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DEVELOPMENT OF A COMPUTER PROGRAM TO OBTAIN ORDINATES FOR NACA 6- AND 6A-SERIES AIRFOILS

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16. Abstract

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SUMMARY

A computer program was developed to produce the ordinates for airfoils of any thickness, thickness distribution, or camber in the NACA 6- and 6A-series. For the 6-series and for all but the leading edge of the 6A-series, agreement between the ordinates obtained from the new program and previously published values is generally within 5×10^{-5} chord. Near the leading edge of the 6A-series airfoils, differences up to 3.5×10^{-4} chord are found. The program which is given in the appendix will also produce plots of the nondimensional airfoil ordinates and a punch card output of ordinates in the input format of a readily available program for determining the pressure distributions of arbitrary airfoils in subsonic potential viscous flow.

INTRODUCTION

The NACA 6-series airfoil sections were developed in the early 1940's, and discussions of the method of the derivations and the resulting ordinates have been published in references 1 and 2. As aircraft speeds increased, more attention was focused on the thinner airfoils of this series. However, difficulties were encountered in the structural design and fabrication of these thinner sections because of the very thin trailing edges. As a result, the NACA 6A-series airfoil sections were developed, and details of these have been published in reference 3. Essentially, the modification consisted of a near-constant slope from about the 80-percent chord station to the trailing edge and an increase in the trailing-edge thickness from zero to a finite value.

Recently, parametric theoretical studies have been made to investigate the use of these airfoil sections for both rotorcraft and conventional aircraft. The results of one investigation are presented in reference 4 and show advantages of an NACA 6-series cambered airfoil for use as a tail rotor on helicopters. It was tedious and expensive to make these studies because no method was available for calculating the desired ordinates rapidly and accurately. Because the 6-series airfoils do not have an analytic expression for the ordinates, use must be made of the ordinates published in references 1 to 3. Also, the ordinates are not linear with variations in thickness-chord ratio so that airfoils

obtained by linearly increasing or decreasing the ordinates of an originally derived shape will be approximate, as mentioned in reference 1. The published ordinates have been cross-plotted as a function of thickness and published in reference 5, but the values must be read off the graphs and only 26 longitudinal locations from nose to tail were available.

An attempt, using a derivative of the NACA 4-digit series, to provide a computer program for ordinates of the NACA 6-series airfoils was made in reference 6. However, as stated in the reference, the resulting accuracy of only 3.5×10^{-3} chord is not sufficient for many applications.

The purpose of this paper is to review the basic design procedure for the NACA 6-series airfoils and to describe a program which will generate sufficiently accurate ordinates for airfoils of any thickness, thickness distribution, or camber with an acceptable expenditure of computer time.

SYMBOLS

a	basic length, usually considered unity
A	mean-line designation, fraction of chord from leading edge over which design load is uniform
c	airfoil chord
C	airfoil chord on computer-generated plots
CLI	design section lift coefficient
x	distance along chord
X	distance along chord on computer-generated plots
y	airfoil ordinate normal to chord, positive above chord
Y	airfoil ordinate normal to chord on computer-generated plots
z	complex variable in circle plane
z'	complex variable in near-circle plane
δ	local inclination of camber line (or mean line)

ϵ airfoil parameter, $\phi - \theta$

ζ complex variable in airfoil plane

θ angular coordinate of z'

ϕ angular coordinate of z

ψ airfoil parameter determining radial coordinate of z

ψ_o average value of ψ, $\frac{1}{2\pi}\int_0^{2\pi} \psi \, d\phi$

Subscripts:

u upper surface

l lower surface

t thickness

cam cambered

ANALYSIS

Basic Airfoil Derivation

As described in references 1 and 2, the basic symmetrical NACA 6-series airfoils were developed by means of conformal transformations. The use of these transformations to relate the flow about an arbitrary airfoil to that of a near circle and then to a circle had been developed earlier and the results are presented in reference 7. The basic airfoil parameters ψ and ϵ are derived as a function of ϕ, where $\theta - \phi$ is defined as $-\epsilon$. Figure 1, taken from reference 1, shows the relationship between these variables in the complex plane. These parameters are used to compute both the airfoil ordinates and the potential flow velocity distribution around the airfoil. For the NACA 6-series airfoils, the shape of the velocity distribution and the longitudinal location of maximum velocity (or minimum pressure) were prescribed. The airfoil parameters ψ and ϵ which give the desired velocity distribution were obtained through an iterative process. Then the airfoil ordinates could be calculated from these parameters by use of the equations presented in references 1 and 7. Thus, for each prescribed velocity distribution, a set of basic airfoil parameters is obtained. However, as stated in reference 1,

it is possible to define a set of basic parameters ψ and ϵ which could be multiplied by a constant factor to obtain airfoils of various thickness-chord ratios while maintaining the minimum pressure at the same chordwise location. Thus, for each NACA 6-series airfoil family (i.e., 63-, 64-, or 65-series) there is one basic set of ψ and ϵ values.

Calculation of Symmetrical Airfoils

There is a unique curve of ψ and ϵ as a function of ϕ for each NACA 6-series airfoil family. This curve can be scaled by a constant factor to provide airfoils of different thickness within this family. A computer program could therefore be developed to calculate the airfoil ordinates for given values of ψ and ϵ. Although the values of these basic airfoil parameters were not published, tabulated values existed in files or could be computed by the method of reference 7 from published airfoil ordinates. For the 6-series airfoils, values of ψ and ϵ were available for 21 values of ϕ, and 26 values were available for the 6A-series airfoils. To provide more values of ψ and ϵ for storage in a computer subroutine, a fit to the original values was made with an existing parametric linked cubic spline-fit program and nine additional values were obtained between each of the original values. This process was carried out for each airfoil series, and the results were stored in the computer program as two subroutines for each airfoil family.

To calculate the ordinates for an arbitrary airfoil, the program first determines which airfoil series is desired and calls for the subroutine for this series. The airfoil represented by the stored values of ψ and ϵ is calculated and its maximum thickness-chord ratio is determined. The ratio of the desired value to that obtained in this determination is calculated. Then, ψ and ϵ are multiplied by this ratio to arrive at a new airfoil thickness-chord ratio. The iteration is repeated until the computed thickness-chord ratio is within 0.01 percent of the desired value, or until 10 iterations have been performed. Usually convergence occurs within four iterations. After the iterative process has converged within the limit established, any residual difference between the computed thickness-chord ratio and that desired is eliminated by linearly scaling the y ordinate and its first and second derivatives by the appropriate scale factor. The first and second derivatives of the airfoil ordinates as a function of chord are computed by a subroutine labeled "DIF" in the program. Although these ordinates and slopes are calculated at more than 200 internally controlled chord stations, a subroutine is used to interpolate between these points (by use of a vertical axis parabolic curve fit labeled "FTLUP") so that the output will be in specified increments of chord stations. As the leading edge is approached, the increments become smaller. As programed, ordinates are printed at increments of 0.00025c from the leading edge to $x/c = 0.01250$, at increments of 0.0025c from $x/c = 0.01250$ to 0.1000, and at increments of 0.01c from $x/c = 0.1000$ to the trailing edge.

Calculation of the Leading-Edge Radius

The values of leading-edge radius of these airfoils, published in references 1 to 3, were initially determined by plotting the ordinates to a large scale and fairing in the best circle fit by hand. Values of the tangency point between the circle and airfoil surface obtained in this manner were not published. To provide smooth analytic ordinates around the leading edge for the computer program, a tilted ellipse has been used. This tilted ellipse is described by the basic ellipse function plus an additive term, linear in x, which vanished at the origin, and thus has three arbitrary constants. The resulting fit to the airfoil ordinates is exact for the ordinate itself and the first derivative, and quite close for the second derivative, though examination of the second derivative in the region of tangency generally reveals a small discrepancy. The ellipse is defined so that it has the same ordinate and slope as the airfoil surface at the eleventh tabulated value of ϕ in the airfoil parameter subroutine. (The eleventh stored point is actually the second point of the original tabulated values.) This tangency point is usually located at about the 0.005 chord station but varies with airfoil thickness and series. By use of this method a smooth transition between airfoil and ellipse is produced, the tangency point is known, and there is a continuous variation of leading-edge shape with thickness-chord ratio. The nondimensional radius of curvature of the ellipse at the airfoil origin is also calculated in the program and its value is in close agreement with the published values of the leading-edge radius for known airfoils.

Calculation of Cambered Airfoils

To calculate ordinates for a cambered airfoil, the desired mean line is first computed and then the ordinates of the symmetrical airfoil are measured normal to the mean line at the same chord station. This procedure leads to a set of parametric equations, where $(y/c)_t$, $(y/c)_{cam}$, and δ are all functions of the original independent variable x/c. The ordinates on the cambered airfoil, $(x/c)_{cam}$ and $(y/c)_{cam}$, are given by

$$(x/c)_{cam} = (x/c) - (y/c)_t \sin \delta$$

$$(y/c)_{cam} = (y/c)_{cam} + (y/c)_t \cos \delta$$

where δ is the local inclination of the camber line and $(y/c)_t$ is assumed to be negative to obtain the lower surface ordinates. This procedure is also described in reference 1. The local slopes of the cambered airfoil can be shown to be

$$\left(\frac{dy}{dx}\right)_u = \frac{\tan \delta \sec \delta + \left(\frac{dy}{dx}\right)_t - \left(\frac{y}{c}\right)_t \left(\frac{d\delta}{dx}\right) \tan \delta}{\sec \delta - \left(\frac{dy}{dx}\right)_t \tan \delta - \left(\frac{y}{c}\right)_t \left(\frac{d\delta}{dx}\right)}$$

and

$$\left(\frac{dy}{dx}\right)_l = \frac{\tan\delta\sec\delta - \left(\frac{dy}{dx}\right)_t + \left(\frac{y}{c}\right)_t\left(\frac{d\delta}{dx}\right)\tan\delta}{\sec\delta + \left(\frac{dy}{dx}\right)_t\tan\delta + \left(\frac{y}{c}\right)_t\left(\frac{d\delta}{dx}\right)}$$

by parametric differentiation of $(x/c)_{cam}$ and $(y/c)_{cam}$ with respect to the original x/c and use of the relationship

$$\left(\frac{dy}{dx}\right)_{cam} = \left(\frac{d(y/c)_{cam}}{d(x/c)}\right)\Bigg/\left(\frac{d(x/c)_{cam}}{d(x/c)}\right)$$

The mean line for all cambered airfoils of the NACA 6-series is the single analytic expression presented in reference 1 and is a function of the design lift coefficient and type of loading desired. The calculation of these camber lines has been included in the program so that any desired combination of airfoil family, thickness-chord ratio, design lift coefficient, and type of loading may be obtained. The design lift coefficient and type of loading desired are input variables. The $A = 0.8$ modified mean line which is used with the NACA 6A-series airfoils (see ref. 3) has also been incorporated. As the reference indicates, this mean line loading should always be used with the 6A-series.

The standard mean line loadings for the 6-series airfoils consist of loading uniform over the entire chord ($A = 1.0$), or a uniform loading to a given chord station followed by a value decreasing linearly to zero at the trailing edge. By combining two or more types of loading, many different types of mean lines can be obtained. For example, reference 8 presents data for airfoils which combine two mean lines to give zero loading to the 60-percent chord station followed by a linearly increasing load to the trailing edge. This procedure produces the so-called S-type mean line, having negative camber forward and positive camber aft. Other references have combined up to four mean lines to produce desired types of loadings. The program presented herein can combine up to 10 different mean line combinations if desired.

RESULTS AND DISCUSSION

Program Capabilities

The program which has been developed from the analysis described is presented in the appendix. The output of the program consists of tabulated ordinates, computer-generated plots of nondimensional ordinates, and punched card listings of the ordinates. The punched cards are in the format of the input of the program described in reference 9 so that pressure distributions over the generated shape may be readily obtained. To show graphically the capabilities of the program, sample computer plots are presented

in figures 2 to 9. The subscript designations of the lift-coefficient range of minimum drag for these airfoils, as described in references 1 to 3, have been deleted in the computer plots and tables. Figure 2 illustrates the possibility of changing the thickness-chord ratio for a fixed series. Figures 3 and 4 show the series variations within the NACA 6 and 6A families of airfoils, respectively. The variations in design lift coefficient with a constant mean line loading and the variations of mean line loading for a constant design lift coefficient are shown in figures 5 and 6, respectively. By combining more than one mean line for a given airfoil, the variations illustrated in figure 7 may be obtained. If a thickness-chord ratio of 0.0 is specified, the shape of the mean line or combination of mean lines is calculated. The results of this procedure are shown in figures 8 and 9. Note that the mean lines of figure 9 are those for the airfoils of figure 7.

