

The S833, S834, and S835 Airfoils

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ABSTRACT

A family of quiet, thick, natural-laminar-flow airfoils, the S833, S834, and S835, for 1- to 3-meter-diameter, variable-speed/variable-pitch, horizontal-axis wind turbines has been designed and analyzed theoretically. The two primary objectives of high maximum lift, relatively insensitive to roughness, and low profile drag have generally been achieved. The airfoils should exhibit docile stalls, which meets the design goal. The constraints on the pitching moment and the airfoil thicknesses have been satisfied.

INTRODUCTION

The majority of the airfoils in use on horizontal-axis wind turbines today were originally developed for aircraft. The design requirements for these airfoils, primarily National Advisory Committee for Aeronautics (NACA) and National Aeronautics and Space Administration (NASA) airfoils (refs. 1–6), are significantly different from those for wind-turbine airfoils (ref. 7). Accordingly, several families of airfoils have been designed specifically for horizontal-axis wind-turbine applications, both in the United States, as shown in the following table, and in Europe (e.g., ref. 8).

| Wind Turbine | | Airfoil-Thickness Category | Airfoil | | | Reference |
|--------------|----------------------------------|----------------------------|---------------|---------------|--------------|-----------|
| Diameter | Type | | Primary | Tip | Root | |
| 3–10 m | Variable speed Variable pitch | Thick | — | S822 | S823 | 14 |
| 10–20 m | Variable speed Variable pitch | Thin | S801 | S802 S803 | S804 | 9 |
| | Stall regulated | Thin | S805 S805A | S806 S806A | S807 S808 | |
| 20–30 m | Stall regulated | Thick | S819 | S820 | S821 | 13 |
| | | | S809 | S810 | S811 | 10 |
| 20–30 m | Stall regulated | Thick | S812 | S813 | S814 S815 | 10 and 11 |
| | | | S825 | S826 | S814 S815 | 15 and 11 |
| 20–40 m | Variable speed Variable pitch | — | S825 | S826 | S814 S815 | 15 and 11 |
| 30–50 m | Stall regulated | Thick | S816 | S817 | S818 | 12 |
| 40–50 m | Stall regulated | Thick | S827 | S828 | S818 | 16 and 12 |
| | Variable speed Variable pitch | | S830 | S831 S832 | S818 | 17 and 12 |

An overview of almost all the airfoil families in the preceding table is given in reference 18.

The family of airfoils designed under the present study is intended for 1- to 3-meter-diameter, variable-speed/variable-pitch, horizontal-axis wind turbines. It is meant to not only augment the table but also to be quieter than the previous families. The airfoils of the present family should be more suitable for variable-speed/variable-pitch wind turbines than the S822 and S823 airfoils (ref. 14) and appropriate for lower Reynolds numbers (i.e., smaller machines).

Because of the limitations of the theoretical method (refs. 19 and 20) employed in this study, the results presented are in no way guaranteed to be accurate—either in an absolute or in a relative sense. This statement applies to the entire study.

SYMBOLS

| | |
|----------|---|
| C_p | pressure coefficient |
| c | airfoil chord, m |
| c_d | section profile-drag coefficient |
| c_l | section lift coefficient |
| c_m | section pitching-moment coefficient about quarter-chord point |
| R | Reynolds number based on free-stream conditions and airfoil chord |
| t | airfoil thickness, m |
| x | airfoil abscissa, m |
| y | airfoil ordinate, m |
| α | angle of attack relative to x-axis, deg |

Subscripts:

| | |
|-----|-------------------------------|
| ll | lower limit of low-drag range |
| max | maximum |
| S | separation |
| T | transition |

ul upper limit of low-drag range

0 zero lift

Abbreviations:

L. lower surface

NACA National Advisory Committee for Aeronautics

NASA National Aeronautics and Space Administration

NREL National Renewable Energy Laboratory

S. boundary-layer separation location, x_S/c

T. boundary-layer transition location, x_T/c

U. upper surface

AIRFOIL DESIGN

OBJECTIVES AND CONSTRAINTS

The aerodynamic noise produced by wind-turbine blades is generated primarily by the outboard portion of the blades, where the flow velocity is highest (ref. 21). Recent research suggests that the lift (lift coefficient times blade chord) produced by the outboard portion of the blade should be constrained to alleviate the noise. Accordingly, a decreasing, as opposed to increasing outboard, maximum lift coefficient is specified. In addition, the airfoil thickness decreases toward the blade tip to reduce the noise due to thickness. The remainder of the design specifications for the family of airfoils are consistent with those for previous airfoil families having large thickness or high maximum lift coefficient.

The design specifications were originally outlined by, and later refined during discussions with, James L. Tangler of the National Renewable Energy Laboratory (NREL). The final specifications are contained in table I. The family consists of three airfoils, primary, tip, and root, corresponding to the 0.75, 0.95, and 0.40 blade radial stations, respectively.

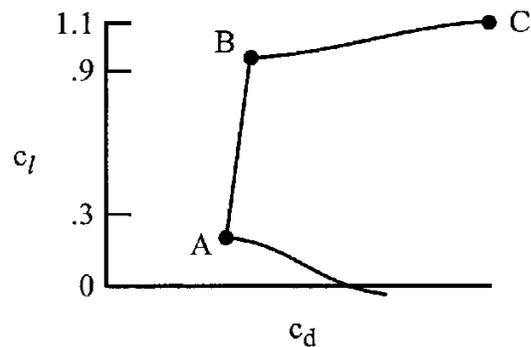
Two primary objectives are evident from the specifications. The first objective is to achieve high maximum lift coefficients. A requirement related to this objective is that the maximum lift coefficients not decrease significantly with transition fixed near the leading edge on both surfaces. In addition, the airfoils should exhibit docile stall characteristics. The second objective is to obtain low profile-drag coefficients over the specified ranges of lift coefficients.

Two major constraints were placed on the design of these airfoils. First, the zero-lift pitching-moment coefficient must be no more negative than -0.15 . Second, the airfoil thicknesses must equal those specified.

The specifications for these airfoils are similar to those for the S822 and S823 airfoils (ref. 14), except the Reynolds numbers are lower. In addition, the present family contains one more airfoil to more precisely define the blade.

PHILOSOPHY

Given the above objectives and constraints, certain characteristics of the designs are apparent. The following sketch illustrates a drag polar that meets the goals for the primary airfoil. (The polars for the tip and root airfoils should be qualitatively similar.)

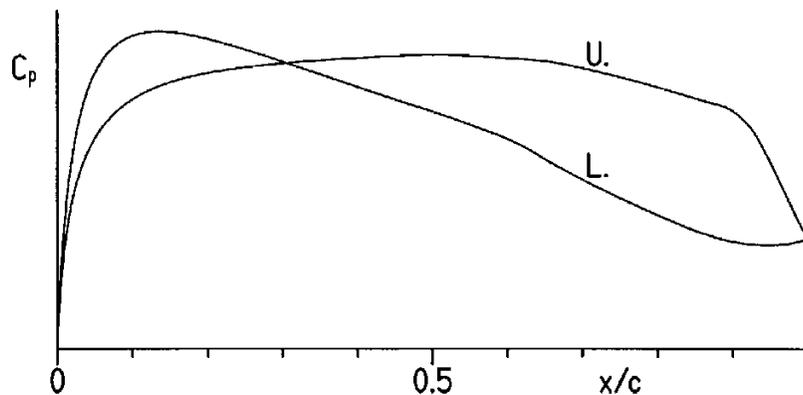


Sketch 1

The desired airfoil shape can be traced to the pressure distributions that occur at the various points in sketch 1. Point A is the lower limit of the low-drag, lift-coefficient range. The lift coefficient at point A is lower than the objective specified in table I. The difference is intended as a margin against such contingencies as manufacturing tolerances, operational deviations, three-dimensional effects, and inaccuracies in the theoretical method. A similar margin is also desirable at the upper limit of the low-drag range, point B, although this margin is constrained by the proximity of the upper limit to the maximum lift coefficient. The profile-drag coefficient at point B is not as low as at point A, unlike the polars of many laminar-flow airfoils where the drag coefficient within the laminar bucket is nearly constant. This characteristic is related to the mitigation of drag- and noise-producing laminar separation bubbles on the upper surface. (See ref. 22.) The small increase in profile-drag coefficient with increasing lift coefficient is relatively inconsequential because the ratio of the profile drag to the total drag of the wind-turbine blade decreases with increasing lift coefficient. The profile-drag coefficient increases very rapidly outside the low-drag range because boundary-layer transition moves quickly toward the leading edge with increasing (or decreasing) lift coefficient.

This feature results in a leading edge that produces a suction peak at higher lift coefficients, which ensures that transition on the upper surface will occur very near the leading edge. Thus, the maximum lift coefficient, point C, occurs with turbulent flow along the entire upper surface and, therefore, should be relatively insensitive to roughness at the leading edge. Note that, because the large thickness of the primary airfoil allows a wider low-drag range to be achieved than specified, the lower limit of the low-drag range should be below point A.

From the preceding discussion, the pressure distributions along the polar can be deduced. The pressure distribution at point A for the primary airfoil should look something like sketch 2. (The pressure distributions for the tip and root airfoils should be qualitatively similar.)



Sketch 2

To achieve low drag, a favorable pressure gradient is desirable along the upper surface to about 50-percent chord. Aft of this point, a region having a shallow, adverse pressure gradient (“transition ramp”) promotes the efficient transition from laminar to turbulent flow (ref. 23). The curved transition ramp (ref. 22) is followed by a convex pressure recovery, which further alleviates laminar separation bubbles. The pressure recovery begins farther forward than dictated by transition-free minimum-drag requirements to decrease the boundary-layer thickness and increase the skin-friction coefficient at the trailing edge with transition fixed, which reduces the noise due to the interaction between the turbulent boundary layer and the trailing edge, a primary noise source for wind turbines. (See ref. 24.) Thus, the specific pressure recovery employed represents a compromise between maximum lift, drag, pitching moment, stall characteristics, and noise. The steep, adverse pressure gradient aft of about 90-percent chord is a “separation ramp,” originally proposed by F. X. Wortmann,¹ which confines turbulent separation to a small region near the trailing edge. By constraining the movement of the separation point at high angles of attack, high lift coefficients can be achieved with little drag

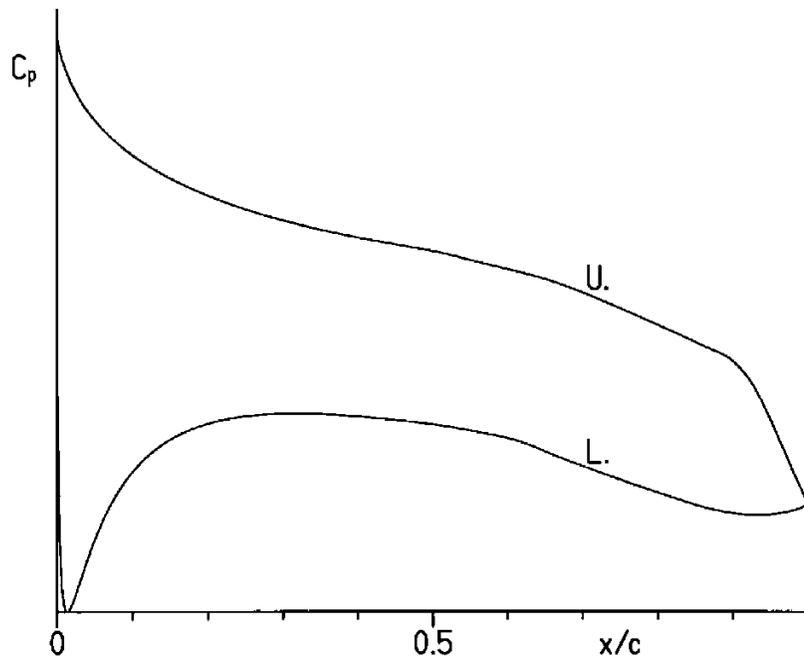
¹Director, Institute for Aerodynamics and Gas Dynamics, University of Stuttgart, Germany.

penalty. This feature has the added benefit of initiating docile stall characteristics. (See ref. 25.)

A moderately adverse pressure gradient is desirable along the lower surface to about 60-percent chord to achieve low drag and alleviate laminar separation bubbles. This region is followed by a curved transition ramp and then a concave pressure recovery, which exhibits lower drag and has less tendency to separate than the corresponding linear or convex pressure recovery (ref. 23). The pressure recovery must begin farther forward than dictated by transition-free minimum-drag requirements to alleviate separation at lower lift coefficients, especially with transition fixed near the leading edge.

The amounts of pressure recovery on the upper and lower surfaces are determined by the airfoil-thickness and pitching-moment constraints.

At point B, the pressure distribution should look like sketch 3.



Sketch 3

No suction spike exists at the leading edge. Instead, a rounded peak occurs just aft of the leading edge. Transition is essentially imminent over the entire forward portion of the upper surface. This feature allows a wider low-drag range to be achieved and higher lift coefficients to be reached without significant separation. It also causes transition to move very quickly

toward the leading edge with increasing lift coefficient, which leads to the roughness insensitivity of the maximum lift coefficient.

Mitigation of laminar separation bubbles, especially on the upper surface, was increasingly emphasized with increasing blade radial station, because of the increasing flow velocity, to eliminate this possible noise source.

EXECUTION

Given the pressure distributions previously discussed, the design of the airfoils is reduced to the inverse problem of transforming the pressure distributions into airfoil shapes. The Eppler Airfoil Design and Analysis Code (refs. 19 and 20) was used because of its unique capability for multipoint design and because of confidence gained during the design, analysis, and experimental verification of many other airfoils. (See refs. 26–31, for example.)

The primary airfoil, which corresponds to the 0.75 blade radial station, is designated the S833. The tip and root airfoils, the S834 and S835, which correspond to the 0.95 and 0.40 blade radial stations, respectively, were derived from the S833 airfoil to increase the aerodynamic and geometric compatibilities of the three airfoils. The airfoil shapes are shown in figure 1 and the coordinates are contained in tables II, III, and IV. The S833 airfoil thickness is 18-percent chord; the S834, 15-percent chord; and the S835, 21-percent chord, which satisfy the design constraints.

THEORETICAL PROCEDURE

The section characteristics are predicted for Reynolds numbers of 0.15×10^6 to 0.70×10^6 . The computations were performed with transition free using transition mode 3, with transition fixed at 2-percent chord on the upper surface and 5-percent chord on the lower surface using transition mode 1, and “rough” using transition mode 9, which simulates distributed roughness due to, for example, leading-edge contamination by water drops or insects. (See ref. 20.)

Because the free-stream Mach number for all relevant wind-turbine operating conditions remains below 0.3, all results are incompressible.

DISCUSSION OF RESULTS

S833 AIRFOIL

Pressure Distributions

The inviscid pressure distributions for the S833 airfoil at various angles of attack are shown in figure 2 and tabulated in appendix A.

Transition and Separation Locations

The variation of boundary-layer transition location with lift coefficient for the S833 airfoil is shown in figure 3 and tabulated in appendix A. In the method of references 19 and 20, the transition location is defined as the end of the laminar boundary layer whether due to natural transition or laminar separation. Transition is normally confirmed in experiments, however, by the detection of an attached turbulent boundary layer. Thus, for conditions that result in relatively long laminar separation bubbles (low lift coefficients for the upper surface, high lift coefficients for the lower surface, and low Reynolds numbers), the apparent agreement between the theoretical and experimental transition locations is poor. In actuality, the difference between the predicted and measured transition locations represents the length of the laminar separation bubble (from laminar separation to turbulent reattachment). Accordingly, for conditions that result in shorter laminar separation bubbles (high lift coefficients for the upper surface, low lift coefficients for the lower surface, and high Reynolds numbers), the apparent agreement between theory and experiment improves. (See refs. 28 and 31.)

The variation of turbulent boundary-layer separation location with lift coefficient for the S833 airfoil is shown in figure 3 and tabulated in appendix A. A small, trailing-edge separation is predicted on the upper surface at all lift coefficients. This separation is caused by the separation ramp (fig. 2). Separation is predicted on the lower surface at lift coefficients in the lower half of the operating range for the intended application. Such separation usually has little effect on the section characteristics. (See ref. 28.)

Section Characteristics

Reynolds number effects.- The section characteristics of the S833 airfoil are shown in figure 3 and tabulated in appendix A. It should be noted that the maximum lift coefficient computed by the method of references 19 and 20, as well as other theoretical methods, is not always realistic. Accordingly, an empirical criterion has been applied to the computed results. This criterion assumes that the maximum lift coefficient has been reached if the drag coefficient of the upper surface is greater than $0.01719 (1 \times 10^6/R)^{1/8}$, which is based on correlations with results for Reynolds numbers from 0.7×10^6 to 1.5×10^6 from the Pennsylvania State University Low-Speed, Low-Turbulence Wind Tunnel. Thus, the maximum lift coefficient for the design Reynolds number of 0.40×10^6 is estimated to be 1.10, which meets the design objective. Based on the variation of the upper-surface separation location with lift coefficient, the stall characteristics are expected to be docile, which meets the design goal. Low profile-drag coefficients are predicted over the range of lift coefficients from below 0 to 0.86. Thus, the lower limit of the low-drag, lift-coefficient range is below the design objective of $c_{l,tl} = 0.30$, although the upper limit of the low-drag range is also below the design objective of $c_{l,ul} = 0.90$, primarily to meet other, more important goals. The zero-lift pitching-moment coefficient is predicted to be -0.14 , which satisfies the design constraint. Because of boundary-layer displacement effects not accounted for in the present analysis, the pitching-moment coefficient is generally overpredicted by about 20 percent. Therefore, the actual zero-lift pitching-moment coefficient should be about -0.12 .

Effect of roughness.- The effect of roughness on the section characteristics of the S833 airfoil is shown in figure 3. The maximum lift coefficient for the design Reynolds number of 0.40×10^6 with transition fixed is estimated to be 1.11, an increase of 1 percent from that with transition free. For the rough condition, the maximum lift coefficient for the design Reynolds number is estimated to be 1.13, an increase of 3 percent from that with transition free. Thus, the design requirement has been satisfied. The effect of roughness on the maximum lift coefficient is nearly constant with Reynolds number. The drag coefficients are, of course, adversely affected by the roughness.

S834 AIRFOIL

Pressure Distributions

The inviscid pressure distributions for the S834 airfoil at various angles of attack are shown in figure 4 and tabulated in appendix B.

Transition and Separation Locations

The variations of transition and separation locations with lift coefficient for the S834 airfoil are shown in figure 5 and tabulated in appendix B. A small, trailing-edge separation is predicted on the upper surface at all lift coefficients. This separation is caused by the separation ramp (fig. 4). Separation is predicted on the lower surface at lift coefficients below the operating range for the intended application. Such separation usually has little effect on the section characteristics.

Section Characteristics

Reynolds number effects.- The section characteristics of the S834 airfoil are shown in figure 5 and tabulated in appendix B. Using the previously described criterion, the maximum lift coefficient for the design Reynolds number of 0.40×10^6 is estimated to be 1.00, which meets the design objective. The stall characteristics are expected to be docile, which meets the design goal. Low drag coefficients are predicted over the range of lift coefficients from below 0 to 0.78. Thus, the lower limit of the low-drag range is below the design objective of $c_{l,11} = 0.20$, although the upper limit is also below the design objective of $c_{l,u1} = 0.80$, primarily to meet other, more important goals. The zero-lift pitching-moment coefficient is predicted to be -0.08 , which satisfies the design constraint. The actual zero-lift pitching-moment coefficient should be about -0.06 .

Effect of roughness.- The effect of roughness on the section characteristics of the S834 airfoil is shown in figure 5. The maximum lift coefficient for the design Reynolds number of 0.40×10^6 is unaffected by fixing transition because transition on the upper surface is predicted to occur forward of 2-percent chord at the maximum lift coefficient. For the rough condition, the maximum lift coefficient for the design Reynolds number is estimated to be 1.02,

an increase of 2 percent from that with transition free. Thus, the design requirement has been satisfied. The effect of roughness on the maximum lift coefficient is nearly constant with Reynolds number. The drag coefficients are, of course, adversely affected by the roughness.

S835 AIRFOIL

Pressure Distributions

The inviscid pressure distributions for the S835 airfoil at various angles of attack are shown in figure 6 and tabulated in appendix C.

Transition and Separation Locations

The variations of transition and separation locations with lift coefficient for the S835 airfoil are shown in figure 7 and tabulated in appendix C. A small, trailing-edge separation is predicted on the upper surface at all lift coefficients. This separation is caused by the separation ramp (fig. 6). Separation is predicted on the lower surface at all lift coefficients within the operating range for the intended application. Such separation usually has little effect on the section characteristics.

Section Characteristics

Reynolds number effects.- The section characteristics of the S835 airfoil are shown in figure 7 and tabulated in appendix C. Using the previously described criterion, the maximum lift coefficient for the design Reynolds number of 0.25×10^6 is estimated to be 1.04, which does not meet the design objective of $c_{l,max} = 1.20$, primarily because the objective is incompatible with the other requirements, especially the combination of large airfoil thickness and low Reynolds number. The stall characteristics are expected to be docile, which meets the design goal. Low drag coefficients are predicted over the range of lift coefficients from below 0 to 0.94. Thus, the lower limit of the low-drag range is below the design objective of $c_{l,II} = 0.40$, although the upper limit is also below the design objective of $c_{l,UI} = 1.00$, primarily to meet other, more important goals. The zero-lift pitching-moment coefficient is predicted to be -0.14 , which satisfies the design constraint. The actual zero-lift pitching-moment coefficient should be about -0.12 .

Effect of roughness.- The effect of roughness on the section characteristics of the S835 airfoil is shown in figure 7. The maximum lift coefficient for the design Reynolds number of 0.25×10^6 with transition fixed is estimated to be 1.00, a reduction of 4 percent from that with transition free. For the rough condition, the maximum lift coefficient for the design Reynolds number is estimated to be 1.03, a reduction of 1 percent from that with transition free. Thus, the design requirement has been satisfied. The effect of roughness on the maximum lift coefficient is nearly constant with Reynolds number. The drag coefficients are, of course, adversely affected by the roughness.

CONCLUDING REMARKS

A family of quiet, thick, natural-laminar-flow airfoils, the S833, S834, and S835, for 1- to 3-meter-diameter, variable-speed/variable-pitch, horizontal-axis wind turbines has been designed and analyzed theoretically. The two primary objectives of high maximum lift coefficients, relatively insensitive to leading-edge roughness, and low profile-drag coefficients have generally been achieved. The airfoils should exhibit docile stall characteristics, which meets the design goal. The constraints on the zero-lift pitching-moment coefficient and the airfoil thicknesses have been satisfied.

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TABLE I.- AIRFOIL DESIGN SPECIFICATIONS

| Blade radial station | 0.75 | 0.95 | 0.40 |
|--|----------------------|--------------------|--------------------|
| Parameter | Objective/Constraint | | |
| Reynolds number R | 0.40×10^6 | 0.40×10^6 | 0.25×10^6 |
| Maximum lift coefficient $c_{l,max}$ | 1.10 | 1.00 | 1.20 |
| Lower limit of low-drag, lift-coefficient range $c_{l,ll}$ | 0.30 | 0.20 | 0.40 |
| Upper limit of low-drag, lift-coefficient range $c_{l,ul}$ | 0.90 | 0.80 | 1.00 |
| Zero-lift pitching-moment coefficient $c_{m,0}$ | ≥ -0.15 | | |
| Airfoil thickness t/c | 18% | 15% | 21% |

TABLE II.- S833 AIRFOIL COORDINATES

| Upper Surface | | Lower Surface | |
|---------------|---------|---------------|----------|
| x/c | y/c | x/c | y/c |
| 0.00014 | 0.00190 | 0.00001 | -0.00039 |
| .00080 | .00413 | .00027 | -.00284 |
| .00134 | .00533 | .00051 | -.00405 |
| .00192 | .00645 | .00516 | -.01488 |
| .00863 | .01509 | .01423 | -.02612 |
| .02100 | .02526 | .02762 | -.03732 |
| .03816 | .03549 | .04509 | -.04794 |
| .05981 | .04544 | .06670 | -.05772 |
| .08580 | .05491 | .09216 | -.06635 |
| .11583 | .06370 | .12149 | -.07365 |
| .14969 | .07168 | .15434 | -.07944 |
| .18700 | .07875 | .19065 | -.08363 |
| .22744 | .08480 | .23002 | -.08613 |
| .27056 | .08979 | .27228 | -.08696 |
| .31595 | .09364 | .31695 | -.08611 |
| .36309 | .09632 | .36379 | -.08365 |
| .41151 | .09778 | .41225 | -.07967 |
| .46067 | .09798 | .46198 | -.07426 |
| .51005 | .09685 | .51236 | -.06755 |
| .55925 | .09430 | .56300 | -.05952 |
| .60790 | .09049 | .61351 | -.05025 |
| .65539 | .08546 | .66384 | -.03971 |
| .70140 | .07919 | .71399 | -.02876 |
| .74562 | .07192 | .76337 | -.01823 |
| .78759 | .06394 | .81124 | -.00889 |
| .82683 | .05549 | .85669 | -.00152 |
| .86284 | .04678 | .89844 | .00302 |
| .89510 | .03796 | .93446 | .00453 |
| .92323 | .02883 | .96316 | .00388 |
| .94764 | .01954 | .98373 | .00224 |
| .96844 | .01109 | .99596 | .00068 |
| .98502 | .00465 | 1.00000 | .00000 |
| .99606 | .00100 | | |
| 1.00000 | .00000 | | |

TABLE III.- S834 AIRFOIL COORDINATES

| Upper Surface | | Lower Surface | |
|---------------|---------|---------------|----------|
| x/c | y/c | x/c | y/c |
| 0.00000 | 0.00009 | 0.00025 | -0.00167 |
| .00031 | .00185 | .00063 | -.00286 |
| .00104 | .00375 | .00092 | -.00356 |
| .00139 | .00447 | .00610 | -.01100 |
| .00812 | .01297 | .01637 | -.01945 |
| .01966 | .02200 | .03135 | -.02779 |
| .03587 | .03119 | .05077 | -.03562 |
| .05652 | .04019 | .07463 | -.04274 |
| .08148 | .04879 | .10266 | -.04895 |
| .11050 | .05682 | .13476 | -.05414 |
| .14337 | .06413 | .17060 | -.05824 |
| .17974 | .07061 | .20996 | -.06119 |
| .21930 | .07620 | .25241 | -.06300 |
| .26160 | .08080 | .29766 | -.06367 |
| .30625 | .08437 | .34519 | -.06325 |
| .35274 | .08686 | .39461 | -.06181 |
| .40059 | .08820 | .44534 | -.05943 |
| .44927 | .08834 | .49692 | -.05621 |
| .49829 | .08714 | .54874 | -.05227 |
| .54733 | .08453 | .60025 | -.04770 |
| .59606 | .08071 | .65083 | -.04259 |
| .64386 | .07578 | .69997 | -.03702 |
| .69034 | .06973 | .74713 | -.03111 |
| .73517 | .06273 | .79183 | -.02494 |
| .77797 | .05503 | .83359 | -.01867 |
| .81829 | .04693 | .87225 | -.01217 |
| .85565 | .03870 | .90787 | -.00651 |
| .88950 | .03056 | .93921 | -.00253 |
| .91941 | .02247 | .96502 | -.00033 |
| .94548 | .01465 | .98421 | .00039 |
| .96754 | .00791 | .99602 | .00024 |
| .98482 | .00310 | 1.00000 | .00000 |
| .99606 | .00061 | | |
| 1.00000 | .00000 | | |

TABLE IV.- S835 AIRFOIL COORDINATES

| Upper Surface | | Lower Surface | |
|---------------|---------|---------------|----------|
| x/c | y/c | x/c | y/c |
| 0.00002 | 0.00099 | 0.00111 | -0.00887 |
| .00023 | .00376 | .00638 | -.02253 |
| .00026 | .00397 | .01577 | -.03657 |
| .00087 | .00677 | .02908 | -.05033 |
| .00200 | .00947 | .04631 | -.06347 |
| .00357 | .01220 | .06721 | -.07550 |
| .00537 | .01477 | .09182 | -.08620 |
| .01649 | .02603 | .11982 | -.09519 |
| .03266 | .03735 | .15121 | -.10230 |
| .05347 | .04838 | .18563 | -.10723 |
| .07871 | .05889 | .22322 | -.10980 |
| .10805 | .06868 | .26372 | -.11014 |
| .14127 | .07759 | .30684 | -.10829 |
| .17797 | .08549 | .35227 | -.10430 |
| .21782 | .09226 | .39970 | -.09827 |
| .26037 | .09783 | .44881 | -.09036 |
| .30519 | .10211 | .49928 | -.08081 |
| .35178 | .10500 | .55072 | -.06993 |
| .39966 | .10638 | .60277 | -.05811 |
| .44851 | .10620 | .65496 | -.04582 |
| .49774 | .10448 | .70679 | -.03361 |
| .54703 | .10115 | .75764 | -.02211 |
| .59600 | .09636 | .80676 | -.01199 |
| .64420 | .09028 | .85324 | -.00393 |
| .69117 | .08310 | .89582 | .00127 |
| .73644 | .07503 | .93260 | .00343 |
| .77953 | .06631 | .96201 | .00332 |
| .81994 | .05718 | .98319 | .00204 |
| .85715 | .04786 | .99583 | .00064 |
| .89062 | .03853 | 1.00000 | .00000 |
| .91994 | .02902 | | |
| .94546 | .01950 | | |
| .96719 | .01097 | | |
| .98447 | .00455 | | |
| .99593 | .00097 | | |
| 1.00000 | .00000 | | |

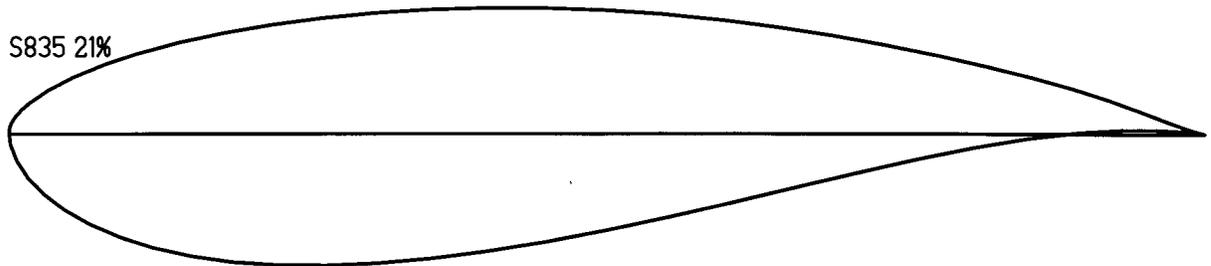
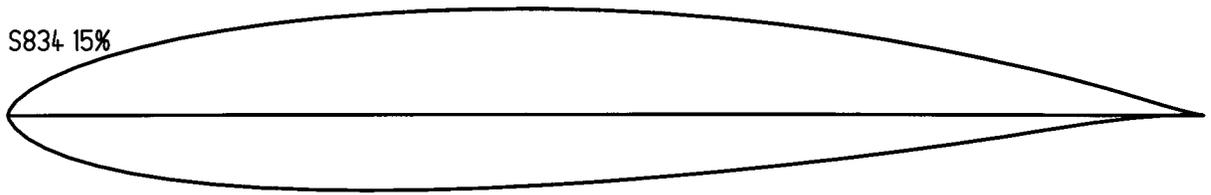
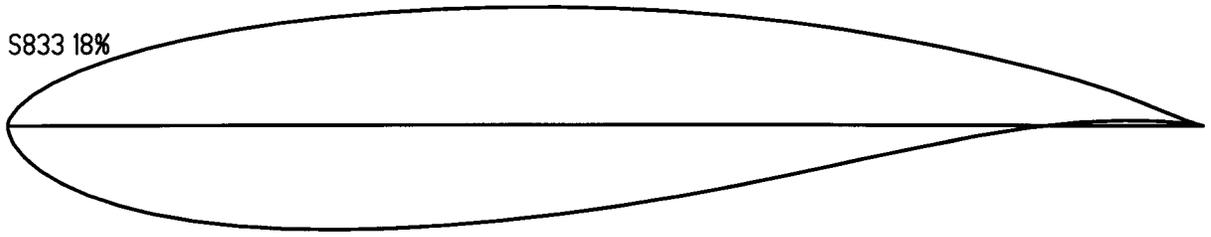
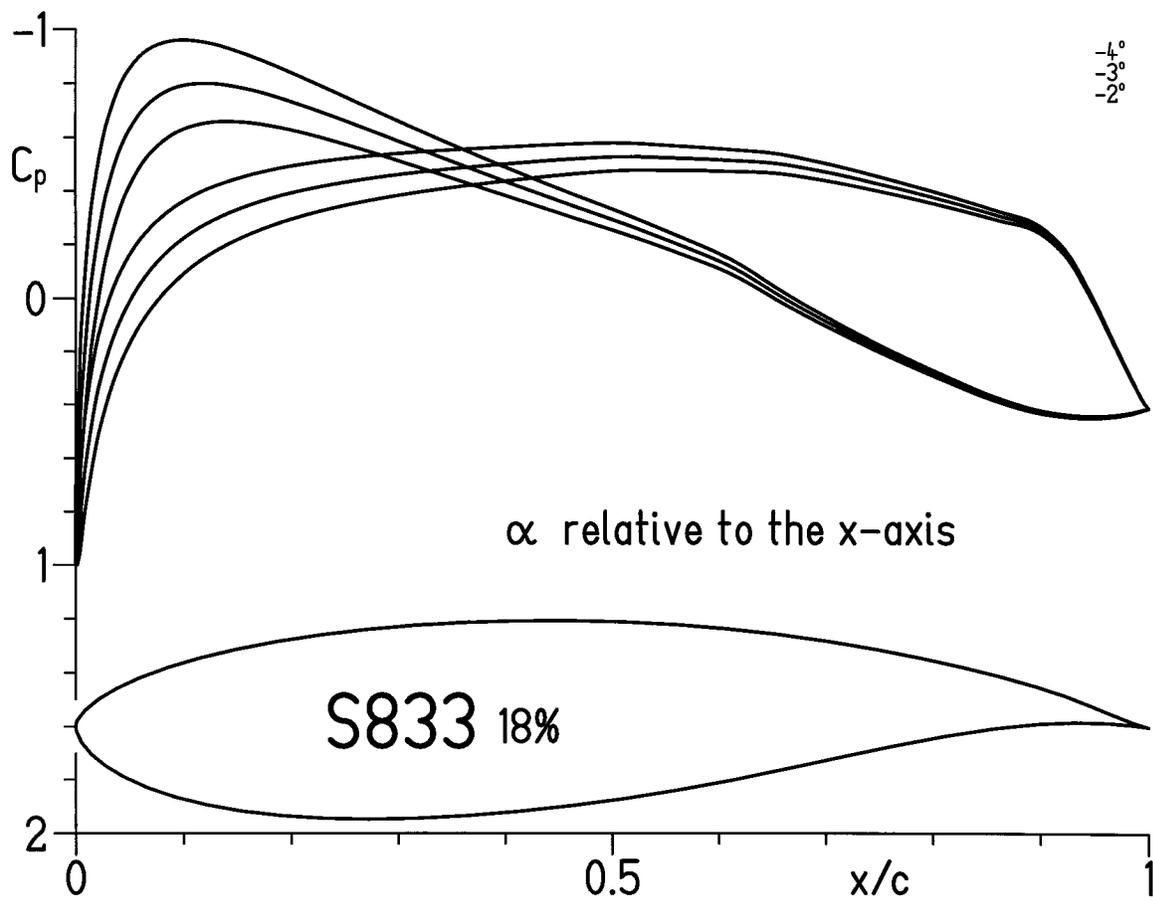
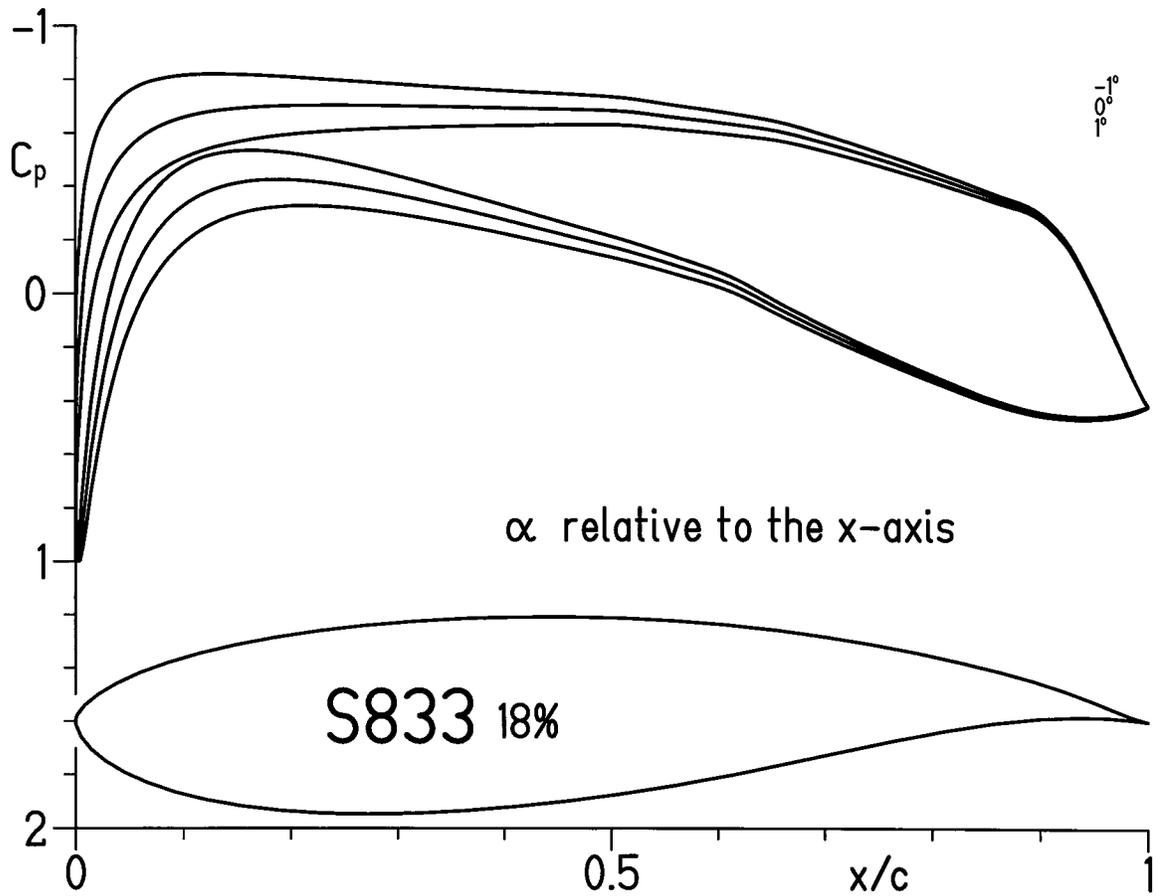


Figure 1.- Airfoil shapes.



