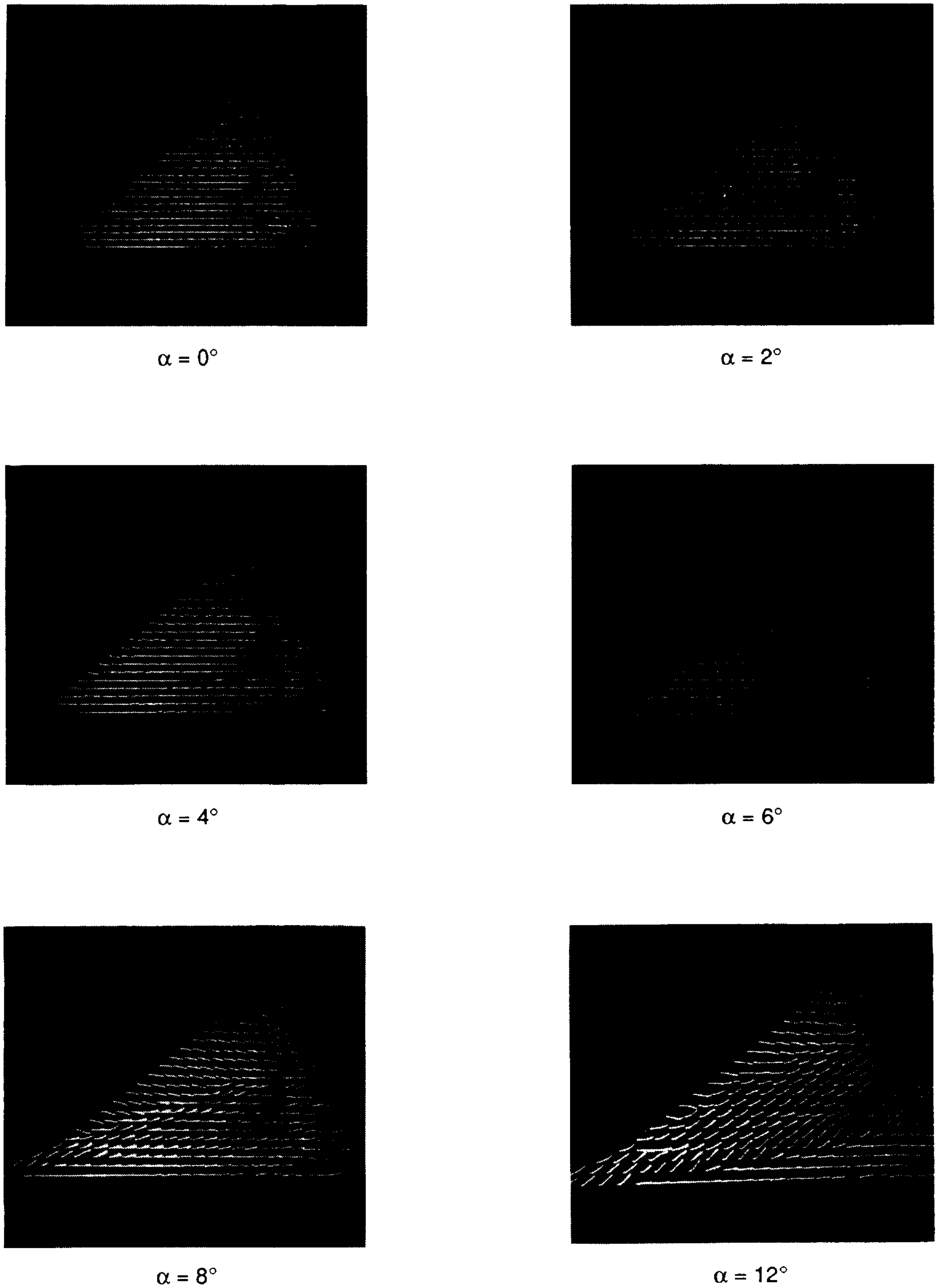
α = 8°



α = 12°

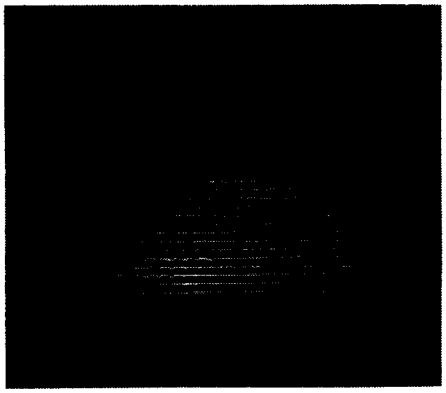
(d) $M = 2.16$.

Figure B1. Concluded.

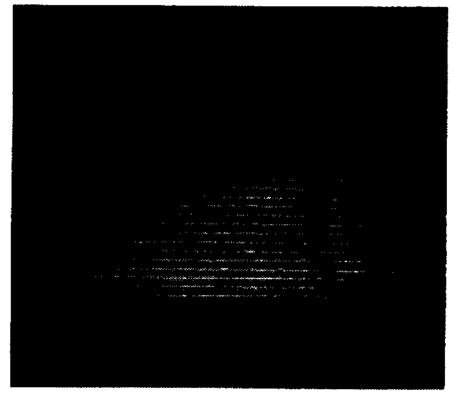


(a) $M = 1.60$.

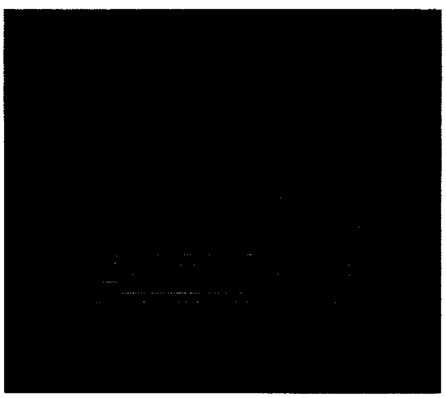
Figure B2. Tuft photographs of uncambered wing at $\alpha = 0°$, $2°$, $4°$, $6°$, $8°$, and $12°$ with $\delta_{LE} = 0°$ and $\delta_{TE} = -10°$.