Sample Output Tabulations

Sample computed ordinates for both a symmetric and a cambered airfoil are presented in tables I and II, respectively. Printed at the top of the first page for each table is the airfoil designation and a listing of the input variables. There follows a summary of parameters such as the longitudinal location of maximum thickness (the point when the slope changes sign), the values of the location of the nose ellipse fit and its radius-chord ratio at the origin, and the number of iterations and scaling factor used to determine the airfoil from its basic parameters. Both nondimensional and dimensional ordinates are listed. The dimensional quantities have the same units as the input value of the chord. First and second derivatives of the surface slope are also presented for the symmetric airfoils, but only first derivatives are tabulated for the cambered airfoils.

Accuracy of Results

About 25 cases, including several from each airfoil family, were computed for thickness-chord ratios from 0.06 to 0.15 and the results were compared with the values published in references 1 to 3. For the NACA 6-series airfoils the agreement was generally within 5×10^{-5} chord. The NACA 6A-series airfoils show differences of as much as 3.5×10^{-4} chord near the leading edge, but from about $x/c = 0.10$ to $x/c = 0.95$ the accuracy is about the same as for the 6-series. A plot showing a comparison of the present method with published ordinates for the first 0.05 chord of an NACA 64A-015 airfoil is shown in figure 10. This is the case of poorest agreement found in the comparisons made. The equations for the airfoil geometry dictate that the trailing-edge thickness be zero; however, the 6A-series have a finite trailing-edge thickness. The best result for these airfoils can be obtained by using the ordinate and slope at $x/c = 0.95$ and extrapolating to the trailing edge.

Card Input Format

The input to the program is in a card format as follows:

CARD 1 – Tabulated data title card. Any designation may be used in columns 2 to 80.

CARD 2 – Airfoil and camber line series designations are as follows:

NACA airfoil family	Card designation*	Columns
63-series	63	9, 10
64-series	64	↓
65-series	65	
66-series	66	
67-series	67	
63A-series	63A	8, 9, 10
64A-series	64A	↓
65A-series	65A	

Camber line	Card designation*	Columns
NACA 6-series	63	19, 20
	64	↓
	65	
	66	
NACA 6A-series	63A	18, 19, 20
	64A	↓
	65A	

*These are Hollerith cards; designations must be in exact columns.

CARD 3 – Airfoil parameter card. (Note that cards 3 to 6 are in floating point mode. Numbers are entered with a decimal point.)

Description	Variable	Columns
Thickness-chord ratio of airfoil (i.e., 0.120)	TOC	1-10
Published leading-edge radius may be entered if desired (not used in program)	LER	11-20
Model chord used for listing ordinates in dimensional units	CHD	21-30
Design lift coefficient (i.e., 0.20); set to 0.0 for a symmetrical airfoil	CLI	31-40
Mean line chordwise loading (use 0.8 for 6A-series airfoils)	A	41-50
Number of mean lines to be summed (if only one, leave blank or insert 1.0)	CMBNMR	51-60

CARDS 4, 5, and 6 – Up to nine additional mean lines may be summed on these cards. These cards are not necessary for only one mean line.

Description	Variable	Columns
Design lift for second mean line	CLI	1-10
Loading for second mean line	A	11-20
Design lift for third mean line	CLI	21-30
Loading for third mean line	A	31-40
Design lift for fourth mean line	CLI	41-50
Loading for fourth mean line	A	51-60
Design lift for fifth mean line	CLI	61-70
Loading for fifth mean line	A	71-80

CARD 7 – Title card for plot of airfoil ordinate. Any designation may be used in columns 1 to 80.

CONCLUDING REMARKS

A computer program has been developed to calculate rapidly the ordinates for airfoils of any thickness, thickness distribution, or camber in the NACA 6- and 6A-series. The program is included as an appendix to this report. Comparisons of the computer-generated ordinates with previously published ordinates for the same airfoil show that the agreement is generally within 5×10^{-5} chord. Exceptions were noted for the leading-edge region of the 6A-series airfoils, where differences of as much as 3.5×10^{-4} chord occurred. The program will also produce plots of the airfoil nondimensional ordinates and a punch card output of ordinates in the input format of a readily available program for determining the pressure distributions of arbitrary airfoils in subsonic potential viscous flow.

Langley Research Center,
National Aeronautics and Space Administration,
Hampton, Va., June 25, 1974.