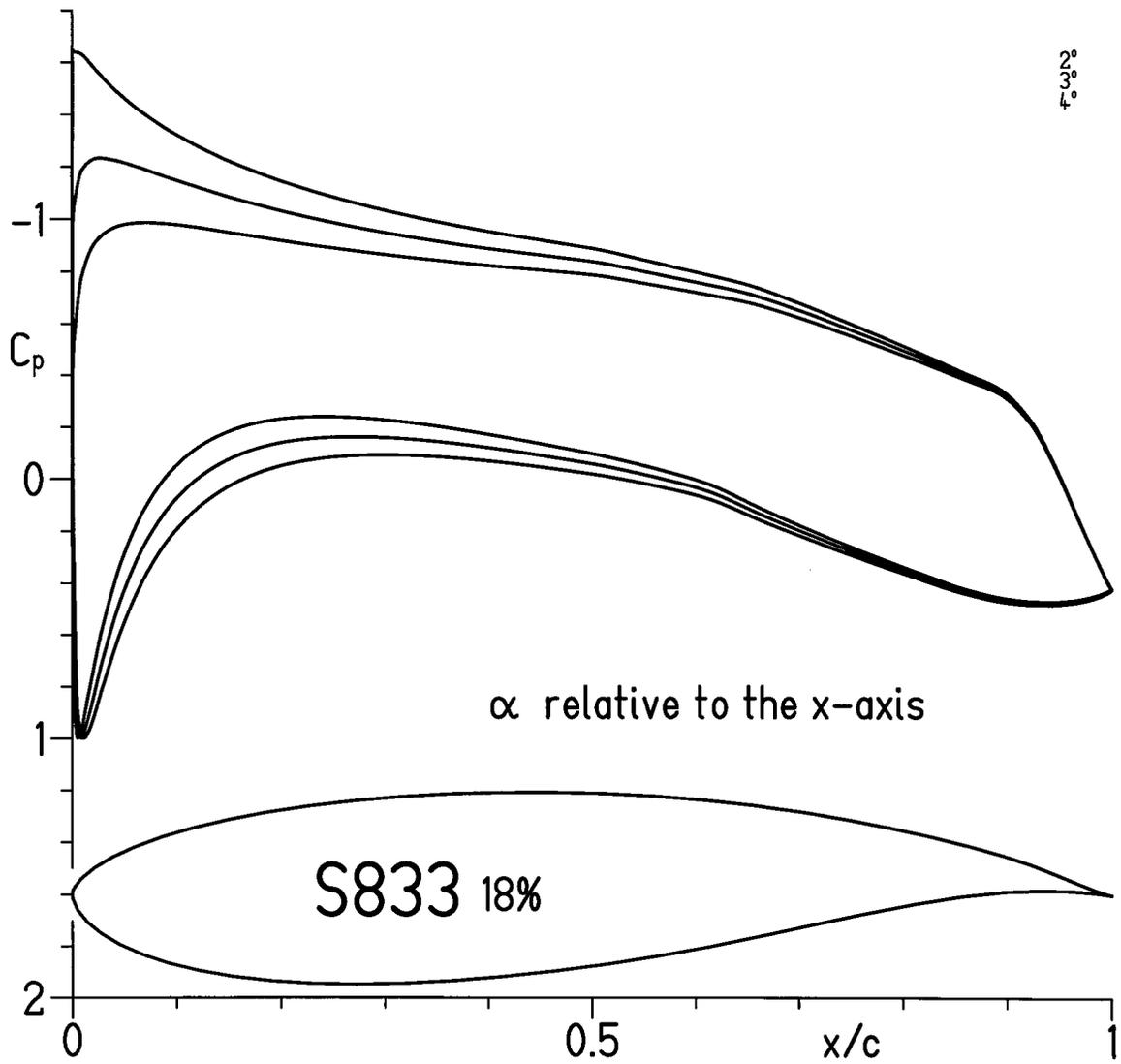
(a) $\alpha = -4^\circ, -3^\circ, \text{ and } -2^\circ$.

Figure 2.- Inviscid pressure distributions for S833 airfoil.



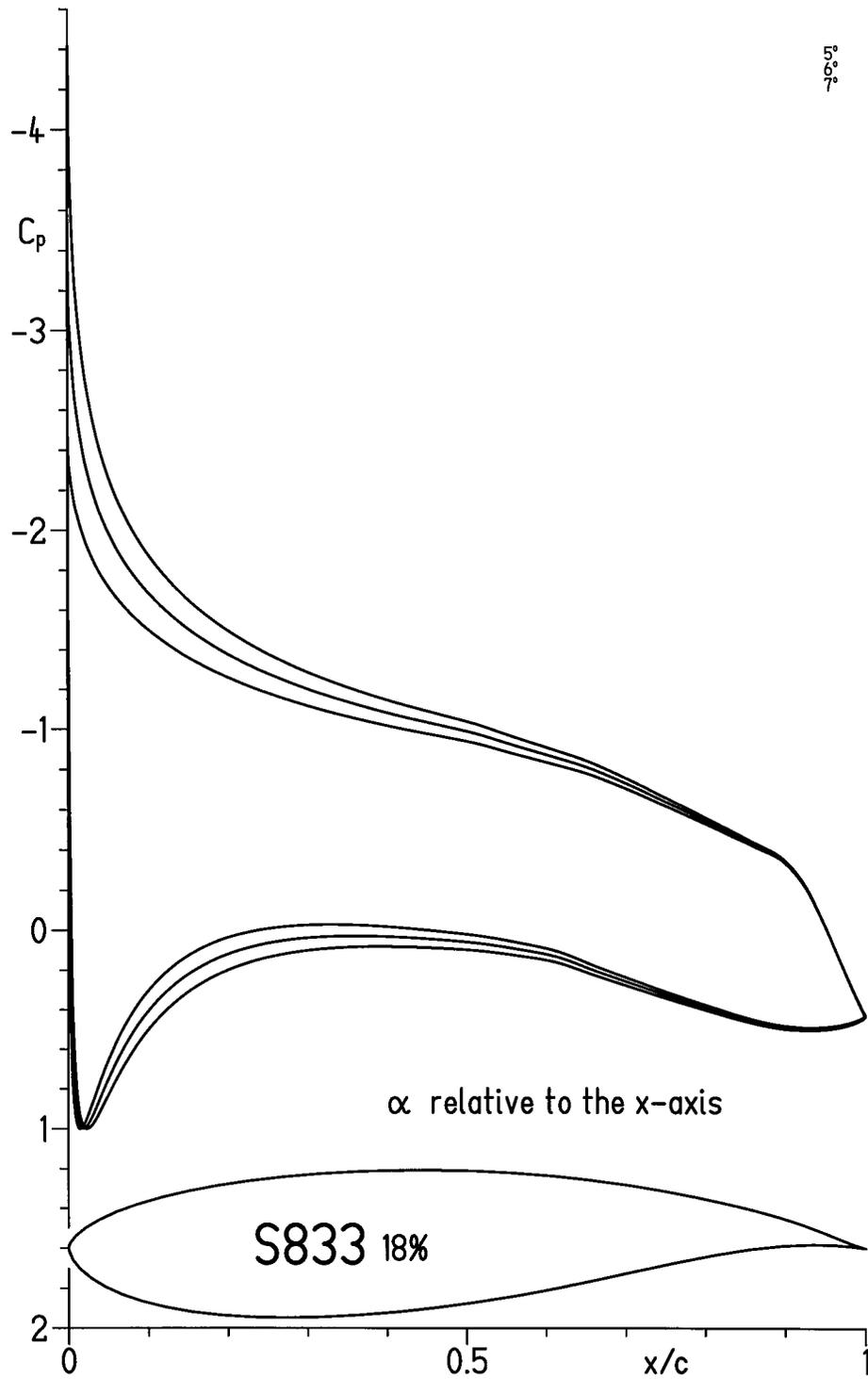
(b) $\alpha = -1^\circ, 0^\circ, \text{ and } 1^\circ$.

Figure 2.- Continued.



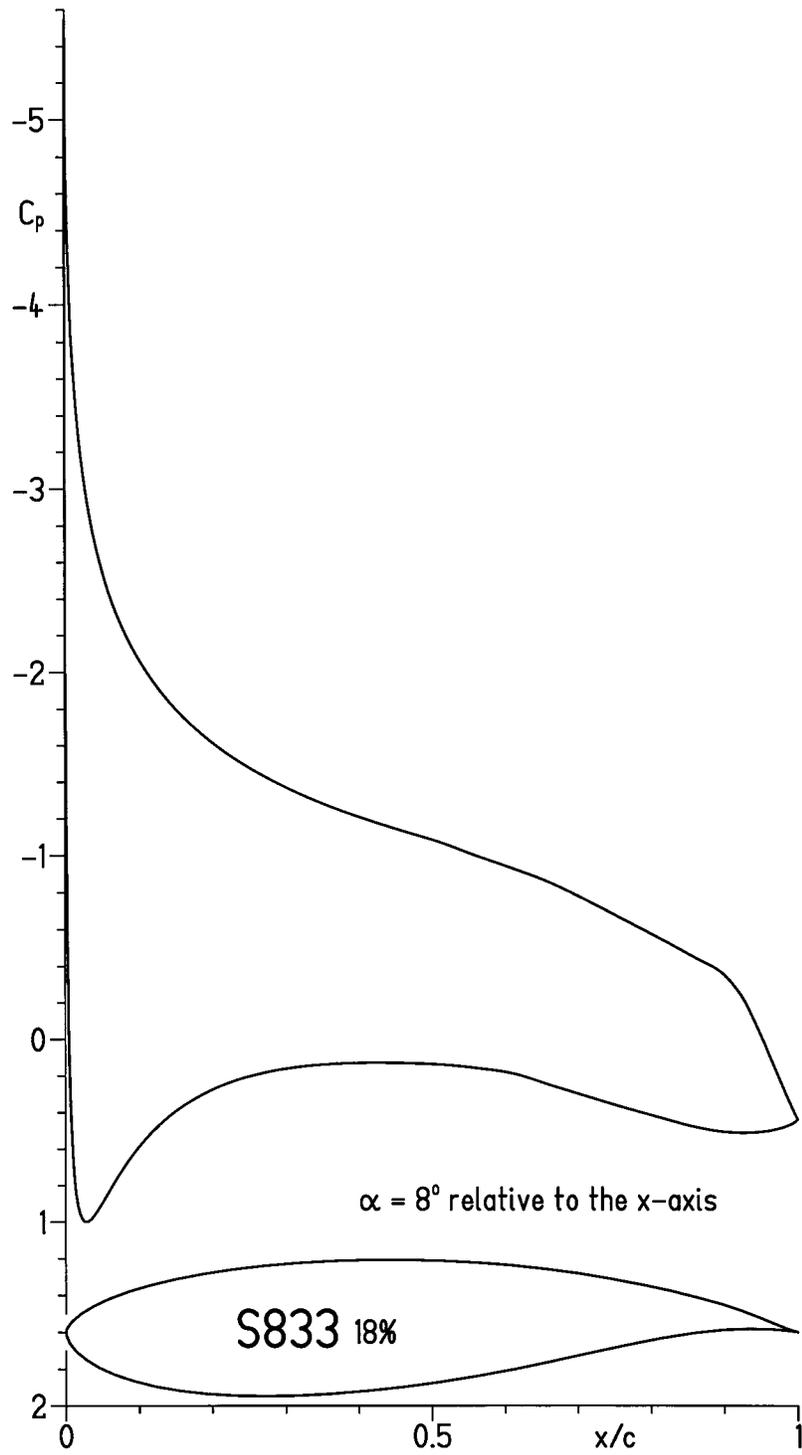
(c) $\alpha = 2^\circ, 3^\circ, \text{ and } 4^\circ$.

Figure 2.- Continued.



(d) $\alpha = 5^\circ, 6^\circ, \text{ and } 7^\circ$.

Figure 2.- Continued.

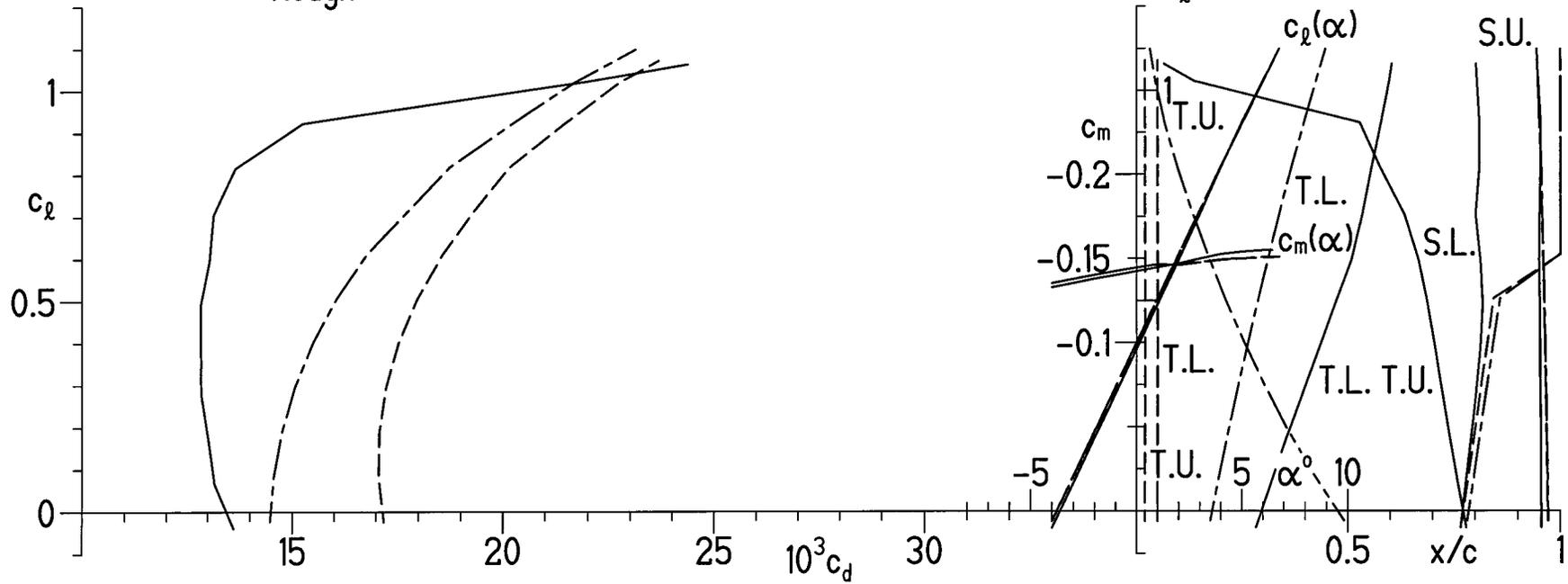


(e) $\alpha = 8^\circ$.

Figure 2.- Concluded.

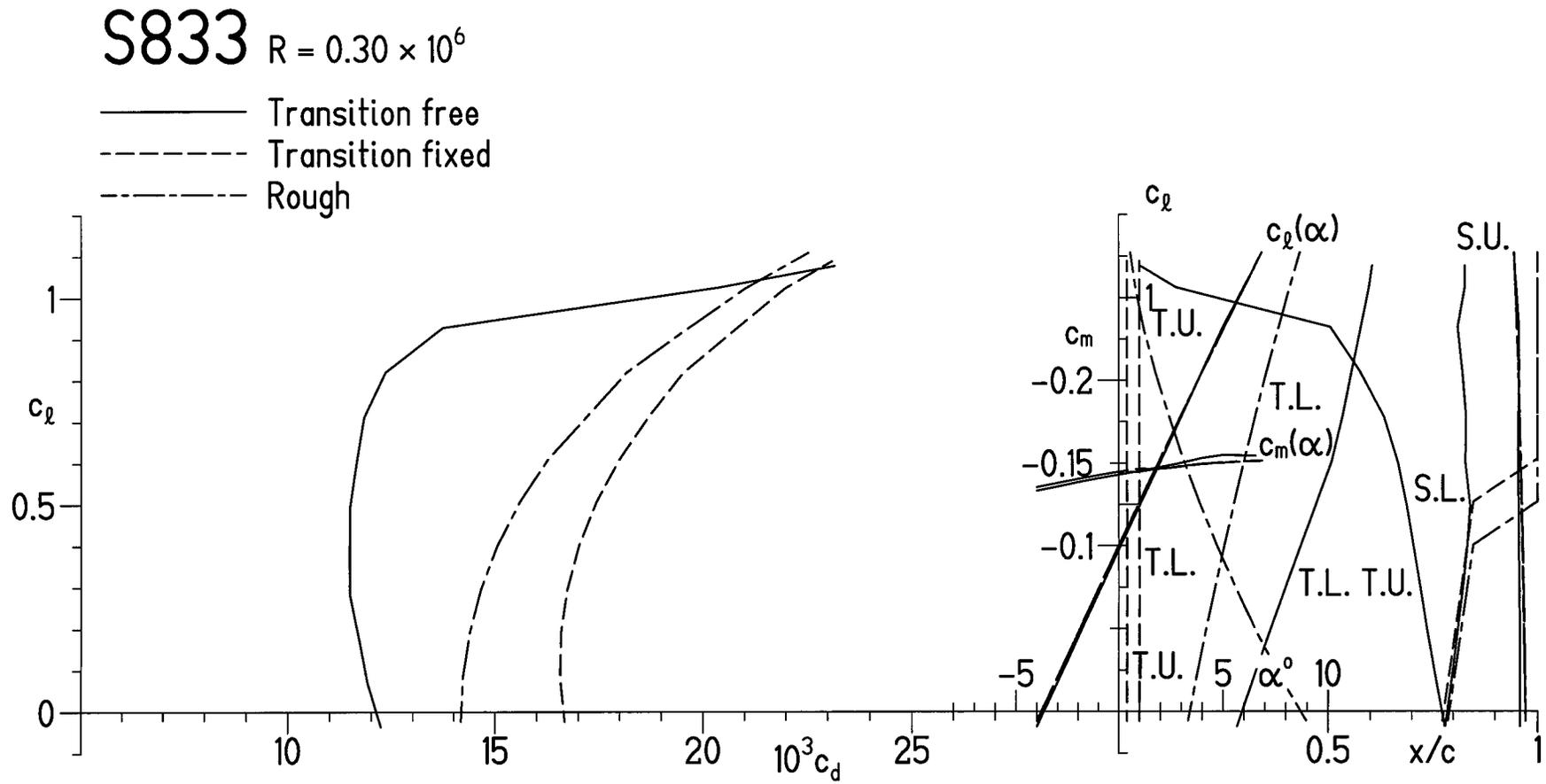
S833 $R = 0.25 \times 10^6$

— Transition free
 - - - Transition fixed
 - · - · - Rough



(a) $R = 0.25 \times 10^6$.

Figure 3.- Section characteristics of S833 airfoil with transition free, transition fixed, and rough.

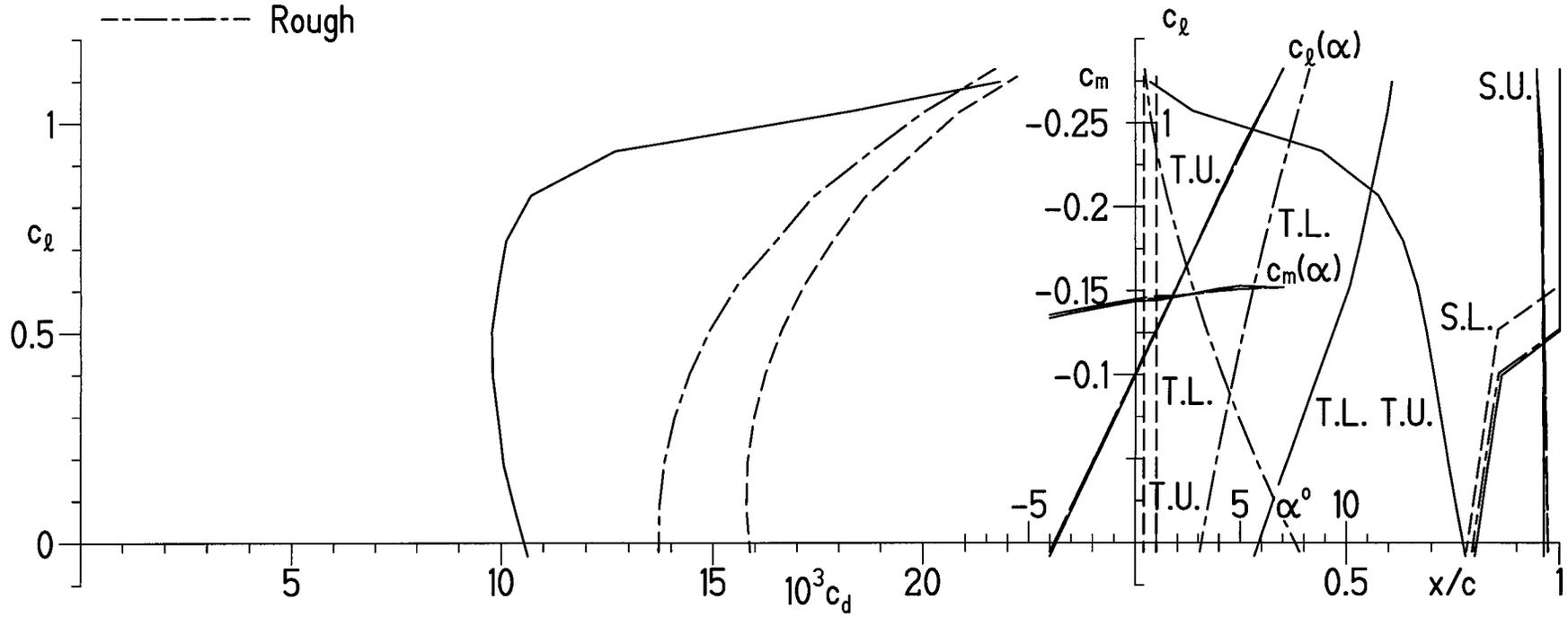


(b) $R = 0.30 \times 10^6$.

Figure 3.- Continued.

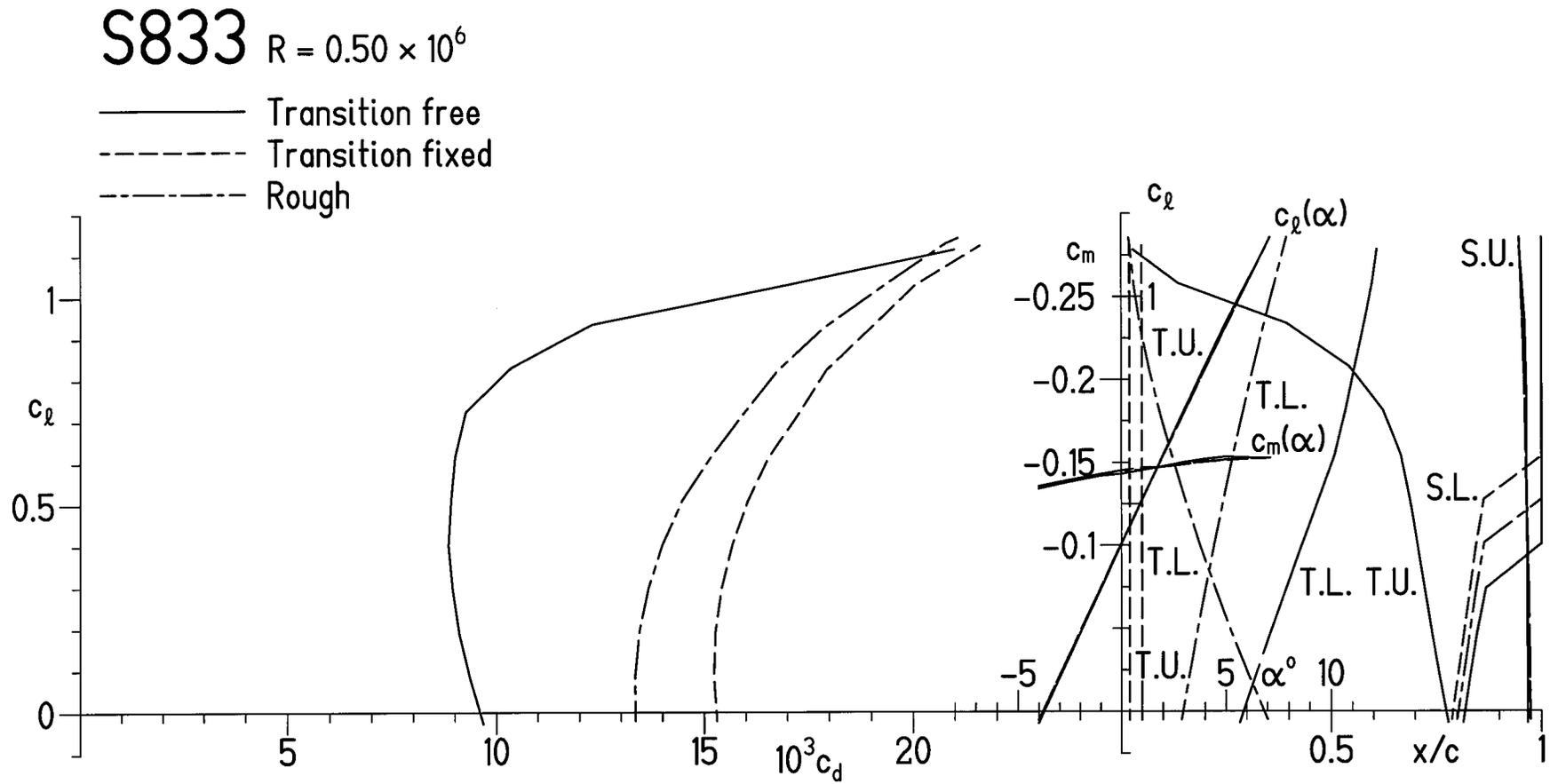
S833 $R = 0.40 \times 10^6$

- Transition free
- - - Transition fixed
- · - · - Rough



(c) $R = 0.40 \times 10^6$.

Figure 3.- Continued.

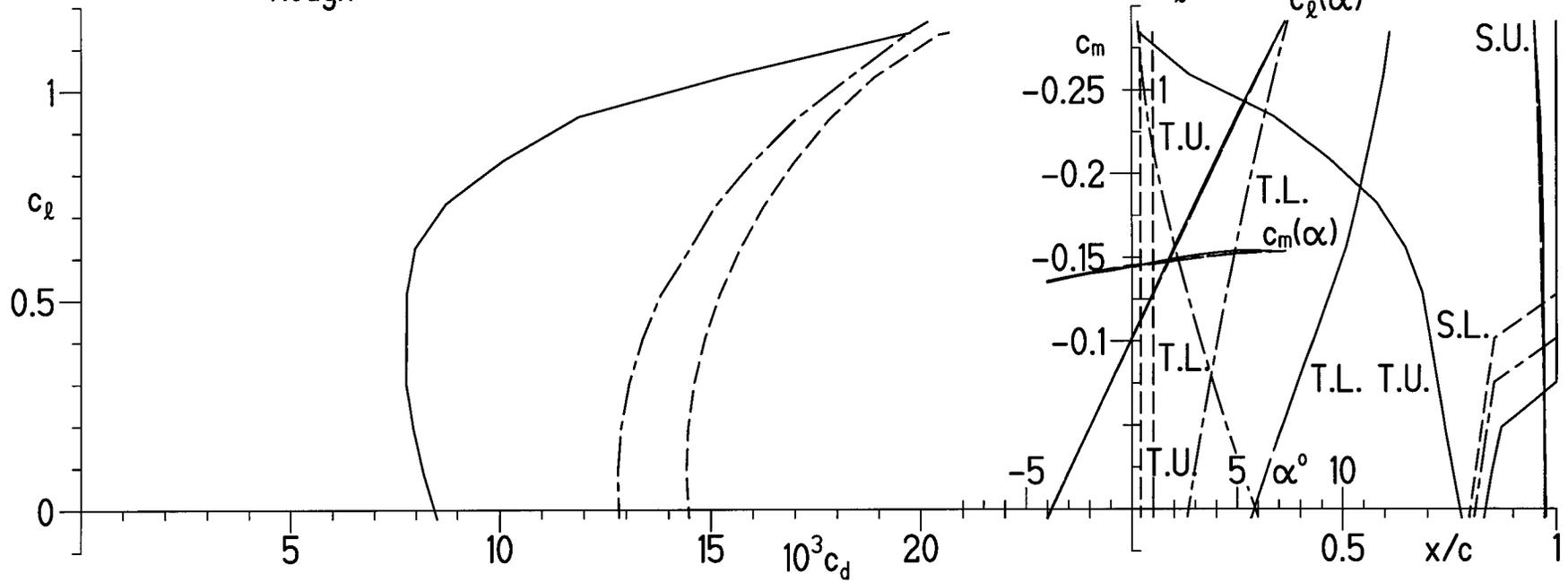


(d) $R = 0.50 \times 10^6$.

Figure 3.- Continued.

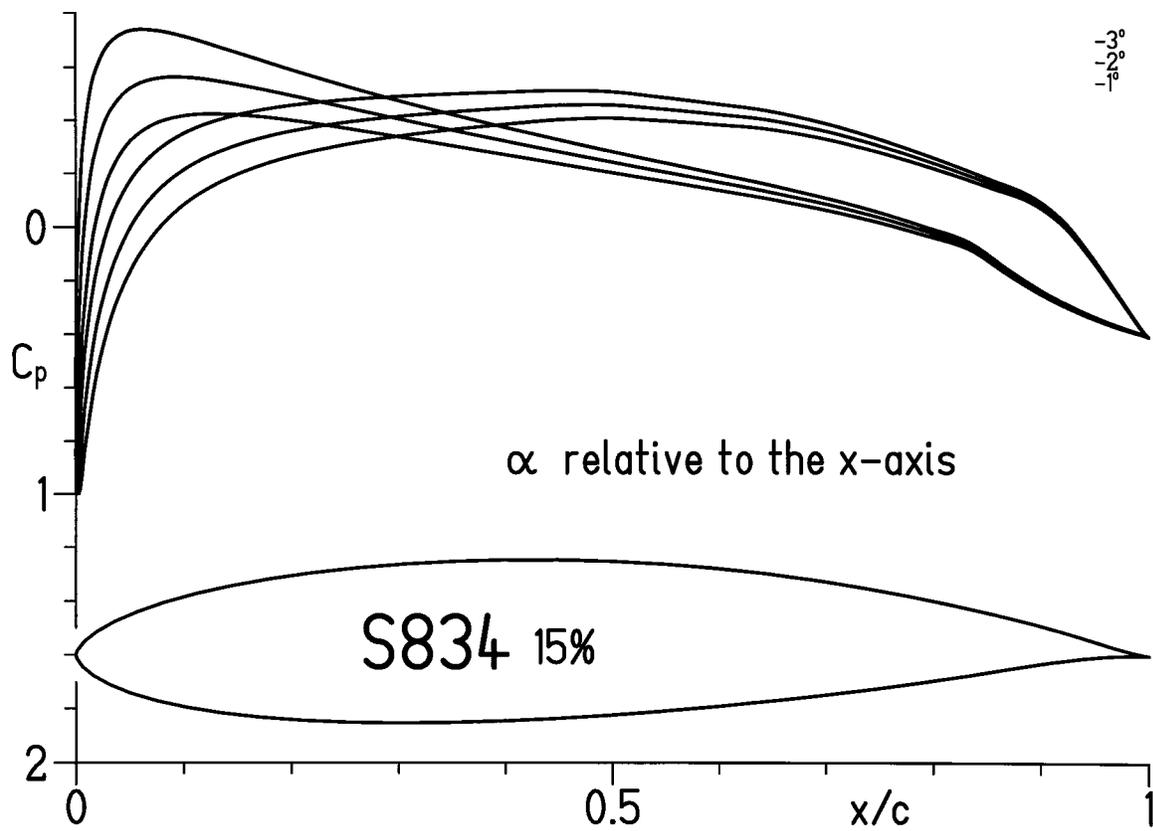
S833 $R = 0.70 \times 10^6$

— Transition free
 - - - Transition fixed
 - · - · - Rough



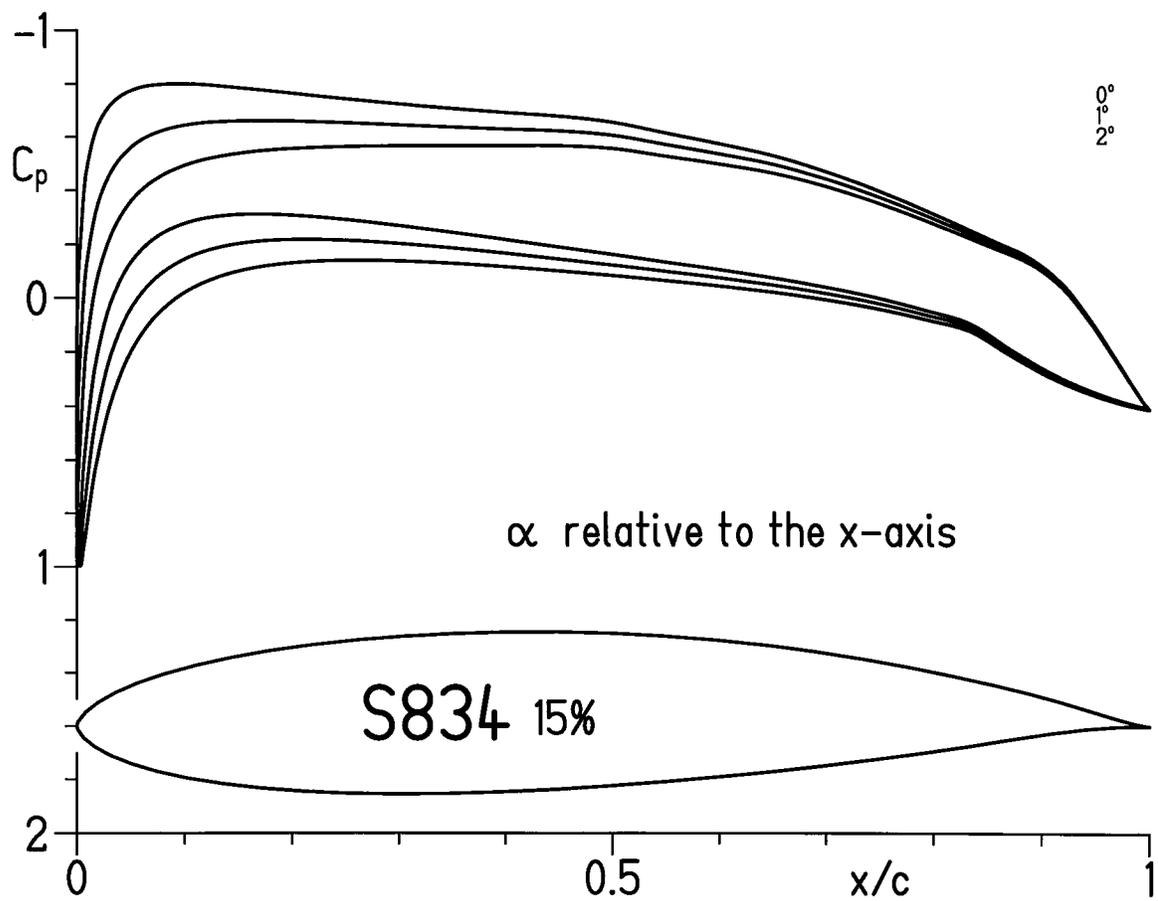
(e) $R = 0.70 \times 10^6$.

Figure 3.- Concluded.