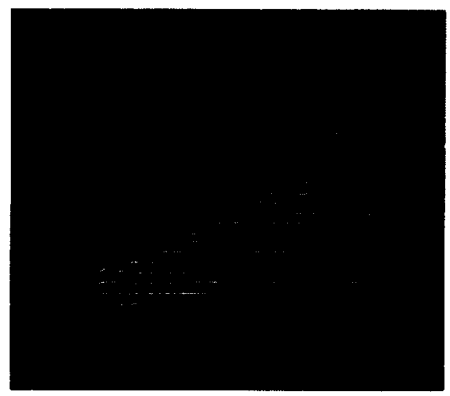
$\alpha = 0°$



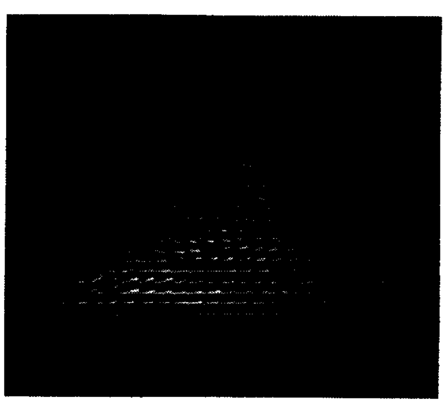
$\alpha = 2°$



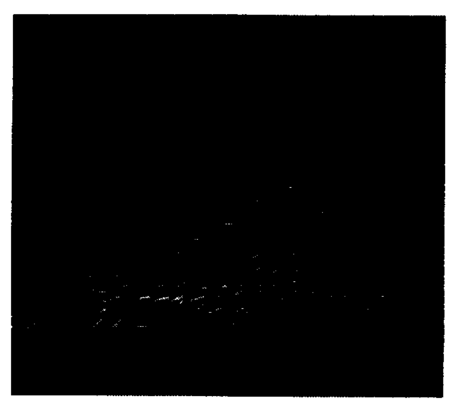
$\alpha = 4°$



$\alpha = 6°$



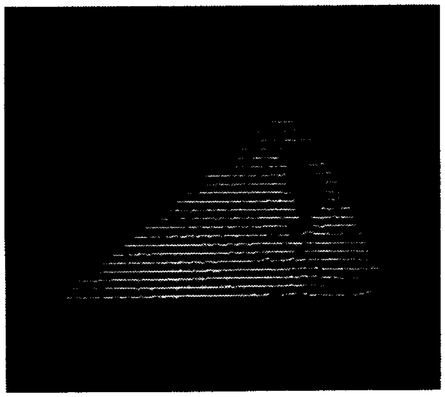
$\alpha = 8°$



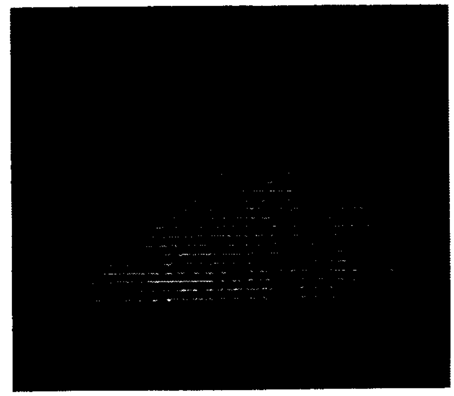
$\alpha = 12°$

(b) $M = 1.80$.

Figure B2. Continued.

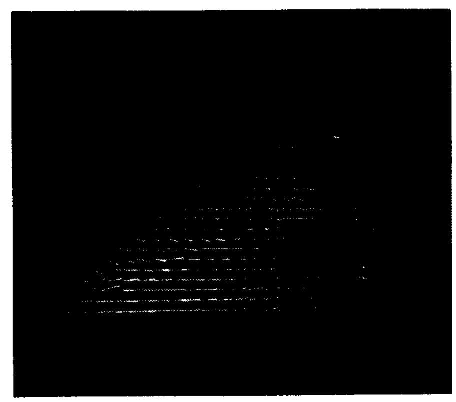


$\alpha = 0°$

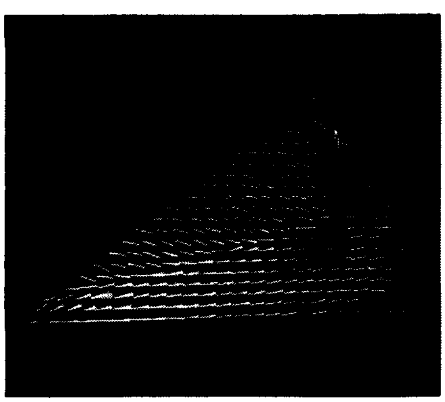


$\alpha = 2°$

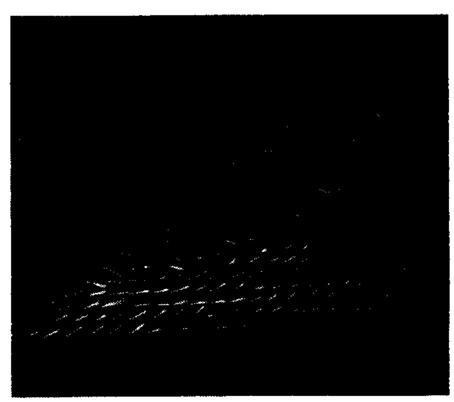
$\alpha = 4°$



$\alpha = 6°$



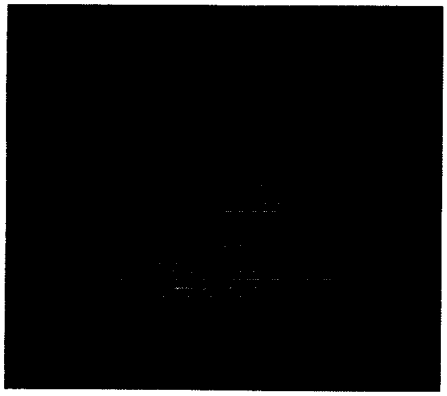
$\alpha = 8°$



$\alpha = 12°$

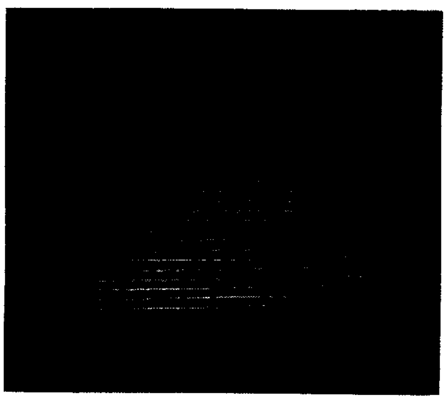
(c) $M = 2.00$.

Figure B2. Continued.



$\alpha = 0°$

$\alpha = 2°$



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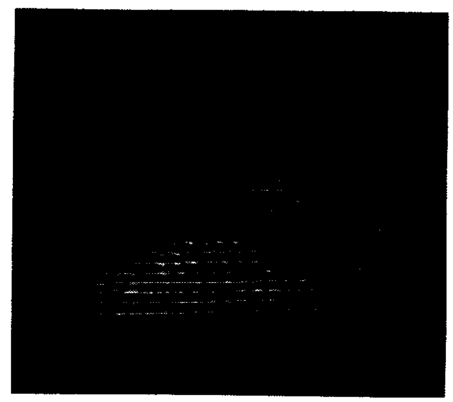
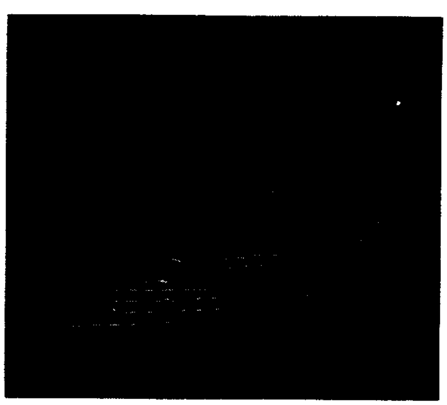
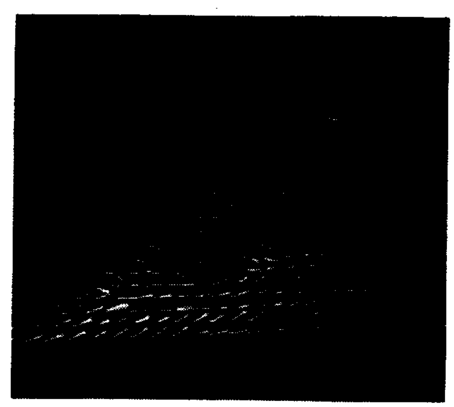


$\alpha = 6°$



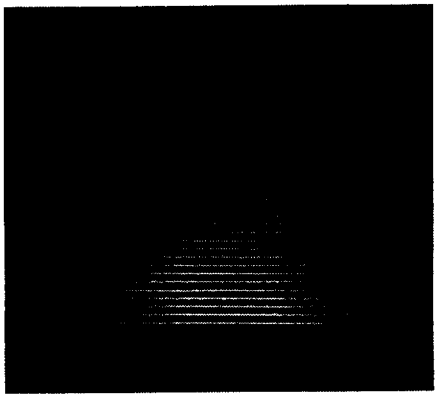
$\alpha = 8°$



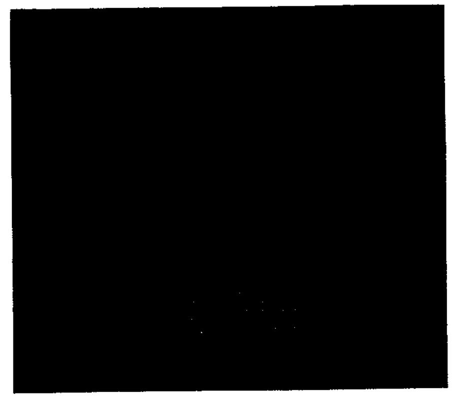
$\alpha = 12°$

(d) $M = 2.16$.