APPENDIX

COMPUTER PROGRAM FOR ORDINATES OF NACA 6- AND 6A-SERIES AIRFOILS

The program presented herein is written in the Langley Research Center version of FORTRAN IV and has been used on the Control Data series 6000 computer systems. The computational program, the basic airfoil parameter subroutine, and the plotting routine are presented. In the airfoil program, two subroutines (FTLUP and DIF) are used. The first subroutine is used to interpolate between a series of consecutive points using a parabolic curve fit, and the second subroutine is used to define the slope at a given point in a consecutive series of points. Any standard subroutines which have these capabilities can be substituted for those used herein. Also, several unlisted subroutines are used in the plotting routine, which is presented as a guide for users. The program requires about 73000_8 storage locations and takes about 20 seconds to compile. Each case takes approximately 12 seconds to execute on the Control Data 6400 computer system.

```
                PROGRAM LADSON(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,PUNCH)                    100000
000003          DIMENSION XU(200), XL(200), YU(200), YL(200)                        A  20       200000
000003          COMMON /MAIN/ YSTART(3),CHD,KON,TITLE1(8)                          A  30       300000
000003          DIMENSION XA(32), XAU(32), YAU(32), XAL(32), YAL(32), NAME(8)      A  40       400000
000003          DIMENSION XT(201), YT(201), YTP(201), YTPP(201), PHI(201), EPS(201 A  50       500000
                1), PSI(201)                                                       A  60       600000
000003          DIMENSION CLI(10), A(10), TANTH0(10), YCMB(10), TANTH(10), YCP2(10 A  70       700000
                1), IF6XA(10)                                                      A  80       800000
000003          INTEGER SERIET,SERIEC                                              A  90       900000
000003          COSH(X)=0.5*(EXP(X)+EXP(-X))                                       A 100      1000000
000016          SINH(X)=0.5*(EXP(X)-EXP(-X))                                       A 110      1100000
000030          E=0.1**10                                                          A 120      1200000
000032          PI=3.141592654                                                     A 130      1300000
000033          YSTART(1)=1.0                                                      A 140      1400000
000035          YSTART(2)=4.0                                                      A 150      1500000
000036          YSTART(3)=7.0                                                      A 160      1600000
000040          KON=0                                                              A 170      1700000
000040          DX=0.01                                                            A 180      1800000
000042          DO 20 I=1,10                                                       A 190      1900000
000044          IF6XA(I)=0                                                         A 200      2000000
000045       20 CONTINUE                                                           A 210      2100000
             C     INPUT PARAMETERS NORMALIZED BY THE CHORD (CHD)                  A 220      2200000
             C     TOC - T/C, THICKNESS, RLE - LEADING EDGE RADIUS, XM - X(YMAX)/CHOR A 230   2300000
             C     DX - INTERVAL/CHORD, CHD - CHORD IN DESIRED UNITS               A 240      2400000
             C       SET UP PLOTTING ROUTINE                                       A 250      2500000
000047          CALL PSEUDO                                                        A 260      2600000
000050          CALL LERJY                                                                    2600001
             C       READ LOCATIONS FOR PUNCHED OUTPUT                             A 270      2700000
000051          READ (5,430) N,(XA(I),I=1,N)                                       A 280      2800000
             C       READ SPECIFICATIONS FOR PROFILE                               A 290      2900000
000066       30 READ (5,440) NAME,SERIET,SERIEC,TOC,RLE,CHD,CLI(1),A(1),CMBNMR     A 300      3000000
000114          ICKY=CMBNMR                                                        A 310      3100000
000116          IF (ICKY.LT.1) ICKY=1                                              A 320      3200000
000122          IF (ENDFILE 5) 40,50                                               A 330      3300000
             C       END PLOTTING AFTER LAST CASE                                  A 340      3400000
000125       40 CALL CALPLT (0,0,999)                                              A 350      3500000
000130          STOP                                                               A 360      3600000
000132       50 CONTINUE                                                           A 370      3700000
             C       READ ADDITIONAL ADDITIVE CAMBERLINES                          A 380      3800000
000132          IF (ICKY.GT.1) READ (5,450) (CLI(J),A(J),J=2,ICKY)                 A 390      3900000
000151          ICKYP=ICKY+1                                                       A 400      4000000
000153          DO 60 J=ICKYP,10                                                   A 410      4100000
```

```
000154          CLI(J)=0.0                                                    A 420    4200000
000155          A(J)=CLI(J)                                                   A 430    4300000
000157       60 CONTINUE                                                      A 440    4400000
000160          KON=KON+1                                                     A 450    4500000
000162          FRAC=1.0                                                      A 460    4600000
             C    PRINT INPUTS                                              A 470    4700000
000163          PRINT 500, NAME                                               A 480    4800000
000171          PRINT 460, TOC,RLE,CHD,(CLI(J),J=1,ICKY)                      A 490    4900000
000212          PRINT 470, (A(J),J=1,ICKY)                                    A 500    5000000
             C    COLUMN HEADING FORMATS                                    A 510    5100000
             C    SLOPE OF CAMBERLINE AT ORIGIN, TANTHO                     A 520    5200000
000225          L=0                                                           A 530    5300000
000226          CLIS=CLI(1)                                                   A 540    5400000
000227          AS=A(1)                                                       A 550    5500000
000231       70 L=L+1                                                         A 560    5600000
000233          A(1)=A(L)                                                     A 570    5700000
000234          CLI(1)=CLI(L)                                                 A 580    5800000
000236          X=0.0                                                         A 590    5900000
000236          Y=0.0                                                         A 600    6000000
000237          XC=0.0                                                        A 610    6100000
000240          YC=0.0                                                        A 620    6200000
000241          XU(1)=0.0                                                     A 630    6300000
000242          YU(1)=0.0                                                     A 640    6400000
000243          XL(1)=0.0                                                     A 650    6500000
000244          YL(1)=0.0                                                     A 660    6600000
000245          XUC=0.0                                                       A 670    6700000
000246          YUC=0.0                                                       A 680    6800000
000247          XLC=0.0                                                       A 690    6900000
000250          YLC=0.0                                                       A 700    7000000
000251          XAU(1)=0.0                                                    A 710    7100000
000252          YAU(1)=0.0                                                    A 720    7200000
000253          XAL(1)=0.0                                                    A 730    7300000
000254          YAL(1)=0.0                                                    A 740    7400000
000255          K=2                                                           A 750    7500000
000256          U=0.005                                                       A 760    7600000
000260          V=-(A-U)/ABS(A-U)                                             A 770    7700000
000265          OMXL=(1.-U)*ALOG(1.-U)                                        A 780    7800000
000274          AMXL=(A-U)*ALOG(ABS(A-U))                                     A 790    7900000
000303          OMXL1=-ALOG(1.-U)-1.                                          A 800    8000000
000310          AMXL1=-ALOG(ABS(A-U))+V                                       A 810    8100000
000317          OMXL2=1./(1.-U)                                               A 820    8200000
000321          AMXL2=-V/ABS(A-U)                                             A 830    8300000
000325          IF (A.LT.E.OR.ABS(1.-A).LT.E) GO TO 80                        A 840    8400000
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```
000336          G=-(A*A*(.5*ALOG(A)-0.25)+0.25)/(1.-A)                                  A 850    8500000
000346          Q=1.0                                                                   A 860    8600000
000350          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G                    A 870    8700000
000362          Z=.5*(A-U)*AMXL-.5*(1.-U)*OMXL-.25*(A-U)**2+.25*(1.-U)**2               A 880    8800000
000377          Z1=.5*((A-U)*AMXL1-AMXL-(1.-U)*OMXL1+OMXL+(A-U)-(1.-U))                 A 890    8900000
000414          Z2=.5*(A-U)*AMXL2-AMXL1-.5*(1.-U)*OMXL2+OMXL1                           A 900    9000000
000427       80 CONTINUE                                                                A 910    9100000
000427          IF (A.LT.E) GO TO 90                                                    A 920    9200000
000432          IF (ABS(A-1.).LT.E) GO TO 100                                           A 930    9300000
000436       90 H=-.5                                                                   A 940    9400000
000437          Q=1.0                                                                   A 950    9500000
000441          Z1=U*ALOG(U)-.5*U-.5*(1.-U)*OMXL1+.5*OMXL-.5                            A 960    9600000
000453          GO TO 110                                                               A 970    9700000
000454      100 H=0.0                                                                   A 980    9800000
000455          Q=H                                                                     A 990    9900000
000456          Z1=-OMXL1                                                               A1000   10000000
000460          GO TO 110                                                               A1010   10100000
000461      110 TANTHO(L)=CLI*(Z1/(1.-Q*A)-1.-ALOG(U)-H)/PI/(A+1.)/2.0                  A1020   10200000
000500          IF (ICKY.GT.1.AND.L.LT.ICKY) GO TO 70                                   A1030   10300000
000510          IF (ICKY.EQ.1) GO TO 130                                                A1040   10400000
000511          DO 120 J=2,ICKY                                                         A1050   10500000
000512      120 TANTHO(1)=TANTHO(1)+TANTHO(J)                                           A1060   10600000
000516      130 CONTINUE                                                                A1070   10700000
                C       SLOPE OF PROFILE AT ORIGIN, UPPER AND LOWER                     A1080   10800000
000516          YP=10.**10                                                              A1090   10900000
000520          YPP=10.**10                                                             A1100   11000000
000522          YUP=-1/TANTHO                                                           A1110   11100000
000524          YLP=-1/TANTHO                                                           A1120   11200000
                C       FIRST STATION AFT OF ORIGIN ON UNCAMBERED PROFILE               A1130   11300000
000526          I=1                                                                     A1140   11400000
000527          X=.00025                                                                A1150   11500000
                C       START LOOP FOR X INCREMENT                                      A1160   11600000
000531      140 CONTINUE                                                                A1170   11700000
                C       SKIP THICKNESS COMPUTATION AFTER FIRST PASS                     A1180   11800000
000531          IF (I.GT.1) GO TO 240                                                   A1190   11900000
                C       SELECT SERIES                                                   A1200   12000000
000535          IF (SERIET.EQ.10H        63) CALL PHEP63 (PHI,EPS)                      A1210   12100000
000541          IF (SERIET.EQ.10H        64) CALL PHEP64 (PHI,EPS)                      A1220   12200000
000545          IF (SERIET.EQ.10H        65) CALL PHEP65 (PHI,EPS)                      A1230   12300000
000551          IF (SERIET.EQ.10H        66) CALL PHEP66 (PHI,EPS)                      A1240   12400000
000555          IF (SERIET.EQ.10H        67) CALL PHEP67 (PHI,EPS)                      A1250   12500000
000561          IF (SERIET.EQ.10H        63) CALL PHPS63 (PHI,PSI)                      A1260   12600000
000565          IF (SERIET.EQ.10H        64) CALL PHPS64 (PHI,PSI)                      A1270   12700000
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000571          IF (SERIET.EQ.10H        65) CALL PHPS65 (PHI,PSI)                    A1280   12800000
000575          IF (SERIET.EQ.10H        66) CALL PHPS66 (PHI,PSI)                    A1290   12900000
000601          IF (SERIET.EQ.10H        67) CALL PHPS67 (PHI,PSI)                    A1300   13000000
000605          IF (SERIET.EQ.10H       63A) CALL PHEP63A (PHI,EPS)                   A1310   13100000
000611          IF (SERIET.EQ.10H       64A) CALL PHEP64A (PHI,EPS)                   A1320   13200000
000615          IF (SERIET.EQ.10H       65A) CALL PHEP65A (PHI,EPS)                   A1330   13300000
000621          IF (SERIET.EQ.10H       63A) CALL PHPS63A (PHI,PSI)                   A1340   13400000
000625          IF (SERIET.EQ.10H       64A) CALL PHPS64A (PHI,PSI)                   A1350   13500000
000631          IF (SERIET.EQ.10H       65A) CALL PHPS65A (PHI,PSI)                   A1360   13600000
000635          RAT=1.0                                                               A1370   13700000
000636          IT=0                                                                  A1380   13800000
000637          ACRAT=1.0                                                             A1390   13900000
          C       LOOP START FOR THICKNESS ITERATION                                  A1400   14000000
000641      150 CONTINUE                                                              A1410   14100000
000641          IT=IT+1                                                               A1420   14200000
000643          PRINT 510, IT,RAT                                                     A1430   14300000
000652          ACRAT=ACRAT*RAT                                                       A1440   14400000
000654          YMAX=0.0                                                              A1450   14500000
000655          DO 160 J=1,201                                                        A1460   14600000
000656          XT(J)=-2.0*COSH(PSI(J)*ACRAT)*COS(PHI(J)-EPS(J)*ACRAT)                A1470   14700000
000672          YT(J)=2.0*SINH(PSI(J)*ACRAT)*SIN(PHI(J)-EPS(J)*ACRAT)                 A1480   14800000
000706          IF (YT(J).GT.YMAX) XYM=XT(J)                                          A1490   14900000
000713          IF (YT(J).GT.YMAX) YMAX=YT(J)                                         A1500   15000000
000717      160 CONTINUE                                                              A1510   15100000
000721          XTP=1.0                                                               A1520   15200000
000723          DO 170 J=2,201                                                        A1530   15300000
000724          YTP(J)=DIF(J,5,201,XT,YT)                                             A1540   15400000
000731          IF (J.LT.3) GO TO 170                                                 A1550   15500000
000733          IF (YTP(J).LT.0.0.AND.YTP(J-1).GT.0.0) XTP=XT(J-1)+YTP(J-1)*(XT(J)    A1560   15600000
               1-XT(J-1))/(YTP(J-1)-YTP(J))                                         A1570   15700000
000752      170 CONTINUE                                                              A1580   15800000
000754          YTP(1)=10.**6                                                         A1590   15900000
000756          CALL FILUP (XTP,YM,2,201,XT,YT)                                       A1600   16000000
000762          DO 180 J=2,201                                                        A1610   16100000
000764          YTPP(J)=DIF(J,5,201,XT,YTP)                                           A1620   16200000
000771      180 CONTINUE                                                              A1630   16300000
000773          YTPP(1)=10.**6                                                        A1640   16400000
000775          XO=XT(1)                                                              A1650   16500000
000776          XL=XT(201)                                                            A1660   16600000
001000          TR=2.*YM/(XL-XO)                                                      A1670   16700000
001003          IF (TOC.LE.E) GO TO 190                                               A1680   16800000
          C       TEST THICKNESS                                                      A1690   16900000
001006          RAT=TOC/TR                                                            A1700   17000000
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001007          IF (ABS(RAT-1.0).GT.0.0001.AND.IT.LE.10) GO TO 150                A1710   17100000
001024      190 SF=RAT                                                            A1720   17200000
001025          IF (TOC.LT.E) SF=0.0                                              A1730   17300000
001031          IF (I.GT.1) GO TO 210                                             A1740   17400000
001035          DO 200 J=1,201                                                    A1750   17500000
001036          XT(J)=(XT(J)-XO)/(XL-XO)                                          A1760   17600000
          C       SCALE LINEARLY TO EXACT THICKNESS                             A1770   17700000
001041          YT(J)=SF*YT(J)/(XL-XO)                                            A1780   17800000
001045          YTP(J)=SF*YTP(J)                                                  A1790   17900000
001046          YTPP(J)=SF*YTPP(J)*(XL-XO)                                        A1800   18000000
001051      200 CONTINUE                                                          A1810   18100000
001053      210 CONTINUE                                                          A1820   18200000
001053          XTP=(XTP-XO)/(XL-XO)                                              A1830   18300000
001056          YMAX=YMAX*SF/(XL-XO)                                              A1840   18400000
001061          YM=YM*SF/(XL-XO)                                                  A1850   18500000
001063          XYM=(XYM-XO)/(XL-XO)                                              A1860   18600000
001066          XL(1)=0.0                                                         A1870   18700000
001066          IF (TOC.LE.E) GO TO 230                                           A1880   18800000
          C       FIT TILTED ELLIPSE AT ELEVENTH PROFILE POINT                  A1890   18900000
001071          CN=2.*YTP(11)-YT(11)/XT(11)+0.1                                   A1900   19000000
001076          AN=XT(11)*(YTP(11)*XT(11)-YT(11))/(XT(11)*(2.*YTP(11)-CN)-YT(11)) A1910   19100000
001105          BN=SQRT((YT(11)-CN*XT(11))**2/(1.-(XT(11)-AN)**2/AN**2))          A1920   19200000
001117          DO 220 J=1,10                                                     A1930   19300000
001120          YT(J)=BN*SQRT(1.-(XT(J)-AN)**2/AN**2)+CN*XT(J)                    A1940   19400000
001134          IF (XT(J).LE.E) GO TO 220                                         A1950   19500000
001137          YTP(J)=BN**2*(AN-XT(J))/AN**2/(YT(J)-CN*XT(J))+CN                 A1960   19600000
001153          YTPP(J)=-BN**4/AN**2/(YT(J)-CN*XT(J))**3                          A1970   19700000
001162      220 CONTINUE                                                          A1980   19800000
001164          RNP=BN**2/AN                                                      A1990   19900000
001166          IF (I.EQ.1) PRINT 520, XYM,YMAX,XTP,YM,XT(11),YT(11),YTP(11),RNP,R A2000   20000000
               1AT,ACRAT,IT                                                       A2010   20100000
001222      230 CONTINUE                                                          A2020   20200000
001222          X=0.0                                                             A2030   20300000
001223          ALI=ABS(CLI(1))                                                   A2040   20400000
          C       PRINT UNCAMBERED COLUMN HEADINGS AND ORIGIN POINT              A2050   20500000
001225          IF (ALI.LE.E.AND.ICKY.EQ.1) PRINT 480                             A2060   20600000
001242          IF (ALI.LE.E.AND.ICKY.EQ.1) PRINT 550, X,Y,YP,YPP,XC,YC           A2070   20700000
          C       PRINT CAMBERED COLUMN HEADINGS AND ORIGIN POINT                A2080   20800000
001273          IF (ALI.GT.E.OR.ICKY.GT.1) PRINT 490                              A2090   20900000
001311          IF (ALI.GT.E.OR.ICKY.GT.1) PRINT 540, X,XU(I),YU(I),XUC,YUC,YUP,XL A2100   21000000
               1(I),YL(I),XLC,YLC,YLP                                             A2110   21100000
001355          X=0.00025                                                         A2120   21200000
001356          XL(1)=0.0                                                         A2130   21300000
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001360      240 CONTINUE                                                          A2140   21400000
          C       INTERPOLATE FOR THICKNESS AND DERIVATIVES AT DESIRED VALUES OF X A2150   21500000
001360          CALL FTLUP (X,Y,2,201,XT,YT)                                      A2160   21600000
001364          CALL FTLUP (X,YP,2,201,XT,YTP)                                    A2170   21700000
001370          CALL FTLUP (X,YPP,2,201,XT,YTPP)                                  A2180   21800000
          C       COMPUTE CAMBERLINE                                            A2190   21900000
001374          L=0                                                               A2200   22000000
001375          A(1)=AS                                                           A2210   22100000
001376          CLI(1)=CLIS                                                       A2220   22200000
001400      250 L=L+1                                                             A2230   22300000
001402          A(1)=A(L)                                                         A2240   22400000
001403          CLI(1)=CLI(L)                                                     A2250   22500000
001405          XC=X*CHD                                                          A2260   22600000
001407          YC=Y*CHD                                                          A2270   22700000
001410          XLL=X*ALOG(X)                                                     A2280   22800000
001413          Q=1.0                                                             A2290   22900000
001415          IF (ABS(1.-A).LT.E.AND.ABS(1.-X).LT.E) GO TO 300                  A2300   23000000
001430          IF (A.LT.E.AND.(1.-X).LT.E) GO TO 310                             A2310   23100000
001441          IF (ABS(A-X).LT.E) GO TO 260                                      A2320   23200000
001445          IF (ABS(1.-X).LT.E) GO TO 280                                     A2330   23300000
001450          IF (ABS(A-1.).LT.E) GO TO 290                                     A2340   23400000
001454          V=-(A-X)/ABS(A-X)                                                 A2350   23500000
001461          OMXL=(1.-X)*ALOG(1.-X)                                            A2360   23600000
001467          AMXL=(A-X)*ALOG(ABS(A-X))                                         A2370   23700000
001476          OMXL1=-ALOG(1.-X)-1.                                              A2380   23800000
001503          AMXL1=-ALOG(ABS(A-X))-1.                                          A2390   23900000
001512          OMXL2=1./(1.-X)                                                   A2400   24000000
001514          AMXL2=1./(A-X)                                                    A2410   24100000
001520          Z=.5*(A-X)*AMXL-.5*(1.-X)*OMXL-.25*(A-X)**2+.25*(1.-X)**2         A2420   24200000
001534          Z1=.5*((A-X)*AMXL1-AMXL-(1.-X)*OMXL1+OMXL+(A-X)-(1.-X))           A2430   24300000
001551          Z2=.5*(A-X)*AMXL2-AMXL1-.5*(1.-X)*OMXL2+OMXL1                     A2440   24400000
001563          IF (A.LE.E) GO TO 270                                             A2450   24500000
001566          G=-(A*A*(.5*ALOG(A)-0.25)+0.25)/(1.-A)                            A2460   24600000
001577          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G              A2470   24700000
001611          GO TO 320                                                         A2480   24800000
001612      260 Z=-.5*(1.-X)**2*ALOG(1.-X)+0.25*(1.-X)**2                         A2490   24900000
001622          Z1=-.5*(1.-X)*(-ALOG(1.-X)-1.)+.5*(1.-X)*ALOG(1.-X)-.5*(1.-X)     A2500   25000000
001637          Z2=-ALOG(1.-X)-0.5                                                A2510   25100000
001644          G=-(A**2*(.5*ALOG(A)-0.25)+0.25)/(1.-A)                           A2520   25200000
001655          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G              A2530   25300000
001667          GO TO 320                                                         A2540   25400000
001670      270 G=-.25                                                            A2550   25500000
001671          H=-.5                                                             A2560   25600000
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001673          GO TO 320
001674      280 CONTINUE
001674          G=-(A**2*(.5*ALOG(A)-0.25)+0.25)/(1.-A)
001705          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G
001717          Z=.5*(A-1.)**2*ALOG(ABS(A-1.))-0.25*(A-1.)**2
001731          Z1=-(A-1.)*ALOG(ABS(A-1.))
001741          Z2=-10.**10
001744          GO TO 320
001744      290 G=0.0
001745          H=G
001746          Q=G
001747          Z=-(1.-X)*ALOG(1.-X)
001756          Z1=ALOG(1.-X)+1.
001763          Z2=-1./(1.-X)
001766          GO TO 320
001766      300 G=0.0
001767          H=G
001770          Q=G
001771          Z=0.0
001772          Z1=-10.**10
001775          Z2=-10.**10
001777          GO TO 320
002000      310 G=-.25
002001          H=-.5
002003          Q=1.0
002004          Z=-.25
002005          Z1=0.0
002006          Z2=-10.**10
002011          GO TO 320
002012      320 YCM8(L)=CLI*(Z/(1.-Q*A)-XLL+G-H*X)/PI/(A+1.)/2.
002030          XSV=X
002031          IF (X.LT.0.005) X=0.005
002034          TANTH(L)=CLI*(Z1/(1.-Q*A)-1.-ALOG(X)-H)/PI/(A+1.)/2.0
002053          X=XSV
002054          IF (IF6XA(L).EQ.1) TANTH(L)=-5.0
002061          IF (X.GT.0.005) GO TO 330
002065          YCP2(L)=0.0
002066          GO TO 350
002066      330 CONTINUE
002066          IF (ABS(1.-X).GT.E) GO TO 340
002074          YCP2(L)=1./E
002075          GO TO 350
002076      340 PIA=PI*(A+1.)*2.
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A2570   25700000
A2580   25800000
A2590   25900000
A2600   26000000
A2610   26100000
A2620   26200000
A2630   26300000
A2640   26400000
A2650   26500000
A2660   26600000
A2670   26700000
A2680   26800000
A2690   26900000
A2700   27000000
A2710   27100000
A2720   27200000
A2730   27300000
A2740   27400000
A2750   27500000
A2760   27600000
A2770   27700000
A2780   27800000
A2790   27900000
A2800   28000000
A2810   28100000
A2820   28200000
A2830   28300000
A2840   28400000
A2850   28500000
A2860   28600000
A2870   28700000
A2880   28800000
A2890   28900000
A2900   29000000
A2910   29100000
A2920   29200000
A2930   29300000
A2940   29400000
A2950   29500000
A2960   29600000
A2970   29700000
A2980   29800000
A2990   29900000
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002101          YCP2(L)=CLI*(Z2/(1.-Q*A)-1./X)/PIA                                  A3000   30000000
002112      350 CONTINUE                                                            A3010   30100000
            C     MODIFIED CAMBERLINE OPTION                                        A3020   30200000
002112          IF (SERIEC.EQ.10H       63A.OR.SERIEC.EQ.10H       64A.OR.SERIEC.E  A3030   30300000
               1Q.10H       65A) GO TO 360                                        A3040   30400000
002125          GO TO 380                                                         A3050   30500000
002126      360 YCMB(L)=YCMB(L)*0.97948                                           A3060   30600000
002130          TANTH(L)=TANTH(L)*0.97948                                         A3070   30700000
002132          YCP2(L)=YCP2(L)*0.97948                                           A3080   30800000
002134          IF(ABS(A-.8).LT.E.OR.CLI.LT.E) GO TO 370                                  30900001
002146          PRINT 530                                                         A3100   31000000
002151          READ (5,500) NPWIPE                                               A3110   31100000
002157          IF (KON.EQ.3) KON=0                                               A3120   31200000
002162          IF(KON.EQ.0) CALL NFRAME                                          A3121   31300001
002164          GO TO 30                                                          A3130   31400000
002165      370 CONTINUE                                                          A3140   31500000
002165          IF (TANTH(L).LE.-.24521*CLI) YCMB(L)=0.24521*CLI*(1.-X)           A3150   31600000
002175          IF (TANTH(L).LE.-.24521*CLI) YCP2(L)=0.0                          A3160   31700000
002203          IF (TANTH(L).LE.-.24521*CLI) TANTH(L)=-0.24521*CLI                A3170   31800000
002211          IF (TANTH(L).LE.-.24521*CLI) IF6XA(L)=1                           A3180   31900000
002217      380 CONTINUE                                                          A3190   32000000
002217          IF (ICKY.GT.1.AND.L.LT.ICKY) GO TO 250                            A3200   32100000
002227          IF (ICKY.EQ.1) GO TO 400                                          A3210   32200000
002230          DO 390 J=2,ICKY                                                   A3220   32300000
002231          YCMB(1)=YCMB(1)+YCMB(J)                                           A3230   32400000
002233          TANTH(1)=TANTH(1)+TANTH(J)                                        A3240   32500000
002235          YCP2(1)=YCP2(1)+YCP2(J)                                           A3250   32600000
002237      390 CONTINUE                                                          A3260   32700000
002241      400 CONTINUE                                                          A3270   32800000
002241          F=SQRT(1.+TANTH**2)                                               A3280   32900000
002245          THP=YCP2/F**2                                                     A3290   33000000
002247          SINTH=TANTH/F                                                     A3300   33100000
002251          COSTH=1./F                                                        A3310   33200000
            C     CAMBERLINE AND DERIVATIVES COMPUTED                             A3320   33300000
002253          I=I+1                                                             A3330   33400000
            C     COMBINE THICKNESS DISTRIBUTUION AND CAMBERLINE                  A3340   33500000
002255          XU(I)=X-Y*SINTH                                                   A3350   33600000
002260          YU(I)=YCMB+Y*COSTH                                                A3360   33700000
002263          XL(I)=X+Y*SINTH                                                   A3370   33800000
002266          YL(I)=YCMB-Y*COSTH                                                A3380   33900000
            C     SELECT VALUES FOR PUNCHED OUTPUT                                A3390   34000000
002271          IF (ABS(X-XA(K)).GT..1**6) GO TO 410                              A3400   34100000
002300          XAU(K)=XU(I)                                                      A3410   34200000
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002302          YAU(K)=YU(I)                                                    A3420   34300000
002303          XAL(K)=XL(I)                                                    A3430   34400000
002305          YAL(K)=YL(I)                                                    A3440   34500000
002306          K=K+1                                                           A3450   34600000
002310       410 CONTINUE                                                       A3460   34700000
             C     MULTIPLY BY CHORD                                           A3470   34800000
002310          XUC=XU(I)*CHD                                                   A3480   34900000
002312          YUC=YU(I)*CHD                                                   A3490   35000000
002314          XLC=XL(I)*CHD                                                   A3500   35100000
002315          YLC=YL(I)*CHD                                                   A3510   35200000
002317          IF (ALI.LE.E.AND.ICKY.EQ.1) GO TO 420                           A3520   35300000
             C     FIND LOCAL SLOPE OF CAMBERED PROFILE                        A3530   35400000
002331          YUP=(TANTH*E+YP-TANTH*Y*THP)/(E-YP*TANTH-Y*THP)                 A3540   35500000
002342          YLP=(TANTH*E-YP+TANTH*Y*THP)/(E+YP*TANTH+Y*THP)                 A3550   35600000
002354          IF (TUC.LT.E) GO TO 420                                         A3560   35700000
002357       420 CONTINUE                                                       A3570   35800000
             C     FIND X INCREMENT                                            A3580   35900000
002357          IF (X.LE.0.0975) FRAC=0.25                                      A3590   36000000
002364          IF (X.LE.0.01225) FRAC=0.025                                    A3600   36100000
             C     PRINT PROFILE IN APPROPRIATE FORMAT                         A3610   36200000
002371          IF (ALI.GT.E.OR.ICKY.GT.1) PRINT 540, X,XU(I),YU(I),XUC,YUC,YUP,XL  A3620   36300000
                1(I),YL(I),XLC,YLC,YLP                                          A3630   36400000
002435          IF (ALI.LE.E.AND.ICKY.EQ.1) PRINT 550, X,Y,YP,YPP,XC,YC         A3640   36500000
             C     INCREMENT X AND RETURN TO START OF X LOOP                   A3650   36600000
002466          X=X+FRAC*DX                                                     A3660   36700000
002471          FRAC=1.0                                                        A3670   36800000
002472          IF (X.LE.1.0) GO TO 140                                         A3680   36900000
             C     PLOT AIRFOIL PROFILE                                        A3690   37000000
002474          CALL PLOT (XU,XL,YU,YL,I)                                       A3700   37100000
             C     PUNCH SELECTED OUTPUT                                       A3710   37200000
002500          PUNCH 560, TITLE1,(XAU(J),J=1,32)                               A3720   37300000
                *,(YAU(J),J=1,32)                                                       37400000
                *,(XAL(J),J=1,32)                                                       37500000
                *,(YAL(J),J=1,32)                                                       37600000
             C     RETURN TO READ FOR NEXT CASE                                A3730   37700000
002536          GO TO 30                                                        A3740   37800000
             C                                                                 A3750   37900000
002537       430 FORMAT (I3/(8F10.0))                                           A3760   38000000
002537       440 FORMAT (8A10/2A10/6F10.0)                                      A3770   38100000
002537       450 FORMAT (8F10.0)                                                A3780   38200000
002537       460 FORMAT (5HOTUC=,F10.6,5H RLE=,F10.6,5H CHD=,F10.6/5H CLI=,10F10.6)  A3790   38300000
002537       470 FORMAT (5H   A=,10F10.6//)                                     A3800   38400000
002537       480 FORMAT (9X,3HX/C,10X,3HY/C,8X,5HDY/DX,6X,7HD2Y/DX2,22X,1HX,12X,1HY  A3810   38500000
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     1/)                                                                                A3820    38600000
002537     490 FORMAT (11oHOUNCAMBERED                                  UPPER SURFACE VALU  A3830    38700000
     1ES                                                        LOWER SURFACE VALUES /6X,  A3840    38800000
     23HX/C11X,4HXU/C,7X,4HYU/C,8X,2HXU,9X,2HYU,6X,7HDYU/DXU,12X,4HXL/C,                    A3850    38900000
     37X,4HYL/C,8X,2HXL,9X,2HYL,6X,7HDYL/DXL)                                           A3860    39000000
002537     500 FORMAT (8A10)                                                              A3870    39100000
002537     510 FORMAT (5H RAT(,I2,2H)=,F10.5)                                             A3880    39200000
002537     520 FORMAT (//16H PEAK IS AT X/C=,F10.6/16H MAXIMUM Y/C IS ,F10.6/34H          A3890    39300000
     1SLOPE CHANGES SIGN AT X/C, Y/C = ,2F10.6/20H X/C FIT OF ELLIPSE ,F                A3900    39400000
     210.6/20H Y/C FIT OF ELLIPSE ,F10.6/22H SLOPE FIT OF ELLIPSE ,F10.6                A3910    39500000
     3/51H RADIUS AT ORIGIN OF ELLIPSE THRU XT(11)/C,YT(11)/C,F10.6/39H                 A3920    39600000
     4RATIO OF T/C INPUT TO T/C COMPUTED IS ,F10.6/31H CUMULATIVE SCALIN                A3930    39700000
     5G OF EPS,PSI ,F10.6/22H NUMBER OF ITERATIONS=,I10)                                A3940    39800000
002537     530 FORMAT (53H  MODIFIED CAMBER LINE OPTION ALLOWED ONLY FOR A=0.8 )          A3950    39900000
002537     540 FORMAT (F10.6,4X,5F11.6,6X,5F11.6)                                         A3960    40000000
002537     550 FORMAT (4F13.6,10X,2F13.6)                                                 A3970    40100000
002537     560 FORMAT (8A10/(8F10.5))                                                     A3980    40200000
002537         END                                                                        A3990-   40300000
```

```
LADSON

PROGRAM LENGTH INCLUDING I/O BUFFERS
016235

FUNCTION ASSIGNMENTS
COSH   -  000005     SINH   -  000017

STATEMENT ASSIGNMENTS
30     -  000056     40     -  000125     50     -  000132     70     -  000231
80     -  000427     90     -  000436     100    -  000454     110    -  000461
120    -  000512     130    -  000516     140    -  000531     150    -  000641
160    -  000717     170    -  000752     190    -  001024     210    -  001053
220    -  001162     230    -  001222     240    -  001360     250    -  001400
260    -  001612     270    -  001670     280    -  001674     290    -  001744
300    -  001766     310    -  002000     320    -  002012     330    -  002066
340    -  002076     350    -  002112     360    -  002126     370    -  002165
380    -  002217     400    -  002241     410    -  002310     420    -  002357
430    -  002671     440    -  002674     450    -  002677     460    -  002701
470    -  002711     480    -  002715     490    -  002725     500    -  002756
510    -  002760     520    -  002764     530    -  003033     540    -  003042
550    -  003046     560    -  003052

BLOCK NAMES AND LENGTHS
MAIN   -  000015

VARIABLE ASSIGNMENTS
A      -  007750     ACRAT  -  010122     ALI    -  010136     AMXL   -  010101
AMXL1  -  010103     AMXL2  -  010105     AN     -  010133     AS     -  010064
BN     -  010134     CHD    -  000003C01  CLI    -  007736     CLIS   -  010063
CMBNMR -  010055     CN     -  010132     COSTH  -  010146     DX     -  010050
E      -  010046     EPS    -  007114     F      -  010143     FRAC   -  010061
G      -  010106     H      -  010110     I      -  010051     ICKY   -  010056
ICKYP  -  010060     IFOXA  -  010032     IT     -  010121     J      -  010057
K      -  010075     KON    -  000004C01  L      -  010062     N      -  010052
NAME   -  005127     NPWIPE -  010142     OMXL   -  010100     OMXL1  -  010102
OMXL2  -  010104     PHI    -  006603     PI     -  010047     PIA    -  010141
PSI    -  007425     Q      -  010107     RAT    -  010120     RLE    -  010054
RNP    -  010135     SERIEC -  010045     SERIET -  010044     SF     -  010131
SINTH  -  010145     TANTH  -  010006     TANTH0 -  007762     THP    -  010144
TITLE1 -  000005C01  TOC    -  010053     TR     -  010130     U      -  010076
```