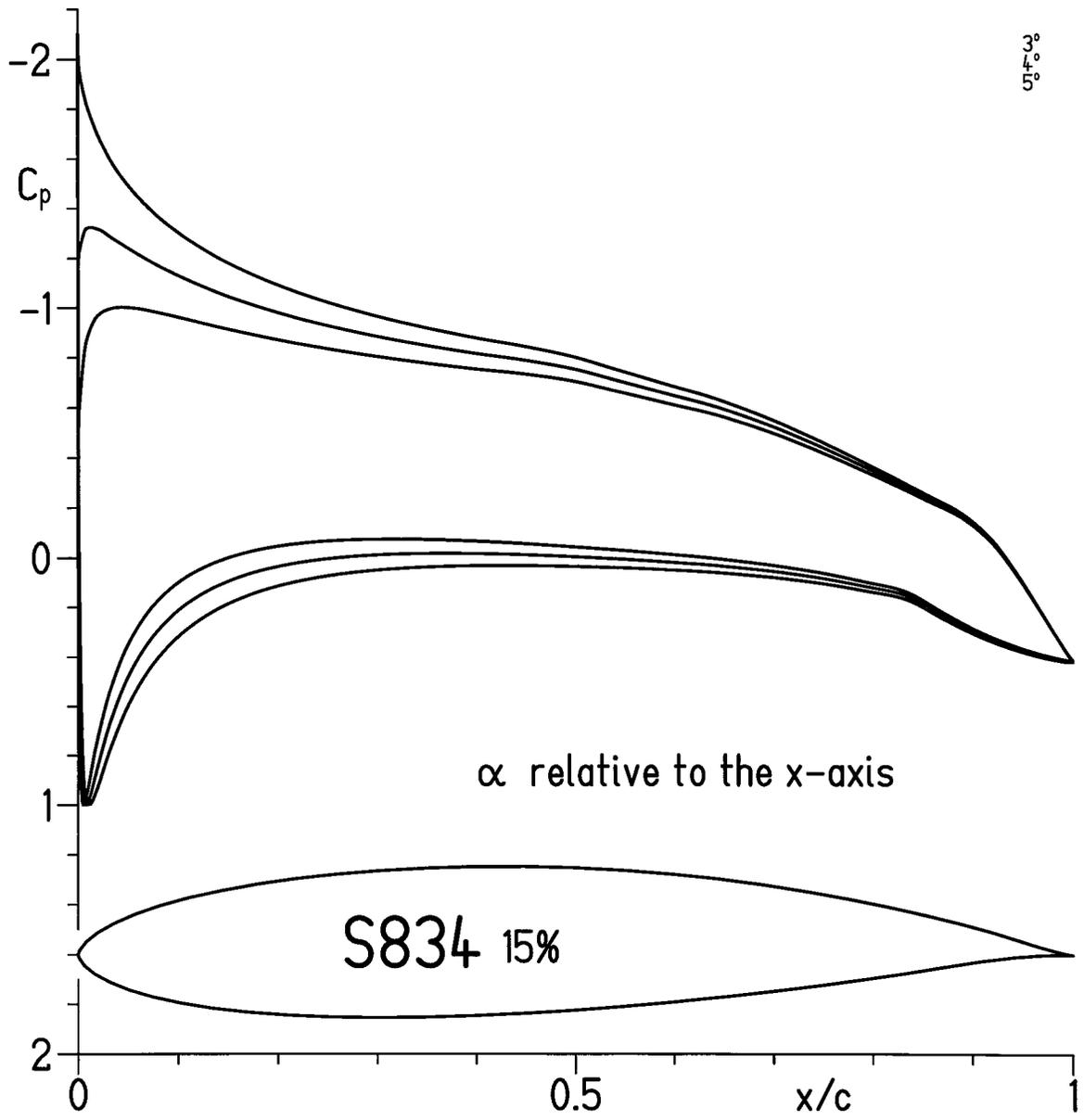
(a) $\alpha = -3^\circ, -2^\circ, \text{ and } -1^\circ$.

Figure 4.- Inviscid pressure distributions for S834 airfoil.



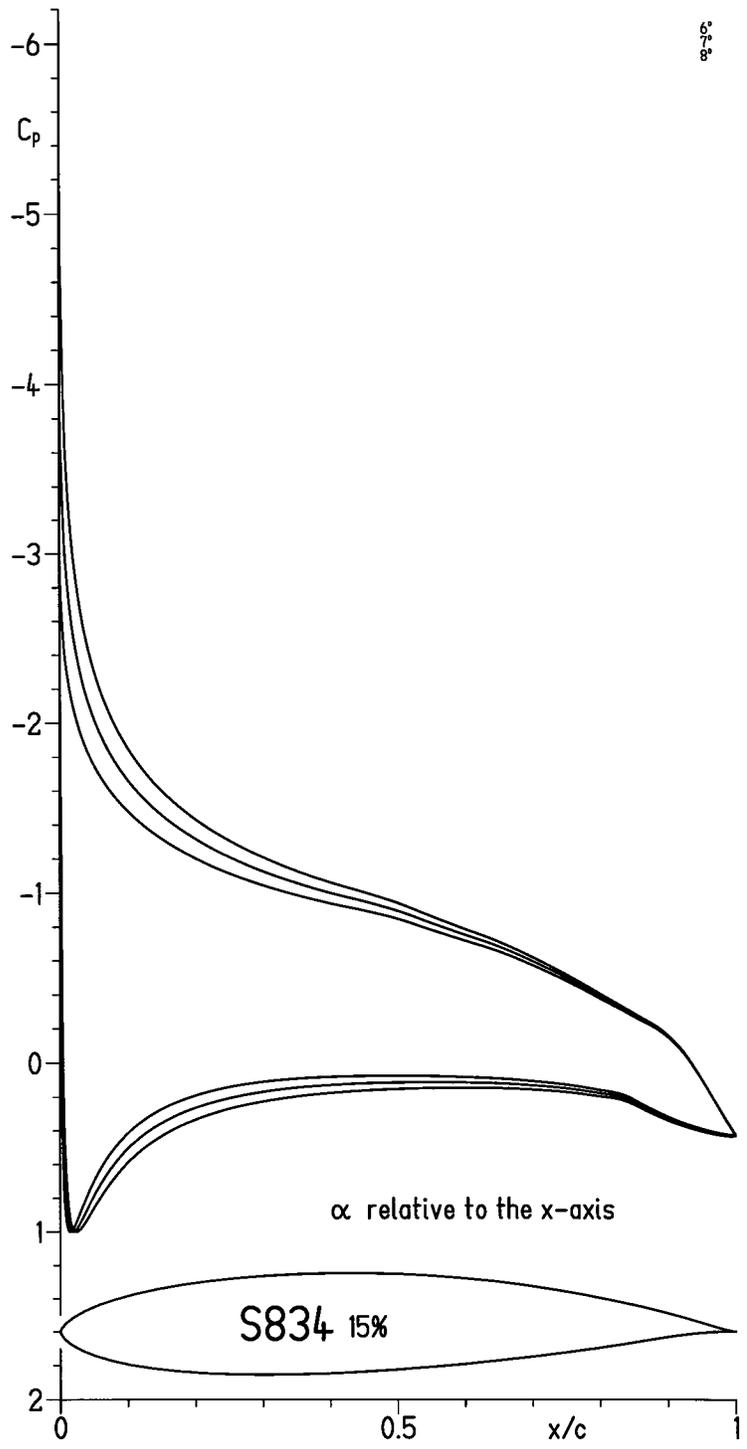
(b) $\alpha = 0^\circ, 1^\circ, \text{ and } 2^\circ$.

Figure 4.- Continued.



(c) $\alpha = 3^\circ, 4^\circ, \text{ and } 5^\circ$.

Figure 4.- Continued.



(d) $\alpha = 6^\circ, 7^\circ, \text{ and } 8^\circ$.

Figure 4.- Concluded.

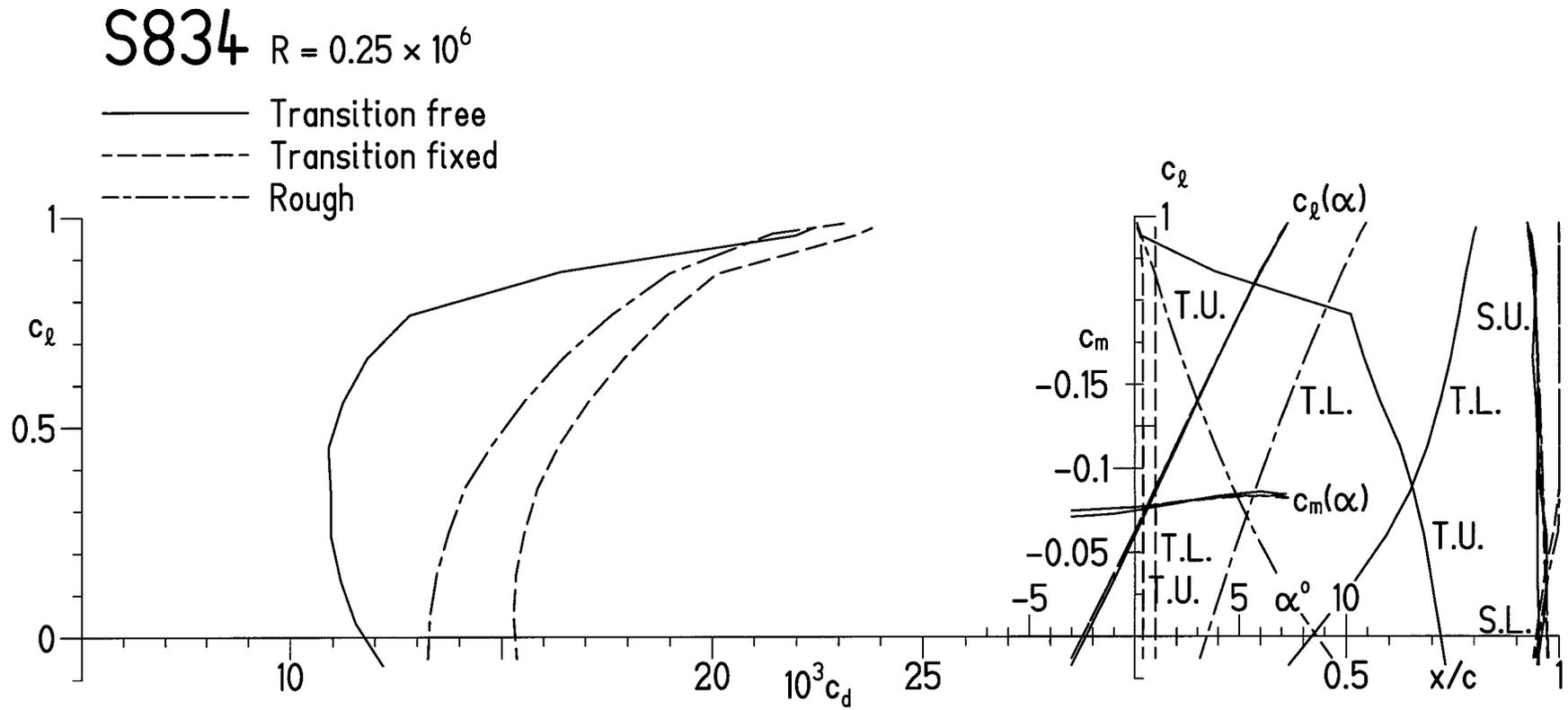
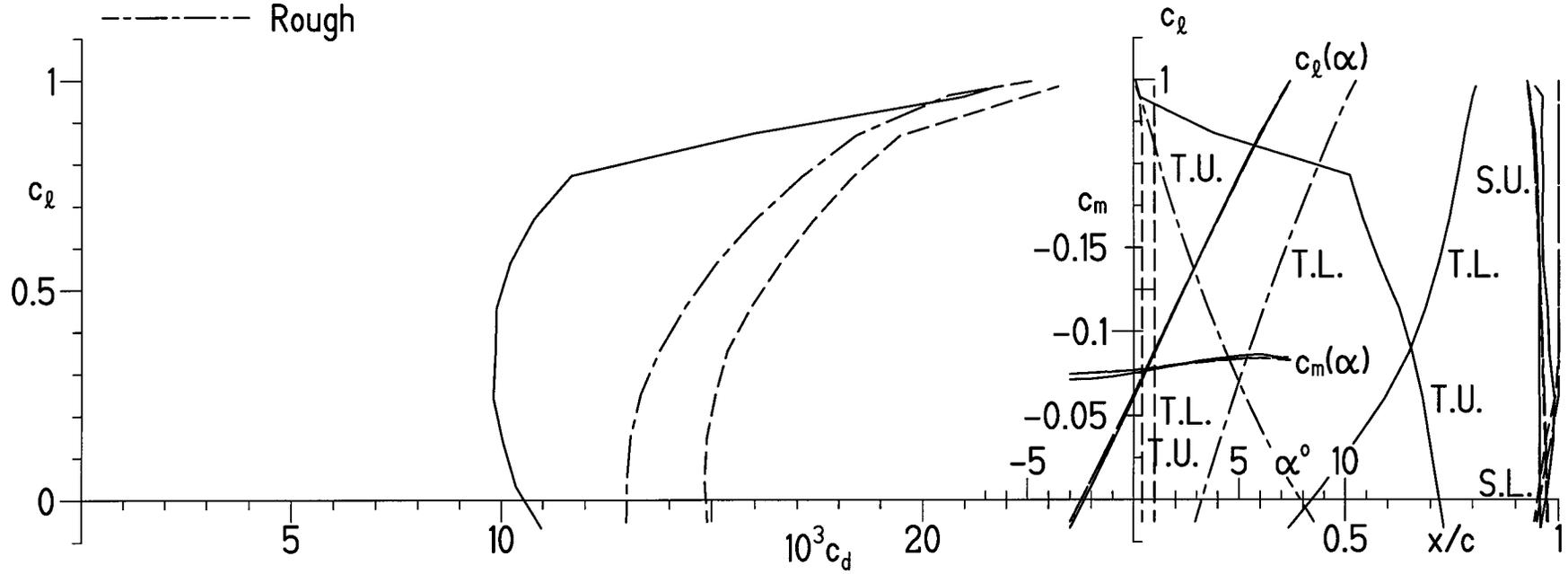
(a) $R = 0.25 \times 10^6$.

Figure 5.- Section characteristics of S834 airfoil with transition free, transition fixed, and rough.

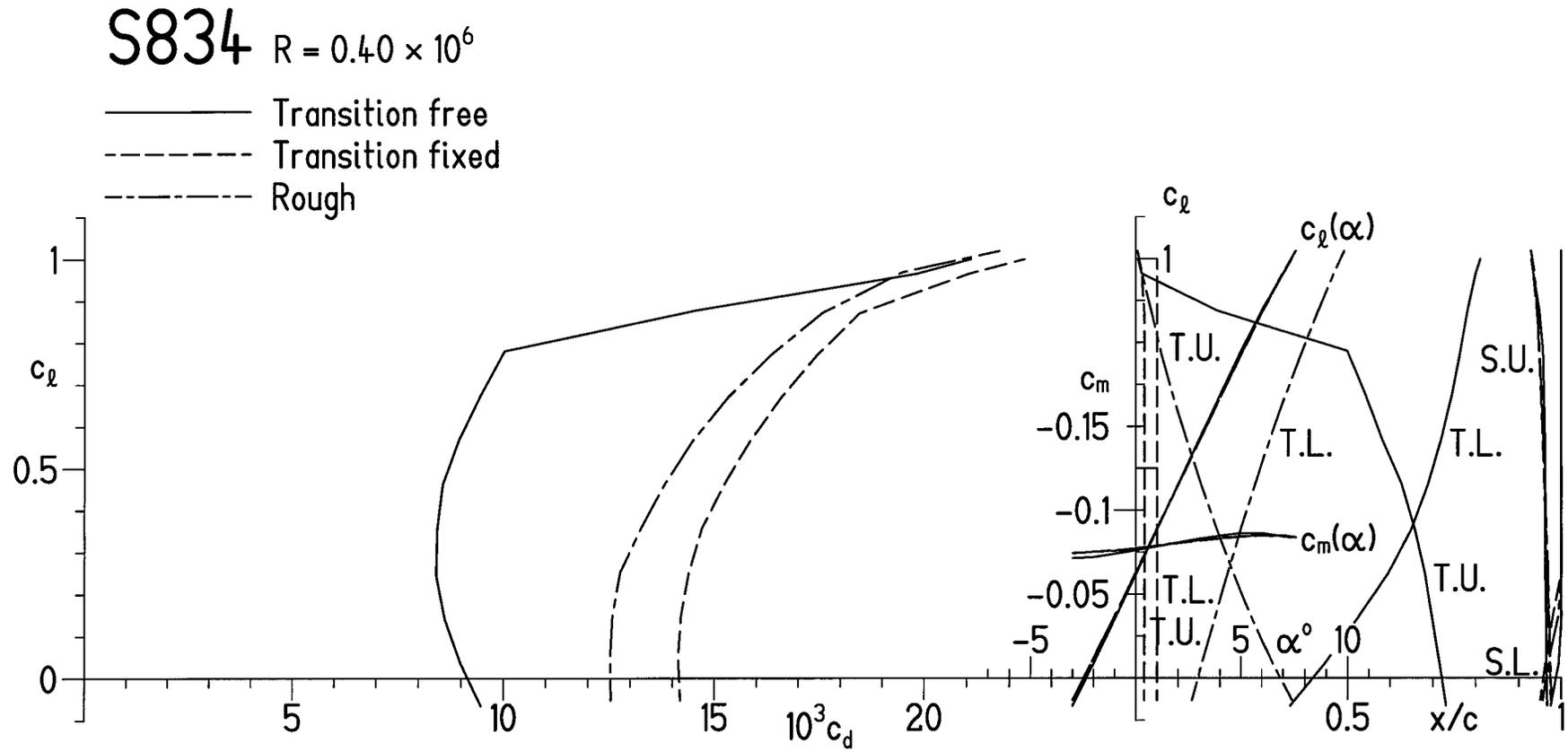
S834 $R = 0.30 \times 10^6$

— Transition free
 - - - Transition fixed
 - - - Rough



(b) $R = 0.30 \times 10^6$.

Figure 5.- Continued.

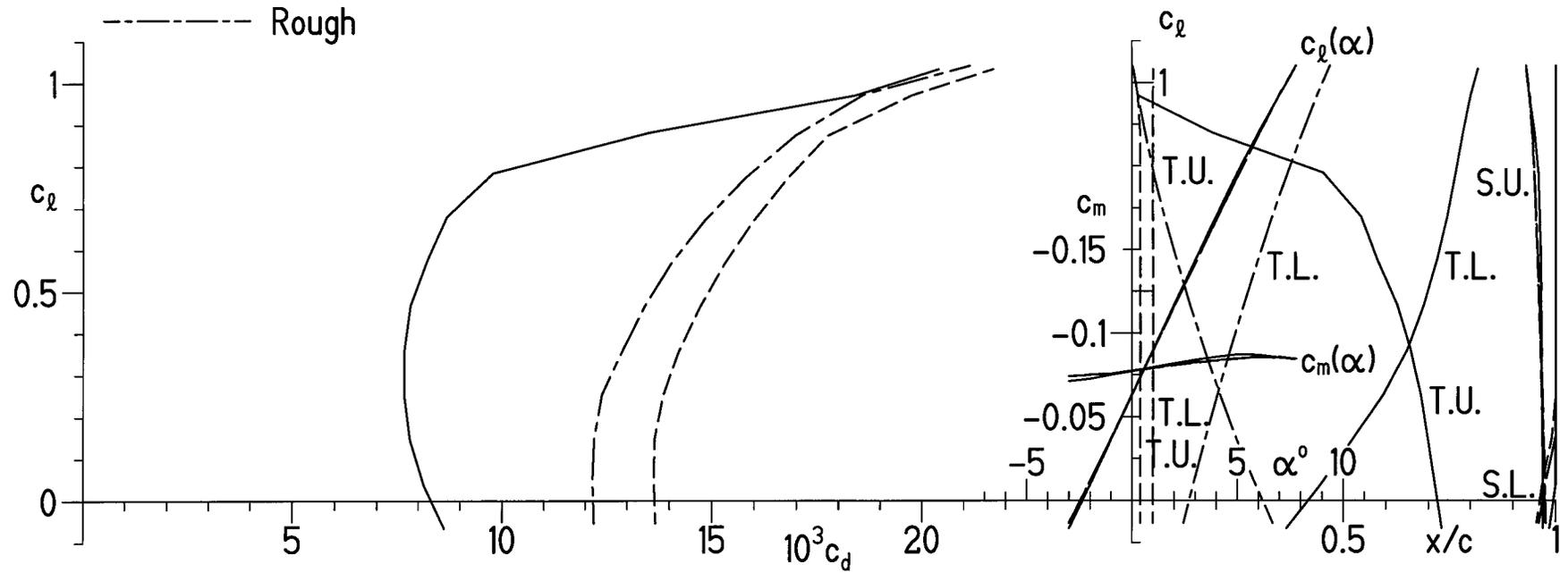


(c) $R = 0.40 \times 10^6$.

Figure 5.- Continued.

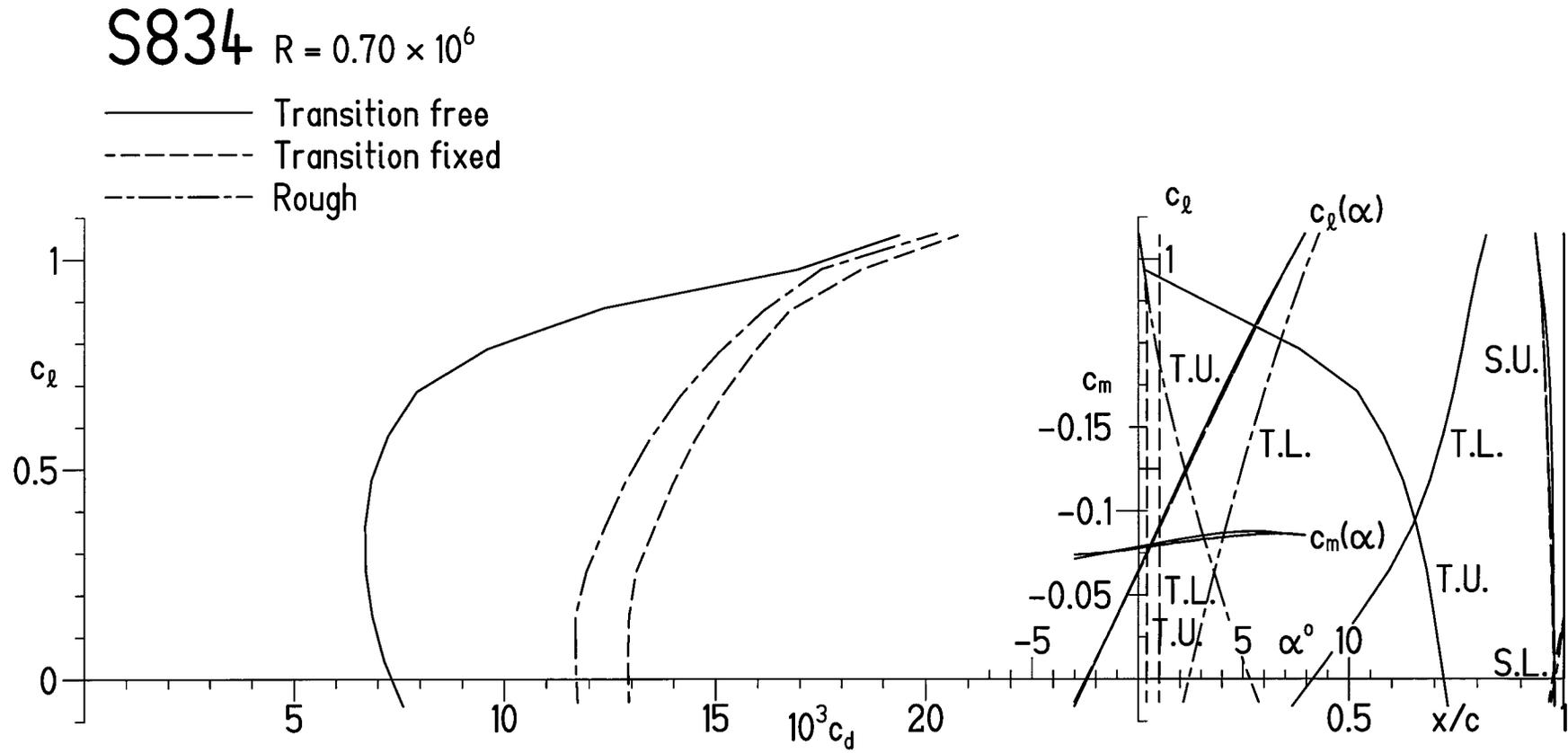
S834 $R = 0.50 \times 10^6$

- Transition free
- - - Transition fixed
- · - · - Rough



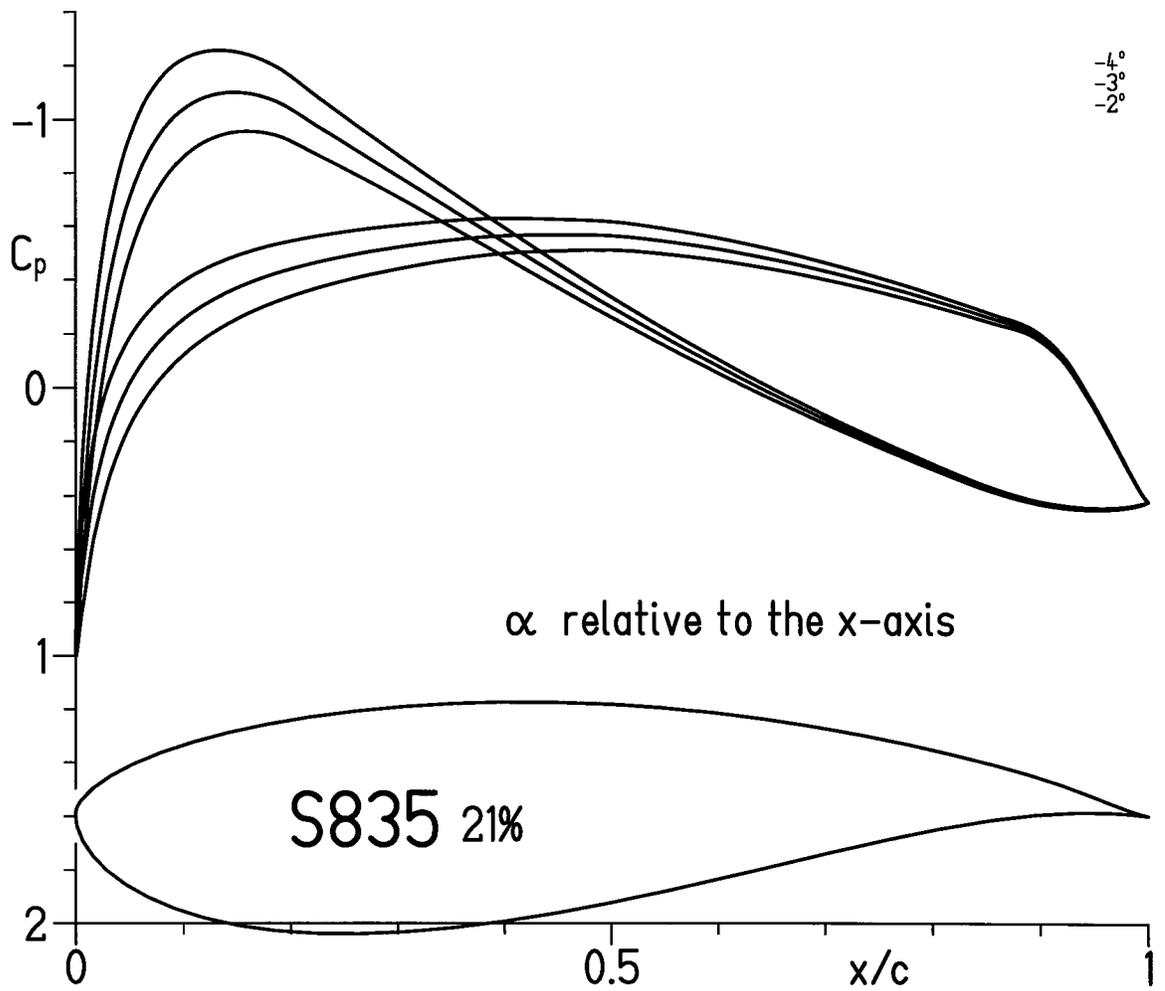
(d) $R = 0.50 \times 10^6$.

Figure 5.- Continued.



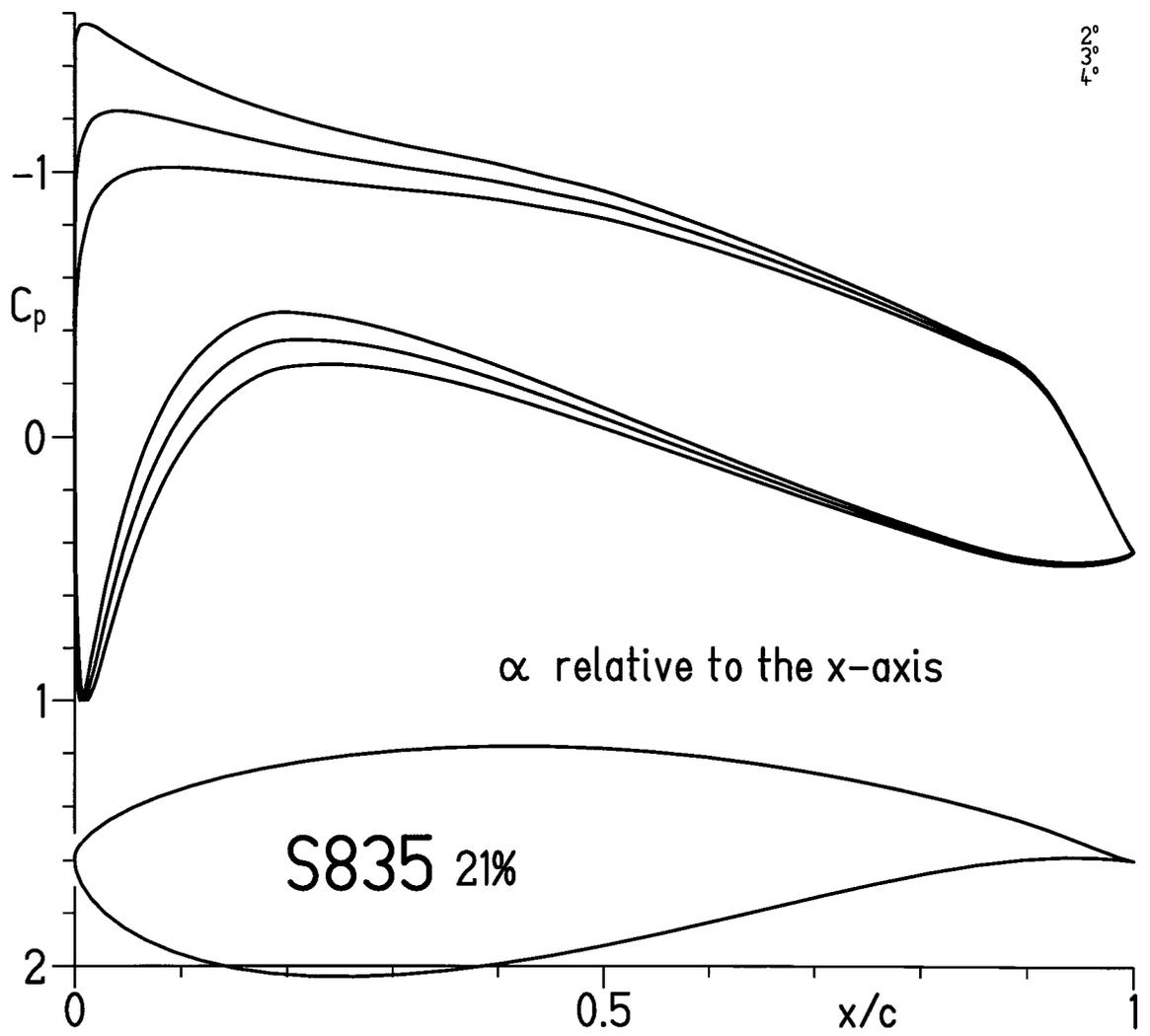
(e) $R = 0.70 \times 10^6$.

Figure 5.- Concluded.



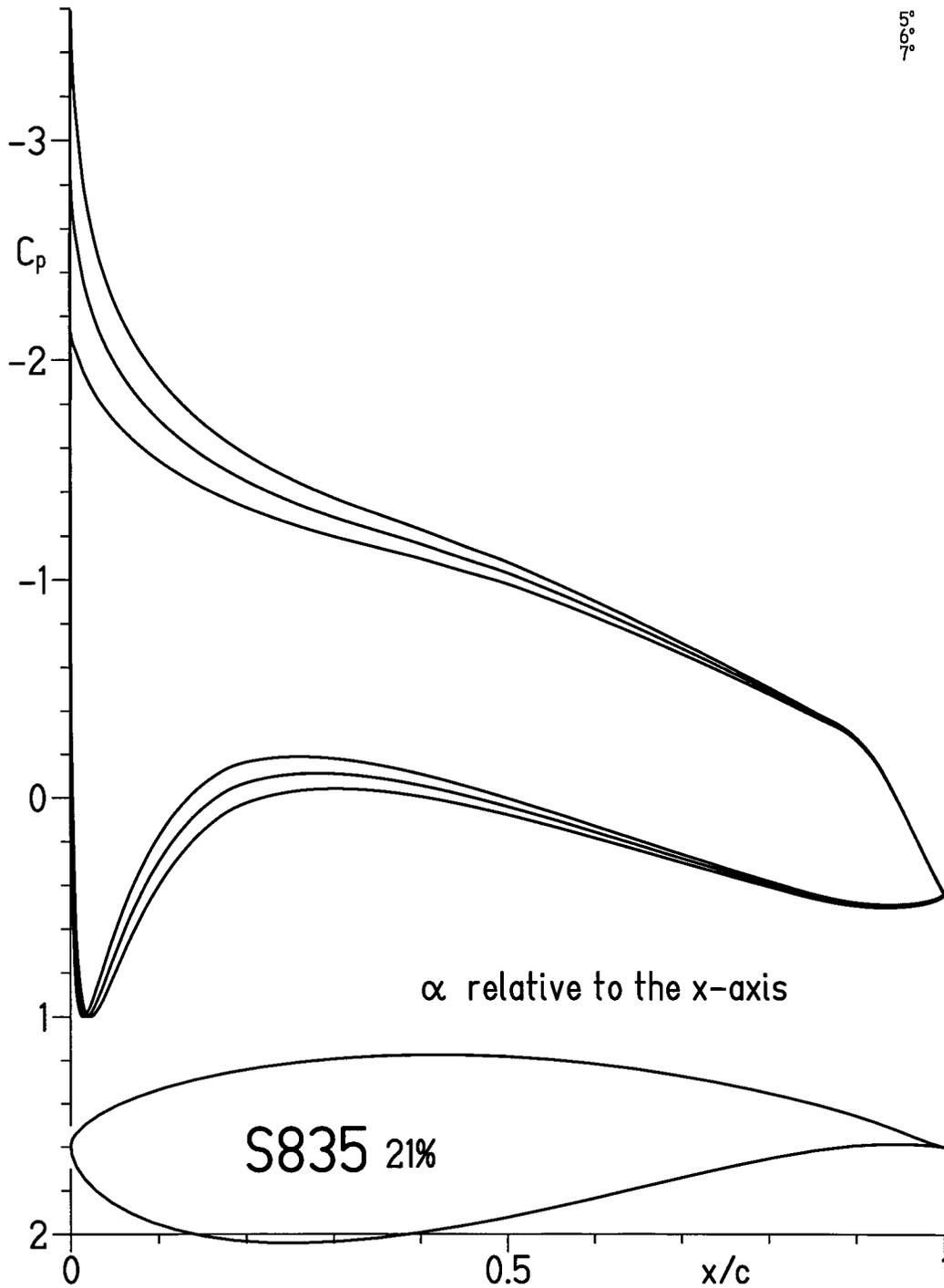
(a) $\alpha = -4^\circ, -3^\circ, \text{ and } -2^\circ$.

Figure 6.- Inviscid pressure distributions for S835 airfoil.



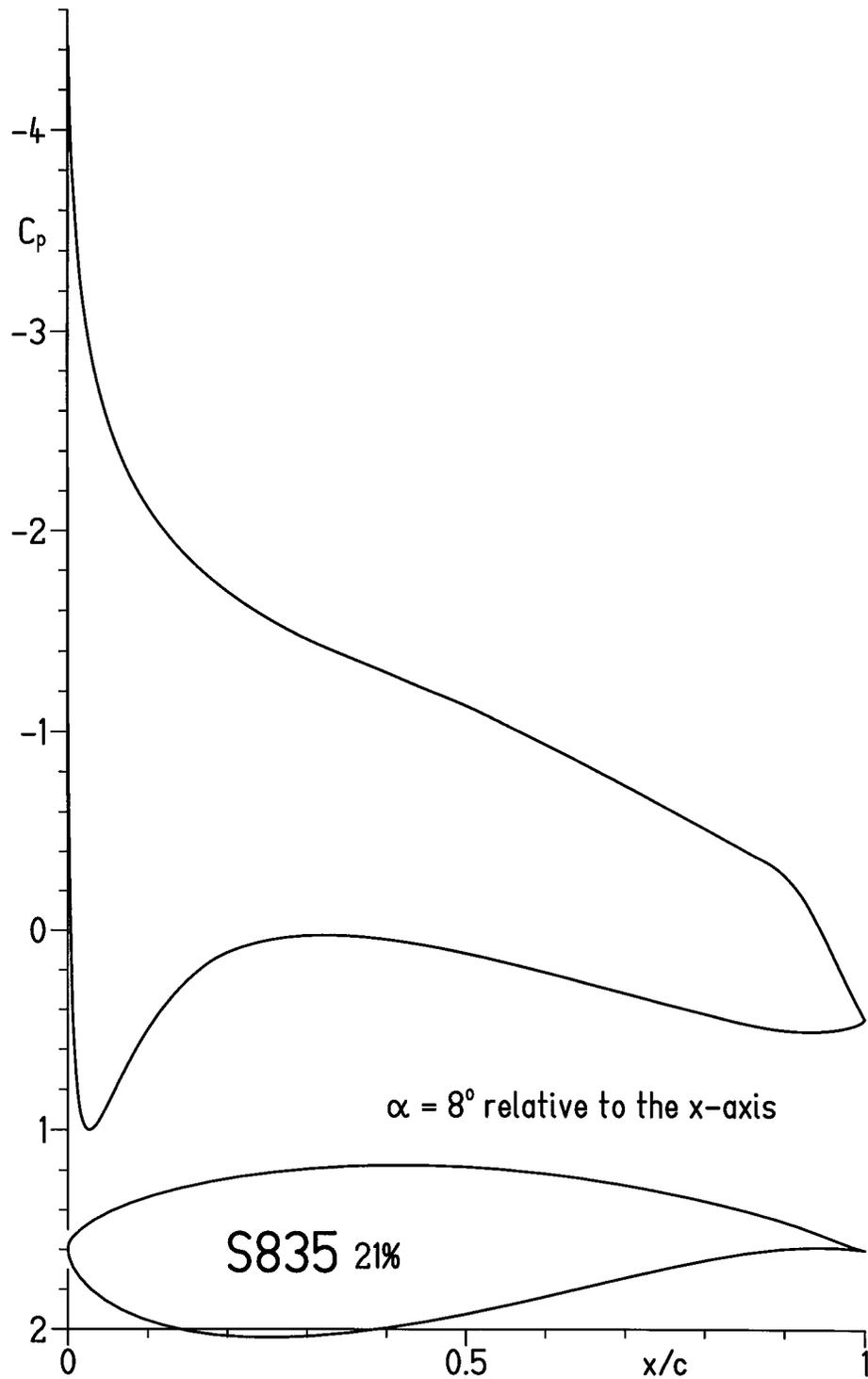
(c) $\alpha = 2^\circ, 3^\circ, \text{ and } 4^\circ$.