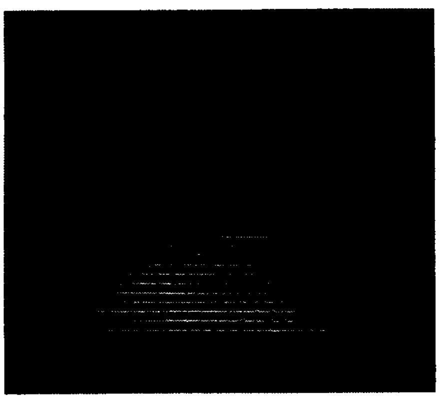
Figure B2. Concluded.



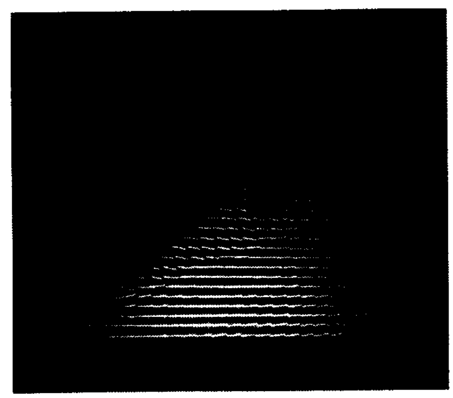
$\alpha = 0°$



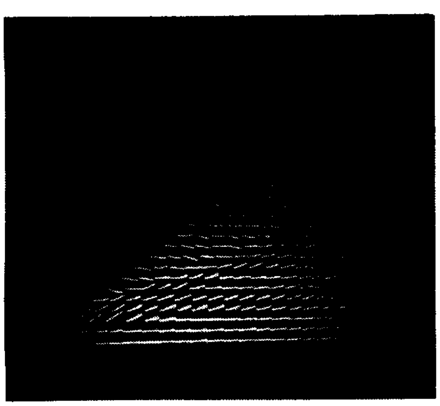
$\alpha = 2°$



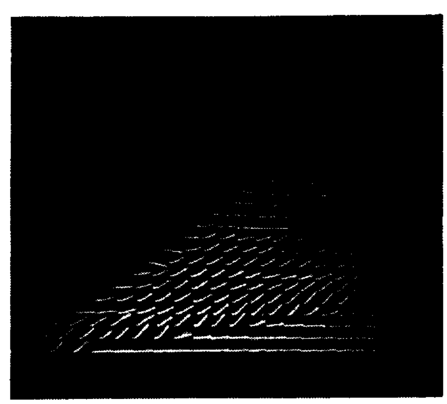
$\alpha = 4°$



$\alpha = 6°$



$\alpha = 8°$

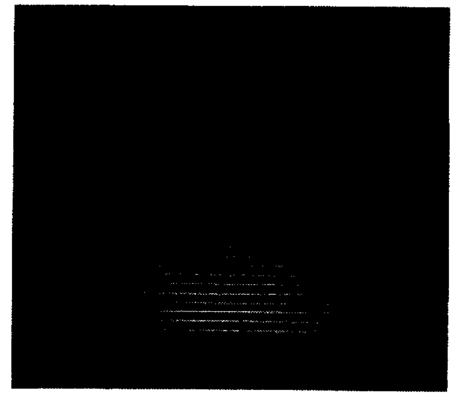


$\alpha = 12°$

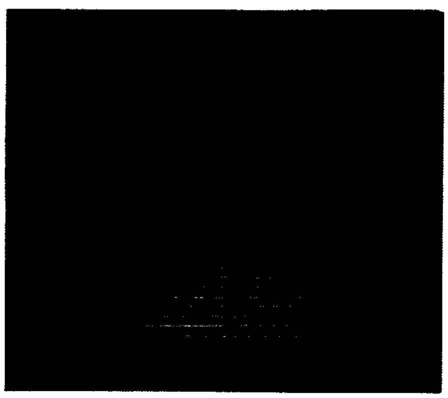
(a) $M = 1.60$.

Figure B3. Tuft photographs of uncambered wing at $\alpha = 0°$, $2°$, $4°$, $6°$, $8°$, and $12°$ with $\delta_{LE} = 0°$ and $\delta_{TE} = 0°$.

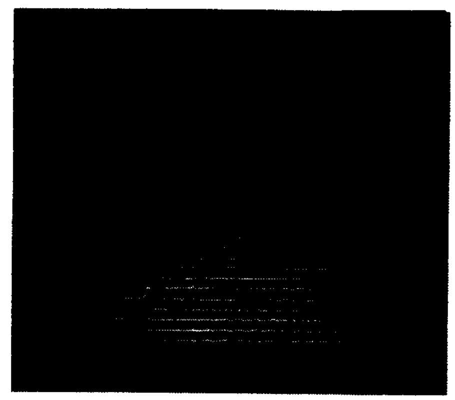
α = 0°



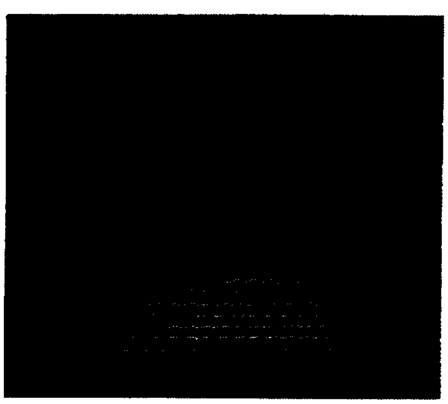
α = 2°



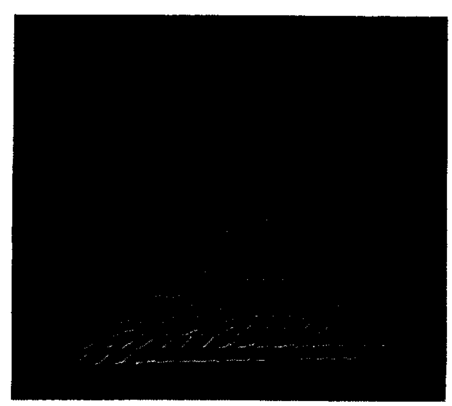
α = 4°



α = 6°



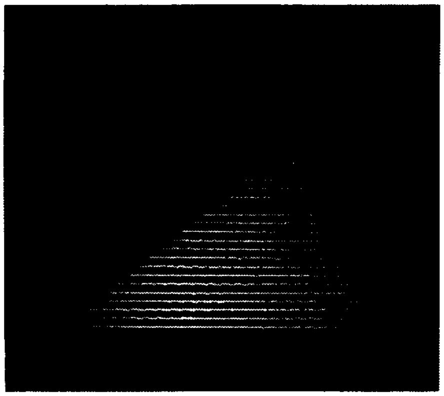
α = 8°



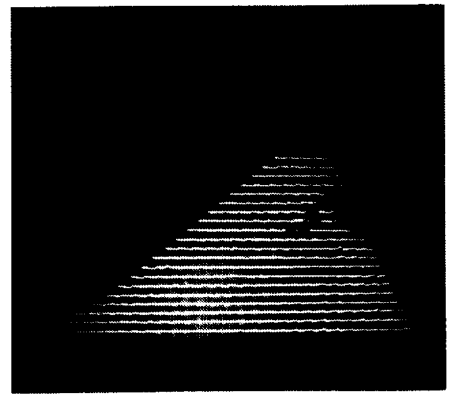
α = 12°

(b) $M = 1.80$.