APPENDIX

```
V       = 010077    X       = 010065    XA      = 004667    XAL     = 005027
XAU     = 004727    XC      = 010067    XL      = 003537    XLC     = 010073
XLL     = 010137    XO      = 010127    XSV     = 010140    XT      = 005137
XTP     = 010125    XU      = 003227    XUC     = 010071    XYM     = 010124
Y       = 010066    YAL     = 005067    YAU     = 004767    YC      = 010070
YCMB    = 007774    YCP2    = 010020    YL      = 004357    YLC     = 010074
YLP     = 010117    YM      = 010126    YMAX    = 010123    YP      = 010114
YPP     = 010115    YSTART  = 000000C01  YT      = 005450    YTP     = 005761
YTPP    = 006272    YU      = 004047    YUC     = 010072    YUP     = 010116
Z       = 010111    Z1      = 010112    Z2      = 010113

START OF CONSTANTS
002541

START OF TEMPORARIES
003055

START OF INDIRECTS
003210

UNUSED COMPILER SPACE
025500
```

```
                SUBROUTINE PLOT (XU,XL,YU,YL,I)
C                 XU,YU - UPPER SURFACE POINTS.  XL,YL - LOWER SURFACE POINTS
C                 I - NUMBER OF POINTS ON ONE SURFACE - OTHER ASSUMED THE SAME
000010          COMMON /MAIN/ YSTART(3),CHD,K,TITLE1(8)
000010          DIMENSION XU(1), XL(1), YU(1), YL(1), X(450), Y(450)
000010          READ 30, (TITLE1(N),N=1,8)
000021          IF (MOD(K,3).EQ.1) CALL CALPLT (1.0,0.0,-3)
C                 LETTER HEIGHT FOR LABELS AND SCALES
000037          HGT=0.14
000040          L=I
C                 LOAD PROFILE POINTS INTO SINGLE ARRAY
000042          DO 10 N=1,I
000043          X(N)=XU(N)
000045          Y(N)=YU(N)
000047          X(I+N)=XL(L)
000052          Y(I+N)=YL(L)
000054       10 L=L-1
000060          M=2*I
C                 PAGE SIZE, INCHES
000060          XPG=10.0
000062          XX=XPG/2.0-1.5*(6./7.*HGT)
000067          XDV=0.0
000070          XTIC=1.0
000071          YPG=2.0
000072          YDV=0.0
000073          YTIC=1.0
C                 MINIMUM
000074          X(M+1)=0.0
000076          Y(M+1)=-0.1
C                 SCALE FACTOR
000100          X(M+2)=1.0/XPG
000101          Y(M+2)=X(M+2)
C                 DRAW AXES
000103          CALL AXES (0.,YSTART(K),90.,YPG,Y(M+1),Y(M+2),YTIC,YDV,1H ,HGT,1)
000124          CALL AXES (0.,YSTART(K),0.,XPG,X(M+1),X(M+2),XTIC,XDV,1H ,HGT,-1)
000146          YLABEL=YSTART(K)-2.5*HGT
C                 LABEL AXES AND TITLE
000152          CALL NUTATE (XX,YLABEL,HGT,3HX/C,0.,3)
000156          YLABEL=YLABEL-1.5*HGT
000161          CALL NUTATE (0.0,YLABEL,HGT,TITLE1,.0,80)
000165          YS=YSTART(K)+1.0
000170          CALL NUTATE (-.92,YS,HGT,3HY/C,0.0,3)
```

```
B  10   40400000
B  20   40500000
B  30   40600000
B  40   40700000
B  50   40800000
B  60   40900000
B  70   41000000
B  80   41100000
B  90   41200000
B 100   41300000
B 110   41400000
B 120   41500000
B 130   41600000
B 140   41700000
B 150   41800000
B 160   41900000
B 170   42000000
B 180   42100000
B 190   42200000
B 200   42300000
B 210   42400000
B 220   42500000
B 230   42600000
B 240   42700000
B 250   42800000
B 260   42900000
B 270   43000000
B 280   43100000
B 290   43200000
B 300   43300000
B 310   43400000
B 320   43500000
B 330   43600000
B 340   43700000
B 350   43800000
B 360   43900000
B 370   44000000
B 380   44100000
B 390   44200000
B 400   44300000
B 410   44400000
B 420   44500000
```