Figure 6.- Continued.



(d) $\alpha = 5^\circ, 6^\circ, \text{ and } 7^\circ$.

Figure 6.- Continued.



(e) $\alpha = 8^\circ$.

Figure 6.- Concluded.

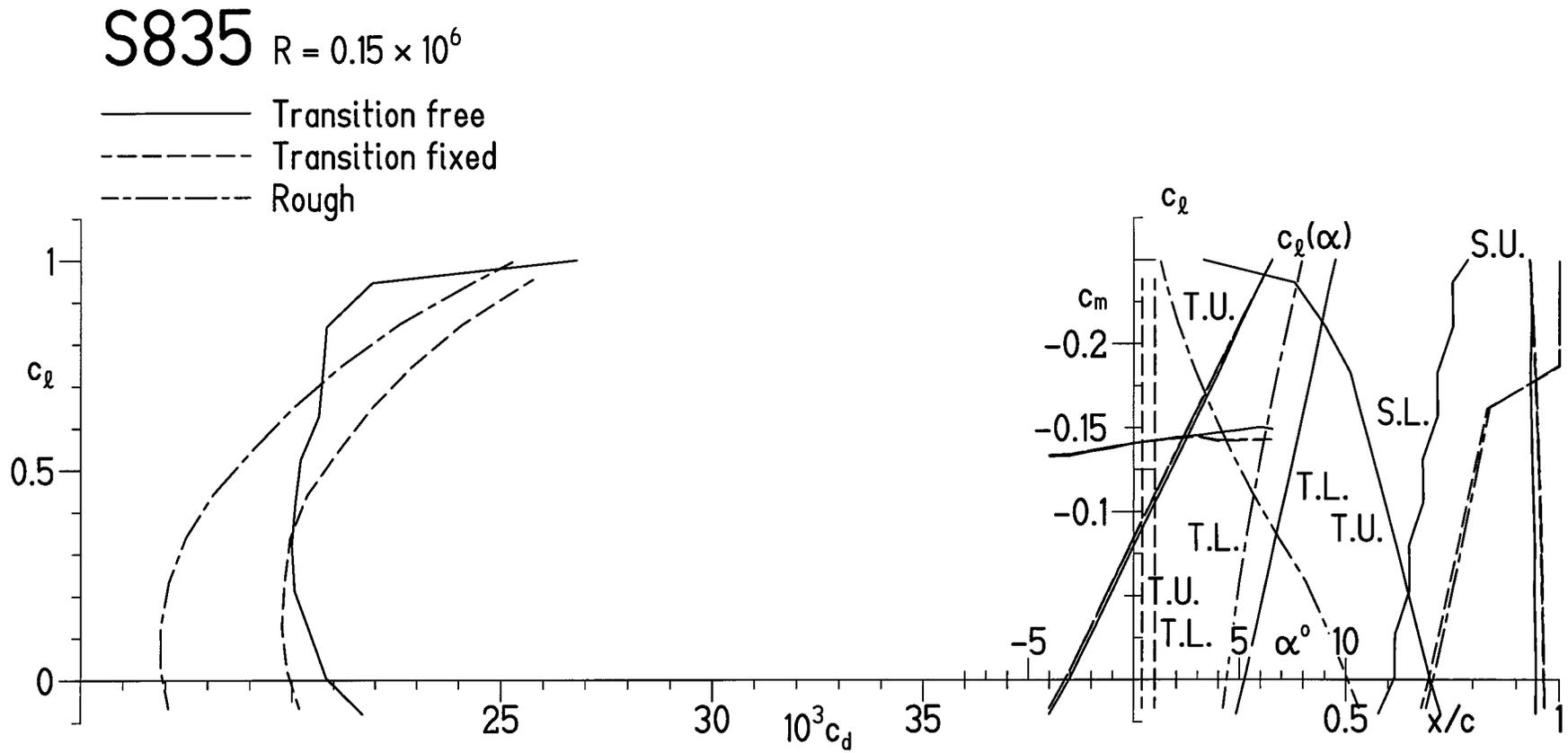
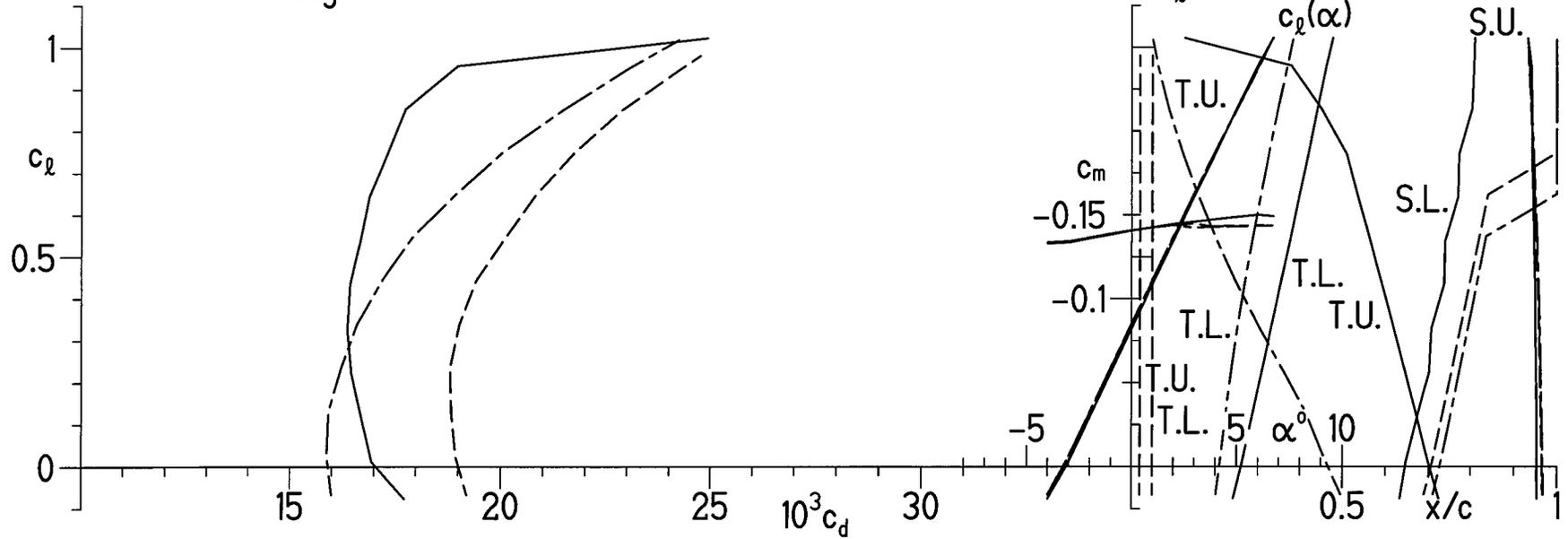
(a) $R = 0.15 \times 10^6$.

Figure 7.- Section characteristics of S835 airfoil with transition free, transition fixed, and rough.

S835 $R = 0.20 \times 10^6$

- Transition free
- - - Transition fixed
- · - Rough

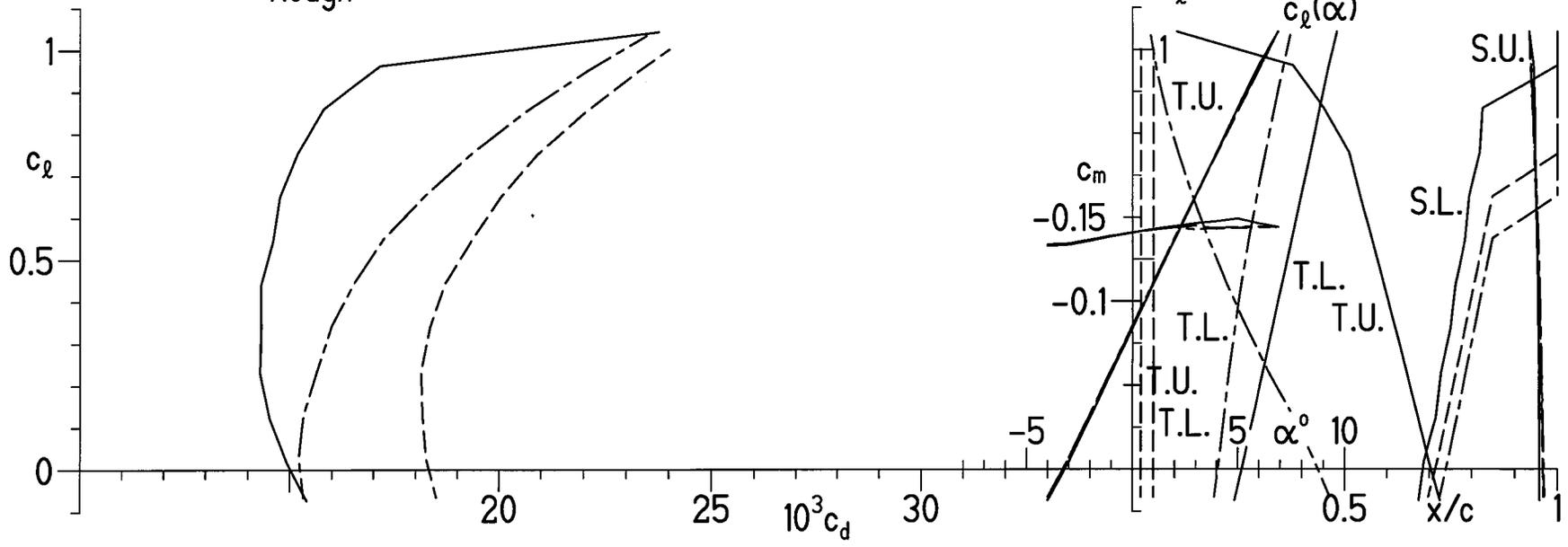


(b) $R = 0.20 \times 10^6$.

Figure 7.- Continued.

S835 $R = 0.25 \times 10^6$

- Transition free
- - - Transition fixed
- · - Rough

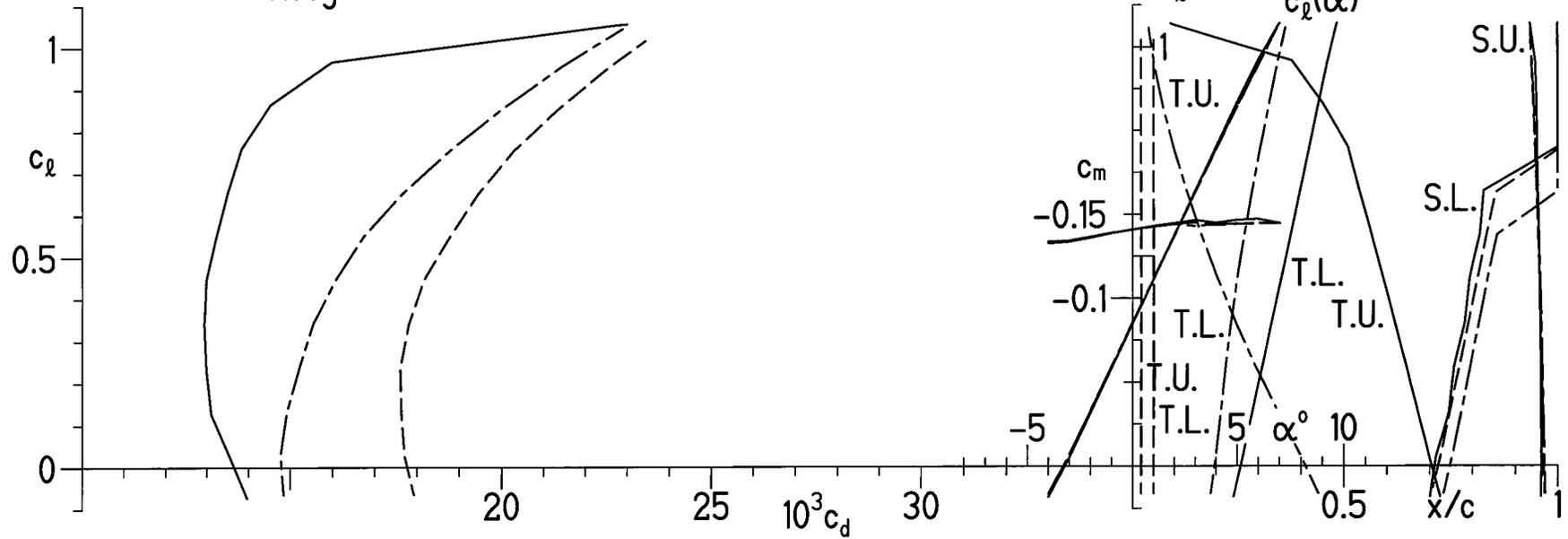


(c) $R = 0.25 \times 10^6$.

Figure 7.- Continued.

S835 $R = 0.30 \times 10^6$

— Transition free
 - - - Transition fixed
 - · - Rough

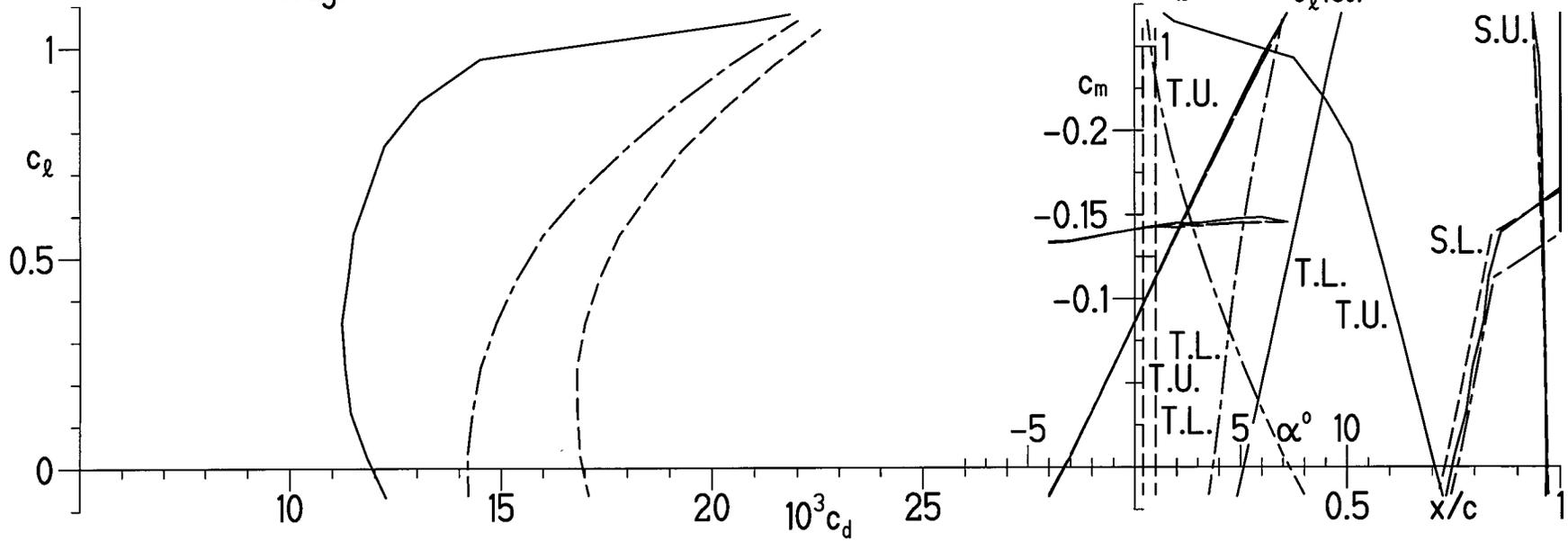


(d) $R = 0.30 \times 10^6$.

Figure 7.- Continued.

S835 $R = 0.40 \times 10^6$

- Transition free
- - - Transition fixed
- · - Rough



(e) $R = 0.40 \times 10^6$.

Figure 7.- Concluded.

APPENDIX A

PRESSURE DISTRIBUTIONS, TRANSITION AND SEPARATION LOCATIONS, AND
SECTION CHARACTERISTICS OF S833 AIRFOIL

| AIRFOIL S833 18% | | | -4.00 -3.00 -2.00 -1.00 0.00 1.00 2.00 | | | | | | | | | | | | | | | | | |
|------------------|---------|----------|--|---|--------|--------|--------|--------|--------|--------|--|--|--|--|--|--|--|--|--|--|
| N | X | Y | NU | CP(X) FOR THE ABOVE ALPHA REL. CHORD LINE | | | | | | | | | | | | | | | | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.414 | 0.414 | 0.414 | 0.415 | 0.417 | 0.418 | 0.420 | | | | | | | | | | |
| 2 | 0.99606 | 0.00100 | 1.00 | 0.393 | 0.392 | 0.391 | 0.391 | 0.391 | 0.392 | 0.393 | | | | | | | | | | |
| 3 | 0.98502 | 0.00465 | 2.00 | 0.309 | 0.307 | 0.305 | 0.303 | 0.302 | 0.302 | 0.301 | | | | | | | | | | |
| 4 | 0.96844 | 0.01109 | 3.00 | 0.172 | 0.167 | 0.164 | 0.160 | 0.158 | 0.155 | 0.153 | | | | | | | | | | |
| 5 | 0.94764 | 0.01954 | 4.00 | 0.002 | -0.005 | -0.012 | -0.017 | -0.023 | -0.027 | -0.031 | | | | | | | | | | |
| 6 | 0.92323 | 0.02883 | 5.00 | -0.160 | -0.171 | -0.180 | -0.190 | -0.198 | -0.206 | -0.213 | | | | | | | | | | |
| 7 | 0.89510 | 0.03796 | 6.00 | -0.253 | -0.267 | -0.280 | -0.292 | -0.304 | -0.315 | -0.325 | | | | | | | | | | |
| 8 | 0.86284 | 0.04678 | 7.00 | -0.288 | -0.305 | -0.321 | -0.337 | -0.351 | -0.365 | -0.379 | | | | | | | | | | |
| 9 | 0.82683 | 0.05549 | 8.00 | -0.325 | -0.346 | -0.365 | -0.384 | -0.402 | -0.420 | -0.436 | | | | | | | | | | |
| 10 | 0.78759 | 0.06394 | 9.00 | -0.364 | -0.387 | -0.411 | -0.433 | -0.455 | -0.476 | -0.497 | | | | | | | | | | |
| 11 | 0.74562 | 0.07192 | 10.00 | -0.401 | -0.429 | -0.456 | -0.483 | -0.509 | -0.534 | -0.558 | | | | | | | | | | |
| 12 | 0.70140 | 0.07919 | 11.00 | -0.436 | -0.468 | -0.500 | -0.531 | -0.561 | -0.591 | -0.620 | | | | | | | | | | |
| 13 | 0.65539 | 0.08546 | 12.00 | -0.463 | -0.500 | -0.536 | -0.572 | -0.607 | -0.642 | -0.676 | | | | | | | | | | |
| 14 | 0.60790 | 0.09049 | 13.00 | -0.471 | -0.513 | -0.553 | -0.594 | -0.634 | -0.674 | -0.713 | | | | | | | | | | |
| 15 | 0.55925 | 0.09430 | 14.00 | -0.474 | -0.520 | -0.566 | -0.612 | -0.657 | -0.702 | -0.747 | | | | | | | | | | |
| 16 | 0.51005 | 0.09685 | 15.00 | -0.475 | -0.526 | -0.577 | -0.628 | -0.679 | -0.730 | -0.780 | | | | | | | | | | |
| 17 | 0.46067 | 0.09798 | 16.00 | -0.460 | -0.517 | -0.573 | -0.630 | -0.687 | -0.744 | -0.800 | | | | | | | | | | |
| 18 | 0.41151 | 0.09778 | 17.00 | -0.440 | -0.502 | -0.564 | -0.627 | -0.690 | -0.754 | -0.817 | | | | | | | | | | |
| 19 | 0.36309 | 0.09632 | 18.00 | -0.417 | -0.485 | -0.555 | -0.624 | -0.694 | -0.765 | -0.836 | | | | | | | | | | |
| 20 | 0.31595 | 0.09364 | 19.00 | -0.391 | -0.466 | -0.542 | -0.620 | -0.698 | -0.777 | -0.856 | | | | | | | | | | |
| 21 | 0.27056 | 0.08979 | 20.00 | -0.360 | -0.443 | -0.527 | -0.613 | -0.700 | -0.789 | -0.878 | | | | | | | | | | |
| 22 | 0.22744 | 0.08480 | 21.00 | -0.322 | -0.414 | -0.507 | -0.603 | -0.701 | -0.800 | -0.902 | | | | | | | | | | |
| 23 | 0.18700 | 0.07875 | 22.00 | -0.276 | -0.377 | -0.481 | -0.588 | -0.698 | -0.811 | -0.926 | | | | | | | | | | |
| 24 | 0.14969 | 0.07168 | 23.00 | -0.216 | -0.328 | -0.445 | -0.565 | -0.689 | -0.817 | -0.949 | | | | | | | | | | |
| 25 | 0.11583 | 0.06370 | 24.00 | -0.139 | -0.264 | -0.394 | -0.530 | -0.672 | -0.818 | -0.970 | | | | | | | | | | |
| 26 | 0.08580 | 0.05491 | 25.00 | -0.037 | -0.175 | -0.322 | -0.476 | -0.638 | -0.807 | -0.983 | | | | | | | | | | |
| 27 | 0.05981 | 0.04544 | 26.00 | 0.099 | -0.054 | -0.219 | -0.394 | -0.581 | -0.778 | -0.985 | | | | | | | | | | |
| 28 | 0.03816 | 0.03549 | 27.00 | 0.279 | 0.113 | -0.070 | -0.270 | -0.485 | -0.717 | -0.964 | | | | | | | | | | |
| 29 | 0.02100 | 0.02526 | 28.00 | 0.514 | 0.341 | 0.142 | -0.082 | -0.332 | -0.607 | -0.907 | | | | | | | | | | |
| 30 | 0.00863 | 0.01509 | 29.00 | 0.797 | 0.642 | 0.445 | 0.204 | -0.080 | -0.405 | -0.773 | | | | | | | | | | |
| 31 | 0.00192 | 0.00645 | 29.88 | 0.994 | 0.925 | 0.782 | 0.563 | 0.270 | -0.097 | -0.539 | | | | | | | | | | |
| 32 | 0.00134 | 0.00533 | 30.00 | 1.000 | 0.955 | 0.827 | 0.618 | 0.328 | -0.044 | -0.497 | | | | | | | | | | |
| 33 | 0.00080 | 0.00413 | 30.13 | 0.995 | 0.980 | 0.875 | 0.679 | 0.394 | 0.018 | -0.447 | | | | | | | | | | |
| 34 | 0.00014 | 0.00190 | 30.38 | 0.934 | 1.000 | 0.954 | 0.797 | 0.528 | 0.149 | -0.340 | | | | | | | | | | |
| 35 | 0.00001 | -0.00039 | 30.63 | 0.837 | 0.966 | 0.999 | 0.935 | 0.776 | 0.520 | 0.169 | | | | | | | | | | |
| 36 | 0.00027 | -0.00284 | 30.88 | 0.719 | 0.894 | 0.985 | 0.993 | 0.916 | 0.756 | 0.512 | | | | | | | | | | |
| 37 | 0.00051 | -0.00405 | 31.00 | 0.658 | 0.850 | 0.965 | 1.000 | 0.956 | 0.834 | 0.633 | | | | | | | | | | |
| 38 | 0.00516 | -0.01488 | 32.00 | 0.116 | 0.388 | 0.610 | 0.782 | 0.905 | 0.977 | 1.000 | | | | | | | | | | |
| 39 | 0.01423 | -0.02612 | 33.00 | -0.330 | -0.051 | 0.196 | 0.410 | 0.591 | 0.739 | 0.855 | | | | | | | | | | |
| 40 | 0.02762 | -0.03732 | 34.00 | -0.637 | -0.378 | -0.140 | 0.076 | 0.270 | 0.441 | 0.590 | | | | | | | | | | |
| 41 | 0.04509 | -0.04794 | 35.00 | -0.825 | -0.594 | -0.377 | -0.176 | 0.011 | 0.181 | 0.336 | | | | | | | | | | |
| 42 | 0.06670 | -0.05772 | 36.00 | -0.923 | -0.721 | -0.529 | -0.348 | -0.177 | -0.017 | 0.132 | | | | | | | | | | |
| 43 | 0.09216 | -0.06635 | 37.00 | -0.958 | -0.783 | -0.615 | -0.455 | -0.302 | -0.156 | -0.019 | | | | | | | | | | |
| 44 | 0.12149 | -0.07365 | 38.00 | -0.949 | -0.798 | -0.653 | -0.512 | -0.377 | -0.247 | -0.123 | | | | | | | | | | |
| 45 | 0.15434 | -0.07944 | 39.00 | -0.911 | -0.781 | -0.655 | -0.533 | -0.414 | -0.300 | -0.189 | | | | | | | | | | |
| 46 | 0.19065 | -0.08363 | 40.00 | -0.853 | -0.742 | -0.634 | -0.527 | -0.424 | -0.323 | -0.225 | | | | | | | | | | |
| 47 | 0.23002 | -0.08613 | 41.00 | -0.784 | -0.689 | -0.595 | -0.503 | -0.413 | -0.325 | -0.239 | | | | | | | | | | |
| 48 | 0.27228 | -0.08696 | 42.00 | -0.708 | -0.626 | -0.546 | -0.466 | -0.388 | -0.311 | -0.235 | | | | | | | | | | |
| 49 | 0.31695 | -0.08611 | 43.00 | -0.628 | -0.558 | -0.489 | -0.420 | -0.352 | -0.285 | -0.219 | | | | | | | | | | |
| 50 | 0.36379 | -0.08365 | 44.00 | -0.548 | -0.488 | -0.428 | -0.369 | -0.310 | -0.251 | -0.194 | | | | | | | | | | |
| 51 | 0.41225 | -0.07967 | 45.00 | -0.467 | -0.416 | -0.365 | -0.314 | -0.263 | -0.212 | -0.162 | | | | | | | | | | |
| 52 | 0.46198 | -0.07426 | 46.00 | -0.388 | -0.345 | -0.301 | -0.257 | -0.213 | -0.169 | -0.125 | | | | | | | | | | |
| 53 | 0.51236 | -0.06755 | 47.00 | -0.312 | -0.274 | -0.237 | -0.199 | -0.161 | -0.123 | -0.086 | | | | | | | | | | |
| 54 | 0.56300 | -0.05952 | 48.00 | -0.228 | -0.197 | -0.165 | -0.133 | -0.101 | -0.069 | -0.036 | | | | | | | | | | |
| 55 | 0.61351 | -0.05025 | 49.00 | -0.139 | -0.113 | -0.086 | -0.059 | -0.032 | -0.005 | 0.023 | | | | | | | | | | |
| 56 | 0.66384 | -0.03971 | 50.00 | -0.014 | 0.007 | 0.028 | 0.049 | 0.071 | 0.093 | 0.115 | | | | | | | | | | |
| 57 | 0.71399 | -0.02876 | 51.00 | 0.099 | 0.116 | 0.132 | 0.149 | 0.167 | 0.184 | 0.202 | | | | | | | | | | |
| 58 | 0.76337 | -0.01823 | 52.00 | 0.201 | 0.214 | 0.227 | 0.240 | 0.254 | 0.268 | 0.282 | | | | | | | | | | |
| 59 | 0.81124 | -0.00889 | 53.00 | 0.291 | 0.301 | 0.311 | 0.321 | 0.332 | 0.343 | 0.355 | | | | | | | | | | |
| 60 | 0.85669 | -0.00152 | 54.00 | 0.369 | 0.377 | 0.384 | 0.392 | 0.401 | 0.409 | 0.418 | | | | | | | | | | |
| 61 | 0.89844 | 0.00302 | 55.00 | 0.420 | 0.426 | 0.432 | 0.438 | 0.445 | 0.451 | 0.459 | | | | | | | | | | |
| 62 | 0.93446 | 0.00453 | 56.00 | 0.440 | 0.445 | 0.449 | 0.454 | 0.460 | 0.465 | 0.471 | | | | | | | | | | |
| 63 | 0.96316 | 0.00388 | 57.00 | 0.441 | 0.444 | 0.447 | 0.451 | 0.456 | 0.460 | 0.465 | | | | | | | | | | |
| 64 | 0.98373 | 0.00224 | 58.00 | 0.429 | 0.432 | 0.434 | 0.437 | 0.441 | 0.444 | 0.448 | | | | | | | | | | |
| 65 | 0.99596 | 0.00068 | 59.00 | 0.417 | 0.418 | 0.420 | 0.422 | 0.424 | 0.427 | 0.430 | | | | | | | | | | |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.414 | 0.414 | 0.414 | 0.415 | 0.417 | 0.418 | 0.420 | | | | | | | | | | |

ALPHA= 4.05 DEGREES CM0=-0.1411 ETA= 1.144

| AIRFOIL S833 18% | | | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | |
|------------------|---------|----------|-------|---|--------|--------|--------|--------|--------|
| N | X | Y | NU | CP(X) FOR THE ABOVE ALPHA REL. CHORD LINE | | | | | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.422 | 0.425 | 0.428 | 0.432 | 0.435 | 0.439 |
| 2 | 0.99606 | 0.00100 | 1.00 | 0.394 | 0.396 | 0.398 | 0.400 | 0.403 | 0.406 |
| 3 | 0.98502 | 0.00465 | 2.00 | 0.302 | 0.302 | 0.303 | 0.305 | 0.307 | 0.309 |
| 4 | 0.96844 | 0.01109 | 3.00 | 0.152 | 0.151 | 0.151 | 0.151 | 0.152 | 0.154 |
| 5 | 0.94764 | 0.01954 | 4.00 | -0.035 | -0.038 | -0.040 | -0.041 | -0.042 | -0.043 |
| 6 | 0.92323 | 0.02883 | 5.00 | -0.219 | -0.225 | -0.230 | -0.234 | -0.237 | -0.240 |
| 7 | 0.89510 | 0.03796 | 6.00 | -0.335 | -0.343 | -0.351 | -0.358 | -0.364 | -0.370 |
| 8 | 0.86284 | 0.04678 | 7.00 | -0.391 | -0.403 | -0.414 | -0.424 | -0.433 | -0.441 |
| 9 | 0.82683 | 0.05549 | 8.00 | -0.452 | -0.467 | -0.481 | -0.495 | -0.507 | -0.519 |
| 10 | 0.78759 | 0.06394 | 9.00 | -0.516 | -0.535 | -0.553 | -0.570 | -0.586 | -0.602 |
| 11 | 0.74562 | 0.07192 | 10.00 | -0.582 | -0.605 | -0.627 | -0.649 | -0.669 | -0.689 |
| 12 | 0.70140 | 0.07919 | 11.00 | -0.648 | -0.676 | -0.703 | -0.729 | -0.754 | -0.778 |
| 13 | 0.65539 | 0.08546 | 12.00 | -0.709 | -0.742 | -0.774 | -0.805 | -0.835 | -0.864 |
| 14 | 0.60790 | 0.09049 | 13.00 | -0.751 | -0.789 | -0.826 | -0.862 | -0.898 | -0.933 |
| 15 | 0.55925 | 0.09430 | 14.00 | -0.791 | -0.834 | -0.877 | -0.919 | -0.960 | -1.001 |
| 16 | 0.51005 | 0.09685 | 15.00 | -0.831 | -0.880 | -0.929 | -0.978 | -1.026 | -1.073 |
| 17 | 0.46067 | 0.09798 | 16.00 | -0.856 | -0.913 | -0.968 | -1.024 | -1.078 | -1.133 |
| 18 | 0.41151 | 0.09778 | 17.00 | -0.880 | -0.943 | -1.006 | -1.069 | -1.132 | -1.194 |
| 19 | 0.36309 | 0.09632 | 18.00 | -0.907 | -0.978 | -1.050 | -1.121 | -1.192 | -1.263 |
| 20 | 0.31595 | 0.09364 | 19.00 | -0.936 | -1.017 | -1.098 | -1.179 | -1.261 | -1.342 |
| 21 | 0.27056 | 0.08979 | 20.00 | -0.969 | -1.060 | -1.153 | -1.246 | -1.339 | -1.433 |
| 22 | 0.22744 | 0.08480 | 21.00 | -1.004 | -1.109 | -1.214 | -1.321 | -1.429 | -1.538 |
| 23 | 0.18700 | 0.07875 | 22.00 | -1.043 | -1.163 | -1.284 | -1.408 | -1.533 | -1.660 |
| 24 | 0.14969 | 0.07168 | 23.00 | -1.084 | -1.222 | -1.363 | -1.507 | -1.654 | -1.803 |
| 25 | 0.11583 | 0.06370 | 24.00 | -1.127 | -1.288 | -1.453 | -1.623 | -1.797 | -1.974 |
| 26 | 0.08580 | 0.05491 | 25.00 | -1.167 | -1.357 | -1.553 | -1.756 | -1.965 | -2.179 |
| 27 | 0.05981 | 0.04544 | 26.00 | -1.203 | -1.430 | -1.668 | -1.914 | -2.170 | -2.434 |
| 28 | 0.03816 | 0.03549 | 27.00 | -1.227 | -1.505 | -1.797 | -2.104 | -2.424 | -2.758 |
| 29 | 0.02100 | 0.02526 | 28.00 | -1.230 | -1.578 | -1.949 | -2.344 | -2.760 | -3.199 |
| 30 | 0.00863 | 0.01509 | 29.00 | -1.182 | -1.632 | -2.123 | -2.653 | -3.223 | -3.831 |
| 31 | 0.00192 | 0.00645 | 29.88 | -1.053 | -1.640 | -2.299 | -3.030 | -3.830 | -4.700 |
| 32 | 0.00134 | 0.00533 | 30.00 | -1.029 | -1.642 | -2.333 | -3.102 | -3.948 | -4.870 |
| 33 | 0.00080 | 0.00413 | 30.13 | -1.001 | -1.644 | -2.373 | -3.189 | -4.091 | -5.077 |
| 34 | 0.00014 | 0.00190 | 30.38 | -0.939 | -1.647 | -2.464 | -3.387 | -4.417 | -5.551 |
| 35 | 0.00001 | -0.00039 | 30.63 | -0.277 | -0.818 | -1.453 | -2.181 | -3.001 | -3.913 |
| 36 | 0.00027 | -0.00284 | 30.88 | 0.185 | -0.225 | -0.717 | -1.291 | -1.946 | -2.682 |
| 37 | 0.00051 | -0.00405 | 31.00 | 0.354 | -0.003 | -0.438 | -0.950 | -1.539 | -2.203 |
| 38 | 0.00516 | -0.01488 | 32.00 | 0.972 | 0.894 | 0.767 | 0.589 | 0.362 | 0.085 |
| 39 | 0.01423 | -0.02612 | 33.00 | 0.936 | 0.985 | 1.000 | 0.981 | 0.930 | 0.844 |
| 40 | 0.02762 | -0.03732 | 34.00 | 0.716 | 0.819 | 0.899 | 0.956 | 0.990 | 1.000 |
| 41 | 0.04509 | -0.04794 | 35.00 | 0.476 | 0.599 | 0.705 | 0.796 | 0.870 | 0.927 |
| 42 | 0.06670 | -0.05772 | 36.00 | 0.269 | 0.396 | 0.510 | 0.613 | 0.704 | 0.783 |
| 43 | 0.09216 | -0.06635 | 37.00 | 0.110 | 0.231 | 0.343 | 0.447 | 0.543 | 0.629 |
| 44 | 0.12149 | -0.07365 | 38.00 | -0.005 | 0.107 | 0.213 | 0.313 | 0.406 | 0.493 |
| 45 | 0.15434 | -0.07944 | 39.00 | -0.083 | 0.019 | 0.116 | 0.209 | 0.298 | 0.381 |
| 46 | 0.19065 | -0.08363 | 40.00 | -0.131 | -0.039 | 0.049 | 0.134 | 0.216 | 0.294 |
| 47 | 0.23002 | -0.08613 | 41.00 | -0.155 | -0.073 | 0.006 | 0.083 | 0.157 | 0.229 |
| 48 | 0.27228 | -0.08696 | 42.00 | -0.161 | -0.089 | -0.018 | 0.051 | 0.118 | 0.183 |
| 49 | 0.31695 | -0.08611 | 43.00 | -0.154 | -0.090 | -0.027 | 0.035 | 0.095 | 0.154 |
| 50 | 0.36379 | -0.08365 | 44.00 | -0.136 | -0.080 | -0.024 | 0.030 | 0.084 | 0.137 |
| 51 | 0.41225 | -0.07967 | 45.00 | -0.112 | -0.062 | -0.013 | 0.035 | 0.083 | 0.130 |
| 52 | 0.46198 | -0.07426 | 46.00 | -0.082 | -0.038 | 0.005 | 0.048 | 0.090 | 0.132 |
| 53 | 0.51236 | -0.06755 | 47.00 | -0.048 | -0.010 | 0.028 | 0.066 | 0.103 | 0.141 |
| 54 | 0.56300 | -0.05952 | 48.00 | -0.003 | 0.029 | 0.062 | 0.095 | 0.128 | 0.160 |
| 55 | 0.61351 | -0.05025 | 49.00 | 0.050 | 0.078 | 0.106 | 0.135 | 0.163 | 0.191 |
| 56 | 0.66384 | -0.03971 | 50.00 | 0.138 | 0.161 | 0.184 | 0.207 | 0.230 | 0.254 |
| 57 | 0.71399 | -0.02876 | 51.00 | 0.221 | 0.239 | 0.258 | 0.277 | 0.296 | 0.315 |
| 58 | 0.76337 | -0.01823 | 52.00 | 0.297 | 0.312 | 0.327 | 0.342 | 0.358 | 0.374 |
| 59 | 0.81124 | -0.00889 | 53.00 | 0.366 | 0.378 | 0.390 | 0.403 | 0.415 | 0.428 |
| 60 | 0.85669 | -0.00152 | 54.00 | 0.427 | 0.437 | 0.447 | 0.456 | 0.467 | 0.477 |
| 61 | 0.89844 | 0.00302 | 55.00 | 0.466 | 0.474 | 0.482 | 0.490 | 0.498 | 0.507 |
| 62 | 0.93446 | 0.00453 | 56.00 | 0.477 | 0.484 | 0.490 | 0.497 | 0.505 | 0.512 |
| 63 | 0.96316 | 0.00388 | 57.00 | 0.470 | 0.476 | 0.481 | 0.488 | 0.494 | 0.500 |
| 64 | 0.98373 | 0.00224 | 58.00 | 0.452 | 0.457 | 0.462 | 0.467 | 0.473 | 0.478 |
| 65 | 0.99596 | 0.00068 | 59.00 | 0.433 | 0.437 | 0.441 | 0.445 | 0.450 | 0.455 |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.422 | 0.425 | 0.428 | 0.432 | 0.435 | 0.439 |