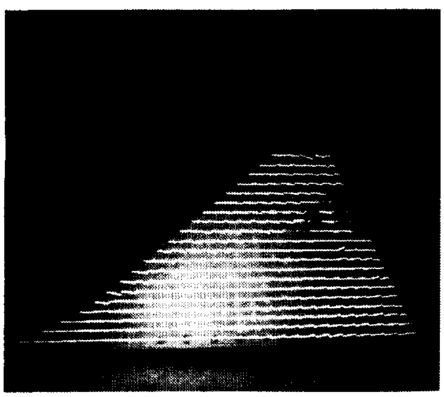
Figure B3. Continued.



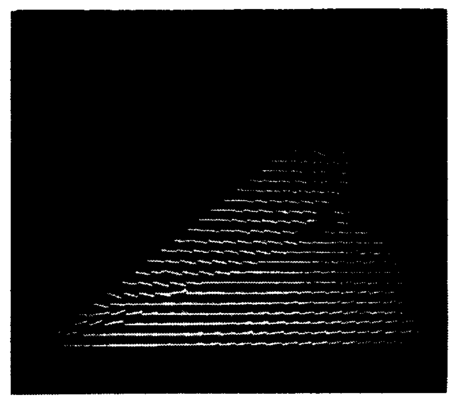
$\alpha = 0°$



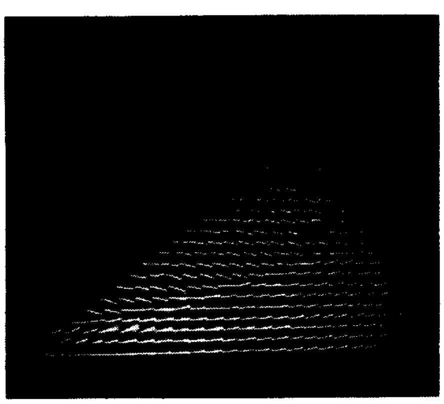
$\alpha = 2°$



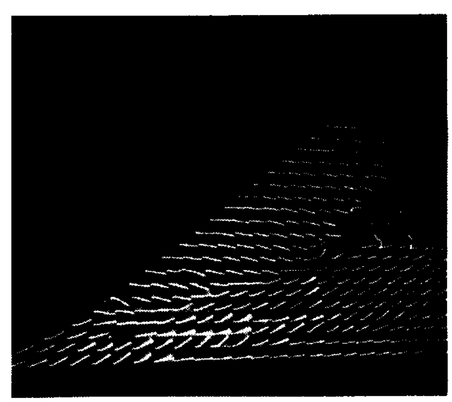
$\alpha = 4°$



$\alpha = 6°$



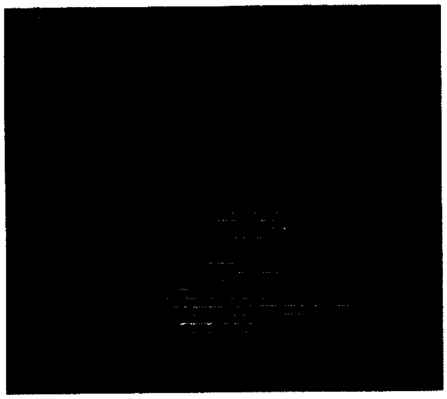
$\alpha = 8°$



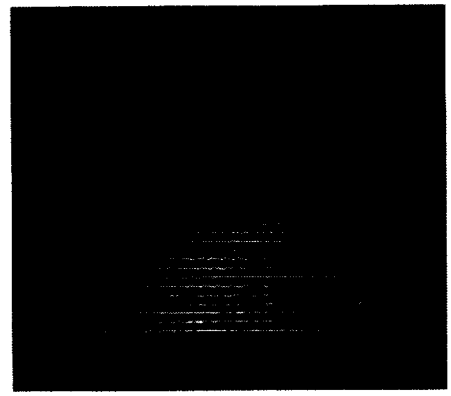
$\alpha = 12°$

(c) $M = 2.00$.

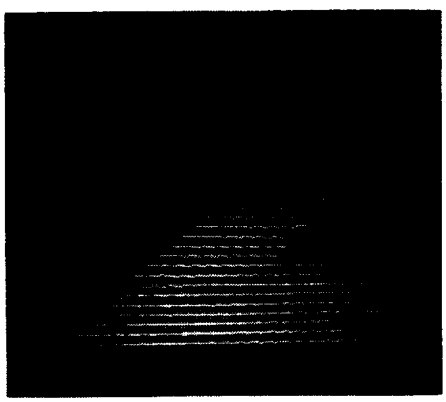
Figure B3. Continued.