APPENDIX

```
B 430   44600000
B 440   44700000
B 450   44800000
B 460   44900000
B 470   45000000
B 480   45100000
B 490   45200000
B 500   45300000
B 510   45400000
B 520   45500000
B 530   45600000
B 540   45700000
B 550   45800000
B 560   45900000
B 570-  46000000
```

```
000174          C     RELOCATE ORIGIN
000201                CALL CALPLT (0.0,YSTART(K),-3)
                      LAP=0
                C     PLOT PROFILE
000202                CALL LINPLT (X,Y,M,1,LAP,0,1,0)
000212                CALL CALPLT (0.0,-YSTART(K),-3)
                C     ADVANCE FRAME EVERY THIRD PLOT
000217                IF (K.LT.3) GO TO 20
000225                K=0
000225                CALL NFRAME
000226          20    CONTINUE
000226                RETURN
                C
000227          30    FORMAT (8A10)
000227                END
```

```
PLOT

SUBPROGRAM LENGTH
002150

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
20      -  000226    30      -  000277

BLOCK NAMES AND LENGTHS
MAIN    -  000015

VARIABLE ASSIGNMENTS
HGT     -  002133    K       -  000004C01 L       -  002134    LAP     -  002147
M       -  002135    N       -  002132    TITLE1  -  000005C01 X       -  000326
XDV     -  002140    XPG     -  002136    XTIC    -  002141    XX      -  002137
Y       -  001230    YDV     -  002143    YLABEL  -  002145    YPG     -  002142
YS      -  002146    YSTART  -  000000C01 YTIC    -  002144

START OF CONSTANTS
000231

START OF TEMPORARIES
000301

START OF INDIRECTS
000306

UNUSED COMPILER SPACE
035400
```

```
                      FUNCTION DIF (L,M,NP,VARI,VARD)                                    C   10   46100000
                C     *** DOCUMENT DATE 08-01-68   SUBROUTINE REVISED 08-01-68 *********  C   20   46200000
                C        THIS FUNCTION SUBPROGRAM FINDS THE DERIVATIVE AT A GIVEN POINT,  C   30   46300000
                C        L, FOR THE DESIRED X AND Y IN A GIVEN TABLE.  THE N-POINT        C   40   46400000
                C        LAGRANGIAN FORMULA IS USED WHERE N IS ODD.                       C   50   46500000
                C                                                                         C   60   46600000
                C        L = INTEGER, THE POINT OF X AND Y AT WHICH DERIVATIVE IS FOUND   C   70   46700000
                C        M = INTEGER, 1-5, TO DETERMINE THE POINT FORMULA, N.  N=2*M+1    C   80   46800000
                C        NP= INTEGER, THE NUMBER OF POINTS IN TABLE OF VARIABLES           C   90   46900000
                C        VARI = ARRAY OF INDEPENDENT VARIABLE, X.  VARI(NP)               C  100   47000000
                C        VARD = ARRAY OF DEPENDENT VARIABLE, Y.    VARD(NP)               C  110   47100000
                C                                                                         C  120   47200000
000010                   DIMENSION VARI(NP), VARD(NP), X(11), Y(11)                       C  130   47300000
                C                                                                         C  140   47400000
000010                   DIF=0177700000000000000000                                       C  150   47500000
000011                   IF (M.LT.1) RETURN                                               C  160   47600000
000015                   N=2*M+1                                                          C  170   47700000
000017                   IF (M.GT.5.OR.N.GT.NP) RETURN                                    C  180   47800000
000030                   M1=M+1                                                           C  190   47900000
000031                   M2=NP-M+1                                                        C  200   48000000
000033                   K=L                                                              C  210   48100000
000034                   IF (L.LE.M1.OR.N.EQ.NP) GO TO 10                                 C  220   48200000
000044                   K=M1                                                             C  230   48300000
000044                   IF (L.LT.M2) GO TO 10                                            C  240   48400000
000047                   K=L-(NP-N)                                                       C  250   48500000
000052                10 MX=L-K                                                         C  260   48600000
000054                   DO 20 J=1,N                                                      C  270   48700000
000055                   MJ=MX+J                                                          C  280   48800000
000056                   X(J)=VARI(MJ)                                                    C  290   48900000
000061                20 Y(J)=VARD(MJ)                                                  C  300   49000000
000065                   A=1.                                                             C  310   49100000
000066                   B=0.                                                             C  320   49200000
000066                   C=0.                                                             C  330   49300000
000070                   DO 40 J=1,N                                                      C  340   49400000
000071                   IF (J.EQ.K) GO TO 40                                             C  350   49500000
000073                   P=1.                                                             C  360   49600000
000074                   DO 30 I=1,N                                                      C  370   49700000
000076                   IF (I.EQ.J) GO TO 30                                             C  380   49800000
000100                   P=P*(X(J)-X(I))                                                  C  390   49900000
000103                30 CONTINUE                                                       C  400   50000000
000106                   T=X(K)-X(J)                                                      C  410   50100000
000111                   B=B+Y(J)/(P*T)                                                   C  420   50200000
```

APPENDIX

```
C 430    50300000
C 440    50400000
C 450    50500000
C 460    50600000
C 470    50700000
C 480—   50800000
```

```
000114          A=A*T
000116          C=C+1./T
000120       40 CONTINUE
000123          DIF=A*B+Y(K)*C
000127          RETURN
000130          END
```