ALPHA= 4.05 DEGREES CM0=-0.1411 ETA= 1.144

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 250000 MU= 300 | R= 250000 MU= 100 | R= 250000 MU= 900 |
|---------------|--|---|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2298 0.0447 0.6008* LOWER 0.7243 0.2332 0.7605* TOTAL CL=-0.039 100CD=1.3613 CM=-0.1329 | S TURB S SEP 100CD 1.0030 0.0296 0.8642 0.9627 0.2306 0.8548 CL=-0.024 100CD=1.7191 CM=-0.1353 | S TURB S SEP 100CD 0.5207 0.0284 0.6869 0.8329 0.2177 0.7604 CL=-0.023 100CD=1.4473 CM=-0.1353 |
| -3.00 | S TURB S SEP 100CD UPPER 0.2503 0.0456 0.6482* LOWER 0.6884 0.2213 0.6678* TOTAL CL= 0.066 100CD=1.3160 CM=-0.1354 | S TURB S SEP 100CD 1.0030 0.0313 0.9318 0.9627 0.2153 0.7748 CL= 0.082 100CD=1.7066 CM=-0.1378 | S TURB S SEP 100CD 0.5904 0.0302 0.7722 0.8119 0.2021 0.6842 CL= 0.083 100CD=1.4564 CM=-0.1378 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2698 0.0457 0.7046* LOWER 0.6514 0.2090 0.5966* TOTAL CL= 0.174 100CD=1.3012 CM=-0.1380 | S TURB S SEP 100CD 1.0030 0.0331 1.0060 0.9627 0.2002 0.7023 CL= 0.188 100CD=1.7083 CM=-0.1402 | S TURB S SEP 100CD 0.6517 0.0320 0.8595 0.7898 0.1867 0.6159 CL= 0.189 100CD=1.4755 CM=-0.1402 |
| -1.00 | S TURB S SEP 100CD UPPER 0.2876 0.0477 0.7522* LOWER 0.6139 0.1975 0.5320* TOTAL CL= 0.279 100CD=1.2842 CM=-0.1401 | S TURB S SEP 100CD 1.0030 0.0349 1.0871 0.9627 0.1853 0.6365 CL= 0.294 100CD=1.7237 CM=-0.1425 | S TURB S SEP 100CD 0.7068 0.0340 0.9510 0.7669 0.1720 0.5550 CL= 0.295 100CD=1.5060 CM=-0.1425 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3053 0.0484 0.8103* LOWER 0.5759 0.1871 0.4728* TOTAL CL= 0.385 100CD=1.2831 CM=-0.1424 | S TURB S SEP 100CD 1.0030 0.0369 1.1758 0.9627 0.1710 0.5769 CL= 0.400 100CD=1.7527 CM=-0.1446 | S TURB S SEP 100CD 0.7573 0.0360 1.0486 0.7431 0.1572 0.5002 CL= 0.401 100CD=1.5488 CM=-0.1445 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3235 0.0490 0.8594* LOWER 0.5372 0.1811 0.4236* TOTAL CL= 0.491 100CD=1.2829 CM=-0.1447 | S TURB S SEP 100CD 1.0030 0.0390 1.2737 0.9627 0.1564 0.5229 CL= 0.505 100CD=1.7966 CM=-0.1464 | S TURB S SEP 100CD 0.8034 0.0381 1.1541 0.7184 0.1406 0.4516 CL= 0.506 100CD=1.6057 CM=-0.1464 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3449 0.0508 0.9058* LOWER 0.4986 0.1869 0.3982* TOTAL CL= 0.596 100CD=1.3040 CM=-0.1469 | S TURB S SEP 100CD 1.0030 0.0413 1.3815 0.9627 0.0000 0.4743 CL= 0.609 100CD=1.8558 CM=-0.1460 | S TURB S SEP 100CD 0.8453 0.0404 1.2700 0.6928 0.0000 0.4076 CL= 0.610 100CD=1.6776 CM=-0.1462 |
| 3.00 | S TURB S SEP 100CD UPPER 0.3785 0.0494 0.9356* LOWER 0.4725 0.1984 0.3780* TOTAL CL= 0.705 100CD=1.3136 CM=-0.1498 | S TURB S SEP 100CD 1.0030 0.0438 1.5000 0.9627 0.0000 0.4306 CL= 0.713 100CD=1.9306 CM=-0.1475 | S TURB S SEP 100CD 0.8836 0.0430 1.3985 0.6664 0.0000 0.3769 CL= 0.714 100CD=1.7754 CM=-0.1477 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4360 0.0468 0.9996* LOWER 0.4505 0.1891 0.3657* TOTAL CL= 0.816 100CD=1.3653 CM=-0.1524 | S TURB S SEP 100CD 1.0030 0.0460 1.6154 0.9627 0.0000 0.3993 CL= 0.817 100CD=2.0147 CM=-0.1489 | S TURB S SEP 100CD 0.9190 0.0452 1.5282 0.6397 0.0000 0.3454 CL= 0.818 100CD=1.8737 CM=-0.1492 |
| 5.00 | S TURB S SEP 100CD UPPER 0.4842 0.0471 1.0889* LOWER 0.4280 0.1890 0.4359* TOTAL CL= 0.923 100CD=1.5249 CM=-0.1538 | S TURB S SEP 100CD 1.0030 0.0497 1.7738 0.9627 0.0000 0.3679 CL= 0.919 100CD=2.1417 CM=-0.1497 | S TURB S SEP 100CD 0.9498 0.0490 1.7039 0.6115 0.0000 0.3155 CL= 0.920 100CD=2.0195 CM=-0.1500 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8773 0.0520 1.7998* LOWER 0.4083 0.1949 0.3964* TOTAL CL= 1.022 100CD=2.1961 CM=-0.1547 | S TURB S SEP 100CD 1.0030 0.0533 1.9359* 0.9627 0.0000 0.3384 CL= 1.020 100CD=2.2743 CM=-0.1504 | S TURB S SEP 100CD 0.9743 0.0527 1.8822 0.5829 0.0000 0.2880 CL= 1.021 100CD=2.1702 CM=-0.1506 |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEC.) | R= | 250000 | MU= | 300 | R= | 250000 | MU= | 100 | R= | 250000 | MU= | 900 |
|-------------|-------|------------|--------------|--------------|---------|--------|-------|-----|-------|--------|-----|-----|
| 6.44 | S | TURB | S | SEP | 100CD | | | | | | | |
| | UPPER | 0.9522 | 0.0555 | 2.0407* | | | | | | | | |
| | LOWER | 0.4019 | 0.1973 | 0.3973* | | | | | | | | |
| | TOTAL | CL= 1.063 | 100CD=2.4380 | | | | | | | | | |
| | | CM=-0.1546 | | | | | | | | | | |
| 6.52 | | | S | TURB | S | SEP | 100CD | | | | | |
| | UPPER | | 1.0030 | 0.0555 | 2.0439* | | | | | | | |
| | LOWER | | 0.9627 | 0.0000 | 0.3240 | | | | | | | |
| | TOTAL | | CL= 1.072 | 100CD=2.3679 | | | | | | | | |
| | | | CM=-0.1505 | | | | | | | | | |
| 6.78 | | | | | S | TURB | S | SEP | 100CD | | | |
| | UPPER | | 0.9888 | 0.0561 | 2.0447* | | | | | | | |
| | LOWER | | 0.5600 | 0.0000 | 0.2679 | | | | | | | |
| | TOTAL | | CL= 1.099 | 100CD=2.3126 | | | | | | | | |
| | | | CM=-0.1508 | | | | | | | | | |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 300000 | MU= 300 | R= 300000 | MU= 100 | R= 300000 | MU= 900 |
|---------------|-----------|------------------------|------------------------|------------------------|-----------|-------------|
| -4.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.2298 0.0412 0.5330* | 1.0030 0.0287 0.8406 | 0.5644 0.0276 0.6826 | | |
| | LOWER | 0.7243 0.2186 0.6897* | 0.9627 0.2256 0.8264 | 0.8414 0.2124 0.7347 | | |
| | TOTAL | CL=-0.036 100CD=1.2228 | CL=-0.023 100CD=1.6670 | CL=-0.022 100CD=1.4173 | | |
| | | CM=-0.1332 | CM=-0.1354 | CM=-0.1354 | | |
| -3.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.2503 0.0418 0.5767* | 1.0030 0.0304 0.9062 | 0.6261 0.0294 0.7609 | | |
| | LOWER | 0.6884 0.2044 0.6142* | 0.9627 0.2104 0.7498 | 0.8211 0.1967 0.6611 | | |
| | TOTAL | CL= 0.071 100CD=1.1910 | CL= 0.083 100CD=1.6559 | CL= 0.084 100CD=1.4221 | | |
| | | CM=-0.1358 | CM=-0.1379 | CM=-0.1379 | | |
| -2.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.2698 0.0418 0.6241* | 1.0030 0.0322 0.9780 | 0.6816 0.0312 0.8432 | | |
| | LOWER | 0.6514 0.1909 0.5462* | 0.9627 0.1954 0.6802 | 0.7997 0.1814 0.5952 | | |
| | TOTAL | CL= 0.178 100CD=1.1703 | CL= 0.189 100CD=1.6582 | CL= 0.190 100CD=1.4384 | | |
| | | CM=-0.1384 | CM=-0.1403 | CM=-0.1403 | | |
| -1.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.2876 0.0429 0.6639* | 1.0030 0.0341 1.0563 | 0.7313 0.0331 0.9292 | | |
| | LOWER | 0.6139 0.1781 0.4844* | 0.9627 0.1807 0.6171 | 0.7776 0.1667 0.5364 | | |
| | TOTAL | CL= 0.284 100CD=1.1483 | CL= 0.295 100CD=1.6734 | CL= 0.296 100CD=1.4656 | | |
| | | CM=-0.1407 | CM=-0.1426 | CM=-0.1426 | | |
| 0.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3053 0.0442 0.7201* | 1.0030 0.0360 1.1422 | 0.7779 0.0351 1.0226 | | |
| | LOWER | 0.5759 0.1666 0.4284* | 0.9627 0.1665 0.5597 | 0.7543 0.1514 0.4835 | | |
| | TOTAL | CL= 0.390 100CD=1.1485 | CL= 0.401 100CD=1.7018 | CL= 0.402 100CD=1.5061 | | |
| | | CM=-0.1429 | CM=-0.1447 | CM=-0.1447 | | |
| 1.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3235 0.0449 0.7669* | 1.0030 0.0381 1.2361 | 0.8203 0.0372 1.1235 | | |
| | LOWER | 0.5372 0.1590 0.3823* | 0.9627 0.1516 0.5078 | 0.7306 0.0000 0.4363 | | |
| | TOTAL | CL= 0.497 100CD=1.1492 | CL= 0.506 100CD=1.7439 | CL= 0.507 100CD=1.5598 | | |
| | | CM=-0.1451 | CM=-0.1466 | CM=-0.1448 | | |
| 2.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3449 0.0464 0.8131* | 1.0030 0.0404 1.3396 | 0.8593 0.0395 1.2347 | | |
| | LOWER | 0.4986 0.1705 0.3518* | 0.9627 0.0000 0.4609 | 0.7056 0.0000 0.3942 | | |
| | TOTAL | CL= 0.602 100CD=1.1650 | CL= 0.610 100CD=1.8005 | CL= 0.612 100CD=1.6289 | | |
| | | CM=-0.1475 | CM=-0.1463 | CM=-0.1465 | | |
| 3.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3785 0.0454 0.8506* | 1.0030 0.0428 1.4534 | 0.8950 0.0420 1.3580 | | |
| | LOWER | 0.4725 0.1688 0.3321* | 0.9627 0.0000 0.4188 | 0.6801 0.0000 0.3661 | | |
| | TOTAL | CL= 0.711 100CD=1.1827 | CL= 0.714 100CD=1.8722 | CL= 0.716 100CD=1.7241 | | |
| | | CM=-0.1500 | CM=-0.1478 | CM=-0.1480 | | |
| 4.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.4360 0.0438 0.9225* | 1.0030 0.0450 1.5638 | 0.9280 0.0442 1.4829 | | |
| | LOWER | 0.4505 0.1774 0.3111* | 0.9627 0.0000 0.3897 | 0.6540 0.0000 0.3352 | | |
| | TOTAL | CL= 0.820 100CD=1.2336 | CL= 0.819 100CD=1.9535 | CL= 0.820 100CD=1.8181 | | |
| | | CM=-0.1529 | CM=-0.1493 | CM=-0.1495 | | |
| 5.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.5067 0.0435 1.0265 | 1.0030 0.0485 1.7154 | 0.9566 0.0479 1.6520 | | |
| | LOWER | 0.4280 0.1886 0.3468* | 0.9627 0.0000 0.3590 | 0.6266 0.0000 0.3061 | | |
| | TOTAL | CL= 0.928 100CD=1.3733 | CL= 0.921 100CD=2.0743 | CL= 0.922 100CD=1.9580 | | |
| | | CM=-0.1548 | CM=-0.1501 | CM=-0.1503 | | |
| 6.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.8773 0.0502 1.7008* | 1.0030 0.0520 1.8670* | 0.9791 0.0515 1.8230 | | |
| | LOWER | 0.4083 0.1715 0.3367* | 0.9627 0.0000 0.3303 | 0.5987 0.0000 0.2793 | | |
| | TOTAL | CL= 1.025 100CD=2.0375 | CL= 1.022 100CD=2.1973 | CL= 1.023 100CD=2.1023 | | |
| | | CM=-0.1545 | CM=-0.1509 | CM=-0.1510 | | |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 300000 MU= 300 | R= 300000 MU= 100 | R= 300000 MU= 900 |
|---------------|------------------------------|------------------------------|-------------------|
| 6.55 | S TURB S SEP 100CD | | |
| | UPPER 0.9666 0.0546 1.9947* | | |
| | LOWER 0.4005 0.1713 0.3215* | | |
| | TOTAL CL= 1.077 100CD=2.3162 | | |
| | CM=-0.1543 | | |
| 6.66 | S TURB S SEP 100CD | | |
| | UPPER 1.0030 0.0548 1.9981* | | |
| | LOWER 0.9627 0.0000 0.3125 | | |
| | TOTAL CL= 1.088 100CD=2.3106 | | |
| | CM=-0.1510 | | |
| 6.86 | | S TURB S SEP 100CD | |
| | | UPPER 0.9934 0.0552 1.9969* | |
| | | LOWER 0.5740 0.0000 0.2578 | |
| | | TOTAL CL= 1.109 100CD=2.2547 | |
| | | CM=-0.1512 | |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEC.) | R= 400000 MU= 300 | R= 400000 MU= 100 | R= 400000 MU= 900 |
|-------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2298 0.0367 0.4485* LOWER 0.7243 0.1975 0.6150* TOTAL CL=-0.031 100CD=1.0634 CM=-0.1337 | S TURB S SEP 100CD 1.0030 0.0273 0.8046 0.9627 0.2178 0.7840 CL=-0.022 100CD=1.5886 CM=-0.1355 | S TURB S SEP 100CD 0.6230 0.0264 0.6712 0.8544 0.2045 0.6985 CL=-0.021 100CD=1.3697 CM=-0.1356 |
| -3.00 | S TURB S SEP 100CD UPPER 0.2503 0.0364 0.4883* LOWER 0.6884 0.1822 0.5451* TOTAL CL= 0.077 100CD=1.0333 CM=-0.1365 | S TURB S SEP 100CD 1.0030 0.0290 0.8670 0.9627 0.2027 0.7124 CL= 0.085 100CD=1.5795 CM=-0.1381 | S TURB S SEP 100CD 0.6751 0.0281 0.7425 0.8351 0.1888 0.6287 CL= 0.086 100CD=1.3712 CM=-0.1381 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2698 0.0371 0.5243* LOWER 0.6514 0.1674 0.4817* TOTAL CL= 0.184 100CD=1.0060 CM=-0.1390 | S TURB S SEP 100CD 1.0030 0.0307 0.9352 0.9627 0.1879 0.6472 CL= 0.191 100CD=1.5824 CM=-0.1405 | S TURB S SEP 100CD 0.7223 0.0299 0.8171 0.8150 0.1738 0.5663 CL= 0.192 100CD=1.3834 CM=-0.1405 |
| -1.00 | S TURB S SEP 100CD UPPER 0.2876 0.0379 0.5694* LOWER 0.6139 0.1519 0.4237* TOTAL CL= 0.290 100CD=0.9931 CM=-0.1413 | S TURB S SEP 100CD 1.0030 0.0326 1.0095 0.9627 0.1735 0.5879 CL= 0.297 100CD=1.5974 CM=-0.1428 | S TURB S SEP 100CD 0.7660 0.0318 0.8971 0.7939 0.1589 0.5104 CL= 0.298 100CD=1.4075 CM=-0.1428 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3053 0.0380 0.6053* LOWER 0.5759 0.1359 0.3741* TOTAL CL= 0.398 100CD=0.9794 CM=-0.1437 | S TURB S SEP 100CD 1.0030 0.0346 1.0907 0.9627 0.1592 0.5339 CL= 0.402 100CD=1.6245 CM=-0.1449 | S TURB S SEP 100CD 0.8066 0.0338 0.9838 0.7720 0.1423 0.4604 CL= 0.404 100CD=1.4443 CM=-0.1448 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3235 0.0395 0.6464* LOWER 0.5372 0.0000 0.3315* TOTAL CL= 0.504 100CD=0.9779 CM=-0.1441 | S TURB S SEP 100CD 1.0030 0.0366 1.1793 0.9627 0.1433 0.4849 CL= 0.508 100CD=1.6642 CM=-0.1468 | S TURB S SEP 100CD 0.8444 0.0358 1.0784 0.7491 0.0000 0.4155 CL= 0.509 100CD=1.4940 CM=-0.1452 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3449 0.0400 0.6896* LOWER 0.4986 0.0000 0.3032* TOTAL CL= 0.611 100CD=0.9928 CM=-0.1464 | S TURB S SEP 100CD 1.0030 0.0388 1.2766 0.9627 0.0000 0.4406 CL= 0.613 100CD=1.7172 CM=-0.1467 | S TURB S SEP 100CD 0.8790 0.0381 1.1825 0.7255 0.0000 0.3760 CL= 0.614 100CD=1.5585 CM=-0.1470 |
| 3.00 | S TURB S SEP 100CD UPPER 0.3785 0.0397 0.7326* LOWER 0.4725 0.0000 0.2791* TOTAL CL= 0.719 100CD=1.0118 CM=-0.1488 | S TURB S SEP 100CD 1.0030 0.0412 1.3833 0.9627 0.0000 0.4011 CL= 0.717 100CD=1.7843 CM=-0.1483 | S TURB S SEP 100CD 0.9114 0.0405 1.2989 0.7011 0.0000 0.3510 CL= 0.718 100CD=1.6499 CM=-0.1485 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4368 0.0393 0.8113* LOWER 0.4505 0.0000 0.2601* TOTAL CL= 0.827 100CD=1.0713 CM=-0.1511 | S TURB S SEP 100CD 1.0030 0.0433 1.4863 0.9627 0.0000 0.3750 CL= 0.821 100CD=1.8613 CM=-0.1498 | S TURB S SEP 100CD 0.9409 0.0427 1.4162 0.6762 0.0000 0.3210 CL= 0.822 100CD=1.7372 CM=-0.1500 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5719 0.0405 1.0142 LOWER 0.4280 0.0000 0.2551* TOTAL CL= 0.933 100CD=1.2693 CM=-0.1528 | S TURB S SEP 100CD 1.0030 0.0467 1.6282 0.9627 0.0000 0.3454 CL= 0.923 100CD=1.9736 CM=-0.1507 | S TURB S SEP 100CD 0.9664 0.0462 1.5752 0.6500 0.0000 0.2931 CL= 0.924 100CD=1.8683 CM=-0.1509 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8773 0.0478 1.5691* LOWER 0.4083 0.0000 0.2650* TOTAL CL= 1.029 100CD=1.8341 CM=-0.1523 | S TURB S SEP 100CD 1.0030 0.0500 1.7676 0.9627 0.0000 0.3178 CL= 1.025 100CD=2.0854 CM=-0.1515 | S TURB S SEP 100CD 0.9860 0.0496 1.7359 0.6231 0.0000 0.2673 CL= 1.026 100CD=2.0032 CM=-0.1517 |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= | 400000 | MU= | 300 | R= | 400000 | MU= | 100 | R= | 400000 | MU= | 900 |
|---------------|-------|------------|--------------|---------|-------|--------|-----|-----|----|--------|-----|-----|
| 6.73 | S | TURB | S | SEP | 100CD | | | | | | | |
| | UPPER | 0.9850 | 0.0533 | 1.9265* | | | | | | | | |
| | LOWER | 0.3982 | 0.0000 | 0.2550* | | | | | | | | |
| | TOTAL | CL= 1.098 | 100CD=2.1814 | | | | | | | | | |
| | | CM=-0.1517 | | | | | | | | | | |
| 6.85 | S | TURB | S | SEP | 100CD | | | | | | | |
| | UPPER | 1.0030 | 0.0535 | 1.9265* | | | | | | | | |
| | LOWER | 0.9627 | 0.0000 | 0.2961 | | | | | | | | |
| | TOTAL | CL= 1.110 | 100CD=2.2225 | | | | | | | | | |
| | | CM=-0.1518 | | | | | | | | | | |
| 7.00 | S | TURB | S | SEP | 100CD | | | | | | | |
| | UPPER | 0.9998 | 0.0537 | 1.9222* | | | | | | | | |
| | LOWER | 0.5958 | 0.0000 | 0.2437 | | | | | | | | |
| | TOTAL | CL= 1.126 | 100CD=2.1659 | | | | | | | | | |
| | | CM=-0.1520 | | | | | | | | | | |
| 7.02 | S | TURB | S | SEP | 100CD | | | | | | | |
| | UPPER | 1.0006 | 0.0538 | 1.9276* | | | | | | | | |
| | LOWER | 0.5952 | 0.0000 | 0.2432 | | | | | | | | |
| | TOTAL | CL= 1.128 | 100CD=2.1709 | | | | | | | | | |
| | | CM=-0.1520 | | | | | | | | | | |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 500000 MU= 300 | R= 500000 MU= 100 | R= 500000 MU= 900 |
|---------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2298 0.0328 0.4003* LOWER 0.7243 0.1840 0.5679* TOTAL CL=-0.027 100CD=0.9682 CM=-0.1342 | S TURB S SEP 100CD 1.0030 0.0262 0.7777 0.9627 0.2116 0.7531 CL=-0.020 100CD=1.5308 CM=-0.1357 | S TURB S SEP 100CD 0.6618 0.0254 0.6612 0.8640 0.1987 0.6734 CL=-0.020 100CD=1.3346 CM=-0.1357 |
| -3.00 | S TURB S SEP 100CD UPPER 0.2503 0.0325 0.4347* LOWER 0.6884 0.1682 0.5017* TOTAL CL= 0.081 100CD=0.9364 CM=-0.1370 | S TURB S SEP 100CD 1.0030 0.0279 0.8378 0.9627 0.1967 0.6851 CL= 0.086 100CD=1.5229 CM=-0.1382 | S TURB S SEP 100CD 0.7074 0.0271 0.7270 0.8457 0.1831 0.6064 CL= 0.087 100CD=1.3334 CM=-0.1382 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2698 0.0333 0.4692* LOWER 0.6514 0.1516 0.4412* TOTAL CL= 0.188 100CD=0.9104 CM=-0.1395 | S TURB S SEP 100CD 1.0030 0.0296 0.9033 0.9627 0.1820 0.6230 CL= 0.192 100CD=1.5263 CM=-0.1407 | S TURB S SEP 100CD 0.7501 0.0288 0.7974 0.8264 0.1682 0.5464 CL= 0.193 100CD=1.3438 CM=-0.1407 |
| -1.00 | S TURB S SEP 100CD UPPER 0.2876 0.0340 0.5078* LOWER 0.6139 0.1315 0.3863* TOTAL CL= 0.295 100CD=0.8941 CM=-0.1419 | S TURB S SEP 100CD 1.0030 0.0315 0.9747 0.9627 0.1678 0.5664 CL= 0.298 100CD=1.5411 CM=-0.1430 | S TURB S SEP 100CD 0.7897 0.0307 0.8732 0.8062 0.1529 0.4926 CL= 0.299 100CD=1.3658 CM=-0.1429 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3053 0.0343 0.5406* LOWER 0.5759 0.0000 0.3434* TOTAL CL= 0.403 100CD=0.8841 CM=-0.1431 | S TURB S SEP 100CD 1.0030 0.0334 1.0526 0.9627 0.1531 0.5148 CL= 0.404 100CD=1.5674 CM=-0.1451 | S TURB S SEP 100CD 0.8267 0.0327 0.9556 0.7852 0.1352 0.4446 CL= 0.405 100CD=1.4002 CM=-0.1450 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3235 0.0356 0.5793* LOWER 0.5372 0.0000 0.3109* TOTAL CL= 0.509 100CD=0.8902 CM=-0.1453 | S TURB S SEP 100CD 1.0030 0.0355 1.1372 0.9627 0.1363 0.4680 CL= 0.509 100CD=1.6052 CM=-0.1470 | S TURB S SEP 100CD 0.8611 0.0347 1.0457 0.7632 0.0000 0.4015 CL= 0.510 100CD=1.4473 CM=-0.1455 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3449 0.0362 0.6169* LOWER 0.4986 0.0000 0.2835* TOTAL CL= 0.616 100CD=0.9004 CM=-0.1475 | S TURB S SEP 100CD 1.0030 0.0376 1.2302 0.9627 0.0000 0.4257 CL= 0.614 100CD=1.6558 CM=-0.1471 | S TURB S SEP 100CD 0.8930 0.0369 1.1449 0.7405 0.0000 0.3714 CL= 0.615 100CD=1.5163 CM=-0.1473 |
| 3.00 | S TURB S SEP 100CD UPPER 0.3885 0.0357 0.6665 LOWER 0.4725 0.0000 0.2596* TOTAL CL= 0.725 100CD=0.9261 CM=-0.1501 | S TURB S SEP 100CD 1.0030 0.0400 1.3318 0.9627 0.0000 0.3957 CL= 0.719 100CD=1.7275 CM=-0.1487 | S TURB S SEP 100CD 0.9229 0.0393 1.2561 0.7169 0.0000 0.3394 CL= 0.720 100CD=1.5955 CM=-0.1489 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4698 0.0369 0.7934 LOWER 0.4505 0.0000 0.2422* TOTAL CL= 0.831 100CD=1.0356 CM=-0.1519 | S TURB S SEP 100CD 1.0030 0.0420 1.4296 0.9627 0.0000 0.3640 CL= 0.823 100CD=1.7936 CM=-0.1502 | S TURB S SEP 100CD 0.9499 0.0415 1.3680 0.6930 0.0000 0.3107 CL= 0.824 100CD=1.6787 CM=-0.1504 |
| 5.00 | S TURB S SEP 100CD UPPER 0.6167 0.0392 1.0059 LOWER 0.4280 0.0000 0.2261* TOTAL CL= 0.935 100CD=1.2320 CM=-0.1533 | S TURB S SEP 100CD 1.0030 0.0453 1.5642 0.9627 0.0000 0.3353 CL= 0.926 100CD=1.8996 CM=-0.1512 | S TURB S SEP 100CD 0.9732 0.0444 1.5060 0.6675 0.0000 0.2836 CL= 0.927 100CD=1.7896 CM=-0.1515 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8773 0.0462 1.4847* LOWER 0.4083 0.0000 0.2266* TOTAL CL= 1.032 100CD=1.7112 CM=-0.1528 | S TURB S SEP 100CD 1.0030 0.0485 1.6966 0.9627 0.0000 0.3084 CL= 1.028 100CD=2.0050 CM=-0.1520 | S TURB S SEP 100CD 0.9907 0.0482 1.6730 0.6420 0.0000 0.2588 CL= 1.028 100CD=1.9318 CM=-0.1521 |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= | 500000 | MU= | 300 | R= | 500000 | MU= | 100 | R= | 500000 | MU= | 900 |
|---------------|----|--------|--------|--------|---------|---------|--------|-----|----|--------|-----|-----|
| 6.86 | | | S TURB | S SEP | 100CD | | | | | | | |
| | | | UPPER | 0.9933 | 0.0522 | 1.8758* | | | | | | |
| | | | LOWER | 0.3962 | 0.0000 | 0.2237* | | | | | | |
| | | | TOTAL | CL= | 1.114 | 100CD= | 2.0995 | | | | | |
| | | | | CM= | -0.1523 | | | | | | | |
| 6.95 | | | S TURB | S SEP | 100CD | | | | | | | |
| | | | UPPER | 1.0030 | 0.0524 | 1.8759* | | | | | | |
| | | | LOWER | 0.9627 | 0.0000 | 0.2850 | | | | | | |
| | | | TOTAL | CL= | 1.123 | 100CD= | 2.1609 | | | | | |
| | | | | CM= | -0.1524 | | | | | | | |
| 7.00 | | | S TURB | S SEP | 100CD | | | | | | | |
| | | | UPPER | 1.0030 | 0.0521 | 1.8430* | | | | | | |
| | | | LOWER | 0.6154 | 0.0000 | 0.2365 | | | | | | |
| | | | TOTAL | CL= | 1.129 | 100CD= | 2.0795 | | | | | |
| | | | | CM= | -0.1526 | | | | | | | |
| 7.13 | | | S TURB | S SEP | 100CD | | | | | | | |
| | | | UPPER | 1.0054 | 0.0527 | 1.8747* | | | | | | |
| | | | LOWER | 0.6119 | 0.0000 | 0.2337 | | | | | | |
| | | | TOTAL | CL= | 1.142 | 100CD= | 2.1084 | | | | | |
| | | | | CM= | -0.1525 | | | | | | | |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 700000 MU= 300 | R= 700000 MU= 100 | R= 700000 MU= 900 |
|---------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2298 0.0274 0.3415* LOWER 0.7243 0.1671 0.5099* TOTAL CL=-0.022 100CD=0.8514 CM=-0.1350 | S TURB S SEP 100CD 1.0030 0.0246 0.7387 0.9627 0.2023 0.7095 CL=-0.019 100CD=1.4482 CM=-0.1359 | S TURB S SEP 100CD 0.7119 0.0239 0.6437 0.8781 0.1902 0.6397 CL=-0.018 100CD=1.2833 CM=-0.1359 |
| -3.00 | S TURB S SEP 100CD UPPER 0.2503 0.0274 0.3699* LOWER 0.6884 0.1494 0.4482* TOTAL CL= 0.086 100CD=0.8180 CM=-0.1378 | S TURB S SEP 100CD 1.0030 0.0262 0.7956 0.9627 0.1874 0.6463 CL= 0.088 100CD=1.4419 CM=-0.1384 | S TURB S SEP 100CD 0.7507 0.0255 0.7038 0.8610 0.1749 0.5764 CL= 0.088 100CD=1.2802 CM=-0.1384 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2698 0.0282 0.4023* LOWER 0.6514 0.1271 0.3908* TOTAL CL= 0.194 100CD=0.7932 CM=-0.1404 | S TURB S SEP 100CD 1.0030 0.0279 0.8573 0.9627 0.1731 0.5885 CL= 0.194 100CD=1.4458 CM=-0.1409 | S TURB S SEP 100CD 0.7872 0.0273 0.7686 0.8429 0.1599 0.5196 CL= 0.195 100CD=1.2883 CM=-0.1409 |
| -1.00 | S TURB S SEP 100CD UPPER 0.2876 0.0285 0.4303* LOWER 0.6139 0.0000 0.3452* TOTAL CL= 0.302 100CD=0.7755 CM=-0.1420 | S TURB S SEP 100CD 1.0030 0.0297 0.9245 0.9627 0.1589 0.5357 CL= 0.300 100CD=1.4601 CM=-0.1432 | S TURB S SEP 100CD 0.8210 0.0291 0.8384 0.8240 0.1436 0.4690 CL= 0.301 100CD=1.3074 CM=-0.1432 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3053 0.0296 0.4626* LOWER 0.5759 0.0000 0.3135* TOTAL CL= 0.409 100CD=0.7762 CM=-0.1444 | S TURB S SEP 100CD 1.0030 0.0316 0.9977 0.9627 0.1432 0.4875 CL= 0.406 100CD=1.4852 CM=-0.1454 | S TURB S SEP 100CD 0.8535 0.0310 0.9151 0.8042 0.0000 0.4236 CL= 0.407 100CD=1.3387 CM=-0.1440 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3235 0.0306 0.4964* LOWER 0.5372 0.0000 0.2807* TOTAL CL= 0.516 100CD=0.7771 CM=-0.1467 | S TURB S SEP 100CD 1.0030 0.0337 1.0772 0.9627 0.0000 0.4438 CL= 0.512 100CD=1.5210 CM=-0.1458 | S TURB S SEP 100CD 0.8831 0.0330 0.9986 0.7837 0.0000 0.3832 CL= 0.513 100CD=1.3817 CM=-0.1460 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3638 0.0306 0.5448 LOWER 0.4986 0.0000 0.2525* TOTAL CL= 0.624 100CD=0.7974 CM=-0.1493 | S TURB S SEP 100CD 1.0030 0.0358 1.1637 0.9627 0.0000 0.4043 CL= 0.617 100CD=1.5680 CM=-0.1477 | S TURB S SEP 100CD 0.9119 0.0352 1.0916 0.7623 0.0000 0.3567 CL= 0.618 100CD=1.4483 CM=-0.1478 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4310 0.0321 0.6418 LOWER 0.4725 0.0000 0.2306* TOTAL CL= 0.730 100CD=0.8724 CM=-0.1512 | S TURB S SEP 100CD 1.0030 0.0376 1.2469 0.9627 0.0000 0.3785 CL= 0.722 100CD=1.6254 CM=-0.1494 | S TURB S SEP 100CD 0.9382 0.0370 1.1845 0.7403 0.0000 0.3258 CL= 0.723 100CD=1.5104 CM=-0.1496 |
| 4.00 | S TURB S SEP 100CD UPPER 0.5434 0.0346 0.7982 LOWER 0.4505 0.0000 0.2123* TOTAL CL= 0.834 100CD=1.0104 CM=-0.1527 | S TURB S SEP 100CD 1.0030 0.0401 1.3491 0.9627 0.0000 0.3480 CL= 0.826 100CD=1.6970 CM=-0.1509 | S TURB S SEP 100CD 0.9621 0.0396 1.3000 0.7175 0.0000 0.2980 CL= 0.827 100CD=1.5981 CM=-0.1510 |
| 5.00 | S TURB S SEP 100CD UPPER 0.6755 0.0377 0.9940 LOWER 0.4280 0.0000 0.1946* TOTAL CL= 0.937 100CD=1.1886 CM=-0.1538 | S TURB S SEP 100CD 1.0030 0.0428 1.4605 0.9627 0.0000 0.3205 CL= 0.930 100CD=1.7810 CM=-0.1521 | S TURB S SEP 100CD 0.9822 0.0424 1.4288 0.6938 0.0000 0.2723 CL= 0.930 100CD=1.7011 CM=-0.1522 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8773 0.0433 1.3607* LOWER 0.4083 0.0000 0.1855* TOTAL CL= 1.036 100CD=1.5462 CM=-0.1539 | S TURB S SEP 100CD 1.0030 0.0462 1.5948 0.9627 0.0000 0.2949 CL= 1.031 100CD=1.8897 CM=-0.1528 | S TURB S SEP 100CD 0.9971 0.0461 1.5829 0.6693 0.0000 0.2486 CL= 1.032 100CD=1.8316 CM=-0.1529 |

B.L.SUMMARY AIRFOIL S833 18% ALPHA0= 4.052 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 700000 | MU= 300 | | R= 700000 | MU= 100 | | R= 700000 | MU= 900 | | | | | | | |
|---------------|-----------|------------|--------------|-----------|------------|--------------|-----------|------------|--------------|------------|--------------|---------|-----|-------|-------|
| 7.00 | S | TURB | S | SEP | 100CD | S | TURB | S | SEP | 100CD | S | TURB | S | SEP | 100CD |
| | UPPER | 0.9996 | 0.0502 | 1.7745* | | 1.0030 | 0.0501 | 1.7723* | | 1.0073 | 0.0497 | 1.7390* | | | |
| | LOWER | 0.3947 | 0.0000 | 0.1795* | | 0.9627 | 0.0000 | 0.2714 | | 0.6446 | 0.0000 | 0.2269 | | | |
| | TOTAL | CL= 1.132 | 100CD=1.9540 | | CL= 1.132 | 100CD=2.0437 | | CL= 1.133 | 100CD=1.9659 | | | | | | |
| | | CM=-0.1532 | | | CM=-0.1533 | | | CM=-0.1534 | | | | | | | |
| 7.05 | S | TURB | S | SEP | 100CD | S | TURB | S | SEP | 100CD | | | | | |
| | UPPER | 1.0020 | 0.0506 | 1.7975* | | 1.0030 | 0.0506 | 1.7977* | | | | | | | |
| | LOWER | 0.3942 | 0.0000 | 0.1790* | | 0.9627 | 0.0000 | 0.2703 | | | | | | | |
| | TOTAL | CL= 1.137 | 100CD=1.9765 | | CL= 1.137 | 100CD=2.0680 | | | | | | | | | |
| | | CM=-0.1532 | | | CM=-0.1532 | | | | | | | | | | |
| 7.30 | | | | | | | | | | S | TURB | S | SEP | 100CD | |
| | UPPER | | | | | | | | | 1.0103 | 0.0510 | 1.7966* | | | |
| | LOWER | | | | | | | | | 0.6369 | 0.0000 | 0.2207 | | | |
| | TOTAL | | | | | | | | | CL= 1.163 | 100CD=2.0173 | | | | |
| | | | | | | | | | | CM=-0.1535 | | | | | |