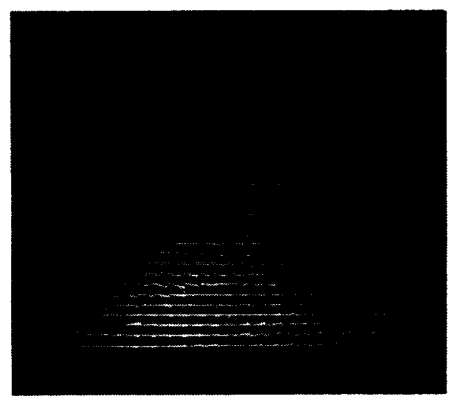
α = 0°



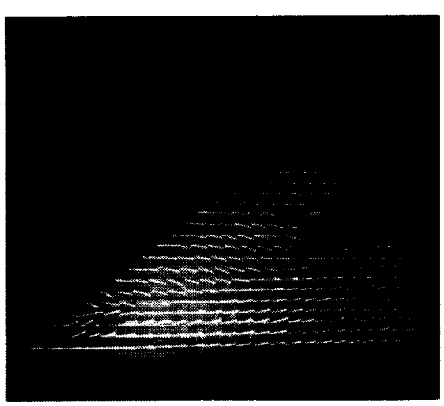
α = 2°



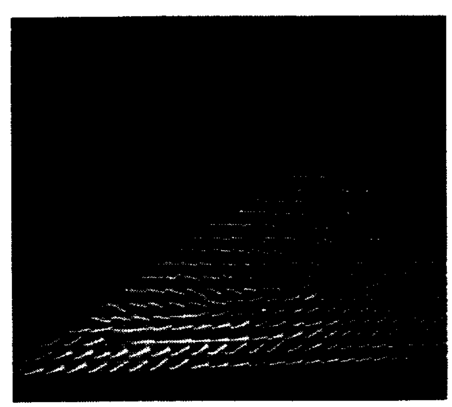
α = 4°



α = 6°



α = 8°

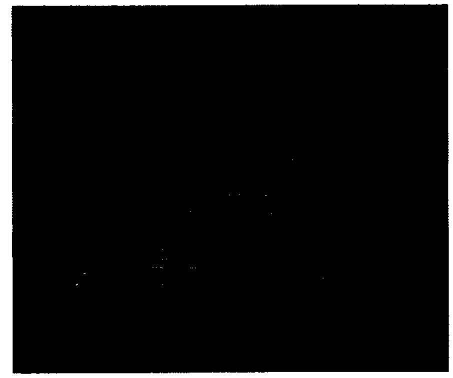


α = 12°

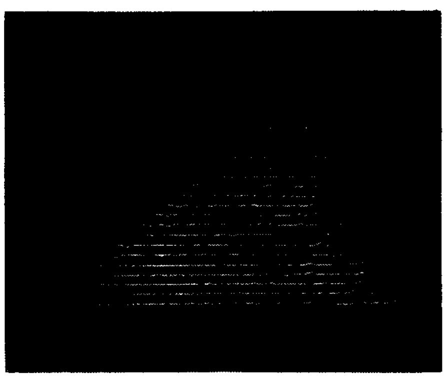
(d) $M = 2.16$.

Figure B3. Concluded.

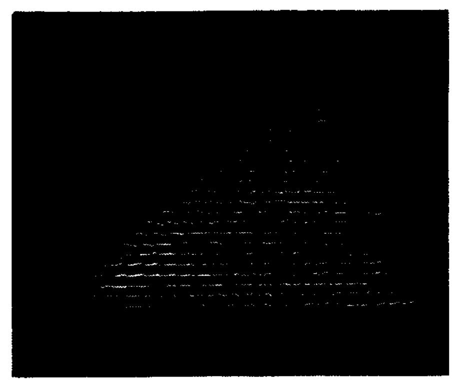
α = 0°



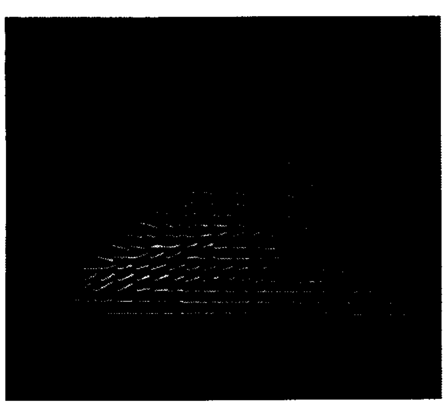
α = 2°



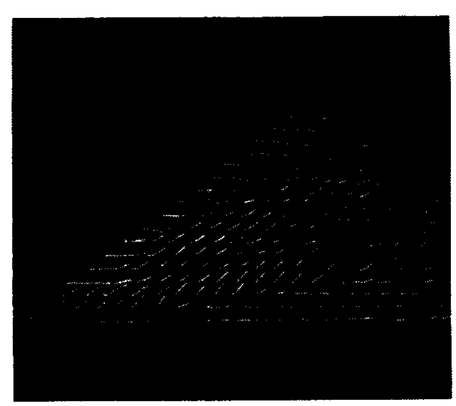
α = 4°



α = 6°



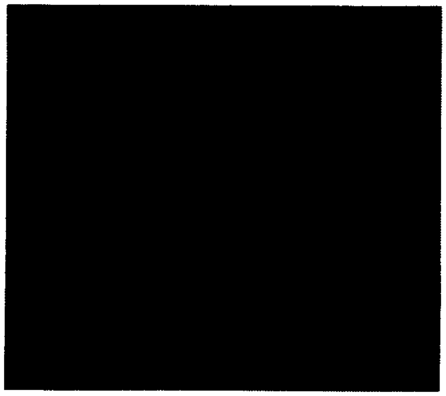
α = 8°



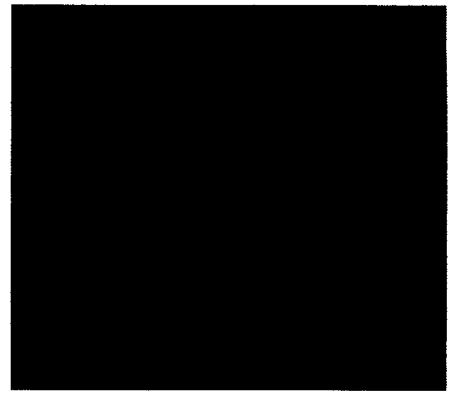
α = 12°

(a) $M = 1.60$.

Figure B4. Tuft photographs of uncambered wing at $\alpha = 0^\circ$, 2°, 4°, 6°, 8°, and 12° with $\delta_{LE} = 0^\circ$ and $\delta_{TE} = 10^\circ$.

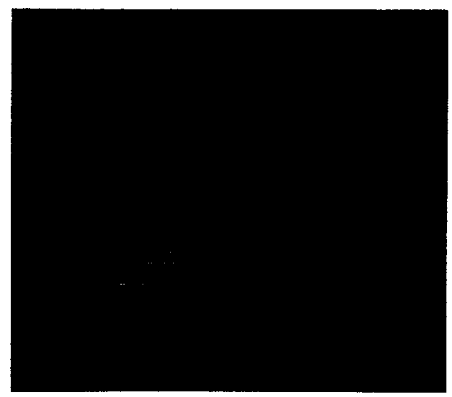


$\alpha = 0°$



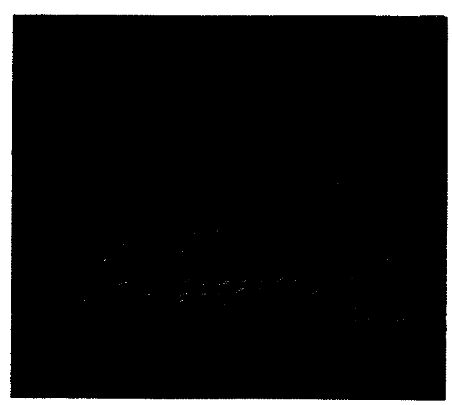
$\alpha = 2°$

$\alpha = 4°$



$\alpha = 6°$

$\alpha = 8°$

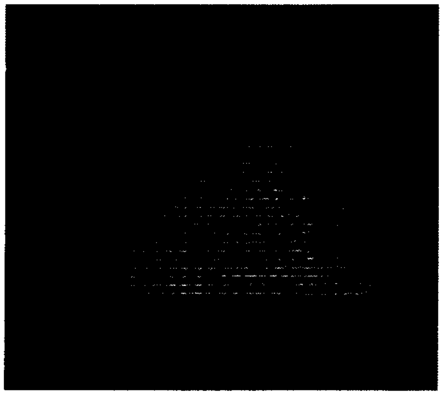


$\alpha = 12°$

(b) $M = 1.80$.

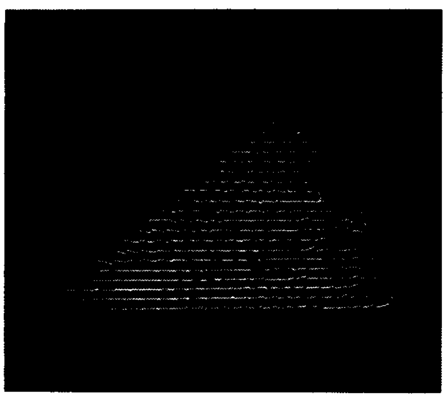
Figure B4. Continued.

C-2.