APPENDIX

```
DIF

SUBPROGRAM LENGTH
000213

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
10   -  000052     30

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
A    -  000205     B
I    -  000211     J
MX   -  000202     M1
P    -  000210     T

START OF CONSTANTS
000132

START OF TEMPORARIES
000135

START OF INDIRECTS
000143

UNUSED COMPILER SPACE
036000
```

```
-  000103     40     -  000120

-  000206     C      -  000207     DIF    -  000147
-  000203     K      -  000201     MJ     -  000204
-  000177     M2     -  000200     N      -  000176
-  000212     X      -  000150     Y      -  000163
```

```
000011          SUBROUTINE FTLUP (X,Y,M,N,VARI,VARD)                                D  10    50900000
                C       ***DOCUMENT DATE  7/7/69     SUBROUTINE REVISED  7/7/69  *********  D  20    51000000
                C          MODIFICATION OF LIBRARY INTERPOLATION SUBROUTINE  FTLUP           D  30    51100000
000011          DIMENSION VARI(1), VARD(1), V(3), YY(2)                             D  40    51200000
000011          DIMENSION II(43)                                                    D  50    51300000
                C        INITIALIZE ALL INTERVAL POINTERS TO -1.0   FOR MONOTONICITY CHECK  D  60    51400000
000011          DATA (II(J),J=1,43)/43*-1/                                          D  70    51500000
000011          MA=IABS(M)                                                          D  80    51600000
                C               ASSIGN INTERVAL POINTER FOR GIVEN VARI TABLE        D  90    51700000
                C        THE SAME POINTER WILL BE USED ON A GIVEN VARI TABLE EVERY TIME  D 100   51800000
000012          LI=MOD(LOCF(VARI(1)),43)+1                                          D 110    51900000
000025          I=II(LI)                                                            D 120    52000000
000027          IF (I.GE.0) GO TO 60                                                D 130    52100000
000031          IF (N.LT.2) GO TO 60                                                D 140    52200000
                C       MONOTONICITY CHECK                                          D 150    52300000
000033          IF (VARI(2)-VARI(1)) 20,20,40                                       D 160    52400000
                C       ERROR IN MONOTONICITY                                       D 170    52500000
000036        10 K=LOCF(VARI(1))                                                    D 180    52600000
000045          PRINT 170, J,K,(VARI(J),J=1,N),(VARD(J),J=1,N)                               52700000
000103          STOP                                                                D 200    52800000
                C       MONOTONIC DECREASING                                        D 210    52900000
000105        20 DO 30 J=2,N                                                        D 220    53000000
000112          IF (VARI(J)-VARI(J-1)) 30,10,10                                     D 230    53100000
000116        30 CONTINUE                                                           D 240    53200000
000121          GO TO 60                                                            D 250    53300000
                C       MONOTONIC INCREASING                                        D 260    53400000
000121        40 DO 50 J=2,N                                                        D 270    53500000
000123          IF (VARI(J)-VARI(J-1)) 10,10,50                                     D 280    53600000
000127        50 CONTINUE                                                           D 290    53700000
                C       INTERPOLATION                                               D 300    53800000
000132        60 IF (I.LE.0) I=1                                                    D 310    53900000
000135          IF (I.GE.N) I=N-1                                                   D 320    54000000
000141          IF (N.LE.1) GO TO 70                                                D 330    54100000
000143          IF (MA.NE.0) GO TO 80                                               D 340    54200000
                C       ZERO ORDER                                                  D 350    54300000
000144        70 Y=VARD(1)                                                          D 360    54400000
000145          GO TO 160                                                           D 370    54500000
                C       LOCATE I INTERVAL (X(I).LE.X.LT.X(I+1))                     D 380    54600000
000146        80 IF ((VARI(I)-X)*(VARI(I+1)-X)) 110,110,90                          D 390    54700000
                C       IN GIVES DIRECTION FOR SEARCH OF INTERVALS                  D 400    54800000
000153        90 IN=SIGN(1.0,(VARI(I+1)-VARI(I))*(X-VARI(I)))                       D 410    54900000
                C       IF X OUTSIDE ENDPOINTS, EXTRAPOLATE FROM END INTERVAL       D 420    55000000
```