APPENDIX B

PRESSURE DISTRIBUTIONS, TRANSITION AND SEPARATION LOCATIONS, AND
SECTION CHARACTERISTICS OF S834 AIRFOIL

| AIRFOIL S834 15% | | | | -3.00 | -2.00 | -1.00 | 0.00 | 1.00 | 2.00 |
|------------------|---------|----------|-------|---|--------|--------|--------|--------|--------|
| N | X | Y | NU | CP(X) FOR THE ABOVE ALPHA REL. CHORD LINE | | | | | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.411 | 0.411 | 0.412 | 0.412 | 0.414 | 0.415 |
| 2 | 0.99606 | 0.00061 | 1.00 | 0.397 | 0.396 | 0.395 | 0.395 | 0.395 | 0.395 |
| 3 | 0.98482 | 0.00310 | 2.00 | 0.335 | 0.332 | 0.330 | 0.329 | 0.328 | 0.327 |
| 4 | 0.96754 | 0.00791 | 3.00 | 0.234 | 0.230 | 0.226 | 0.223 | 0.220 | 0.217 |
| 5 | 0.94548 | 0.01465 | 4.00 | 0.110 | 0.103 | 0.097 | 0.091 | 0.086 | 0.082 |
| 6 | 0.91941 | 0.02247 | 5.00 | -0.012 | -0.022 | -0.030 | -0.039 | -0.046 | -0.054 |
| 7 | 0.88950 | 0.03056 | 6.00 | -0.094 | -0.107 | -0.119 | -0.130 | -0.140 | -0.150 |
| 8 | 0.85565 | 0.03870 | 7.00 | -0.143 | -0.158 | -0.173 | -0.187 | -0.201 | -0.214 |
| 9 | 0.81829 | 0.04693 | 8.00 | -0.194 | -0.213 | -0.231 | -0.248 | -0.265 | -0.281 |
| 10 | 0.77797 | 0.05503 | 9.00 | -0.245 | -0.267 | -0.289 | -0.310 | -0.331 | -0.350 |
| 11 | 0.73517 | 0.06273 | 10.00 | -0.293 | -0.320 | -0.345 | -0.371 | -0.395 | -0.419 |
| 12 | 0.69034 | 0.06973 | 11.00 | -0.335 | -0.365 | -0.395 | -0.425 | -0.454 | -0.482 |
| 13 | 0.64386 | 0.07578 | 12.00 | -0.365 | -0.400 | -0.435 | -0.469 | -0.503 | -0.536 |
| 14 | 0.59606 | 0.08071 | 13.00 | -0.382 | -0.421 | -0.461 | -0.499 | -0.538 | -0.576 |
| 15 | 0.54733 | 0.08453 | 14.00 | -0.396 | -0.440 | -0.484 | -0.528 | -0.572 | -0.616 |
| 16 | 0.49829 | 0.08714 | 15.00 | -0.406 | -0.456 | -0.506 | -0.556 | -0.606 | -0.655 |
| 17 | 0.44927 | 0.08834 | 16.00 | -0.400 | -0.455 | -0.510 | -0.566 | -0.621 | -0.677 |
| 18 | 0.40059 | 0.08820 | 17.00 | -0.383 | -0.443 | -0.505 | -0.566 | -0.628 | -0.690 |
| 19 | 0.35274 | 0.08686 | 18.00 | -0.363 | -0.430 | -0.498 | -0.566 | -0.635 | -0.705 |
| 20 | 0.30625 | 0.08437 | 19.00 | -0.341 | -0.415 | -0.490 | -0.566 | -0.643 | -0.721 |
| 21 | 0.26160 | 0.08080 | 20.00 | -0.314 | -0.396 | -0.479 | -0.564 | -0.650 | -0.738 |
| 22 | 0.21930 | 0.07620 | 21.00 | -0.281 | -0.371 | -0.464 | -0.559 | -0.656 | -0.755 |
| 23 | 0.17974 | 0.07061 | 22.00 | -0.239 | -0.340 | -0.443 | -0.550 | -0.660 | -0.772 |
| 24 | 0.14337 | 0.06413 | 23.00 | -0.184 | -0.296 | -0.413 | -0.534 | -0.659 | -0.787 |
| 25 | 0.11050 | 0.05682 | 24.00 | -0.112 | -0.238 | -0.369 | -0.507 | -0.650 | -0.798 |
| 26 | 0.08148 | 0.04879 | 25.00 | -0.014 | -0.155 | -0.304 | -0.461 | -0.626 | -0.799 |
| 27 | 0.05652 | 0.04019 | 26.00 | 0.119 | -0.038 | -0.207 | -0.388 | -0.580 | -0.784 |
| 28 | 0.03587 | 0.03119 | 27.00 | 0.300 | 0.128 | -0.062 | -0.270 | -0.496 | -0.740 |
| 29 | 0.01966 | 0.02200 | 28.00 | 0.541 | 0.361 | 0.152 | -0.085 | -0.352 | -0.646 |
| 30 | 0.00812 | 0.01297 | 29.00 | 0.833 | 0.677 | 0.470 | 0.212 | -0.096 | -0.454 |
| 31 | 0.00139 | 0.00447 | 30.00 | 0.989 | 0.984 | 0.875 | 0.662 | 0.344 | -0.076 |
| 32 | 0.00104 | 0.00375 | 30.09 | 0.971 | 0.996 | 0.908 | 0.708 | 0.395 | -0.030 |
| 33 | 0.00031 | 0.00185 | 30.34 | 0.845 | 0.984 | 0.980 | 0.834 | 0.545 | 0.113 |
| 34 | 0.00000 | 0.00009 | 30.59 | 0.540 | 0.861 | 0.995 | 0.944 | 0.706 | 0.282 |
| 35 | 0.00025 | -0.00167 | 30.84 | 0.356 | 0.716 | 0.931 | 1.000 | 0.923 | 0.700 |
| 36 | 0.00063 | -0.00286 | 31.00 | 0.248 | 0.620 | 0.867 | 0.987 | 0.981 | 0.848 |
| 37 | 0.00092 | -0.00356 | 31.09 | 0.189 | 0.566 | 0.826 | 0.969 | 0.995 | 0.904 |
| 38 | 0.00610 | -0.01100 | 32.00 | -0.284 | 0.082 | 0.387 | 0.631 | 0.814 | 0.935 |
| 39 | 0.01637 | -0.01945 | 33.00 | -0.563 | -0.252 | 0.025 | 0.268 | 0.477 | 0.651 |
| 40 | 0.03135 | -0.02779 | 34.00 | -0.689 | -0.432 | -0.195 | 0.020 | 0.215 | 0.389 |
| 41 | 0.05077 | -0.03562 | 35.00 | -0.735 | -0.522 | -0.323 | -0.136 | 0.037 | 0.196 |
| 42 | 0.07463 | -0.04274 | 36.00 | -0.735 | -0.557 | -0.389 | -0.229 | -0.078 | 0.063 |
| 43 | 0.10266 | -0.04895 | 37.00 | -0.710 | -0.561 | -0.418 | -0.281 | -0.150 | -0.026 |
| 44 | 0.13476 | -0.05414 | 38.00 | -0.672 | -0.545 | -0.423 | -0.305 | -0.191 | -0.082 |
| 45 | 0.17060 | -0.05824 | 39.00 | -0.626 | -0.518 | -0.413 | -0.311 | -0.212 | -0.116 |
| 46 | 0.20996 | -0.06119 | 40.00 | -0.576 | -0.484 | -0.393 | -0.304 | -0.218 | -0.133 |
| 47 | 0.25241 | -0.06300 | 41.00 | -0.526 | -0.446 | -0.367 | -0.290 | -0.214 | -0.140 |
| 48 | 0.29766 | -0.06367 | 42.00 | -0.475 | -0.406 | -0.337 | -0.270 | -0.203 | -0.138 |
| 49 | 0.34519 | -0.06325 | 43.00 | -0.425 | -0.365 | -0.305 | -0.246 | -0.187 | -0.129 |
| 50 | 0.39461 | -0.06181 | 44.00 | -0.376 | -0.324 | -0.271 | -0.219 | -0.168 | -0.117 |
| 51 | 0.44534 | -0.05943 | 45.00 | -0.328 | -0.283 | -0.237 | -0.192 | -0.146 | -0.101 |
| 52 | 0.49692 | -0.05621 | 46.00 | -0.282 | -0.243 | -0.203 | -0.163 | -0.123 | -0.083 |
| 53 | 0.54874 | -0.05227 | 47.00 | -0.238 | -0.203 | -0.168 | -0.133 | -0.098 | -0.063 |
| 54 | 0.60025 | -0.04770 | 48.00 | -0.195 | -0.165 | -0.134 | -0.104 | -0.073 | -0.042 |
| 55 | 0.65083 | -0.04259 | 49.00 | -0.151 | -0.125 | -0.099 | -0.072 | -0.046 | -0.018 |
| 56 | 0.69997 | -0.03702 | 50.00 | -0.105 | -0.083 | -0.061 | -0.038 | -0.014 | 0.009 |
| 57 | 0.74713 | -0.03111 | 51.00 | -0.056 | -0.037 | -0.018 | 0.002 | 0.022 | 0.042 |
| 58 | 0.79183 | -0.02494 | 52.00 | -0.001 | 0.015 | 0.031 | 0.047 | 0.064 | 0.081 |
| 59 | 0.83359 | -0.01867 | 53.00 | 0.057 | 0.069 | 0.082 | 0.096 | 0.110 | 0.124 |
| 60 | 0.87225 | -0.01217 | 54.00 | 0.164 | 0.173 | 0.183 | 0.193 | 0.204 | 0.215 |
| 61 | 0.90787 | -0.00651 | 55.00 | 0.254 | 0.261 | 0.268 | 0.276 | 0.284 | 0.293 |
| 62 | 0.93921 | -0.00253 | 56.00 | 0.317 | 0.322 | 0.328 | 0.333 | 0.340 | 0.346 |
| 63 | 0.96502 | -0.00033 | 57.00 | 0.360 | 0.363 | 0.367 | 0.372 | 0.376 | 0.381 |
| 64 | 0.98421 | 0.00039 | 58.00 | 0.387 | 0.389 | 0.392 | 0.395 | 0.398 | 0.402 |
| 65 | 0.99602 | 0.00024 | 59.00 | 0.403 | 0.404 | 0.406 | 0.407 | 0.410 | 0.412 |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.411 | 0.411 | 0.412 | 0.412 | 0.414 | 0.415 |

ALPHA= 2.55 DEGREES CMO=-0.0769 ETA= 1.121

| AIRFOIL S834 15% | | | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 |
|------------------|---------|----------|-------|--------|---------------------|--------|------------|--------|
| N | X | Y | NU | CP(X) | FOR THE ABOVE ALPHA | REL. | CHORD LINE | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.417 | 0.419 | 0.421 | 0.424 | 0.427 |
| 2 | 0.99606 | 0.00061 | 1.00 | 0.396 | 0.397 | 0.399 | 0.400 | 0.403 |
| 3 | 0.98482 | 0.00310 | 2.00 | 0.326 | 0.326 | 0.327 | 0.328 | 0.329 |
| 4 | 0.96754 | 0.00791 | 3.00 | 0.215 | 0.214 | 0.213 | 0.213 | 0.213 |
| 5 | 0.94548 | 0.01465 | 4.00 | 0.078 | 0.075 | 0.072 | 0.070 | 0.068 |
| 6 | 0.91941 | 0.02247 | 5.00 | -0.060 | -0.066 | -0.071 | -0.076 | -0.080 |
| 7 | 0.88950 | 0.03056 | 6.00 | -0.160 | -0.168 | -0.176 | -0.183 | -0.190 |
| 8 | 0.85565 | 0.03870 | 7.00 | -0.226 | -0.237 | -0.248 | -0.258 | -0.268 |
| 9 | 0.81829 | 0.04693 | 8.00 | -0.296 | -0.311 | -0.325 | -0.339 | -0.351 |
| 10 | 0.77797 | 0.05503 | 9.00 | -0.370 | -0.388 | -0.406 | -0.423 | -0.439 |
| 11 | 0.73517 | 0.06273 | 10.00 | -0.442 | -0.465 | -0.487 | -0.508 | -0.528 |
| 12 | 0.69034 | 0.06973 | 11.00 | -0.510 | -0.537 | -0.563 | -0.589 | -0.614 |
| 13 | 0.64386 | 0.07578 | 12.00 | -0.568 | -0.600 | -0.631 | -0.662 | -0.691 |
| 14 | 0.59606 | 0.08071 | 13.00 | -0.613 | -0.650 | -0.687 | -0.722 | -0.757 |
| 15 | 0.54733 | 0.08453 | 14.00 | -0.659 | -0.701 | -0.743 | -0.784 | -0.825 |
| 16 | 0.49829 | 0.08714 | 15.00 | -0.704 | -0.753 | -0.801 | -0.849 | -0.896 |
| 17 | 0.44927 | 0.08834 | 16.00 | -0.732 | -0.787 | -0.842 | -0.897 | -0.951 |
| 18 | 0.40059 | 0.08820 | 17.00 | -0.752 | -0.814 | -0.876 | -0.938 | -1.000 |
| 19 | 0.35274 | 0.08686 | 18.00 | -0.774 | -0.844 | -0.915 | -0.985 | -1.055 |
| 20 | 0.30625 | 0.08437 | 19.00 | -0.799 | -0.878 | -0.958 | -1.038 | -1.118 |
| 21 | 0.26160 | 0.08080 | 20.00 | -0.826 | -0.916 | -1.007 | -1.098 | -1.191 |
| 22 | 0.21930 | 0.07620 | 21.00 | -0.856 | -0.958 | -1.062 | -1.167 | -1.273 |
| 23 | 0.17974 | 0.07061 | 22.00 | -0.887 | -1.005 | -1.125 | -1.246 | -1.370 |
| 24 | 0.14337 | 0.06413 | 23.00 | -0.920 | -1.055 | -1.195 | -1.337 | -1.482 |
| 25 | 0.11050 | 0.05682 | 24.00 | -0.952 | -1.111 | -1.275 | -1.443 | -1.616 |
| 26 | 0.08148 | 0.04879 | 25.00 | -0.980 | -1.168 | -1.363 | -1.565 | -1.774 |
| 27 | 0.05652 | 0.04019 | 26.00 | -0.999 | -1.225 | -1.462 | -1.709 | -1.966 |
| 28 | 0.03587 | 0.03119 | 27.00 | -1.000 | -1.277 | -1.571 | -1.881 | -2.207 |
| 29 | 0.01966 | 0.02200 | 28.00 | -0.969 | -1.319 | -1.696 | -2.099 | -2.529 |
| 30 | 0.00812 | 0.01297 | 29.00 | -0.862 | -1.319 | -1.824 | -2.378 | -2.978 |
| 31 | 0.00139 | 0.00447 | 30.00 | -0.600 | -1.226 | -1.953 | -2.781 | -3.708 |
| 32 | 0.00104 | 0.00375 | 30.09 | -0.566 | -1.213 | -1.970 | -2.837 | -3.811 |
| 33 | 0.00031 | 0.00185 | 30.34 | -0.460 | -1.173 | -2.027 | -3.020 | -4.151 |
| 34 | 0.00000 | 0.00009 | 30.59 | -0.328 | -1.123 | -2.101 | -3.262 | -4.604 |
| 35 | 0.00025 | -0.00167 | 30.84 | 0.332 | -0.181 | -0.838 | -1.639 | -2.582 |
| 36 | 0.00063 | -0.00286 | 31.00 | 0.589 | 0.204 | -0.307 | -0.942 | -1.702 |
| 37 | 0.00092 | -0.00356 | 31.09 | 0.696 | 0.371 | -0.070 | -0.627 | -1.300 |
| 38 | 0.00610 | -0.01100 | 32.00 | 0.994 | 0.991 | 0.926 | 0.799 | 0.610 |
| 39 | 0.01637 | -0.01945 | 33.00 | 0.790 | 0.894 | 0.963 | 0.996 | 0.995 |
| 40 | 0.03135 | -0.02779 | 34.00 | 0.541 | 0.672 | 0.781 | 0.868 | 0.934 |
| 41 | 0.05077 | -0.03562 | 35.00 | 0.341 | 0.472 | 0.589 | 0.691 | 0.779 |
| 42 | 0.07463 | -0.04274 | 36.00 | 0.195 | 0.317 | 0.430 | 0.533 | 0.626 |
| 43 | 0.10266 | -0.04895 | 37.00 | 0.092 | 0.204 | 0.308 | 0.406 | 0.496 |
| 44 | 0.13476 | -0.05414 | 38.00 | 0.023 | 0.123 | 0.218 | 0.308 | 0.392 |
| 45 | 0.17060 | -0.05824 | 39.00 | -0.023 | 0.066 | 0.152 | 0.234 | 0.312 |
| 46 | 0.20996 | -0.06119 | 40.00 | -0.052 | 0.028 | 0.105 | 0.179 | 0.251 |
| 47 | 0.25241 | -0.06300 | 41.00 | -0.067 | 0.004 | 0.073 | 0.140 | 0.205 |
| 48 | 0.29766 | -0.06367 | 42.00 | -0.073 | -0.010 | 0.052 | 0.112 | 0.171 |
| 49 | 0.34519 | -0.06325 | 43.00 | -0.072 | -0.016 | 0.039 | 0.094 | 0.147 |
| 50 | 0.39461 | -0.06181 | 44.00 | -0.066 | -0.016 | 0.033 | 0.082 | 0.130 |
| 51 | 0.44534 | -0.05943 | 45.00 | -0.056 | -0.011 | 0.033 | 0.077 | 0.120 |
| 52 | 0.49692 | -0.05621 | 46.00 | -0.043 | -0.003 | 0.036 | 0.076 | 0.115 |
| 53 | 0.54874 | -0.05227 | 47.00 | -0.028 | 0.008 | 0.043 | 0.078 | 0.113 |
| 54 | 0.60025 | -0.04770 | 48.00 | -0.011 | 0.021 | 0.052 | 0.083 | 0.115 |
| 55 | 0.65083 | -0.04259 | 49.00 | 0.009 | 0.037 | 0.065 | 0.093 | 0.121 |
| 56 | 0.69997 | -0.03702 | 50.00 | 0.033 | 0.058 | 0.082 | 0.107 | 0.132 |
| 57 | 0.74713 | -0.03111 | 51.00 | 0.063 | 0.084 | 0.105 | 0.127 | 0.149 |
| 58 | 0.79183 | -0.02494 | 52.00 | 0.099 | 0.117 | 0.135 | 0.154 | 0.173 |
| 59 | 0.83359 | -0.01867 | 53.00 | 0.139 | 0.154 | 0.170 | 0.186 | 0.202 |
| 60 | 0.87225 | -0.01217 | 54.00 | 0.227 | 0.239 | 0.251 | 0.264 | 0.277 |
| 61 | 0.90787 | -0.00651 | 55.00 | 0.302 | 0.311 | 0.321 | 0.331 | 0.341 |
| 62 | 0.93921 | -0.00253 | 56.00 | 0.353 | 0.361 | 0.368 | 0.376 | 0.385 |
| 63 | 0.96502 | -0.00033 | 57.00 | 0.387 | 0.392 | 0.398 | 0.405 | 0.412 |
| 64 | 0.98421 | 0.00039 | 58.00 | 0.406 | 0.411 | 0.415 | 0.420 | 0.426 |
| 65 | 0.99602 | 0.00024 | 59.00 | 0.415 | 0.418 | 0.422 | 0.426 | 0.430 |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.417 | 0.419 | 0.421 | 0.424 | 0.427 |

ALPHA0= 2.55 DEGREES CM0=-0.0769 ETA= 1.121

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 200000 MU= 300 | R= 200000 MU= 100 | R= 200000 MU= 900 |
|---------------|--|---|---|
| -3.00 | S TURB S SEP 100CD UPPER 0.2762 0.0564 0.7302* LOWER 0.6372 0.0646 0.6825* TOTAL CL=-0.071 100CD=1.4127 CM=-0.0708 | S TURB S SEP 100CD 0.9981 0.0295 0.7803 0.9563 0.0660 0.8150 CL=-0.051 100CD=1.5953 CM=-0.0748 | S TURB S SEP 100CD 0.4993 0.0273 0.6179 0.8349 0.0603 0.7519 CL=-0.051 100CD=1.3698 CM=-0.0748 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2923 0.0566 0.7707* LOWER 0.5573 0.0519 0.5807* TOTAL CL= 0.029 100CD=1.3514 CM=-0.0715 | S TURB S SEP 100CD 0.9981 0.0322 0.8452 0.9563 0.0532 0.7408 CL= 0.049 100CD=1.5860 CM=-0.0755 | S TURB S SEP 100CD 0.5638 0.0300 0.6947 0.8017 0.0467 0.6755 CL= 0.049 100CD=1.3702 CM=-0.0755 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3095 0.0568 0.8030* LOWER 0.4814 0.0487 0.5056* TOTAL CL= 0.133 100CD=1.3086 CM=-0.0730 | S TURB S SEP 100CD 0.9981 0.0356 0.9223 0.9563 0.0395 0.6742 CL= 0.149 100CD=1.5965 CM=-0.0761 | S TURB S SEP 100CD 0.6331 0.0330 0.7811 0.7671 0.0320 0.6084 CL= 0.149 100CD=1.3895 CM=-0.0762 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3267 0.0608 0.8308* LOWER 0.4098 0.0529 0.4520* TOTAL CL= 0.233 100CD=1.2828 CM=-0.0741 | S TURB S SEP 100CD 0.9981 0.0386 1.0021 0.9563 0.0207 0.6091 CL= 0.249 100CD=1.6113 CM=-0.0768 | S TURB S SEP 100CD 0.6943 0.0367 0.8776 0.7307 0.0107 0.5443 CL= 0.250 100CD=1.4219 CM=-0.0768 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3511 0.0591 0.8521* LOWER 0.3534 0.0653 0.4179* TOTAL CL= 0.340 100CD=1.2701 CM=-0.0764 | S TURB S SEP 100CD 0.9981 0.0418 1.0904 0.9563 0.0001 0.5563 CL= 0.351 100CD=1.6468 CM=-0.0777 | S TURB S SEP 100CD 0.7495 0.0401 0.9756 0.6932 0.0000 0.4885 CL= 0.353 100CD=1.4641 CM=-0.0780 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3825 0.0589 0.8727* LOWER 0.3140 0.0707 0.3854* TOTAL CL= 0.443 100CD=1.2581 CM=-0.0780 | S TURB S SEP 100CD 0.9981 0.0453 1.1889 0.9563 0.0000 0.5056 CL= 0.456 100CD=1.6944 CM=-0.0792 | S TURB S SEP 100CD 0.7988 0.0437 1.0807 0.6539 0.0000 0.4482 CL= 0.457 100CD=1.5288 CM=-0.0796 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4287 0.0572 0.9082* LOWER 0.2830 0.0768 0.3597* TOTAL CL= 0.550 100CD=1.2679 CM=-0.0804 | S TURB S SEP 100CD 0.9981 0.0492 1.2986 0.9563 0.0000 0.4724 CL= 0.559 100CD=1.7711 CM=-0.0806 | S TURB S SEP 100CD 0.8443 0.0476 1.1989 0.6133 0.0000 0.4130 CL= 0.561 100CD=1.6118 CM=-0.0810 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4669 0.0582 0.9986* LOWER 0.2576 0.0705 0.2793 TOTAL CL= 0.656 100CD=1.2779 CM=-0.0822 | S TURB S SEP 100CD 0.9981 0.0535 1.4215 0.9563 0.0000 0.4394 CL= 0.661 100CD=1.8608 CM=-0.0817 | S TURB S SEP 100CD 0.8865 0.0520 1.3321 0.5711 0.0000 0.3785 CL= 0.663 100CD=1.7107 CM=-0.0821 |
| 5.00 | S TURB S SEP 100CD UPPER 0.4980 0.0616 1.0823* LOWER 0.2378 0.0738 0.2572 TOTAL CL= 0.758 100CD=1.3396 CM=-0.0836 | S TURB S SEP 100CD 0.9981 0.0584 1.5583 0.9563 0.0000 0.4077 CL= 0.762 100CD=1.9660 CM=-0.0825 | S TURB S SEP 100CD 0.9255 0.0571 1.4848 0.5275 0.0000 0.3457 CL= 0.764 100CD=1.8305 CM=-0.0829 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8188 0.0611 1.5319* LOWER 0.2202 0.0769 0.2372 TOTAL CL= 0.865 100CD=1.7692 CM=-0.0858 | S TURB S SEP 100CD 0.9981 0.0640 1.7178* 0.9563 0.0000 0.3779 CL= 0.861 100CD=2.0957 CM=-0.0830 | S TURB S SEP 100CD 0.9590 0.0629 1.6606 0.4829 0.0000 0.3151 CL= 0.863 100CD=1.9757 CM=-0.0833 |
| 7.00 | S TURB S SEP 100CD UPPER 1.0058 0.0762 2.1183* LOWER 0.2016 0.0856 0.2180 TOTAL CL= 0.950 100CD=2.3363 CM=-0.0843 | S TURB S SEP 100CD 1.0058 0.0762 2.1183* 0.9563 0.0000 0.3502 CL= 0.950 100CD=2.4685 CM=-0.0814 | S TURB S SEP 100CD 1.0058 0.0722 1.9699* 0.4367 0.0000 0.2863 CL= 0.956 100CD=2.2563 CM=-0.0825 |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

ALPHA(DEG.) R= 200000 MU= 300 R= 200000 MU= 100 R= 200000 MU= 900

7.19 S TURB S SEP 100CD S TURB S SEP 100CD
UPPER 1.0156 0.0799 2.2012* 1.0156 0.0799 2.2012*
LOWER 0.1961 0.0908 0.2140 0.9563 0.0000 0.3452
TOTAL CL= 0.965 100CD=2.4152 CL= 0.965 100CD=2.5464
CM=-0.0840 CM=-0.0807

7.30 S TURB S SEP 100CD
UPPER 1.0170 0.0792 2.1769*
LOWER 0.4226 0.0000 0.2781
TOTAL CL= 0.978 100CD=2.4549
CM=-0.0811

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 300000 | MU= 300 | R= 300000 | MU= 100 | R= 300000 | MU= 900 | | | | |
|---------------|-----------|-----------|--------------|------------|-----------|--------------|------------|-----------|--------------|------------|
| -3.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.2762 | 0.0418 | 0.5188* | 0.9981 | 0.0270 | 0.7338 | 0.5834 | 0.0248 | 0.5988 |
| | LOWER | 0.6372 | 0.0422 | 0.5780* | 0.9563 | 0.0568 | 0.7554 | 0.8572 | 0.0509 | 0.6989 |
| | TOTAL | CL=-0.067 | 100CD=1.0968 | CM=-0.0714 | CL=-0.052 | 100CD=1.4892 | CM=-0.0746 | CL=-0.052 | 100CD=1.2977 | CM=-0.0746 |
| -2.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.2923 | 0.0445 | 0.5466* | 0.9981 | 0.0297 | 0.7941 | 0.6440 | 0.0276 | 0.6706 |
| | LOWER | 0.5573 | 0.0249 | 0.4881* | 0.9563 | 0.0434 | 0.6885 | 0.8274 | 0.0362 | 0.6284 |
| | TOTAL | CL= 0.033 | 100CD=1.0347 | CM=-0.0718 | CL= 0.048 | 100CD=1.4827 | CM=-0.0754 | CL= 0.048 | 100CD=1.2990 | CM=-0.0753 |
| -1.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3095 | 0.0448 | 0.5811* | 0.9981 | 0.0325 | 0.8604 | 0.6983 | 0.0306 | 0.7458 |
| | LOWER | 0.4814 | 0.0132 | 0.4229* | 0.9563 | 0.0287 | 0.6282 | 0.7964 | 0.0166 | 0.5618 |
| | TOTAL | CL= 0.136 | 100CD=1.0040 | CM=-0.0732 | CL= 0.149 | 100CD=1.4885 | CM=-0.0762 | CL= 0.149 | 100CD=1.3076 | CM=-0.0759 |
| 0.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3267 | 0.0452 | 0.6112* | 0.9981 | 0.0360 | 0.9397 | 0.7471 | 0.0337 | 0.8254 |
| | LOWER | 0.4098 | 0.0101 | 0.3691* | 0.9563 | 0.0072 | 0.5689 | 0.7637 | 0.0000 | 0.5065 |
| | TOTAL | CL= 0.242 | 100CD=0.9802 | CM=-0.0751 | CL= 0.250 | 100CD=1.5086 | CM=-0.0768 | CL= 0.251 | 100CD=1.3319 | CM=-0.0769 |
| 1.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3511 | 0.0464 | 0.6467* | 0.9981 | 0.0391 | 1.0211 | 0.7928 | 0.0375 | 0.9182 |
| | LOWER | 0.3534 | 0.0221 | 0.3384* | 0.9563 | 0.0000 | 0.5155 | 0.7297 | 0.0000 | 0.4591 |
| | TOTAL | CL= 0.349 | 100CD=0.9851 | CM=-0.0775 | CL= 0.354 | 100CD=1.5365 | CM=-0.0782 | CL= 0.356 | 100CD=1.3773 | CM=-0.0786 |
| 2.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3825 | 0.0458 | 0.6812* | 0.9981 | 0.0425 | 1.1112 | 0.8345 | 0.0409 | 1.0145 |
| | LOWER | 0.3140 | 0.0258 | 0.3064* | 0.9563 | 0.0000 | 0.4807 | 0.6941 | 0.0000 | 0.4240 |
| | TOTAL | CL= 0.456 | 100CD=0.9876 | CM=-0.0797 | CL= 0.458 | 100CD=1.5919 | CM=-0.0798 | CL= 0.460 | 100CD=1.4386 | CM=-0.0802 |
| 3.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4287 | 0.0448 | 0.7393* | 0.9981 | 0.0461 | 1.2113 | 0.8730 | 0.0447 | 1.1220 |
| | LOWER | 0.2830 | 0.0372 | 0.2813* | 0.9563 | 0.0000 | 0.4481 | 0.6571 | 0.0000 | 0.3897 |
| | TOTAL | CL= 0.564 | 100CD=1.0206 | CM=-0.0822 | CL= 0.562 | 100CD=1.6594 | CM=-0.0813 | CL= 0.564 | 100CD=1.5117 | CM=-0.0816 |
| 4.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4669 | 0.0475 | 0.8198* | 0.9981 | 0.0502 | 1.3224 | 0.9092 | 0.0488 | 1.2439 |
| | LOWER | 0.2576 | 0.0386 | 0.2583* | 0.9563 | 0.0000 | 0.4163 | 0.6187 | 0.0000 | 0.3571 |
| | TOTAL | CL= 0.668 | 100CD=1.0781 | CM=-0.0839 | CL= 0.665 | 100CD=1.7388 | CM=-0.0825 | CL= 0.667 | 100CD=1.6010 | CM=-0.0828 |
| 5.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4980 | 0.0502 | 0.8955* | 0.9981 | 0.0548 | 1.4462 | 0.9427 | 0.0536 | 1.3837 |
| | LOWER | 0.2378 | 0.0360 | 0.2731* | 0.9563 | 0.0000 | 0.3862 | 0.5788 | 0.0000 | 0.3263 |
| | TOTAL | CL= 0.772 | 100CD=1.1687 | CM=-0.0854 | CL= 0.767 | 100CD=1.8323 | CM=-0.0835 | CL= 0.768 | 100CD=1.7101 | CM=-0.0838 |
| 6.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.8188 | 0.0555 | 1.3439* | 0.9981 | 0.0600 | 1.5875* | 0.9711 | 0.0592 | 1.5445 |
| | LOWER | 0.2202 | 0.0403 | 0.2548* | 0.9563 | 0.0000 | 0.3580 | 0.5376 | 0.0000 | 0.2976 |
| | TOTAL | CL= 0.873 | 100CD=1.5987 | CM=-0.0863 | CL= 0.866 | 100CD=1.9455 | CM=-0.0841 | CL= 0.868 | 100CD=1.8422 | CM=-0.0843 |
| 7.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 1.0058 | 0.0698 | 1.9124* | 1.0058 | 0.0698 | 1.9124* | 1.0058 | 0.0669 | 1.7920* |
| | LOWER | 0.2016 | 0.0374 | 0.1845 | 0.9563 | 0.0000 | 0.3318 | 0.4954 | 0.0000 | 0.2707 |
| | TOTAL | CL= 0.959 | 100CD=2.0969 | CM=-0.0843 | CL= 0.959 | 100CD=2.2443 | CM=-0.0832 | CL= 0.963 | 100CD=2.0627 | CM=-0.0840 |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEC.) | R= | 300000 | MU= | 300 | R= | 300000 | MU= | 100 | R= | 300000 | MU= | 900 | | | |
|-------------|-------|------------|--------|--------------|-------|------------|--------|--------------|-----|--------|--------|--------------|-------|-----|-------|
| 7.27 | S | TURB | S | SEP | 100CD | S | TURB | S | SEP | 100CD | S | TURB | S | SEP | 100CD |
| | UPPER | 1.0166 | 0.0729 | 1.9978* | | 1.0166 | 0.0729 | 1.9978* | | 1.0166 | 0.0729 | 1.9978* | | | |
| | LOWER | 0.1938 | 0.0548 | 0.1789 | | 0.9563 | 0.0000 | 0.3251 | | 0.9563 | 0.0000 | 0.3251 | | | |
| | TOTAL | CL= | 0.983 | 100CD=2.1767 | | CL= | 0.983 | 100CD=2.3229 | | CL= | 0.983 | 100CD=2.3229 | | | |
| | | CM=-0.0845 | | | | CM=-0.0828 | | | | | | | | | |
| 7.40 | | | | | | | | | S | TURB | S | SEP | 100CD | | |
| | UPPER | | | | | 1.0179 | 0.0733 | 1.9990* | | | | | | | |
| | LOWER | | | | | 0.4779 | 0.0000 | 0.2604 | | | | | | | |
| | TOTAL | | | | | CL= | 0.997 | 100CD=2.2594 | | | | | | | |
| | | | | | | CM=-0.0829 | | | | | | | | | |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 400000 MU= 300 | R= 400000 MU= 100 | R= 400000 MU= 900 |
|---------------|--|---|---|
| -3.00 | S TURB S SEP 100CD UPPER 0.2762 0.0333 0.4288* LOWER 0.6372 0.0248 0.5177* TOTAL CL=-0.066 100CD=0.9465 CM=-0.0714 | S TURB S SEP 100CD 0.9981 0.0252 0.7024 0.9563 0.0499 0.7167 CL=-0.052 100CD=1.4191 CM=-0.0744 | S TURB S SEP 100CD 0.6381 0.0233 0.5879 0.8717 0.0440 0.6663 CL=-0.053 100CD=1.2542 CM=-0.0744 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2923 0.0356 0.4575* LOWER 0.5573 0.0061 0.4410* TOTAL CL= 0.035 100CD=0.8985 CM=-0.0720 | S TURB S SEP 100CD 0.9981 0.0278 0.7598 0.9563 0.0359 0.6542 CL= 0.048 100CD=1.4140 CM=-0.0752 | S TURB S SEP 100CD 0.6894 0.0260 0.6529 0.8441 0.0286 0.5997 CL= 0.048 100CD=1.2525 CM=-0.0751 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3095 0.0362 0.4863* LOWER 0.4814 0.0000 0.3748* TOTAL CL= 0.141 100CD=0.8611 CM=-0.0740 | S TURB S SEP 100CD 0.9981 0.0306 0.8228 0.9563 0.0201 0.5980 CL= 0.149 100CD=1.4208 CM=-0.0761 | S TURB S SEP 100CD 0.7360 0.0289 0.7214 0.8153 0.0072 0.5366 CL= 0.148 100CD=1.2580 CM=-0.0757 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3267 0.0381 0.5156* LOWER 0.4098 0.0000 0.3253* TOTAL CL= 0.247 100CD=0.8410 CM=-0.0760 | S TURB S SEP 100CD 0.9981 0.0340 0.8979 0.9563 0.0000 0.5413 CL= 0.251 100CD=1.4392 CM=-0.0768 | S TURB S SEP 100CD 0.7791 0.0319 0.7955 0.7852 0.0000 0.4809 CL= 0.253 100CD=1.2764 CM=-0.0773 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3511 0.0382 0.5525* LOWER 0.3534 0.0000 0.2911* TOTAL CL= 0.355 100CD=0.8436 CM=-0.0784 | S TURB S SEP 100CD 0.9981 0.0371 0.9748 0.9563 0.0000 0.4954 CL= 0.356 100CD=1.4702 CM=-0.0786 | S TURB S SEP 100CD 0.8191 0.0356 0.8823 0.7536 0.0000 0.4438 CL= 0.357 100CD=1.3261 CM=-0.0789 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3825 0.0385 0.5927* LOWER 0.3140 0.0000 0.2636* TOTAL CL= 0.462 100CD=0.8564 CM=-0.0807 | S TURB S SEP 100CD 0.9981 0.0404 1.0597 0.9563 0.0000 0.4633 CL= 0.460 100CD=1.5230 CM=-0.0803 | S TURB S SEP 100CD 0.8565 0.0390 0.9726 0.7203 0.0000 0.4092 CL= 0.462 100CD=1.3818 CM=-0.0806 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4287 0.0388 0.6535* LOWER 0.2830 0.0000 0.2419* TOTAL CL= 0.570 100CD=0.8954 CM=-0.0830 | S TURB S SEP 100CD 0.9981 0.0440 1.1537 0.9563 0.0000 0.4313 CL= 0.564 100CD=1.5850 CM=-0.0818 | S TURB S SEP 100CD 0.8905 0.0426 1.0732 0.6860 0.0000 0.3760 CL= 0.566 100CD=1.4492 CM=-0.0821 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4669 0.0411 0.7236* LOWER 0.2576 0.0000 0.2227* TOTAL CL= 0.675 100CD=0.9463 CM=-0.0847 | S TURB S SEP 100CD 0.9981 0.0479 1.2576 0.9563 0.0000 0.4007 CL= 0.668 100CD=1.6583 CM=-0.0831 | S TURB S SEP 100CD 0.9233 0.0467 1.1881 0.6503 0.0000 0.3449 CL= 0.669 100CD=1.5330 CM=-0.0834 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5101 0.0434 0.7976* LOWER 0.2378 0.0000 0.2049* TOTAL CL= 0.780 100CD=1.0025 CM=-0.0864 | S TURB S SEP 100CD 0.9981 0.0522 1.3729 0.9563 0.0000 0.3716 CL= 0.770 100CD=1.7444 CM=-0.0841 | S TURB S SEP 100CD 0.9533 0.0512 1.3196 0.6131 0.0000 0.3156 CL= 0.771 100CD=1.6352 CM=-0.0844 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8188 0.0521 1.2433* LOWER 0.2202 0.0000 0.2127* TOTAL CL= 0.877 100CD=1.4561 CM=-0.0862 | S TURB S SEP 100CD 0.9981 0.0572 1.5017* 0.9563 0.0000 0.3445 CL= 0.870 100CD=1.8462 CM=-0.0848 | S TURB S SEP 100CD 0.9784 0.0566 1.4697 0.5747 0.0000 0.2883 CL= 0.871 100CD=1.7580 CM=-0.0850 |
| 7.00 | S TURB S SEP 100CD UPPER 1.0058 0.0660 1.7865* LOWER 0.2016 0.0000 0.1968* TOTAL CL= 0.965 100CD=1.9833 CM=-0.0843 | S TURB S SEP 100CD 1.0058 0.0660 1.7865* 0.9563 0.0000 0.3194 CL= 0.965 100CD=2.1059 CM=-0.0843 | S TURB S SEP 100CD 1.0058 0.0637 1.6851* 0.5351 0.0000 0.2627 CL= 0.968 100CD=1.9478 CM=-0.0849 |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