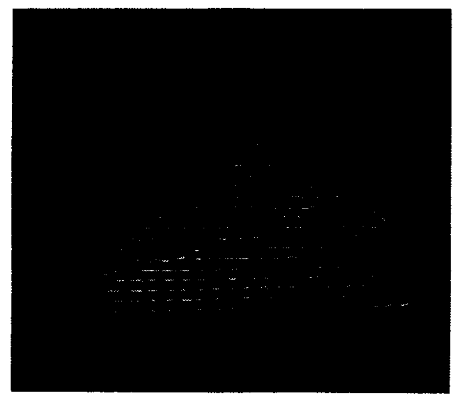


α = 0°

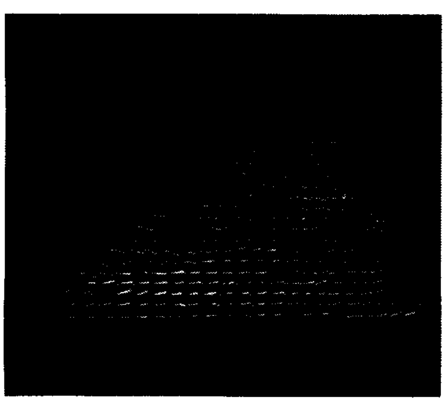
α = 2°



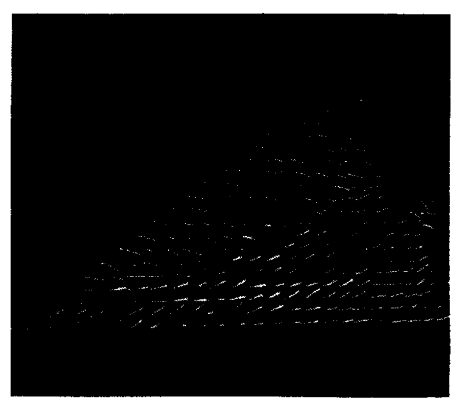
α = 4°



α = 6°



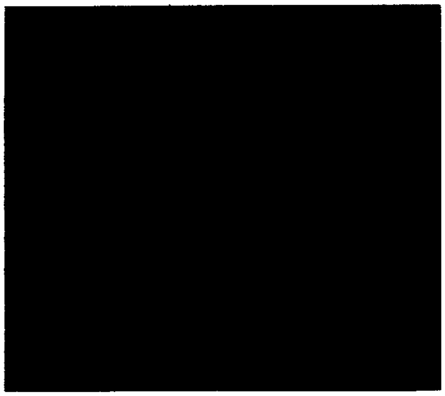
α = 8°



α = 12°

(c) $M = 2.00$.

Figure B4. Continued.

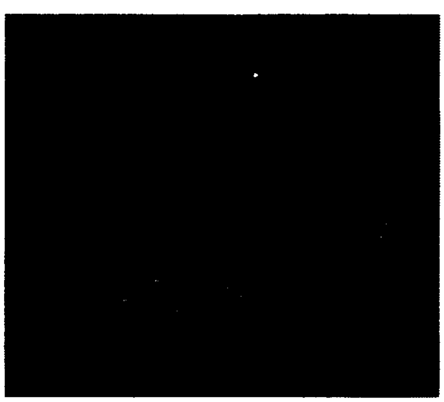


$\alpha = 0°$

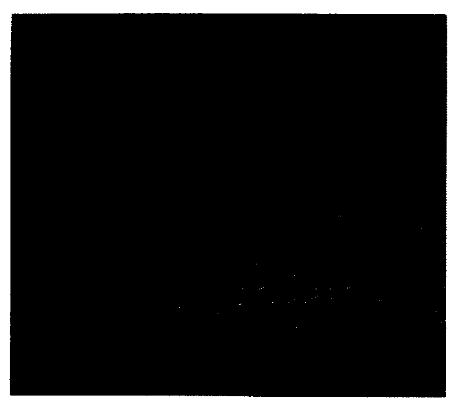
$\alpha = 2°$

$\alpha = 4°$

$\alpha = 6°$



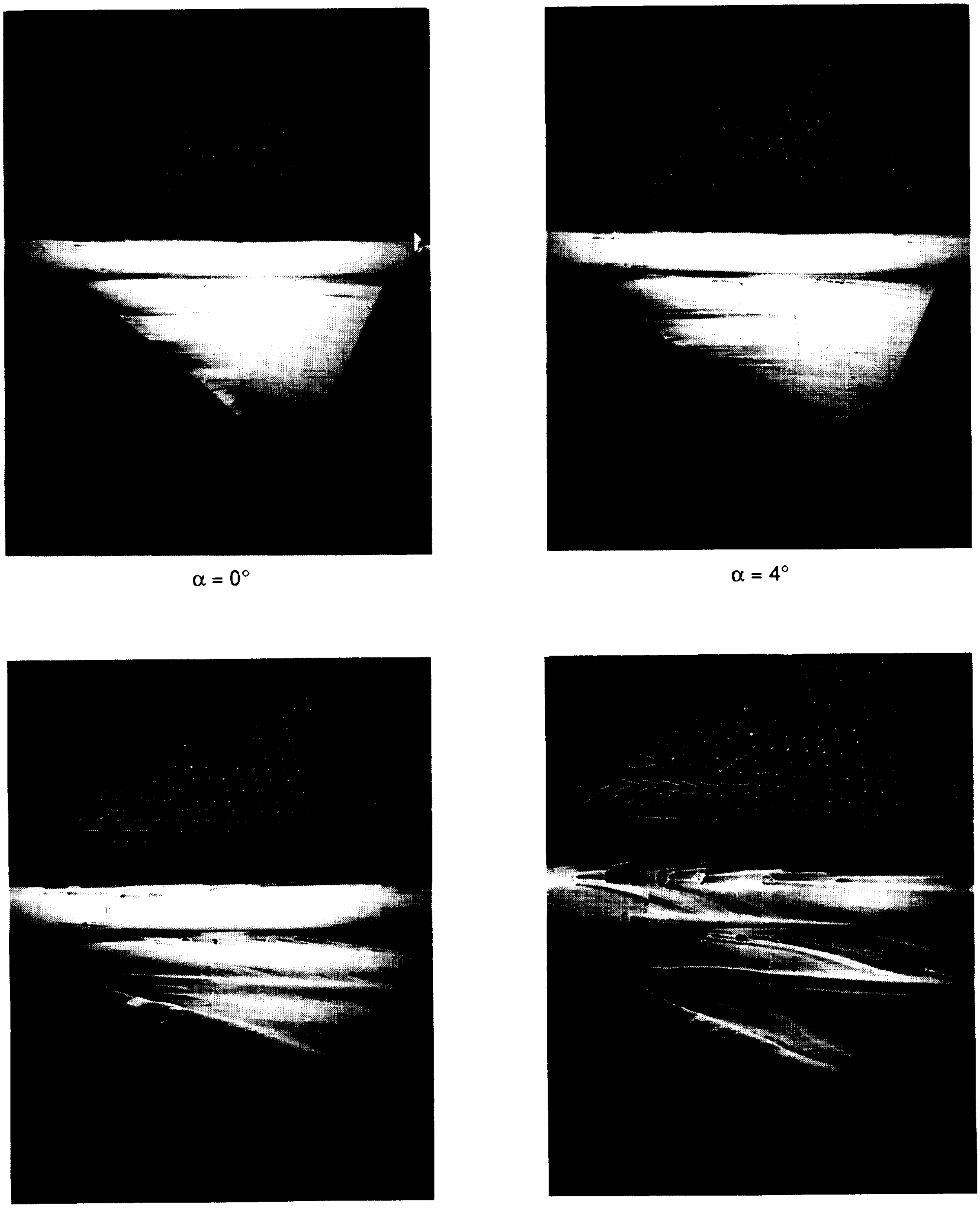
$\alpha = 8°$



$\alpha = 12°$

(d) $M = 2.16$.