APPENDIX

```
000162      100 IF (((I+IN).LE.0) GO TO 110                                   D 430   55100000
000165          IF (((I+IN).GE.N) GO TO 110                                   D 440   55200000
000167              I=I+IN                                                    D 450   55300000
000170          IF ((VARI(I)-X)*(VARI(I+1)-X)) 110,110,100                    D 460   55400000
000174      110 IF (MA.EQ.2) GO TO 120                                        D 470   55500000
                C     FIRST ORDER                                           D 480   55600000
000176              Y=(VARD(I)*(VARI(I+1)-X)-VARD(I+1)*(VARI(I)-X))/(VARI(I+1)-VARI(I)  D 490   55700000
                   1)                                                       D 500   55800000
                      GO TO 160                                             D 510   55900000
                C     SECOND ORDER                                          D 520   56000000
000211      120 IF (N.EQ.2) GO TO 10                                          D 530   56100000
000213          IF (I.EQ.(N-1)) GO TO 140                                     D 540   56200000
000216          IF (I.EQ.1) GO TO 130                                         D 550   56300000
                C     PICK THIRD POINT                                      D 560   56400000
000217              SK=VARI(I+1)-VARI(I)                                      D 570   56500000
000221              IF ((SK*(X-VARI(I-1))).LT.(SK*(VARI(I+2)-X))) GO TO 140   D 580   56600000
000231      130 L=I                                                           D 590   56700000
000233          GO TO 150                                                     D 600   56800000
000233      140 L=I-1                                                         D 610   56900000
000235      150 V(1)=VARI(L)-X                                                D 620   57000000
000237          V(2)=VARI(L+1)-X                                              D 630   57100000
000241          V(3)=VARI(L+2)-X                                              D 640   57200000
000243          YY(1)=(VARD(L)*V(2)-VARD(L+1)*V(1))/(VARI(L+1)-VARI(L))       D 650   57300000
000252          YY(2)=(VARD(L+1)*V(3)-VARD(L+2)*V(2))/(VARI(L+2)-VARI(L+1))   D 660   57400000
000263          Y=(YY(1)*V(3)-YY(2)*V(1))/(VARI(L+2)-VARI(L))                 D 670   57500000
000273      160 II(LI)=I                                                      D 680   57600000
000275          RETURN                                                        D 690   57700000
                C                                                           D 700   57800000
000276      170 FORMAT (1H1,50H TABLE BELOW CUT OF ORDER FOR FTLUP  AT POSITION  ,  D 710   57900000
                   115,/31H X TABLE IS STORED IN LOCATION ,06,//(8G15.8))    D 720   58000000
                    END                                                     D 730-  58100000
000276
```

```
FTLUP

SUBPROGRAM LENGTH
000444

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
10      -  000036    20      -  000105    30      -  000116    40      -  000121
50      -  000127    60      -  000132    70      -  000144    80      -  000146
90      -  000153    100     -  000162    110     -  000174    120     -  000211
130     -  000231    140     -  000233    150     -  000235    160     -  000273
170     -  000304

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
I       -  000436    II      -  000361    IN      -  000441    J       -  000440
K       -  000437    L       -  000443    LI      -  000435    MA      -  000434
SK      -  000442    V       -  000354    YY      -  000357

START OF CONSTANTS
000300

START OF TEMPORARIES
000321

START OF INDIRECTS
000337

UNUSED COMPILER SPACE
035200
```

```
000005          SUBROUTINE PHEP63(PHI,EPS)
000005          DIMENSION PHI(1),EPS(1)
000005          DIMENSION PHILD(201),EPSLD(201)
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/
               1   0.00000,   0.00000,    .01569,    .00164,    .03139,
               1    .00327,    .04708,    .00487,    .06278,    .00641,
               1    .07848,    .00789,    .09419,    .00928,    .10990,
               1    .01057,    .12562,    .01174,    .14135,    .01278,
               1    .15708,    .01367,    .17277,    .01439,    .18846,
               1    .01497,    .20416,    .01542,    .21987,    .01576,
               1    .23558,    .01601,    .25129,    .01619,    .26701,
               1    .01632,    .28273,    .01642,    .29844,    .01651,
               1    .31416,    .01661,    .32987,    .01673,    .34559,
               1    .01688,    .36130,    .01705,    .37700,    .01725/
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/
               1    .39271,    .01747,    .40842,    .01771,    .42412,
               1    .01797,    .43983,    .01824,    .45553,    .01853,
               1    .47124,    .01884,    .48695,    .01916,    .50266,
               1    .01949,    .51837,    .01984,    .53407,    .02020,
               1    .54978,    .02058,    .56549,    .02097,    .58120,
               1    .02137,    .59691,    .02179,    .61261,    .02223,
               1    .62832,    .02268,    .64403,    .02315,    .65974,
               1    .02363,    .67545,    .02413,    .69116,    .02464,
               1    .70687,    .02517,    .72257,    .02571,    .73828,
               1    .02626,    .75399,    .02683,    .76969,    .02741/
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/
               1    .78540,    .02801,    .80111,    .02862,    .81682,
               1    .02924,    .83253,    .02988,    .84824,    .03052,
               1    .86395,    .03118,    .87965,    .03185,    .89536,
               1    .03253,    .91107,    .03323,    .92677,    .03393,
               1    .94248,    .03465,    .95819,    .03538,    .97390,
               1    .03611,    .98961,    .03686,   1.00532,    .03762,
               1   1.02103,    .03839,   1.03673,    .03917,   1.05244,
               1    .03995,   1.06815,    .04075,   1.08385,    .04156,
               1   1.09956,    .04237,   1.11527,    .04319,   1.13098,
               1    .04402,   1.14669,    .04486,   1.16240,    .04571/
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/
               1   1.17811,    .04657,   1.19381,    .04743,   1.20952,
               1    .04831,   1.22523,    .04919,   1.24093,    .05008,
               1   1.25664,    .05098,   1.27235,    .05189,   1.28806,
               1    .05280,   1.30376,    .05372,   1.31947,    .05464,
               1   1.33518,    .05556,   1.35089,    .05648,   1.36659,
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58200000
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     1    .05740,   1.38230,    .05831,   1.39801,    .05921,   62400000
     1   1.41372,    .06011,   1.42942,    .06099,   1.44513,   62500000
     1    .06187,   1.46084,    .06273,   1.47654,    .06357,   62600000
     1   1.49225,    .06440,   1.50796,    .06522,   1.52367,   62700000
     1    .06602,   1.53938,    .06681,   1.55509,    .06757/   62800000
000005   DATA (PHILD(I),EPSLD(I),I=101,125)/                     62900000
     1   1.57080,    .06832,   1.58650,    .06905,   1.60221,   63000000
     1    .06976,   1.61791,    .07044,   1.63362,    .07111,   63100000
     1   1.64933,    .07176,   1.66504,    .07238,   1.68075,   63200000
     1    .07298,   1.69646,    .07356,   1.71217,    .07411,   63300000
     1   1.72788,    .07464,   1.74358,    .07514,   1.75929,   63400000
     1    .07562,   1.77500,    .07607,   1.79070,    .07650,   63500000
     1   1.80641,    .07690,   1.82212,    .07727,   1.83783,   63600000
     1    .07761,   1.85354,    .07793,   1.86925,    .07822,   63700000
     1   1.88496,    .07848,   1.90067,    .07871,   1.91637,   63800000
     1    .07891,   1.93208,    .07908,   1.94779,    .07922/   63900000
000005   DATA (PHILD(I),EPSLD(I),I=126,150)/                     64000000
     1   1.96350,    .07933,   1.97921,    .07941,   1.99491,   64100000
     1    .07945,   2.01062,    .07946,   2.02633,    .07944,   64200000
     1   2.04204,    .07938,   2.05775,    .07929,   2.07346,   64300000
     1    .07916,   2.08917,    .07900,   2.10487,    .07880,   64400000
     1   2.12058,    .07856,   2.13629,    .07829,   2.15200,   64500000
     1    .07799,   2.16770,    .07764,   2.18341,    .07726,   64600000
     1   2.19911,    .07685,   2.21482,    .07640,   2.23054,   64700000
     1    .07591,   2.24625,    .07539,   2.26196,    .07483,   64800000
     1   2.27767,    .07423,   2.29338,    .07359,   2.30908,   64900000
     1    .07293,   2.32479,    .07222,   2.34049,    .07148/   65000000
000005   DATA (PHILD(I),EPSLD(I),I=151,175)/                     65100000
     1   2.35619,    .07070,   2.37191,    .06989,   2.38762,   65200000
     1    .06904,   2.40334,    .06815,   2.41905,    .06723,   65300000
     1   2.43476,    .06628,   2.45046,    .06529,   2.46617,   65400000
     1    .06427,   2.48187,    .06322,   2.49757,    .06214,   65500000
     1   2.51327,    .06103,   2.52899,    .05989,   2.54470,   65600000
     1    .05871,   2.56042,    .05751,   2.57613,    .05628,   65700000
     1   2.59184,    .05502,   2.60754,    .05374,   2.62325,   65800000
     1    .05243,   2.63895,    .05109,   2.65465,    .04973,   65900000
     1   2.67035,    .04834,   2.68607,    .04693,   2.70178,   66000000
     1    .04549,   2.71749,    .04404,   2.73320,    .04256/   66100000
000005   DATA (PHILD(I),EPSLD(I),I=176,201)/                     66200000
     1   2.74891,    .04106,   2.76462,    .03955,   2.78032,   66300000
     1    .03802,   2.79603,    .03647,   2.81173,    .03491,   66400000
     1   2.82743,    .03333,   2.84314,    .03174,   2.85885,   66500000
     1    .03014,   2.87456,    .02853,   2.89027,    .02690,   66600000
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        1   2.90598,    .02527,   2.92169,    .02363,   2.93740,          66700000
        1    .02198,   2.95310,    .02032,   2.96881,    .01865,          66800000
        1   2.98451,    .01698,   3.00022,    .01530,   3.01593,          66900000
        1    .01361,   3.03164,    .01192,   3.04735,    .01023,          67000000
        1   3.06305,    .00853,   3.07876,    .00683,   3.09447,          67100000
        1    .00512,   3.11018,    .00342,   3.12588,    .00171,          67200000
        1   3.14159,   0.00000/                                           67300000
000005       DO 201 J=1,201                                               67400000
000006       PHI(J)=PHILD(J)                                              67500000
000010   201 EPS(J)=EPSLD(J)                                              67600000
000014       RETURN                                                       67700000
000015       END                                                          67800000
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                SUBROUTINE PHEP63A(PHI,EPS)                                                    67900000
000005          DIMENSION PHI(1),EPS(1)                                                        68000000
000005          DIMENSION PHILD(251),EPSLD(251)                                                68100000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                                              68200000
               1   0.00000,   0.00000,    .01459,    .00138,    .02917,                       68300000
               1    .00276,    .04376,    .00413,    .05835,    .00548,                       68400000
               1    .07294,    .00683,    .08754,    .00815,    .10213,                       68500000
               1    .00945,    .11673,    .01072,    .13133,    .01196,                       68600000
               1    .14594,    .01317,    .14925,    .01344,    .15256,                       68700000
               1    .01370,    .15587,    .01396,    .15919,    .01421,                       68800000
               1    .16250,    .01445,    .16581,    .01469,    .16912,                       68900000
               1    .01490,    .17244,    .01510,    .17575,    .01529,                       69000000
               1    .17907,    .01546,    .18420,    .01568,    .18933,                       69100000
               1    .01585,    .19447,    .01599,    .19960,    .01610/                       69200000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                                              69300000
               1    .20474,    .01617,    .20988,    .01623,    .21501,                       69400000
               1    .01628,    .22015,    .01631,    .22529,    .01635,                       69500000
               1    .23043,    .01638,    .24002,    .01647,    .24960,                       69600000
               1    .01657,    .25918,    .01670,    .26877,    .01684,                       69700000
               1    .27835,    .01698,    .28793,    .01713,    .29751,                       69800000
               1    .01728,    .30709,    .01741,    .31667,    .01754,                       69900000
               1    .32626,    .01764,    .33981,    .01775,    .35335,                       70000000
               1    .01781,    .36691,    .01785,    .38046,    .01787,                       70100000
               1    .39401,    .01787,    .40756,    .01788,    .42111,                       70200000
               1    .01788,    .43466,    .01791,    .44821,    .01796/                       70300000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                                              70400000
               1    .46176,    .01804,    .47241,    .01814,    .48306,                       70500000
               1    .01826,    .49371,    .01841,    .50436,    .01857,                       70600000
               1    .51501,    .01875,    .52566,    .01895,    .53631,                       70700000
               1    .01917,    .54696,    .01939,    .55761,    .01963,                       70800000
               1    .56826,    .01987,    .57741,    .02009,    .58655,                       70900000
               1    .02031,    .59570,    .02053,    .60485,    .02075,                       71000000
               1    .61399,    .02098,    .62314,    .02121,    .63229,                       71100000
               1    .02144,    .64143,    .02168,    .65058,    .02192,                       71200000
               1    .65973,    .02216,    .67542,    .02257,    .69111,                       71300000
               1    .02299,    .70680,    .02342,    .72249,    .02385/                       71400000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                                             71500000
               1    .73818,    .02429,    .75386,    .02475,    .76955,                       71600000
               1    .02521,    .78524,    .02569,    .80093,    .02618,                       71700000
               1    .81662,    .02669,    .83032,    .02715,    .84402,                       71800000
               1    .02762,    .85772,    .02810,    .87143,    .02859,                       71900000
               1    .88513,    .02909,    .89883,    .02960,    .91253,                       72000000
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     1    .03011,    .92623,    .03063,    .93993,    .03115,    72100000
     1    .95363,    .03168,    .96612,    .03216,    .97860,    72200000
     1    .03265,    .99109,    .03314,   1.00358,    .03363,    72300000
     1   1.01607,    .03412,   1.02856,    .03462,   1.04104,    72400000
     1    .03513,   1.05353,    .03564,   1.06602,    .03616/    72500000
000005       DATA (PHILD(I),EPSLD(I),I=101,125)/                 72600000
     1   1.07850,    .03669,   1.09023,    .03719,   1.10196,    72700000
     1    .03769,   1.11369,    .03821,   1.12541,    .03873,    72800000
     1   1.13714,    .03925,   1.14887,    .03979,   1.16060,    72900000
     1    .04033,   1.17232,    .04087,   1.18405,    .04143,    73000000
     1   1.19577,    .04198,   1.20699,    .04253,   1.21821,    73100000
     1    .04307,   1.22942,    .04362,   1.24064,    .04418,    73200000
     1   1.25186,    .04473,   1.26307,    .04528,   1.27429,    73300000
     1    .04584,   1.28551,    .04639,   1.29672,    .04694,    73400000
     1   1.30794,    .04749,   1.31876,    .04801,   1.32958,    73500000
     1    .04853,   1.34041,    .04904,   1.35123,    .04955/    73600000
000005       DATA (PHILD(I),EPSLD(I),I=126,150)/                 73700000
     1   1.36205,    .05005,   1.37288,    .05056,   1.38370,    73800000
     1    .05106,   1.39453,    .05155,   1.40535,    .05205,    73900000
     1   1.41617,    .05254,   1.42675,    .05302,   1.43732,    74000000
     1    .05350,   1.44789,    .05398,   1.45847,    .05445,    74100000
     1   1.46904,    .05492,   1.47961,    .05538,   1.49019,    74200000
     1    .05585,   1.50076,    .05630,   1.51133,    .05676,    74300000
     1   1.52191,    .05721,   1.53232,    .05764,   1.54273,    74400000
     1    .05807,   1.55315,    .05850,   1.56356,    .05892,    74500000
     1   1.57397,    .05933,   1.58439,    .05973,   1.59480,    74600000
     1    .06012,   1.60522,    .06050,   1.61563,    .06088/    74700000
000005       DATA (PHILD(I),EPSLD(I),I=151,175)/                 74800000
     1   1.62605,    .06124,   1.63637,    .06158,   1.64669,    74900000
     1    .06192,   1.65701,    .06224,   1.66733,    .06255,    75000000
     1   1.67765,    .06286,   1.68797,    .06315,   1.69829,    75100000
     1    .06344,   1.70862,    .06372,   1.71894,    .06399,    75200000
     1   1.72926,    .06425,   1.73961,    .06451,   1.74996,    75300000
     1    .06476,   1.76031,    .06500,   1.77066,    .06523,    75400000
     1   1.78101,    .06546,   1.79136,    .06567,   1.80171,    75500000
     1    .06588,   1.81206,    .06608,   1.82241,    .06626,    75600000
     1   1.83276,    .06643,   1.84322,    .06660,   1.85368,    75700000
     1    .06675,   1.86414,    .06689,   1.87461,    .06702/    75800000
000005       DATA (PHILD(I),EPSLD(I),I=176,200)/                 75900000
     1   1.88507,    .06714,   1.89553,    .06724,   1.90600,    76000000
     1    .06733,   1.91646,    .06740,   1.92692,    .06746,    76100000
     1   1.93738,    .06751,   1.94807,    .06754,   1.95875,    76200000
     1    .06755,   1.96943,    .06756,   1.98011,    .06754,    76300000
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     1    1.99080,     .06752,    2.00148,     .06748,    2.01216,                76400000
     1     .06742,    2.02284,     .06736,    2.03353,     .06728,                76500000
     1    2.04421,     .06718,    2.05529,     .06707,    2.06637,                76600000
     1     .06695,    2.07745,     .06681,    2.08853,     .06667,                76700000
     1    2.09961,     .06650,    2.11068,     .06632,    2.12176,                76800000
     1     .06613,    2.13284,     .06593,    2.14392,     .06571/                76900000
000005       DATA (PHILD(I),EPSLD(I),I=201,225)/                                   77000000
     1    2.15500,     .06548,    2.16671,     .06522,    2.17842,                77100000
     1     .06494,    2.19013,     .06464,    2.20184,     .06434,                77200000
     1    2.21355,     .06401,    2.22526,     .06367,    2.23697,                77300000
     1     .06332,    2.24868,     .06295,    2.26038,     .06257,                77400000
     1    2.27209,     .06217,    2.28483,     .06173,    2.29758,                77500000
     1     .06126,    2.31032,     .06078,    2.32306,     .06029,                77600000
     1    2.33580,     .05979,    2.34855,     .05927,    2.36129,                77700000
     1     .05875,    2.37403,     .05821,    2.38677,     .05767,                77800000
     1    2.39951,     .05712,    2.41402,     .05648,    2.42853,                77900000
     1     .05583,    2.44304,     .05517,    2.45755,     .05448/                78000000
000005       DATA (PHILD(I),EPSLD(I),I=226,251)/                                   78100000
     1    2.47205,     .05376,    2.48656,     .05300,    2.50106,                78200000
     1     .05222,    2.51556,     .05138,    2.53005,     .05050,                78300000
     1    2.54455,     .04957,    2.56243,     .04834,    2.58031,                78400000
     1     .04703,    2.59819,     .04565,    2.61606,     .04421,                78500000
     1    2.63393,     .04273,    2.65180,     .04120,    2.66966,                78600000
     1     .03965,    2.68753,     .03807,    2.70539,     .03649,                78700000
     1    2.72325,     .03491,    2.76507,     .03125,    2.80690,                78800000
     1     .02764,    2.84873,     .02408,    2.89056,     .02056,                78900000
     1    2.93240,     .01708,    2.97423,     .01363,    3.01607,                79000000
     1     .01020,    3.05791,     .00679,    3.09975,     .00339,                79100000
     1    3.14159,    0.00000/                                                    79200000
000005       DO 201 J=1,201                                                        79300000
000006       PHI(J)=FLOAT(J-1)*3.141592654/200.                                    79400000
000013   201 CALL FTLOP(PHI(J),EPS(J),2,251,PHILD,EPSLD)                           79500000
000024       RETURN                                                                79600000
000025       END                                                                   79700000
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```
                SUBROUTINE PHEP64(PHI,EPS)                                      79800000
000005          DIMENSION PHI(1),EPS(1)                                         79900000
000005          DIMENSION PHILD(201),EPSLD(201)                                 80000000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                               80100000
               1   0.00000,   0.00000,    .01568,    .00233,    .03136,        80200000
               1    .00464,    .04705,    .00692,    .06274,    .00914,        80300000
               1    .07843,    .01129,    .09414,    .01336,    .10985,        80400000
               1    .01531,    .12558,    .01714,    .14132,    .01883,        80500000
               1    .15708,    .02035,    .17274,    .02169,    .18842,        80600000
               1    .02287,    .20411,    .02390,    .21981,    .02480,        80700000
               1    .23552,    .02557,    .25124,    .02624,    .26697,        80800000
               1    .02682,    .28270,    .02731,    .29843,    .02774,        80900000
               1    .31416,    .02812,    .32987,    .02846,    .34558,        81000000
               1    .02877,    .36129,    .02905,    .37700,    .02931/        81100000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                               81200000
               1    .39271,    .02957,    .40842,    .02982,    .42412,        81300000
               1    .03007,    .43983,    .03033,    .45553,    .03060,        81400000
               1    .47124,    .03090,    .48695,    .03122,    .50266,        81500000
               1    .03158,    .51837,    .03196,    .53408,    .03236,        81600000
               1    .54979,    .03280,    .56549,    .03326,    .58120,        81700000
               1    .03375,    .59691,    .03427,    .61262,    .03481,        81800000
               1    .62832,    .03538,    .64403,    .03598,    .65975,        81900000
               1    .03660,    .67546,    .03725,    .69117,    .03792,        82000000
               1    .70688,    .03862,    .72258,    .03935,    .73829,        82100000
               1    .04010,    .75399,    .04087,    .76970,    .04167/        82200000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                               82300000
               1    .78540,    .04250,    .80111,    .04335,    .81683,        82400000
               1    .04423,    .83254,    .04512,    .84825,    .04605,        82500000
               1    .86396,    .04699,    .87967,    .04796,    .89537,        82600000
               1    .04896,    .91108,    .04998,    .92678,    .05102,        82700000
               1    .94248,    .05208,    .95820,    .05317,    .97391,        82800000
               1    .05428,    .98962,    .05541,   1.00533,    .05657,        82900000
               1   1.02104,    .05774,   1.03675,    .05894,   1.05245,        83000000
               1    .06016,   1.06816,    .06140,   1.08386,    .06267,        83100000
               1   1.09956,    .06395,   1.11528,    .06526,   1.13099,        83200000
               1    .06658,   1.14671,    .06793,   1.16242,    .06931/        83300000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                              83400000
               1   1.17813,    .07070,   1.19384,    .07213,   1.20954,        83500000
               1    .07357,   1.22524,    .07505,   1.24094,    .07655,        83600000
               1   1.25664,    .07808,   1.27236,    .07964,   1.28807,        83700000
               1    .08123,   1.30378,    .08284,   1.31949,    .08447,        83800000
               1   1.33520,    .08613,   1.35091,    .08780,   1.36661,        83900000
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     1    .08949,   1.38232,    .09119,   1.39802,    .09290,          84000000
     1   1.41372,    .09462,   1.42942,    .09635,   1.44512,          84100000
     1    .09808,   1.46083,    .09980,   1.47653,    .10151,          84200000
     1   1.49223,    .10321,   1.50794,    .10488,   1.52365,          84300000
     1    .10653,   1.53936,    .10815,   1.55508,    .10972/          84400000
000005       DATA (PHILD(I),EPSLD(I),I=101,125)/                       84500000
     1   1.57080,    .11125,   1.58649,    .11273,   1.60218,          84600000
     1    .11415,   1.61788,    .11553,   1.63358,    .11686,          84700000
     1   1.64929,    .11814,   1.66500,    .11938,   1.68072,          84800000
     1    .12057,   1.69643,    .12171,   1.71216,    .12281,          84900000
     1   1.72788,    .12386,   1.74358,    .12487,   1.75928,          85000000
     1    .12583,   1.77498,    .12675,   1.79068,    .12762,          85100000
     1   1.80639,    .12844,   1.82210,    .12922,   1.83781,          85200000
     1    .12994,   1.85353,    .13062,   1.86924,    .13125,          85300000
     1   1.88496,    .13182,   1.90066,    .13234,   1.91637,          85400000
     1    .13281,   1.93207,    .13322,   1.94778,    .13358/          85500000
000005       DATA (PHILD(I),EPSLD(I),I=126,150)/                       85600000
     1   1.96349,    .13389,   1.97920,    .13414,   1.99491,          85700000
     1    .13434,   2.01062,    .13448,   2.02633,    .13456,          85800000
     1   2.04204,    .13459,   2.05775,    .13456,   2.07346,          85900000
     1    .13447,   2.08917,    .13433,   2.10488,    .13413,          86000000
     1   2.12059,    .13387,   2.13630,    .13354,   2.15200,          86100000
     1    .13316,   2.16771,    .13272,   2.18341,    .13222,          86200000
     1   2.19911,    .13166,   2.21483,    .13104,   2.23055,          86300000
     1    .13035,   2.24627,    .12960,   2.26198,    .12879,          86400000
     1   2.27770,    .12792,   2.29340,    .12698,   2.30911,          86500000
     1    .12598,   2.32481,    .12492,   2.34050,    .12380/          86600000
000005       DATA (PHILD(I),EPSLD(I),I=151,175)/                       86700000
     1   2.35619,    .12261,   2.37192,    .12136,   2.38765,          86800000
     1    .12004,   2.40337,    .11866,   2.41909,    .11722,          86900000
     1   2.43480,    .11572,   2.45051,    .11416,   2.46621,          87000000
     1    .11254,   2.48190,    .11087,   2.49759,    .10914,          87100000
     1   2.51327,    .10735,   2.52901,    .10550,   2.54474,          87200000
     1    .10360,   2.56047,    .10164,   2.57619,    .09963,          87300000
     1   2.59190,    .09757,   2.60760,    .09545,   2.62330,          87400000
     1    .09328,   2.63899,    .09105,   2.65467,    .08878,          87500000
     1   2.67035,    .08645,   2.68609,    .08406,   2.70182,          87600000
     1    .08162,   2.71755,    .07913,   2.73327,    .07660/          87700000
000005       DATA (PHILD(I),EPSLD(I),I=176,201)/                       87800000
     1   2.74898,    .07402,   2.76468,    .07139,   2.78038,          87900000
     1    .06873,   2.79607,    .06603,   2.81175,    .06329,          88000000
     1   2.82743,    .06052,   2.84316,    .05770,   2.85889,          88100000
     1    .05486,   2.87461,    .05198,   2.89032,    .04907,          88200000
```