ALPHA(DEG.) R= 400000 MU= 300 R= 400000 MU= 100 R= 400000 MU= 900

7.39 S TURB S SEP 100CD S TURB S SEP 100CD
UPPER 1.0178 0.0707 1.9263* 1.0178 0.0707 1.9263*
LOWER 0.1905 0.0000 0.1837* 0.9555 0.0000 0.3100
TOTAL CL= 0.999 100CD=2.1099 CL= 0.999 100CD=2.2363
CM=-0.0836 CM=-0.0836

7.58 S TURB S SEP 100CD
UPPER 1.0192 0.0713 1.9284*
LOWER 0.5115 0.0000 0.2481
TOTAL CL= 1.019 100CD=2.1765
CM=-0.0838

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.
 *-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 500000 MU= 300 | R= 500000 MU= 100 | R= 500000 MU= 900 |
|---------------|--|---|---|
| -3.00 | S TURB S SEP 100CD UPPER 0.2762 0.0292 0.3790* LOWER 0.6372 0.0143 0.4833* TOTAL CL=-0.066 100CD=0.8624 CM=-0.0713 | S TURB S SEP 100CD 0.9981 0.0238 0.6789 0.9563 0.0442 0.6885 CL=-0.053 100CD=1.3674 CM=-0.0743 | S TURB S SEP 100CD 0.6747 0.0221 0.5783 0.8820 0.0386 0.6432 CL=-0.054 100CD=1.2215 CM=-0.0742 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2923 0.0297 0.4052* LOWER 0.5573 0.0000 0.4079* TOTAL CL= 0.038 100CD=0.8131 CM=-0.0727 | S TURB S SEP 100CD 0.9981 0.0264 0.7342 0.9563 0.0297 0.6292 CL= 0.048 100CD=1.3634 CM=-0.0751 | S TURB S SEP 100CD 0.7198 0.0248 0.6385 0.8563 0.0224 0.5794 CL= 0.047 100CD=1.2179 CM=-0.0749 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3095 0.0305 0.4312* LOWER 0.4814 0.0000 0.3490* TOTAL CL= 0.146 100CD=0.7802 CM=-0.0750 | S TURB S SEP 100CD 0.9981 0.0291 0.7948 0.9563 0.0093 0.5706 CL= 0.148 100CD=1.3653 CM=-0.0758 | S TURB S SEP 100CD 0.7620 0.0276 0.7032 0.8294 0.0013 0.5189 CL= 0.148 100CD=1.2221 CM=-0.0757 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3267 0.0324 0.4616* LOWER 0.4098 0.0000 0.3045* TOTAL CL= 0.252 100CD=0.7661 CM=-0.0772 | S TURB S SEP 100CD 0.9981 0.0325 0.8669 0.9563 0.0000 0.5186 CL= 0.252 100CD=1.3855 CM=-0.0772 | S TURB S SEP 100CD 0.8008 0.0305 0.7735 0.8007 0.0000 0.4669 CL= 0.254 100CD=1.2403 CM=-0.0775 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3511 0.0329 0.4948* LOWER 0.3534 0.0000 0.2715* TOTAL CL= 0.360 100CD=0.7663 CM=-0.0795 | S TURB S SEP 100CD 0.9981 0.0356 0.9405 0.9563 0.0000 0.4821 CL= 0.357 100CD=1.4226 CM=-0.0790 | S TURB S SEP 100CD 0.8375 0.0342 0.8562 0.7709 0.0000 0.4328 CL= 0.359 100CD=1.2890 CM=-0.0793 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3825 0.0338 0.5365* LOWER 0.3140 0.0000 0.2451* TOTAL CL= 0.467 100CD=0.7816 CM=-0.0818 | S TURB S SEP 100CD 0.9981 0.0388 1.0216 0.9563 0.0000 0.4501 CL= 0.462 100CD=1.4717 CM=-0.0806 | S TURB S SEP 100CD 0.8714 0.0375 0.9420 0.7396 0.0000 0.3988 CL= 0.463 100CD=1.3409 CM=-0.0809 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4287 0.0348 0.5976* LOWER 0.2830 0.0000 0.2237* TOTAL CL= 0.574 100CD=0.8213 CM=-0.0839 | S TURB S SEP 100CD 0.9981 0.0423 1.1111 0.9563 0.0000 0.4189 CL= 0.566 100CD=1.5300 CM=-0.0822 | S TURB S SEP 100CD 0.9029 0.0411 1.0381 0.7073 0.0000 0.3667 CL= 0.567 100CD=1.4047 CM=-0.0824 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4669 0.0373 0.6636* LOWER 0.2576 0.0000 0.2053* TOTAL CL= 0.679 100CD=0.8689 CM=-0.0856 | S TURB S SEP 100CD 0.9981 0.0461 1.2101 0.9563 0.0000 0.3892 CL= 0.670 100CD=1.5993 CM=-0.0835 | S TURB S SEP 100CD 0.9330 0.0450 1.1478 0.6736 0.0000 0.3364 CL= 0.671 100CD=1.4842 CM=-0.0838 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5563 0.0404 0.7909 LOWER 0.2378 0.0000 0.1884* TOTAL CL= 0.784 100CD=0.9792 CM=-0.0871 | S TURB S SEP 100CD 0.9981 0.0503 1.3192 0.9563 0.0000 0.3612 CL= 0.772 100CD=1.6803 CM=-0.0846 | S TURB S SEP 100CD 0.9606 0.0494 1.2732 0.6383 0.0000 0.3080 CL= 0.773 100CD=1.5812 CM=-0.0848 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8188 0.0497 1.1751* LOWER 0.2202 0.0000 0.1738* TOTAL CL= 0.880 100CD=1.3489 CM=-0.0869 | S TURB S SEP 100CD 0.9981 0.0551 1.4402 0.9563 0.0000 0.3350 CL= 0.873 100CD=1.7752 CM=-0.0855 | S TURB S SEP 100CD 0.9833 0.0546 1.4164 0.6023 0.0000 0.2817 CL= 0.874 100CD=1.6981 CM=-0.0856 |
| 7.00 | S TURB S SEP 100CD UPPER 1.0058 0.0625 1.6652* LOWER 0.2016 0.0000 0.1766* TOTAL CL= 0.970 100CD=1.8417 CM=-0.0853 | S TURB S SEP 100CD 1.0058 0.0625 1.6652* 0.9563 0.0000 0.3107 CL= 0.970 100CD=1.9759 CM=-0.0853 | S TURB S SEP 100CD 1.0058 0.0611 1.6038* 0.5648 0.0000 0.2571 CL= 0.972 100CD=1.8608 CM=-0.0857 |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

ALPHA(DEG.) R= 500000 MU= 300 R= 500000 MU= 100 R= 500000 MU= 900

7.69 S TURB S SEP 100CD S TURB S SEP 100CD
UPPER 1.0199 0.0699 1.8758* 1.0199 0.0699 1.8758*
LOWER 0.1842 0.0000 0.1648* 0.9555 0.0000 0.2942
TOTAL CL= 1.032 100CD=2.0406 CL= 1.032 100CD=2.1700
CM=-0.0844 CM=-0.0844

7.77 S TURB S SEP 100CD
UPPER 1.0244 0.0699 1.8754*
LOWER 0.5351 0.0000 0.2392
TOTAL CL= 1.041 100CD=2.1146
CM=-0.0845

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 700000 MU= 300 | R= 700000 MU= 100 | R= 700000 MU= 900 |
|---------------|--|---|---|
| -3.00 | S TURB S SEP 100CD UPPER 0.2762 0.0217 0.3223* LOWER 0.6372 0.0009 0.4378* TOTAL CL=-0.064 100CD=0.7601 CM=-0.0715 | S TURB S SEP 100CD 0.9981 0.0217 0.6449 0.9563 0.0353 0.6486 CL=-0.054 100CD=1.2936 CM=-0.0740 | S TURB S SEP 100CD 0.7218 0.0202 0.5621 0.8967 0.0300 0.6111 CL=-0.055 100CD=1.1732 CM=-0.0739 |
| -2.00 | S TURB S SEP 100CD UPPER 0.2923 0.0228 0.3454* LOWER 0.5573 0.0000 0.3692* TOTAL CL= 0.043 100CD=0.7146 CM=-0.0739 | S TURB S SEP 100CD 0.9981 0.0242 0.6971 0.9563 0.0195 0.5937 CL= 0.047 100CD=1.2909 CM=-0.0749 | S TURB S SEP 100CD 0.7603 0.0228 0.6172 0.8733 0.0127 0.5515 CL= 0.046 100CD=1.1686 CM=-0.0747 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3095 0.0238 0.3674* LOWER 0.4814 0.0000 0.3185 TOTAL CL= 0.151 100CD=0.6860 CM=-0.0763 | S TURB S SEP 100CD 0.9981 0.0269 0.7543 0.9563 0.0000 0.5390 CL= 0.149 100CD=1.2933 CM=-0.0757 | S TURB S SEP 100CD 0.7963 0.0256 0.6769 0.8487 0.0000 0.4909 CL= 0.150 100CD=1.1678 CM=-0.0760 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3267 0.0253 0.3958* LOWER 0.4103 0.0000 0.2741 TOTAL CL= 0.258 100CD=0.6699 CM=-0.0786 | S TURB S SEP 100CD 0.9981 0.0297 0.8169 0.9563 0.0000 0.4927 CL= 0.255 100CD=1.3097 CM=-0.0777 | S TURB S SEP 100CD 0.8298 0.0284 0.7418 0.8225 0.0000 0.4514 CL= 0.256 100CD=1.1932 CM=-0.0780 |
| 1.00 | S TURB S SEP 100CD UPPER 0.3511 0.0264 0.4268* LOWER 0.3534 0.0000 0.2420* TOTAL CL= 0.366 100CD=0.6688 CM=-0.0809 | S TURB S SEP 100CD 0.9981 0.0332 0.8911 0.9563 0.0000 0.4619 CL= 0.360 100CD=1.3530 CM=-0.0795 | S TURB S SEP 100CD 0.8620 0.0319 0.8188 0.7954 0.0000 0.4174 CL= 0.361 100CD=1.2362 CM=-0.0797 |
| 2.00 | S TURB S SEP 100CD UPPER 0.3830 0.0277 0.4663* LOWER 0.3140 0.0000 0.2174* TOTAL CL= 0.473 100CD=0.6836 CM=-0.0831 | S TURB S SEP 100CD 0.9981 0.0364 0.9671 0.9563 0.0000 0.4305 CL= 0.465 100CD=1.3976 CM=-0.0812 | S TURB S SEP 100CD 0.8914 0.0352 0.8986 0.7668 0.0000 0.3845 CL= 0.466 100CD=1.2831 CM=-0.0814 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4289 0.0297 0.5271 LOWER 0.2830 0.0000 0.1968* TOTAL CL= 0.580 100CD=0.7239 CM=-0.0851 | S TURB S SEP 100CD 0.9981 0.0398 1.0505 0.9563 0.0000 0.4004 CL= 0.569 100CD=1.4509 CM=-0.0827 | S TURB S SEP 100CD 0.9197 0.0387 0.9887 0.7372 0.0000 0.3536 CL= 0.570 100CD=1.3423 CM=-0.0830 |
| 4.00 | S TURB S SEP 100CD UPPER 0.4904 0.0325 0.6118 LOWER 0.2576 0.0000 0.1802* TOTAL CL= 0.685 100CD=0.7920 CM=-0.0868 | S TURB S SEP 100CD 0.9981 0.0434 1.1424 0.9563 0.0000 0.3720 CL= 0.673 100CD=1.5144 CM=-0.0841 | S TURB S SEP 100CD 0.9462 0.0425 1.0910 0.7066 0.0000 0.3249 CL= 0.674 100CD=1.4159 CM=-0.0844 |
| 5.00 | S TURB S SEP 100CD UPPER 0.6266 0.0382 0.7931 LOWER 0.2378 0.0000 0.1654* TOTAL CL= 0.786 100CD=0.9585 CM=-0.0877 | S TURB S SEP 100CD 0.9981 0.0474 1.2434 0.9563 0.0000 0.3453 CL= 0.775 100CD=1.5887 CM=-0.0853 | S TURB S SEP 100CD 0.9704 0.0468 1.2083 0.6744 0.0000 0.2980 CL= 0.776 100CD=1.5063 CM=-0.0855 |
| 6.00 | S TURB S SEP 100CD UPPER 0.8188 0.0464 1.0839* LOWER 0.2202 0.0000 0.1519* TOTAL CL= 0.884 100CD=1.2358 CM=-0.0877 | S TURB S SEP 100CD 0.9981 0.0519 1.3550 0.9563 0.0000 0.3203 CL= 0.877 100CD=1.6754 CM=-0.0863 | S TURB S SEP 100CD 0.9899 0.0516 1.3413 0.6412 0.0000 0.2730 CL= 0.878 100CD=1.6143 CM=-0.0864 |
| 7.00 | S TURB S SEP 100CD UPPER 1.0058 0.0587 1.5504* LOWER 0.2016 0.0000 0.1433* TOTAL CL= 0.975 100CD=1.6937 CM=-0.0864 | S TURB S SEP 100CD 1.0058 0.0587 1.5504* 0.9563 0.0000 0.2971 CL= 0.975 100CD=1.8475 CM=-0.0864 | S TURB S SEP 100CD 1.0058 0.0576 1.5018* 0.6072 0.0000 0.2497 CL= 0.977 100CD=1.7515 CM=-0.0867 |

B.L.SUMMARY AIRFOIL S834 15% ALPHA0= 2.549 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

ALPHA(DEG.) R= 700000 MU= 300 R= 700000 MU= 100 R= 700000 MU= 900

7.88 S TURB S SEP 100CD S TURB S SEP 100CD
UPPER 1.0247 0.0673 1.7980* 1.0247 0.0673 1.7980*
LOWER 0.1812 0.0000 0.1392* 0.9555 0.0000 0.2780
TOTAL CL= 1.056 100CD=1.9371 CL= 1.056 100CD=2.0760
CM=-0.0855 CM=-0.0855

7.92 S TURB S SEP 100CD
UPPER 1.0248 0.0674 1.7965*
LOWER 0.5744 0.0000 0.2296
TOTAL CL= 1.060 100CD=2.0261
CM=-0.0855

APPENDIX C

PRESSURE DISTRIBUTIONS, TRANSITION AND SEPARATION LOCATIONS, AND
SECTION CHARACTERISTICS OF S835 AIRFOIL

| AIRFOIL S835 21% | | | | -4.00 | -3.00 | -2.00 | -1.00 | 0.00 | 1.00 | 2.00 |
|------------------|---------|----------|-------|---|--------|--------|--------|--------|--------|--------|
| N | X | Y | NU | CP(X) FOR THE ABOVE ALPHA REL. CHORD LINE | | | | | | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.424 | 0.424 | 0.424 | 0.425 | 0.426 | 0.427 | 0.429 |
| 2 | 0.99593 | 0.00097 | 1.00 | 0.405 | 0.404 | 0.403 | 0.403 | 0.403 | 0.403 | 0.404 |
| 3 | 0.98447 | 0.00455 | 2.00 | 0.328 | 0.326 | 0.324 | 0.322 | 0.321 | 0.320 | 0.320 |
| 4 | 0.96719 | 0.01097 | 3.00 | 0.202 | 0.198 | 0.194 | 0.190 | 0.187 | 0.185 | 0.183 |
| 5 | 0.94546 | 0.01950 | 4.00 | 0.046 | 0.039 | 0.032 | 0.026 | 0.021 | 0.016 | 0.012 |
| 6 | 0.91994 | 0.02902 | 5.00 | -0.105 | -0.116 | -0.125 | -0.134 | -0.143 | -0.151 | -0.158 |
| 7 | 0.89062 | 0.03853 | 6.00 | -0.197 | -0.210 | -0.223 | -0.236 | -0.247 | -0.258 | -0.268 |
| 8 | 0.85715 | 0.04786 | 7.00 | -0.238 | -0.255 | -0.271 | -0.286 | -0.301 | -0.315 | -0.328 |
| 9 | 0.81994 | 0.05718 | 8.00 | -0.281 | -0.301 | -0.321 | -0.340 | -0.358 | -0.375 | -0.391 |
| 10 | 0.77953 | 0.06631 | 9.00 | -0.325 | -0.349 | -0.372 | -0.394 | -0.416 | -0.437 | -0.458 |
| 11 | 0.73644 | 0.07503 | 10.00 | -0.367 | -0.395 | -0.422 | -0.449 | -0.475 | -0.500 | -0.525 |
| 12 | 0.69117 | 0.08310 | 11.00 | -0.407 | -0.439 | -0.471 | -0.502 | -0.532 | -0.562 | -0.592 |
| 13 | 0.64420 | 0.09028 | 12.00 | -0.442 | -0.479 | -0.516 | -0.552 | -0.587 | -0.622 | -0.656 |
| 14 | 0.59600 | 0.09636 | 13.00 | -0.472 | -0.514 | -0.555 | -0.597 | -0.638 | -0.678 | -0.718 |
| 15 | 0.54703 | 0.10115 | 14.00 | -0.494 | -0.542 | -0.589 | -0.636 | -0.683 | -0.730 | -0.776 |
| 16 | 0.49774 | 0.10448 | 15.00 | -0.508 | -0.561 | -0.615 | -0.668 | -0.721 | -0.774 | -0.827 |
| 17 | 0.44851 | 0.10620 | 16.00 | -0.504 | -0.564 | -0.623 | -0.683 | -0.743 | -0.802 | -0.862 |
| 18 | 0.39966 | 0.10638 | 17.00 | -0.495 | -0.561 | -0.627 | -0.694 | -0.760 | -0.827 | -0.895 |
| 19 | 0.35178 | 0.10500 | 18.00 | -0.473 | -0.545 | -0.619 | -0.692 | -0.767 | -0.842 | -0.917 |
| 20 | 0.30519 | 0.10211 | 19.00 | -0.442 | -0.521 | -0.602 | -0.683 | -0.766 | -0.850 | -0.934 |
| 21 | 0.26037 | 0.09783 | 20.00 | -0.405 | -0.492 | -0.581 | -0.672 | -0.764 | -0.858 | -0.953 |
| 22 | 0.21782 | 0.09226 | 21.00 | -0.360 | -0.456 | -0.555 | -0.656 | -0.759 | -0.864 | -0.971 |
| 23 | 0.17797 | 0.08549 | 22.00 | -0.305 | -0.411 | -0.521 | -0.634 | -0.749 | -0.868 | -0.989 |
| 24 | 0.14127 | 0.07759 | 23.00 | -0.236 | -0.353 | -0.475 | -0.601 | -0.732 | -0.866 | -1.004 |
| 25 | 0.10805 | 0.06868 | 24.00 | -0.148 | -0.278 | -0.414 | -0.556 | -0.703 | -0.857 | -1.016 |
| 26 | 0.07871 | 0.05889 | 25.00 | -0.032 | -0.176 | -0.327 | -0.488 | -0.656 | -0.832 | -1.016 |
| 27 | 0.05347 | 0.04838 | 26.00 | 0.118 | -0.038 | -0.207 | -0.388 | -0.581 | -0.785 | -1.001 |
| 28 | 0.03266 | 0.03735 | 27.00 | 0.316 | 0.148 | -0.038 | -0.242 | -0.463 | -0.701 | -0.956 |
| 29 | 0.01649 | 0.02603 | 28.00 | 0.566 | 0.396 | 0.198 | -0.027 | -0.280 | -0.559 | -0.865 |
| 30 | 0.00537 | 0.01477 | 29.00 | 0.850 | 0.709 | 0.522 | 0.289 | 0.010 | -0.314 | -0.683 |
| 31 | 0.00357 | 0.01220 | 29.23 | 0.910 | 0.786 | 0.610 | 0.381 | 0.100 | -0.233 | -0.618 |
| 32 | 0.00200 | 0.00947 | 29.48 | 0.963 | 0.865 | 0.706 | 0.486 | 0.205 | -0.137 | -0.538 |
| 33 | 0.00087 | 0.00677 | 29.73 | 0.996 | 0.935 | 0.802 | 0.596 | 0.319 | -0.029 | -0.448 |
| 34 | 0.00026 | 0.00397 | 29.98 | 0.995 | 0.988 | 0.916 | 0.777 | 0.572 | 0.302 | -0.034 |
| 35 | 0.00023 | 0.00376 | 30.00 | 0.993 | 0.990 | 0.922 | 0.788 | 0.588 | 0.322 | -0.008 |
| 36 | 0.00002 | 0.00099 | 30.23 | 0.959 | 0.999 | 0.978 | 0.896 | 0.753 | 0.550 | 0.285 |
| 37 | 0.00111 | -0.00887 | 31.00 | 0.710 | 0.853 | 0.948 | 0.995 | 0.993 | 0.943 | 0.844 |
| 38 | 0.00638 | -0.02253 | 32.00 | 0.249 | 0.463 | 0.641 | 0.784 | 0.891 | 0.961 | 0.996 |
| 39 | 0.01577 | -0.03657 | 33.00 | -0.211 | 0.029 | 0.244 | 0.432 | 0.594 | 0.729 | 0.837 |
| 40 | 0.02908 | -0.05033 | 34.00 | -0.597 | -0.355 | -0.131 | 0.073 | 0.257 | 0.422 | 0.566 |
| 41 | 0.04631 | -0.06347 | 35.00 | -0.889 | -0.658 | -0.440 | -0.237 | -0.049 | 0.124 | 0.282 |
| 42 | 0.06721 | -0.07550 | 36.00 | -1.086 | -0.873 | -0.670 | -0.478 | -0.297 | -0.127 | 0.032 |
| 43 | 0.09182 | -0.08620 | 37.00 | -1.202 | -1.010 | -0.826 | -0.650 | -0.481 | -0.321 | -0.169 |
| 44 | 0.11982 | -0.09519 | 38.00 | -1.251 | -1.081 | -0.916 | -0.757 | -0.604 | -0.457 | -0.316 |
| 45 | 0.15121 | -0.10230 | 39.00 | -1.248 | -1.099 | -0.954 | -0.813 | -0.676 | -0.543 | -0.415 |
| 46 | 0.18563 | -0.10723 | 40.00 | -1.197 | -1.068 | -0.941 | -0.818 | -0.697 | -0.580 | -0.466 |
| 47 | 0.22322 | -0.10980 | 41.00 | -1.088 | -0.979 | -0.871 | -0.765 | -0.661 | -0.560 | -0.461 |
| 48 | 0.26372 | -0.11014 | 42.00 | -0.971 | -0.878 | -0.787 | -0.697 | -0.608 | -0.520 | -0.434 |
| 49 | 0.30684 | -0.10829 | 43.00 | -0.848 | -0.770 | -0.692 | -0.616 | -0.540 | -0.465 | -0.391 |
| 50 | 0.35227 | -0.10430 | 44.00 | -0.721 | -0.655 | -0.590 | -0.525 | -0.461 | -0.397 | -0.333 |
| 51 | 0.39970 | -0.09827 | 45.00 | -0.592 | -0.537 | -0.483 | -0.428 | -0.374 | -0.320 | -0.266 |
| 52 | 0.44881 | -0.09036 | 46.00 | -0.464 | -0.418 | -0.373 | -0.327 | -0.282 | -0.236 | -0.191 |
| 53 | 0.49928 | -0.08081 | 47.00 | -0.337 | -0.300 | -0.262 | -0.224 | -0.187 | -0.148 | -0.110 |
| 54 | 0.55072 | -0.06993 | 48.00 | -0.214 | -0.184 | -0.153 | -0.122 | -0.091 | -0.059 | -0.028 |
| 55 | 0.60277 | -0.05811 | 49.00 | -0.097 | -0.072 | -0.047 | -0.022 | 0.004 | 0.029 | 0.056 |
| 56 | 0.65496 | -0.04582 | 50.00 | 0.014 | 0.033 | 0.053 | 0.074 | 0.095 | 0.116 | 0.137 |
| 57 | 0.70679 | -0.03361 | 51.00 | 0.117 | 0.132 | 0.148 | 0.164 | 0.181 | 0.198 | 0.215 |
| 58 | 0.75764 | -0.02211 | 52.00 | 0.210 | 0.223 | 0.235 | 0.248 | 0.261 | 0.275 | 0.289 |
| 59 | 0.80676 | -0.01199 | 53.00 | 0.294 | 0.304 | 0.314 | 0.324 | 0.334 | 0.345 | 0.356 |
| 60 | 0.85324 | -0.00393 | 54.00 | 0.368 | 0.375 | 0.383 | 0.391 | 0.399 | 0.407 | 0.416 |
| 61 | 0.89582 | 0.00127 | 55.00 | 0.418 | 0.424 | 0.429 | 0.436 | 0.442 | 0.449 | 0.456 |
| 62 | 0.93260 | 0.00343 | 56.00 | 0.441 | 0.445 | 0.450 | 0.455 | 0.460 | 0.465 | 0.471 |
| 63 | 0.96201 | 0.00332 | 57.00 | 0.446 | 0.449 | 0.452 | 0.456 | 0.460 | 0.464 | 0.469 |
| 64 | 0.98319 | 0.00204 | 58.00 | 0.439 | 0.441 | 0.443 | 0.446 | 0.449 | 0.453 | 0.456 |
| 65 | 0.99583 | 0.00064 | 59.00 | 0.429 | 0.430 | 0.431 | 0.433 | 0.435 | 0.438 | 0.440 |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.424 | 0.424 | 0.424 | 0.425 | 0.426 | 0.427 | 0.429 |

ALPHA= 3.54 DEGREES CM0=-0.1386 ETA= 1.167

| AIRFOIL S835 21% | | | 3.00 4.00 5.00 6.00 7.00 8.00 | | | | | | | |
|------------------|---------|----------|-------------------------------|---|--------|--------|--------|--------|--------|--|
| N | X | Y | NU | CP(X) FOR THE ABOVE ALPHA REL. CHORD LINE | | | | | | |
| 1 | 1.00000 | 0.00000 | 0.00 | 0.431 | 0.433 | 0.436 | 0.439 | 0.443 | 0.447 | |
| 2 | 0.99593 | 0.00097 | 1.00 | 0.405 | 0.407 | 0.408 | 0.411 | 0.413 | 0.416 | |
| 3 | 0.98447 | 0.00455 | 2.00 | 0.320 | 0.320 | 0.321 | 0.322 | 0.324 | 0.326 | |
| 4 | 0.96719 | 0.01097 | 3.00 | 0.181 | 0.180 | 0.180 | 0.180 | 0.181 | 0.182 | |
| 5 | 0.94546 | 0.01950 | 4.00 | 0.008 | 0.005 | 0.003 | 0.001 | 0.000 | -0.001 | |
| 6 | 0.91994 | 0.02902 | 5.00 | -0.164 | -0.170 | -0.175 | -0.179 | -0.183 | -0.185 | |
| 7 | 0.89062 | 0.03853 | 6.00 | -0.278 | -0.286 | -0.294 | -0.301 | -0.308 | -0.313 | |
| 8 | 0.85715 | 0.04786 | 7.00 | -0.340 | -0.352 | -0.363 | -0.373 | -0.382 | -0.391 | |
| 9 | 0.81994 | 0.05718 | 8.00 | -0.407 | -0.422 | -0.437 | -0.450 | -0.463 | -0.475 | |
| 10 | 0.77953 | 0.06631 | 9.00 | -0.477 | -0.496 | -0.514 | -0.531 | -0.548 | -0.563 | |
| 11 | 0.73644 | 0.07503 | 10.00 | -0.549 | -0.572 | -0.594 | -0.616 | -0.636 | -0.656 | |
| 12 | 0.69117 | 0.08310 | 11.00 | -0.620 | -0.648 | -0.675 | -0.701 | -0.726 | -0.751 | |
| 13 | 0.64420 | 0.09028 | 12.00 | -0.690 | -0.723 | -0.755 | -0.787 | -0.817 | -0.847 | |
| 14 | 0.59600 | 0.09636 | 13.00 | -0.758 | -0.796 | -0.834 | -0.872 | -0.908 | -0.944 | |
| 15 | 0.54703 | 0.10115 | 14.00 | -0.821 | -0.866 | -0.911 | -0.954 | -0.998 | -1.040 | |
| 16 | 0.49774 | 0.10448 | 15.00 | -0.879 | -0.931 | -0.983 | -1.033 | -1.084 | -1.133 | |
| 17 | 0.44851 | 0.10620 | 16.00 | -0.921 | -0.980 | -1.039 | -1.098 | -1.156 | -1.213 | |
| 18 | 0.39966 | 0.10638 | 17.00 | -0.962 | -1.029 | -1.096 | -1.163 | -1.229 | -1.296 | |
| 19 | 0.35178 | 0.10500 | 18.00 | -0.993 | -1.069 | -1.145 | -1.221 | -1.297 | -1.373 | |
| 20 | 0.30519 | 0.10211 | 19.00 | -1.019 | -1.105 | -1.191 | -1.278 | -1.364 | -1.451 | |
| 21 | 0.26037 | 0.09783 | 20.00 | -1.048 | -1.145 | -1.243 | -1.342 | -1.441 | -1.541 | |
| 22 | 0.21782 | 0.09226 | 21.00 | -1.079 | -1.190 | -1.302 | -1.415 | -1.529 | -1.644 | |
| 23 | 0.17797 | 0.08549 | 22.00 | -1.113 | -1.239 | -1.367 | -1.498 | -1.631 | -1.765 | |
| 24 | 0.14127 | 0.07759 | 23.00 | -1.146 | -1.292 | -1.440 | -1.592 | -1.747 | -1.905 | |
| 25 | 0.10805 | 0.06868 | 24.00 | -1.180 | -1.349 | -1.523 | -1.702 | -1.885 | -2.072 | |
| 26 | 0.07871 | 0.05889 | 25.00 | -1.208 | -1.407 | -1.613 | -1.825 | -2.044 | -2.270 | |
| 27 | 0.05347 | 0.04838 | 26.00 | -1.227 | -1.464 | -1.712 | -1.969 | -2.237 | -2.514 | |
| 28 | 0.03266 | 0.03735 | 27.00 | -1.228 | -1.515 | -1.819 | -2.138 | -2.472 | -2.820 | |
| 29 | 0.01649 | 0.02603 | 28.00 | -1.197 | -1.554 | -1.937 | -2.344 | -2.776 | -3.232 | |
| 30 | 0.00537 | 0.01477 | 29.00 | -1.096 | -1.554 | -2.055 | -2.598 | -3.184 | -3.811 | |
| 31 | 0.00357 | 0.01220 | 29.23 | -1.053 | -1.539 | -2.074 | -2.659 | -3.292 | -3.973 | |
| 32 | 0.00200 | 0.00947 | 29.48 | -1.000 | -1.520 | -2.098 | -2.735 | -3.428 | -4.177 | |
| 33 | 0.00087 | 0.00677 | 29.73 | -0.938 | -1.498 | -2.127 | -2.824 | -3.590 | -4.421 | |
| 34 | 0.00026 | 0.00397 | 29.98 | -0.435 | -0.901 | -1.430 | -2.023 | -2.679 | -3.396 | |
| 35 | 0.00023 | 0.00376 | 30.00 | -0.403 | -0.862 | -1.385 | -1.971 | -2.619 | -3.329 | |
| 36 | 0.00002 | 0.00099 | 30.23 | -0.039 | -0.423 | -0.867 | -1.369 | -1.930 | -2.548 | |
| 37 | 0.00111 | -0.00887 | 31.00 | 0.697 | 0.502 | 0.259 | -0.032 | -0.369 | -0.754 | |
| 38 | 0.00638 | -0.02253 | 32.00 | 0.995 | 0.957 | 0.884 | 0.774 | 0.629 | 0.448 | |
| 39 | 0.01577 | -0.03657 | 33.00 | 0.917 | 0.971 | 0.997 | 0.996 | 0.968 | 0.912 | |
| 40 | 0.02908 | -0.05033 | 34.00 | 0.689 | 0.792 | 0.875 | 0.937 | 0.978 | 0.998 | |
| 41 | 0.04631 | -0.06347 | 35.00 | 0.425 | 0.552 | 0.663 | 0.759 | 0.839 | 0.903 | |
| 42 | 0.06721 | -0.07550 | 36.00 | 0.179 | 0.314 | 0.438 | 0.550 | 0.649 | 0.737 | |
| 43 | 0.09182 | -0.08620 | 37.00 | -0.026 | 0.108 | 0.234 | 0.350 | 0.458 | 0.555 | |
| 44 | 0.11982 | -0.09519 | 38.00 | -0.182 | -0.054 | 0.067 | 0.181 | 0.289 | 0.389 | |
| 45 | 0.15121 | -0.10230 | 39.00 | -0.292 | -0.174 | -0.060 | 0.048 | 0.151 | 0.249 | |
| 46 | 0.18563 | -0.10723 | 40.00 | -0.355 | -0.248 | -0.144 | -0.044 | 0.051 | 0.143 | |
| 47 | 0.22322 | -0.10980 | 41.00 | -0.364 | -0.269 | -0.178 | -0.089 | -0.003 | 0.081 | |
| 48 | 0.26372 | -0.11014 | 42.00 | -0.350 | -0.267 | -0.187 | -0.108 | -0.031 | 0.043 | |
| 49 | 0.30684 | -0.10829 | 43.00 | -0.318 | -0.246 | -0.176 | -0.107 | -0.039 | 0.027 | |
| 50 | 0.35227 | -0.10430 | 44.00 | -0.271 | -0.209 | -0.148 | -0.088 | -0.029 | 0.030 | |
| 51 | 0.39970 | -0.09827 | 45.00 | -0.212 | -0.159 | -0.107 | -0.055 | -0.003 | 0.047 | |
| 52 | 0.44881 | -0.09036 | 46.00 | -0.145 | -0.100 | -0.055 | -0.011 | 0.034 | 0.077 | |
| 53 | 0.49928 | -0.08081 | 47.00 | -0.072 | -0.034 | 0.004 | 0.042 | 0.080 | 0.117 | |
| 54 | 0.55072 | -0.06993 | 48.00 | 0.004 | 0.036 | 0.068 | 0.100 | 0.132 | 0.164 | |
| 55 | 0.60277 | -0.05811 | 49.00 | 0.082 | 0.108 | 0.135 | 0.162 | 0.189 | 0.216 | |
| 56 | 0.65496 | -0.04582 | 50.00 | 0.159 | 0.181 | 0.203 | 0.225 | 0.247 | 0.270 | |
| 57 | 0.70679 | -0.03361 | 51.00 | 0.233 | 0.251 | 0.269 | 0.287 | 0.306 | 0.325 | |
| 58 | 0.75764 | -0.02211 | 52.00 | 0.303 | 0.318 | 0.332 | 0.347 | 0.363 | 0.378 | |
| 59 | 0.80676 | -0.01199 | 53.00 | 0.367 | 0.379 | 0.391 | 0.403 | 0.416 | 0.428 | |
| 60 | 0.85324 | -0.00393 | 54.00 | 0.425 | 0.434 | 0.444 | 0.454 | 0.464 | 0.474 | |
| 61 | 0.89582 | 0.00127 | 55.00 | 0.463 | 0.470 | 0.478 | 0.486 | 0.495 | 0.503 | |
| 62 | 0.93260 | 0.00343 | 56.00 | 0.477 | 0.483 | 0.490 | 0.496 | 0.503 | 0.511 | |
| 63 | 0.96201 | 0.00332 | 57.00 | 0.474 | 0.479 | 0.485 | 0.491 | 0.497 | 0.503 | |
| 64 | 0.98319 | 0.00204 | 58.00 | 0.460 | 0.465 | 0.469 | 0.474 | 0.480 | 0.485 | |
| 65 | 0.99583 | 0.00064 | 59.00 | 0.443 | 0.447 | 0.451 | 0.455 | 0.459 | 0.464 | |
| 66 | 1.00000 | 0.00000 | 60.00 | 0.431 | 0.433 | 0.436 | 0.439 | 0.443 | 0.447 | |