Figure B4. Concluded.

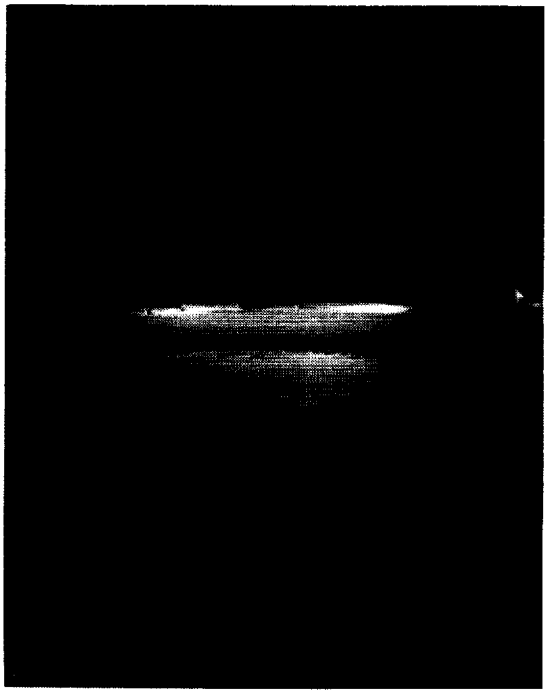


α = 0° α = 4°

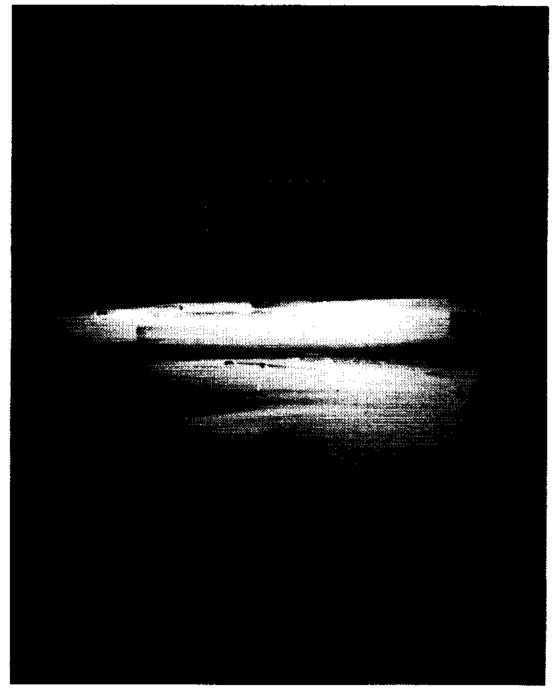
α = 8° α = 12°

(a) $M = 1.60$.

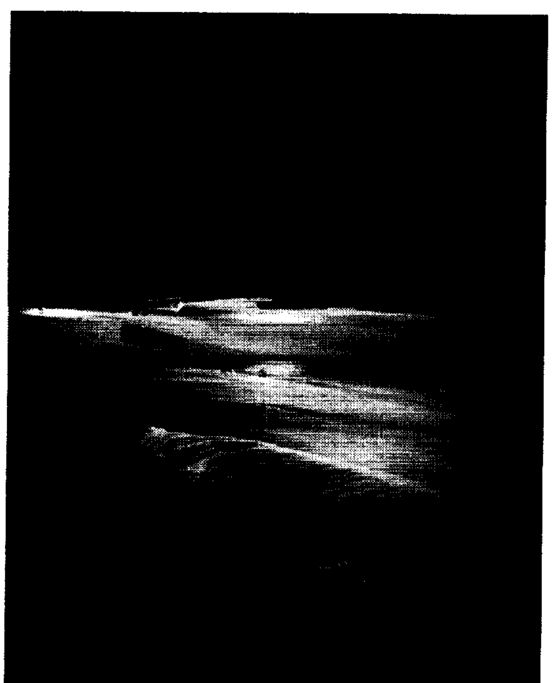
Figure B5. Oil flow and tuft photographs of uncambered wing at $\alpha = 0°$, 4°, 8°, and 12° for $\delta_{LE} = 5°$ and $\delta_{TE} = 0°$.



α = 0°



α = 4°

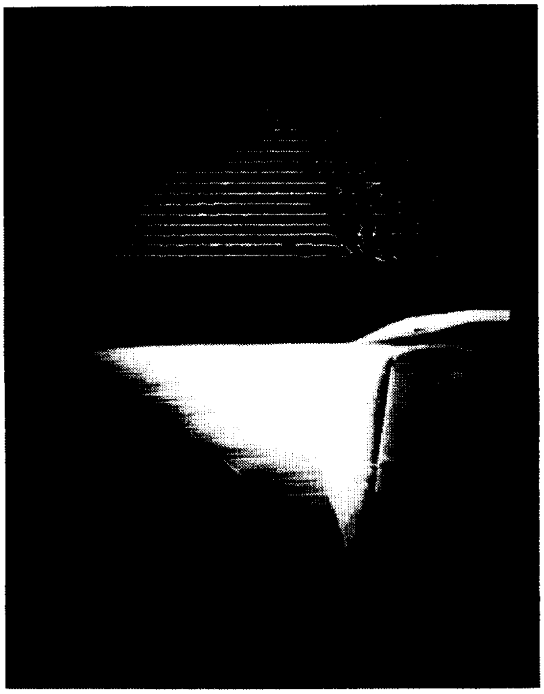


α = 8°

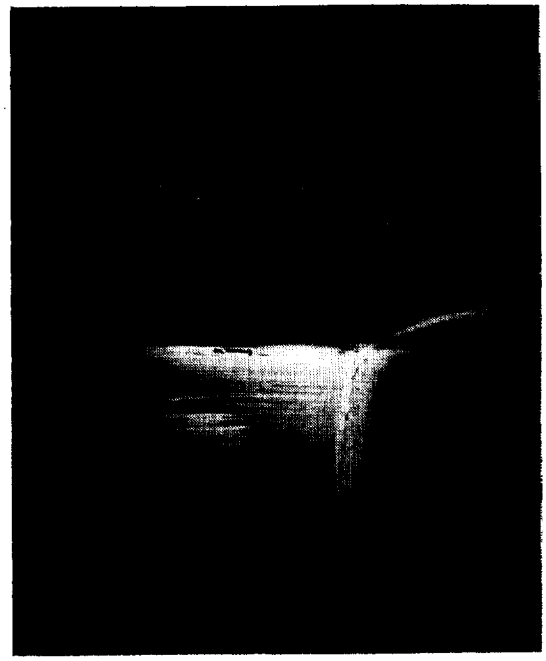
α = 12°

(b) $M = 2.16$.

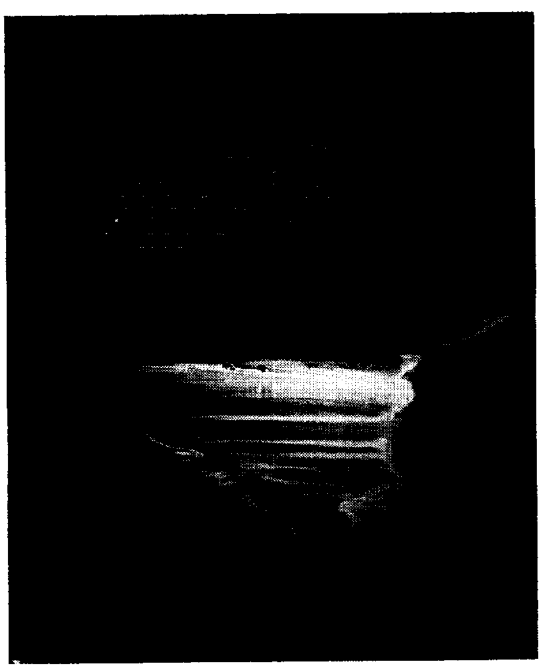
Figure B5. Concluded.



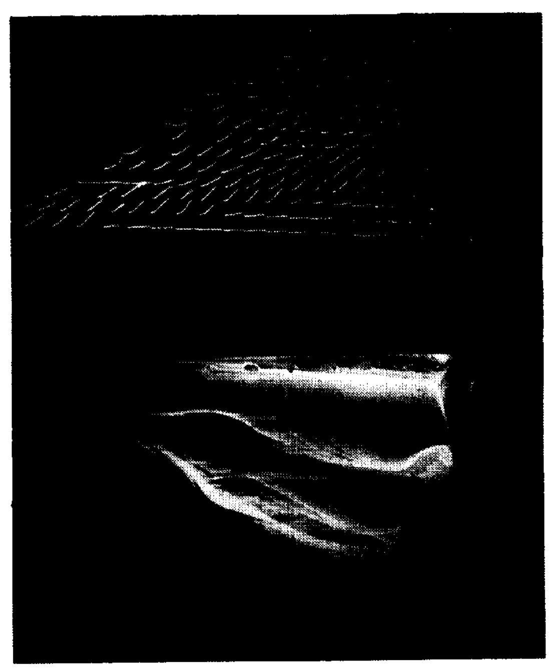
α = 0°



α = 4°



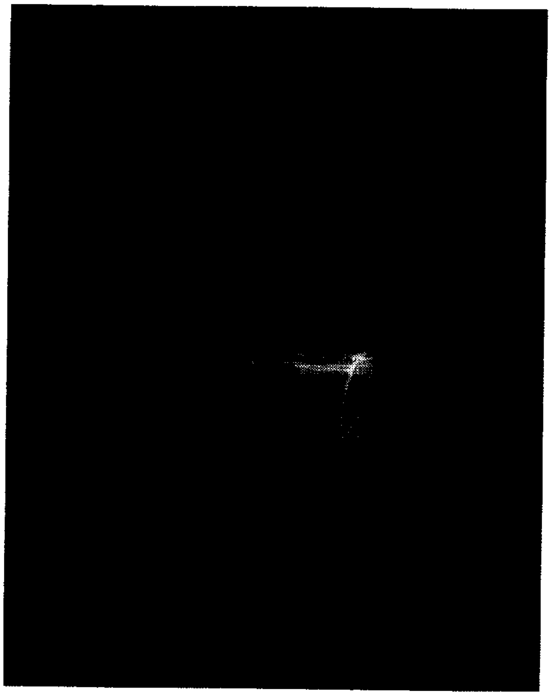
α = 8°



α = 12°

(a) $M = 1.60$.

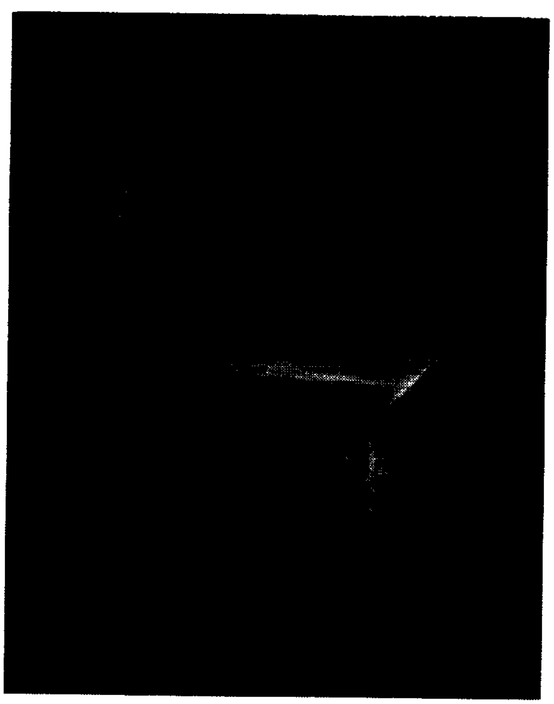
Figure B6. Oil flow and tuft photographs of uncambered wing at $\alpha = 0^\circ$, 4°, 8°, and 12° for $\delta_{LE} = 0^\circ$ and $\delta_{TE} = -30^\circ$.



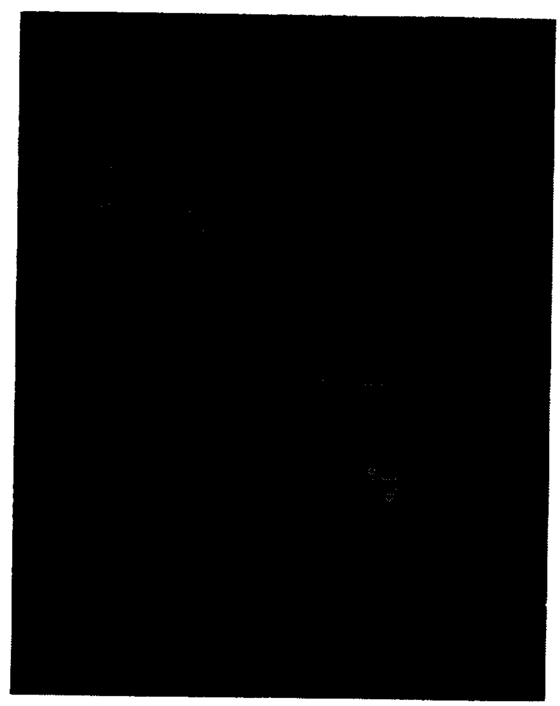
α = 0°

Photograph
not
available

α = 4°



α = 8°



α = 12°

(b) $M = 2.16$.

Figure B6. Concluded.

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13. ABSTRACT *(Maximum 200 words)*
An experimental investigation of the aerodynamic characteristics of thin, moderately swept fighter wings has been conducted to evaluate the effect of camber and twist on the effectiveness of leading- and trailing-edge flaps at supersonic speeds in the Langley Unitary Plan Wind Tunnel. The study geometry consisted of a generic fuselage with camber typical of advanced fighter designs without inlets, canopy, or vertical tail. The model was tested with two wing configurations—an uncambered (flat) wing and a cambered and twisted wing. Each wing had an identical clipped delta planform with an inboard leading edge swept back 65° and an outboard leading edge swept back 50°. The trailing edge was swept forward 25°. The leading-edge flaps were deflected from $-4°$ to 15°, and the trailing-edge flaps were deflected from $-30°$ to 10°. Longitudinal force and moment data were obtained at Mach numbers of 1.60, 1.80, 2.00, and 2.16 for an angle-of-attack range of $-4°$ to 20° at a Reynolds number of 2.16×10^6 per foot and for an angle-of-attack range of $-4°$ to 20° at a Reynolds number of 2.0×10^6 per foot. Vapor screen, tuft, and oil flow visualization data are also included.

14. SUBJECT TERMS
Leading-edge flaps; Trailing-edge flaps; Cambered wing; Supersonic speeds; Longitudinal aerodynamic characteristics

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