ALPHA= 3.54 DEGREES CMO=-0.1386 ETA= 1.167

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 150000 | MU= 300 | R= 150000 | MU= 100 | R= 150000 | MU= 900 |
|---------------|-----------|------------------------|------------------------|------------------------|-----------|-------------|
| -4.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.2866 0.0553 0.8704* | 1.0055 0.0350 0.9340 | 0.4813 0.0341 0.7539 | | |
| | LOWER | 0.7687 0.4232 1.2990* | 0.9686 0.3204 1.0840 | 0.8003 0.3094 0.9531 | | |
| | TOTAL | CL=-0.081 100CD=2.1694 | CL=-0.067 100CD=2.0179 | CL=-0.067 100CD=1.7070 | | |
| | | CM=-0.1329 | CM=-0.1337 | CM=-0.1337 | | |
| -3.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3125 0.0543 0.9285* | 1.0056 0.0371 1.0104 | 0.5183 0.0359 0.8247 | | |
| | LOWER | 0.7475 0.3842 1.1534* | 0.9686 0.2978 0.9778 | 0.7886 0.2870 0.8642 | | |
| | TOTAL | CL= 0.005 100CD=2.0818 | CL= 0.023 100CD=1.9882 | CL= 0.024 100CD=1.6889 | | |
| | | CM=-0.1334 | CM=-0.1341 | CM=-0.1342 | | |
| -2.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3394 0.0562 0.9892* | 1.0056 0.0394 1.0945 | 0.5605 0.0379 0.9057 | | |
| | LOWER | 0.7251 0.3834 1.0553* | 0.9686 0.2754 0.8817 | 0.7757 0.2648 0.7831 | | |
| | TOTAL | CL= 0.108 100CD=2.0445 | CL= 0.127 100CD=1.9762 | CL= 0.129 100CD=1.6888 | | |
| | | CM=-0.1360 | CM=-0.1364 | CM=-0.1365 | | |
| -1.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3661 0.0585 1.0551* | 1.0056 0.0419 1.1875 | 0.6075 0.0401 0.9987 | | |
| | LOWER | 0.7021 0.3491 0.9512* | 0.9686 0.2531 0.7947 | 0.7612 0.2433 0.7091 | | |
| | TOTAL | CL= 0.212 100CD=2.0062 | CL= 0.232 100CD=1.9822 | CL= 0.234 100CD=1.7079 | | |
| | | CM=-0.1379 | CM=-0.1386 | CM=-0.1387 | | |
| 0.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.3933 0.0579 1.1258* | 1.0056 0.0440 1.2786 | 0.6710 0.0422 1.1065 | | |
| | LOWER | 0.6793 0.3505 0.8732* | 0.9686 0.2311 0.7164 | 0.7447 0.2221 0.6413 | | |
| | TOTAL | CL= 0.320 100CD=1.9990 | CL= 0.337 100CD=1.9949 | CL= 0.339 100CD=1.7478 | | |
| | | CM=-0.1408 | CM=-0.1406 | CM=-0.1408 | | |
| 1.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.4208 0.0610 1.2107* | 1.0056 0.0468 1.3903 | 0.7317 0.0451 1.2333 | | |
| | LOWER | 0.6567 0.3165 0.7972* | 0.9686 0.2093 0.6459 | 0.7267 0.2012 0.5796 | | |
| | TOTAL | CL= 0.422 100CD=2.0079 | CL= 0.441 100CD=2.0362 | CL= 0.443 100CD=1.8129 | | |
| | | CM=-0.1422 | CM=-0.1423 | CM=-0.1425 | | |
| 2.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.4482 0.0640 1.2887* | 1.0056 0.0506 1.5270 | 0.7847 0.0489 1.3798 | | |
| | LOWER | 0.6342 0.3179 0.7319* | 0.9686 0.1877 0.5825 | 0.7075 0.1809 0.5237 | | |
| | TOTAL | CL= 0.525 100CD=2.0206 | CL= 0.543 100CD=2.1095 | CL= 0.545 100CD=1.9035 | | |
| | | CM=-0.1443 | CM=-0.1435 | CM=-0.1437 | | |
| 3.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.4761 0.0657 1.3929* | 1.0056 0.0542 1.6637 | 0.8322 0.0525 1.5284 | | |
| | LOWER | 0.6121 0.2824 0.6714* | 0.9686 0.1668 0.5254 | 0.6873 0.1611 0.4732 | | |
| | TOTAL | CL= 0.628 100CD=2.0643 | CL= 0.645 100CD=2.1892 | CL= 0.647 100CD=2.0016 | | |
| | | CM=-0.1453 | CM=-0.1445 | CM=-0.1448 | | |
| 4.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.5025 0.0684 1.4540* | 1.0056 0.0582 1.8131 | 0.8751 0.0566 1.6906 | | |
| | LOWER | 0.5902 0.2838 0.6198* | 0.9686 0.0000 0.4746 | 0.6667 0.0000 0.4281 | | |
| | TOTAL | CL= 0.730 100CD=2.0738 | CL= 0.746 100CD=2.2877 | CL= 0.748 100CD=2.1186 | | |
| | | CM=-0.1471 | CM=-0.1419 | CM=-0.1424 | | |
| 5.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.5620 0.0653 1.5153* | 1.0056 0.0625 1.9784 | 0.9121 0.0611 1.8708 | | |
| | LOWER | 0.5686 0.2464 0.5676* | 0.9686 0.0000 0.4293 | 0.6457 0.0000 0.3882 | | |
| | TOTAL | CL= 0.841 100CD=2.0829 | CL= 0.846 100CD=2.4078 | CL= 0.848 100CD=2.2589 | | |
| | | CM=-0.1486 | CM=-0.1424 | CM=-0.1429 | | |
| 6.00 | S TURB | S SEP 100CD | S TURB | S SEP 100CD | S TURB | S SEP 100CD |
| | UPPER | 0.6333 0.0661 1.6632* | 1.0056 0.0674 2.1597 | 0.9429 0.0662 2.0702 | | |
| | LOWER | 0.5468 0.2482 0.5294* | 0.9686 0.0000 0.4001 | 0.6247 0.0000 0.3633 | | |
| | TOTAL | CL= 0.946 100CD=2.1926 | CL= 0.944 100CD=2.5598 | CL= 0.946 100CD=2.4335 | | |
| | | CM=-0.1504 | CM=-0.1425 | CM=-0.1429 | | |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 150000 | MU= 300 | R= 150000 | MU= 100 | R= 150000 | MU= 900 |
|---------------|------------|--------------|------------|--------------|--------------|---------|
| 6.10 | | | S TURB | S SEP | 100CD | |
| UPPER | | | 1.0056 | 0.0680 | 2.1788 | |
| LOWER | | | 0.9686 | 0.0000 | 0.3968 | |
| TOTAL | | | CL= 0.954 | 100CD=2.5756 | | |
| | | | CM=-0.1425 | | | |
| 6.51 | | | | S TURB | S SEP | 100CD |
| UPPER | | | | 0.9556 | 0.0690 | 2.1787 |
| LOWER | | | | 0.6139 | 0.0000 | 0.3482 |
| TOTAL | | | | CL= 0.995 | 100CD=2.5269 | |
| | | | | CM=-0.1427 | | |
| 6.57 | S TURB | S SEP | 100CD | | | |
| UPPER | 0.8499 | 0.0704 | 2.1759* | | | |
| LOWER | 0.5346 | 0.2118 | 0.5041* | | | |
| TOTAL | CL= 1.000 | 100CD=2.6800 | | | | |
| | CM=-0.1491 | | | | | |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 200000 MU= 300 | R= 200000 MU= 100 | R= 200000 MU= 900 |
|---------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2866 0.0469 0.6892* LOWER 0.7687 0.3665 1.0840* TOTAL CL=-0.076 100CD=1.7732 CM=-0.1329 | S TURB S SEP 100CD 1.0055 0.0335 0.8940 0.9686 0.3101 1.0266 CL=-0.066 100CD=1.9206 CM=-0.1338 | S TURB S SEP 100CD 0.5166 0.0318 0.7135 0.8094 0.2889 0.8857 CL=-0.066 100CD=1.5993 CM=-0.1337 |
| -3.00 | S TURB S SEP 100CD UPPER 0.3125 0.0478 0.7369* LOWER 0.7475 0.3524 0.9581* TOTAL CL= 0.012 100CD=1.6950 CM=-0.1335 | S TURB S SEP 100CD 1.0056 0.0357 0.9667 0.9686 0.2879 0.9276 CL= 0.024 100CD=1.8943 CM=-0.1342 | S TURB S SEP 100CD 0.5578 0.0338 0.7847 0.7977 0.2673 0.8030 CL= 0.026 100CD=1.5877 CM=-0.1342 |
| -2.00 | S TURB S SEP 100CD UPPER 0.3394 0.0474 0.7918* LOWER 0.7251 0.3267 0.8779* TOTAL CL= 0.118 100CD=1.6697 CM=-0.1360 | S TURB S SEP 100CD 1.0056 0.0379 1.0464 0.9686 0.2659 0.8378 CL= 0.129 100CD=1.8842 CM=-0.1365 | S TURB S SEP 100CD 0.6002 0.0360 0.8634 0.7859 0.2462 0.7286 CL= 0.131 100CD=1.5920 CM=-0.1365 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3661 0.0490 0.8526* LOWER 0.7021 0.2988 0.7933* TOTAL CL= 0.224 100CD=1.6459 CM=-0.1382 | S TURB S SEP 100CD 1.0056 0.0398 1.1246 0.9686 0.2440 0.7563 CL= 0.234 100CD=1.8809 CM=-0.1388 | S TURB S SEP 100CD 0.6564 0.0384 0.9612 0.7727 0.2250 0.6604 CL= 0.236 100CD=1.6217 CM=-0.1387 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3933 0.0508 0.9150* LOWER 0.6793 0.2932 0.7214* TOTAL CL= 0.329 100CD=1.6364 CM=-0.1406 | S TURB S SEP 100CD 1.0056 0.0424 1.2200 0.9686 0.2222 0.6826 CL= 0.339 100CD=1.9026 CM=-0.1408 | S TURB S SEP 100CD 0.7149 0.0406 1.0626 0.7577 0.2041 0.5978 CL= 0.341 100CD=1.6603 CM=-0.1408 |
| 1.00 | S TURB S SEP 100CD UPPER 0.4208 0.0517 0.9924* LOWER 0.6567 0.2630 0.6505* TOTAL CL= 0.434 100CD=1.6428 CM=-0.1425 | S TURB S SEP 100CD 1.0056 0.0452 1.3252 0.9686 0.2007 0.6163 CL= 0.443 100CD=1.9414 CM=-0.1425 | S TURB S SEP 100CD 0.7677 0.0435 1.1789 0.7409 0.1834 0.5405 CL= 0.445 100CD=1.7194 CM=-0.1425 |
| 2.00 | S TURB S SEP 100CD UPPER 0.4482 0.0542 1.0688* LOWER 0.6342 0.2605 0.5984* TOTAL CL= 0.538 100CD=1.6672 CM=-0.1445 | S TURB S SEP 100CD 1.0056 0.0489 1.4535 0.9686 0.1795 0.5564 CL= 0.545 100CD=2.0099 CM=-0.1437 | S TURB S SEP 100CD 0.8142 0.0466 1.3040 0.7225 0.1632 0.4883 CL= 0.548 100CD=1.7923 CM=-0.1439 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4761 0.0555 1.1466* LOWER 0.6121 0.2293 0.5422* TOTAL CL= 0.643 100CD=1.6887 CM=-0.1459 | S TURB S SEP 100CD 1.0056 0.0522 1.5800 0.9686 0.1586 0.5024 CL= 0.648 100CD=2.0824 CM=-0.1448 | S TURB S SEP 100CD 0.8564 0.0506 1.4533 0.7031 0.0000 0.4413 CL= 0.650 100CD=1.8946 CM=-0.1422 |
| 4.00 | S TURB S SEP 100CD UPPER 0.5025 0.0588 1.2318* LOWER 0.5902 0.2267 0.4998* TOTAL CL= 0.745 100CD=1.7316 CM=-0.1473 | S TURB S SEP 100CD 1.0056 0.0561 1.7205 0.9686 0.0000 0.4543 CL= 0.749 100CD=2.1748 CM=-0.1426 | S TURB S SEP 100CD 0.8941 0.0545 1.6065 0.6829 0.0000 0.3993 CL= 0.751 100CD=2.0057 CM=-0.1431 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5620 0.0579 1.3167* LOWER 0.5686 0.1960 0.4582* TOTAL CL= 0.853 100CD=1.7749 CM=-0.1487 | S TURB S SEP 100CD 1.0056 0.0603 1.8742 0.9686 0.0000 0.4121 CL= 0.849 100CD=2.2863 CM=-0.1431 | S TURB S SEP 100CD 0.9273 0.0590 1.7759 0.6623 0.0000 0.3722 CL= 0.851 100CD=2.1482 CM=-0.1435 |
| 6.00 | S TURB S SEP 100CD UPPER 0.6333 0.0600 1.4792* LOWER 0.5468 0.1916 0.4195* TOTAL CL= 0.956 100CD=1.8986 CM=-0.1499 | S TURB S SEP 100CD 1.0056 0.0650 2.0423 0.9686 0.0000 0.3853 CL= 0.948 100CD=2.4275 CM=-0.1433 | S TURB S SEP 100CD 0.9544 0.0638 1.9618 0.6414 0.0000 0.3419 CL= 0.950 100CD=2.3037 CM=-0.1437 |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 200000 MU= 300 | R= 200000 MU= 100 | R= 200000 MU= 900 |
|---------------|------------------------|------------------------|-------------------|
| 6.33 | | S TURB S SEP 100CD | |
| UPPER | | 1.0056 0.0666 2.1013 | |
| LOWER | | 0.9686 0.0000 0.3747 | |
| TOTAL | | CL= 0.980 100CD=2.4760 | |
| | | CM=-0.1432 | |
| 6.70 | | S TURB S SEP 100CD | |
| UPPER | | 0.9693 0.0676 2.1023 | |
| LOWER | | 0.6267 0.0000 0.3219 | |
| TOTAL | | CL= 1.018 100CD=2.4242 | |
| | | CM=-0.1435 | |
| 6.75 | S TURB S SEP 100CD | | |
| UPPER | 0.8874 0.0682 2.1016* | | |
| LOWER | 0.5309 0.1894 0.3915* | | |
| TOTAL | CL= 1.022 100CD=2.4931 | | |
| | CM=-0.1491 | | |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 250000 MU= 300 | R= 250000 MU= 100 | R= 250000 MU= 900 |
|---------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2866 0.0418 0.5932* LOWER 0.7687 0.3256 0.9471* TOTAL CL=-0.073 100CD=1.5403 CM=-0.1329 | S TURB S SEP 100CD 1.0055 0.0323 0.8642 0.9686 0.3023 0.9850 CL=-0.066 100CD=1.8492 CM=-0.1338 | S TURB S SEP 100CD 0.5479 0.0305 0.6908 0.8171 0.2762 0.8416 CL=-0.065 100CD=1.5324 CM=-0.1337 |
| -3.00 | S TURB S SEP 100CD UPPER 0.3125 0.0425 0.6388* LOWER 0.7475 0.3135 0.8542* TOTAL CL= 0.017 100CD=1.4930 CM=-0.1336 | S TURB S SEP 100CD 1.0056 0.0345 0.9341 0.9686 0.2803 0.8911 CL= 0.025 100CD=1.8252 CM=-0.1343 | S TURB S SEP 100CD 0.5876 0.0325 0.7591 0.8049 0.2550 0.7623 CL= 0.027 100CD=1.5215 CM=-0.1343 |
| -2.00 | S TURB S SEP 100CD UPPER 0.3394 0.0433 0.6856* LOWER 0.7251 0.2856 0.7661* TOTAL CL= 0.123 100CD=1.4517 CM=-0.1360 | S TURB S SEP 100CD 1.0056 0.0367 1.0107 0.9686 0.2585 0.8056 CL= 0.130 100CD=1.8163 CM=-0.1366 | S TURB S SEP 100CD 0.6366 0.0348 0.8412 0.7933 0.2342 0.6916 CL= 0.132 100CD=1.5329 CM=-0.1366 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3661 0.0436 0.7433* LOWER 0.7021 0.2734 0.6856* TOTAL CL= 0.230 100CD=1.4289 CM=-0.1386 | S TURB S SEP 100CD 1.0056 0.0386 1.0853 0.9686 0.2369 0.7281 CL= 0.236 100CD=1.8134 CM=-0.1389 | S TURB S SEP 100CD 0.6934 0.0373 0.9378 0.7813 0.2135 0.6278 CL= 0.237 100CD=1.5656 CM=-0.1388 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3933 0.0452 0.8041* LOWER 0.6793 0.2508 0.6273* TOTAL CL= 0.335 100CD=1.4314 CM=-0.1407 | S TURB S SEP 100CD 1.0056 0.0412 1.1767 0.9686 0.2153 0.6578 CL= 0.340 100CD=1.8346 CM=-0.1409 | S TURB S SEP 100CD 0.7448 0.0394 1.0308 0.7672 0.1928 0.5688 CL= 0.342 100CD=1.5996 CM=-0.1408 |
| 1.00 | S TURB S SEP 100CD UPPER 0.4208 0.0462 0.8710* LOWER 0.6567 0.2389 0.5604* TOTAL CL= 0.441 100CD=1.4314 CM=-0.1430 | S TURB S SEP 100CD 1.0056 0.0439 1.2770 0.9686 0.1939 0.5944 CL= 0.444 100CD=1.8714 CM=-0.1426 | S TURB S SEP 100CD 0.7921 0.0423 1.1407 0.7516 0.1726 0.5146 CL= 0.446 100CD=1.6553 CM=-0.1425 |
| 2.00 | S TURB S SEP 100CD UPPER 0.4482 0.0484 0.9435* LOWER 0.6342 0.2167 0.5168* TOTAL CL= 0.546 100CD=1.4603 CM=-0.1446 | S TURB S SEP 100CD 1.0056 0.0474 1.3981 0.9686 0.1732 0.5370 CL= 0.547 100CD=1.9352 CM=-0.1439 | S TURB S SEP 100CD 0.8345 0.0453 1.2593 0.7341 0.1516 0.4651 CL= 0.550 100CD=1.7243 CM=-0.1439 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4761 0.0504 1.0123* LOWER 0.6121 0.2066 0.4643* TOTAL CL= 0.650 100CD=1.4766 CM=-0.1463 | S TURB S SEP 100CD 1.0056 0.0507 1.5197 0.9686 0.1518 0.4853 CL= 0.650 100CD=2.0051 CM=-0.1450 | S TURB S SEP 100CD 0.8730 0.0492 1.4014 0.7153 0.0000 0.4204 CL= 0.652 100CD=1.8219 CM=-0.1426 |
| 4.00 | S TURB S SEP 100CD UPPER 0.5025 0.0524 1.0916* LOWER 0.5902 0.1820 0.4277* TOTAL CL= 0.754 100CD=1.5193 CM=-0.1475 | S TURB S SEP 100CD 1.0056 0.0545 1.6529 0.9686 0.0000 0.4393 CL= 0.751 100CD=2.0921 CM=-0.1431 | S TURB S SEP 100CD 0.9075 0.0530 1.5469 0.6956 0.0000 0.3880 CL= 0.753 100CD=1.9349 CM=-0.1435 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5620 0.0533 1.1924* LOWER 0.5686 0.1752 0.3886* TOTAL CL= 0.860 100CD=1.5810 CM=-0.1492 | S TURB S SEP 100CD 1.0056 0.0586 1.7984 0.9686 0.0000 0.4064 CL= 0.852 100CD=2.2048 CM=-0.1436 | S TURB S SEP 100CD 0.9379 0.0573 1.7085 0.6753 0.0000 0.3570 CL= 0.854 100CD=2.0655 CM=-0.1441 |
| 6.00 | S TURB S SEP 100CD UPPER 0.6333 0.0562 1.3604* LOWER 0.5468 0.0000 0.3554* TOTAL CL= 0.962 100CD=1.7158 CM=-0.1462 | S TURB S SEP 100CD 1.0056 0.0631 1.9578 0.9686 0.0000 0.3741 CL= 0.951 100CD=2.3319 CM=-0.1439 | S TURB S SEP 100CD 0.9624 0.0621 1.8858 0.6547 0.0000 0.3275 CL= 0.953 100CD=2.2133 CM=-0.1442 |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 250000 | MU= 300 | R= 250000 | MU= 100 | R= 250000 | MU= 900 |
|---------------|------------|--------------|------------|--------------|--------------|---------|
| 6.51 | | | S TURB | S SEP | 100CD | |
| UPPER | | | 1.0056 | 0.0656 | 2.0442* | |
| LOWER | | | 0.9686 | 0.0000 | 0.3584 | |
| TOTAL | | | CL= 1.001 | 100CD=2.4026 | | |
| | | | CM=-0.1439 | | | |
| 6.83 | | | | S TURB | S SEP | 100CD |
| UPPER | | | | 0.9780 | 0.0664 | 2.0446 |
| LOWER | | | | 0.6374 | 0.0000 | 0.3045 |
| TOTAL | | | | CL= 1.034 | 100CD=2.3491 | |
| | | | | CM=-0.1441 | | |
| 6.92 | S TURB | S SEP | 100CD | | | |
| UPPER | 0.9106 | 0.0669 | 2.0475* | | | |
| LOWER | 0.5273 | 0.0000 | 0.3302* | | | |
| TOTAL | CL= 1.042 | 100CD=2.3777 | | | | |
| | CM=-0.1440 | | | | | |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 300000 | MU= 300 | R= 300000 | MU= 100 | R= 300000 | MU= 900 | | | | |
|---------------|-----------|-----------|--------------|------------|-----------|--------------|------------|-----------|--------------|------------|
| -4.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.2866 | 0.0395 | 0.5338* | 1.0055 | 0.0314 | 0.8406 | 0.5723 | 0.0295 | 0.6744 |
| | LOWER | 0.7687 | 0.2992 | 0.8633* | 0.9686 | 0.2959 | 0.9528 | 0.8238 | 0.2675 | 0.8101 |
| | TOTAL | CL=-0.073 | 100CD=1.3971 | CM=-0.1328 | CL=-0.065 | 100CD=1.7934 | CM=-0.1339 | CL=-0.065 | 100CD=1.4845 | CM=-0.1337 |
| -3.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3125 | 0.0386 | 0.5752* | 1.0056 | 0.0335 | 0.9083 | 0.6153 | 0.0316 | 0.7439 |
| | LOWER | 0.7475 | 0.2856 | 0.7819* | 0.9686 | 0.2741 | 0.8627 | 0.8110 | 0.2462 | 0.7329 |
| | TOTAL | CL= 0.021 | 100CD=1.3570 | CM=-0.1338 | CL= 0.026 | 100CD=1.7710 | CM=-0.1344 | CL= 0.028 | 100CD=1.4768 | CM=-0.1343 |
| -2.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3394 | 0.0394 | 0.6213* | 1.0056 | 0.0358 | 0.9824 | 0.6678 | 0.0339 | 0.8274 |
| | LOWER | 0.7251 | 0.2550 | 0.6885* | 0.9686 | 0.2525 | 0.7806 | 0.7992 | 0.2254 | 0.6646 |
| | TOTAL | CL= 0.127 | 100CD=1.3098 | CM=-0.1361 | CL= 0.131 | 100CD=1.7630 | CM=-0.1367 | CL= 0.133 | 100CD=1.4919 | CM=-0.1366 |
| -1.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3661 | 0.0399 | 0.6730* | 1.0056 | 0.0376 | 1.0545 | 0.7198 | 0.0364 | 0.9174 |
| | LOWER | 0.7021 | 0.2437 | 0.6250* | 0.9686 | 0.2310 | 0.7060 | 0.7879 | 0.2052 | 0.6038 |
| | TOTAL | CL= 0.234 | 100CD=1.2979 | CM=-0.1388 | CL= 0.237 | 100CD=1.7604 | CM=-0.1390 | CL= 0.238 | 100CD=1.5211 | CM=-0.1388 |
| 0.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.3933 | 0.0414 | 0.7313* | 1.0056 | 0.0401 | 1.1426 | 0.7670 | 0.0385 | 1.0069 |
| | LOWER | 0.6793 | 0.2187 | 0.5619* | 0.9686 | 0.2097 | 0.6384 | 0.7748 | 0.1848 | 0.5475 |
| | TOTAL | CL= 0.340 | 100CD=1.2931 | CM=-0.1409 | CL= 0.341 | 100CD=1.7810 | CM=-0.1410 | CL= 0.343 | 100CD=1.5543 | CM=-0.1409 |
| 1.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4208 | 0.0430 | 0.7892* | 1.0056 | 0.0428 | 1.2392 | 0.8103 | 0.0413 | 1.1115 |
| | LOWER | 0.6567 | 0.2073 | 0.5086* | 0.9686 | 0.1884 | 0.5772 | 0.7600 | 0.1648 | 0.4957 |
| | TOTAL | CL= 0.445 | 100CD=1.2977 | CM=-0.1430 | CL= 0.446 | 100CD=1.8164 | CM=-0.1427 | CL= 0.448 | 100CD=1.6072 | CM=-0.1426 |
| 2.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4482 | 0.0446 | 0.8613* | 1.0056 | 0.0463 | 1.3556 | 0.8500 | 0.0443 | 1.2255 |
| | LOWER | 0.6342 | 0.1833 | 0.4608* | 0.9686 | 0.1679 | 0.5216 | 0.7434 | 0.1425 | 0.4484 |
| | TOTAL | CL= 0.551 | 100CD=1.3221 | CM=-0.1447 | CL= 0.549 | 100CD=1.8773 | CM=-0.1440 | CL= 0.551 | 100CD=1.6739 | CM=-0.1440 |
| 3.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.4761 | 0.0467 | 0.9307* | 1.0056 | 0.0495 | 1.4725 | 0.8854 | 0.0481 | 1.3616 |
| | LOWER | 0.6121 | 0.1739 | 0.4192* | 0.9686 | 0.1457 | 0.4719 | 0.7252 | 0.0000 | 0.4055 |
| | TOTAL | CL= 0.655 | 100CD=1.3500 | CM=-0.1464 | CL= 0.651 | 100CD=1.9444 | CM=-0.1451 | CL= 0.653 | 100CD=1.7671 | CM=-0.1429 |
| 4.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.5025 | 0.0486 | 1.0037* | 1.0056 | 0.0532 | 1.6002 | 0.9176 | 0.0518 | 1.5019 |
| | LOWER | 0.5902 | 0.0000 | 0.3791* | 0.9686 | 0.0000 | 0.4274 | 0.7060 | 0.0000 | 0.3764 |
| | TOTAL | CL= 0.760 | 100CD=1.3829 | CM=-0.1449 | CL= 0.753 | 100CD=2.0276 | CM=-0.1435 | CL= 0.755 | 100CD=1.8783 | CM=-0.1439 |
| 5.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.5620 | 0.0497 | 1.1039* | 1.0056 | 0.0572 | 1.7395 | 0.9458 | 0.0560 | 1.6571 |
| | LOWER | 0.5686 | 0.0000 | 0.3490* | 0.9686 | 0.0000 | 0.3968 | 0.6860 | 0.0000 | 0.3458 |
| | TOTAL | CL= 0.865 | 100CD=1.4529 | CM=-0.1465 | CL= 0.854 | 100CD=2.1363 | CM=-0.1441 | CL= 0.856 | 100CD=2.0029 | CM=-0.1445 |
| 6.00 | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | S TURB | S SEP | 100CD | |
| | UPPER | 0.6333 | 0.0534 | 1.2747* | 1.0056 | 0.0616 | 1.8919 | 0.9684 | 0.0606 | 1.8272 |
| | LOWER | 0.5468 | 0.0000 | 0.3234* | 0.9686 | 0.0000 | 0.3653 | 0.6656 | 0.0000 | 0.3169 |
| | TOTAL | CL= 0.967 | 100CD=1.5982 | CM=-0.1471 | CL= 0.953 | 100CD=2.2572 | CM=-0.1444 | CL= 0.955 | 100CD=2.1441 | CM=-0.1447 |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEC.) | R= 300000 MU= 300 | R= 300000 MU= 100 | R= 300000 MU= 900 |
|-------------|------------------------|------------------------|-------------------|
| 6.64 | | S TURB S SEP 100CD | |
| UPPER | | 1.0056 0.0647 1.9980* | |
| LOWER | | 0.9685 0.0000 0.3460 | |
| TOTAL | | CL= 1.016 100CD=2.3440 | |
| | | CM=-0.1443 | |
| 6.92 | | S TURB S SEP 100CD | |
| UPPER | | 0.9840 0.0654 1.9976 | |
| LOWER | | 0.6465 0.0000 0.2921 | |
| TOTAL | | CL= 1.045 100CD=2.2897 | |
| | | CM=-0.1445 | |
| 7.00 | S TURB S SEP 100CD | | |
| UPPER | 0.9220 0.0652 1.9700* | | |
| LOWER | 0.5256 0.0000 0.3021* | | |
| TOTAL | CL= 1.054 100CD=2.2722 | | |
| | CM=-0.1447 | | |
| 7.03 | S TURB S SEP 100CD | | |
| UPPER | 0.9264 0.0658 1.9988* | | |
| LOWER | 0.5249 0.0000 0.3013* | | |
| TOTAL | CL= 1.056 100CD=2.3002 | | |
| | CM=-0.1446 | | |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEG.) | R= 400000 MU= 300 | R= 400000 MU= 100 | R= 400000 MU= 900 |
|---------------|--|--|--|
| -4.00 | S TURB S SEP 100CD UPPER 0.2866 0.0339 0.4607* LOWER 0.7687 0.2675 0.7659* TOTAL CL=-0.069 100CD=1.2266 CM=-0.1331 | S TURB S SEP 100CD 1.0055 0.0298 0.8039 0.9686 0.2858 0.9047 CL=-0.064 100CD=1.7087 CM=-0.1339 | S TURB S SEP 100CD 0.6141 0.0280 0.6544 0.8350 0.2557 0.7672 CL=-0.064 100CD=1.4216 CM=-0.1338 |
| -3.00 | S TURB S SEP 100CD UPPER 0.3125 0.0334 0.4960* LOWER 0.7475 0.2483 0.6858* TOTAL CL= 0.026 100CD=1.1818 CM=-0.1341 | S TURB S SEP 100CD 1.0056 0.0319 0.8683 0.9686 0.2644 0.8202 CL= 0.028 100CD=1.6885 CM=-0.1345 | S TURB S SEP 100CD 0.6635 0.0302 0.7266 0.8215 0.2344 0.6930 CL= 0.030 100CD=1.4196 CM=-0.1344 |
| -2.00 | S TURB S SEP 100CD UPPER 0.3394 0.0343 0.5403* LOWER 0.7251 0.2201 0.6031* TOTAL CL= 0.133 100CD=1.1434 CM=-0.1365 | S TURB S SEP 100CD 1.0056 0.0341 0.9387 0.9686 0.2430 0.7430 CL= 0.133 100CD=1.6817 CM=-0.1368 | S TURB S SEP 100CD 0.7119 0.0325 0.8044 0.8088 0.2135 0.6272 CL= 0.134 100CD=1.4317 CM=-0.1367 |
| -1.00 | S TURB S SEP 100CD UPPER 0.3661 0.0353 0.5842* LOWER 0.7021 0.2045 0.5460* TOTAL CL= 0.239 100CD=1.1303 CM=-0.1390 | S TURB S SEP 100CD 1.0056 0.0360 1.0076 0.9686 0.2217 0.6728 CL= 0.239 100CD=1.6805 CM=-0.1391 | S TURB S SEP 100CD 0.7566 0.0345 0.8812 0.7977 0.1934 0.5697 CL= 0.240 100CD=1.4510 CM=-0.1390 |
| 0.00 | S TURB S SEP 100CD UPPER 0.3933 0.0365 0.6392* LOWER 0.6793 0.1784 0.4831* TOTAL CL= 0.346 100CD=1.1223 CM=-0.1412 | S TURB S SEP 100CD 1.0056 0.0385 1.0909 0.9686 0.2007 0.6091 CL= 0.343 100CD=1.7000 CM=-0.1412 | S TURB S SEP 100CD 0.7982 0.0370 0.9712 0.7860 0.1738 0.5174 CL= 0.345 100CD=1.4886 CM=-0.1410 |
| 1.00 | S TURB S SEP 100CD UPPER 0.4208 0.0382 0.6954* LOWER 0.6567 0.1662 0.4417* TOTAL CL= 0.452 100CD=1.1371 CM=-0.1433 | S TURB S SEP 100CD 1.0056 0.0412 1.1822 0.9686 0.1799 0.5511 CL= 0.448 100CD=1.7334 CM=-0.1429 | S TURB S SEP 100CD 0.8364 0.0397 1.0685 0.7728 0.1535 0.4693 CL= 0.450 100CD=1.5377 CM=-0.1428 |
| 2.00 | S TURB S SEP 100CD UPPER 0.4482 0.0398 0.7566* LOWER 0.6342 0.1379 0.3933* TOTAL CL= 0.557 100CD=1.1500 CM=-0.1450 | S TURB S SEP 100CD 1.0056 0.0440 1.2816 0.9686 0.1593 0.4987 CL= 0.552 100CD=1.7803 CM=-0.1444 | S TURB S SEP 100CD 0.8718 0.0427 1.1756 0.7576 0.0000 0.4251 CL= 0.553 100CD=1.6006 CM=-0.1423 |
| 3.00 | S TURB S SEP 100CD UPPER 0.4761 0.0419 0.8247* LOWER 0.6121 0.0000 0.3620* TOTAL CL= 0.662 100CD=1.1867 CM=-0.1448 | S TURB S SEP 100CD 1.0056 0.0476 1.4015 0.9686 0.0000 0.4514 CL= 0.654 100CD=1.8529 CM=-0.1431 | S TURB S SEP 100CD 0.9033 0.0463 1.3036 0.7407 0.0000 0.3855 CL= 0.656 100CD=1.6891 CM=-0.1435 |
| 4.00 | S TURB S SEP 100CD UPPER 0.5025 0.0438 0.8891* LOWER 0.5902 0.0000 0.3335* TOTAL CL= 0.767 100CD=1.2226 CM=-0.1464 | S TURB S SEP 100CD 1.0056 0.0511 1.5212 0.9686 0.0000 0.4094 CL= 0.756 100CD=1.9306 CM=-0.1441 | S TURB S SEP 100CD 0.9323 0.0499 1.4358 0.7222 0.0000 0.3599 CL= 0.758 100CD=1.7956 CM=-0.1445 |
| 5.00 | S TURB S SEP 100CD UPPER 0.5620 0.0458 0.9963* LOWER 0.5686 0.0000 0.3101* TOTAL CL= 0.871 100CD=1.3064 CM=-0.1477 | S TURB S SEP 100CD 1.0056 0.0550 1.6517 0.9686 0.0000 0.3822 CL= 0.857 100CD=2.0339 CM=-0.1448 | S TURB S SEP 100CD 0.9572 0.0539 1.5817 0.7031 0.0000 0.3302 CL= 0.859 100CD=1.9119 CM=-0.1451 |
| 6.00 | S TURB S SEP 100CD UPPER 0.6378 0.0497 1.1646 LOWER 0.5468 0.0000 0.2854* TOTAL CL= 0.972 100CD=1.4500 CM=-0.1483 | S TURB S SEP 100CD 1.0056 0.0593 1.7935 0.9686 0.0000 0.3517 CL= 0.957 100CD=2.1452 CM=-0.1451 | S TURB S SEP 100CD 0.9769 0.0585 1.7416 0.6829 0.0000 0.3022 CL= 0.959 100CD=2.0438 CM=-0.1454 |

B.L.SUMMARY AIRFOIL S835 21% ALPHA0= 3.539 DEG.

*-WARNING 1998 ALPHA REL. CHORD LINE

| ALPHA(DEC.) | R= 400000 MU= 300 | R= 400000 MU= 100 | R= 400000 MU= 900 |
|-------------|------------------------|------------------------|-------------------|
| 6.85 | | S TURB S SEP 100CD | |
| UPPER | | 1.0056 0.0633 1.9276* | |
| LOWER | | 0.9686 0.0000 0.3272 | |
| TOTAL | | CL= 1.041 100CD=2.2548 | |
| | | CM=-0.1451 | |
| 7.00 | S TURB S SEP 100CD | S TURB S SEP 100CD | |
| UPPER | 0.9220 0.0619 1.8225* | 0.9915 0.0634 1.9159 | |
| LOWER | 0.5256 0.0000 0.2623* | 0.6626 0.0000 0.2764 | |
| TOTAL | CL= 1.059 100CD=2.0848 | CL= 1.057 100CD=2.1923 | |
| | CM=-0.1458 | CM=-0.1453 | |
| 7.06 | | S TURB S SEP 100CD | |
| UPPER | | 0.9922 0.0638 1.9268 | |
| LOWER | | 0.6614 0.0000 0.2750 | |
| TOTAL | | CL= 1.063 100CD=2.2018 | |
| | | CM=-0.1453 | |
| 7.21 | S TURB S SEP 100CD | | |
| UPPER | 0.9481 0.0641 1.9249* | | |
| LOWER | 0.5210 0.0000 0.2581* | | |
| TOTAL | CL= 1.078 100CD=2.1830 | | |
| | CM=-0.1454 | | |

REPORT DOCUMENTATION PAGE

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