APPENDIX

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88300000
88400000
88500000
88600000
88700000
88800000
88900000
89000000
89100000
89200000
89300000
89400000
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     1   2.90603,    .04614,   2.92173,    .04318,   2.93743,
     1    .04020,   2.95313,    .03720,   2.96882,    .03417,
     1   2.98451,    .03113,   3.00023,    .02807,   3.01594,
     1    .02499,   3.03165,    .02189,   3.04736,    .01879,
     1   3.06307,    .01567,   3.07878,    .01255,   3.09448,
     1    .00942,   3.11018,    .00628,   3.12589,    .00314,
     1   3.14159,   0.00000/
000005      DO 201 J=1,201
000006        PHI(J)=PHILD(J)
000010  201   EPS(J)=EPSLD(J)
000014        RETURN
000015        END
```

```
      SUBROUTINE PHEP64A(PHI,EPS)                                        89500000
000005      DIMENSION PHI(1),EPS(1)                                      89600000
000005      DIMENSION PHILD(251),EPSLD(251)                              89700000
000005      DATA (PHILD(I),EPSLD(I),I=1,25 )/                            89800000
     1   0.00000,   0.00000,    .01468,    .00149,    .02936,           89900000
     1    .00297,    .04403,    .00445,    .05872,    .00591,           90000000
     1    .07340,    .00736,    .08808,    .00878,    .10277,           90100000
     1    .01018,    .11746,    .01156,    .13216,    .01290,           90200000
     1    .14686,    .01420,    .15019,    .01449,    .15352,           90300000
     1    .01477,    .15685,    .01505,    .16018,    .01532,           90400000
     1    .16351,    .01558,    .16684,    .01583,    .17017,           90500000
     1    .01606,    .17350,    .01628,    .17684,    .01648,           90600000
     1    .18017,    .01667,    .18528,    .01690,    .19039,           90700000
     1    .01709,    .19551,    .01724,    .20062,    .01736/           90800000
000005      DATA (PHILD(I),EPSLD(I),I=26,50)/                            90900000
     1    .20574,    .01745,    .21086,    .01752,    .21598,           91000000
     1    .01758,    .22109,    .01762,    .22621,    .01767,           91100000
     1    .23133,    .01772,    .24090,    .01782,    .25046,           91200000
     1    .01796,    .26003,    .01811,    .26959,    .01828,           91300000
     1    .27915,    .01845,    .28871,    .01861,    .29827,           91400000
     1    .01877,    .30783,    .01891,    .31739,    .01903,           91500000
     1    .32695,    .01912,    .34040,    .01919,    .35384,           91600000
     1    .01920,    .36728,    .01916,    .38072,    .01908,           91700000
     1    .39417,    .01897,    .40761,    .01886,    .42105,           91800000
     1    .01874,    .43450,    .01862,    .44794,    .01854/           91900000
000005      DATA (PHILD(I),EPSLD(I),I=51,75)/                            92000000
     1    .46139,    .01848,    .47194,    .01846,    .48249,           92100000
     1    .01847,    .49304,    .01851,    .50359,    .01856,           92200000
     1    .51414,    .01864,    .52469,    .01873,    .53523,           92300000
     1    .01883,    .54578,    .01895,    .55633,    .01907,           92400000
     1    .56688,    .01921,    .57595,    .01933,    .58502,           92500000
     1    .01945,    .59410,    .01958,    .60317,    .01972,           92600000
     1    .61224,    .01985,    .62131,    .01999,    .63038,           92700000
     1    .02013,    .63945,    .02028,    .64852,    .02043,           92800000
     1    .65759,    .02058,    .67317,    .02084,    .68874,           92900000
     1    .02111,    .70432,    .02139,    .71989,    .02169/           93000000
000005      DATA (PHILD(I),EPSLD(I),I=76,100)/                           93100000
     1    .73546,    .02199,    .75104,    .02231,    .76661,           93200000
     1    .02264,    .78218,    .02299,    .79776,    .02335,           93300000
     1    .81333,    .02373,    .82695,    .02408,    .84057,           93400000
     1    .02444,    .85419,    .02482,    .86781,    .02520,           93500000
     1    .88142,    .02560,    .89504,    .02601,    .90866,           93600000
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     1    .02643,    .92228,    .02685,    .93589,    .02728,    93700000
     1    .94951,    .02772,    .96194,    .02812,    .97437,    93800000
     1    .02852,    .98679,    .02893,    .99922,    .02935,    93900000
     1   1.01165,    .02977,   1.02407,    .03020,   1.03650,    94000000
     1    .03064,   1.04892,    .03108,   1.06135,    .03153/    94100000
000005       DATA (PHILD(I),EPSLD(I),I=101,125)/                 94200000
     1   1.07377,    .03198,   1.08546,    .03242,   1.09714,    94300000
     1    .03286,   1.10882,    .03332,   1.12050,    .03378,    94400000
     1   1.13219,    .03425,   1.14387,    .03472,   1.15555,    94500000
     1    .03521,   1.16723,    .03571,   1.17891,    .03622,    94600000
     1   1.19059,    .03674,   1.20180,    .03724,   1.21301,    94700000
     1    .03776,   1.22423,    .03828,   1.23544,    .03882,    94800000
     1   1.24665,    .03936,   1.25786,    .03990,   1.26907,    94900000
     1    .04045,   1.28028,    .04100,   1.29149,    .04156,    95000000
     1   1.30270,    .04212,   1.31357,    .04266,   1.32444,    95100000
     1    .04320,   1.33531,    .04375,   1.34618,    .04429/    95200000
000005       DATA (PHILD(I),EPSLD(I),I=126,150)/                 95300000
     1   1.35705,    .04484,   1.36792,    .04539,   1.37878,    95400000
     1    .04594,   1.38965,    .04649,   1.40052,    .04704,    95500000
     1   1.41139,    .04760,   1.42204,    .04814,   1.43268,    95600000
     1    .04869,   1.44333,    .04923,   1.45397,    .04978,    95700000
     1   1.46462,    .05032,   1.47527,    .05087,   1.48591,    95800000
     1    .05141,   1.49656,    .05194,   1.50721,    .05248,    95900000
     1   1.51785,    .05301,   1.52834,    .05352,   1.53883,    96000000
     1    .05403,   1.54932,    .05454,   1.55980,    .05504,    96100000
     1   1.57029,    .05552,   1.58078,    .05600,   1.59127,    96200000
     1    .05647,   1.60176,    .05693,   1.61225,    .05738/    96300000
000005       DATA (PHILD(I),EPSLD(I),I=151,175)/                 96400000
     1   1.62274,    .05781,   1.63312,    .05822,   1.64349,    96500000
     1    .05862,   1.65387,    .05901,   1.66425,    .05939,    96600000
     1   1.67463,    .05976,   1.68501,    .06011,   1.69539,    96700000
     1    .06045,   1.70577,    .06079,   1.71615,    .06111,    96800000
     1   1.72653,    .06143,   1.73692,    .06174,   1.74732,    96900000
     1    .06204,   1.75771,    .06233,   1.76811,    .06262,    97000000
     1   1.77851,    .06289,   1.78890,    .06316,   1.79930,    97100000
     1    .06341,   1.80970,    .06365,   1.82009,    .06389,    97200000
     1   1.83049,    .06411,   1.84100,    .06432,   1.85150,    97300000
     1    .06452,   1.86201,    .06471,   1.87252,    .06489/    97400000
000005       DATA (PHILD(I),EPSLD(I),I=176,200)/                 97500000
     1   1.88303,    .06505,   1.89354,    .06520,   1.90405,    97600000
     1    .06534,   1.91455,    .06546,   1.92506,    .06557,    97700000
     1   1.93557,    .06567,   1.94630,    .06575,   1.95704,    97800000
     1    .06582,   1.96777,    .06587,   1.97850,    .06591,    97900000
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     1    1.98923,    .06594,   1.99996,    .06595,   2.01069,    98000000
     1     .06594,   2.02142,    .06593,   2.03215,    .06590,    98100000
     1    2.04286,    .06586,   2.05401,    .06580,   2.06514,    98200000
     1     .06573,   2.07627,    .06565,   2.08740,    .06555,    98300000
     1    2.09853,    .06544,   2.10965,    .06531,   2.12078,    98400000
     1     .06517,   2.13191,    .06502,   2.14304,    .06485/    98500000
000005       DATA (PHILD(I),EPSLD(I),I=201,225)/                  98600000
     1    2.15416,    .06466,   2.16592,    .06445,   2.17767,    98700000
     1     .06422,   2.18943,    .06398,   2.20118,    .06371,    98800000
     1    2.21293,    .06344,   2.22469,    .06314,   2.23644,    98900000
     1     .06283,   2.24819,    .06251,   2.25994,    .06216,    99000000
     1    2.27169,    .06180,   2.28447,    .06140,   2.29725,    99100000
     1     .06097,   2.31002,    .06053,   2.32279,    .06007,    99200000
     1    2.33557,    .05960,   2.34834,    .05912,   2.36111,    99300000
     1     .05862,   2.37389,    .05811,   2.38666,    .05760,    99400000
     1    2.39943,    .05707,   2.41397,    .05646,   2.42850,    99500000
     1     .05584,   2.44304,    .05520,   2.45757,    .05454/    99600000
000005       DATA (PHILD(I),EPSLD(I),I=226,251)/                  99700000
     1    2.47210,    .05384,   2.48663,    .05312,   2.50115,    99800000
     1     .05235,   2.51568,    .05154,   2.53020,    .05068,    99900000
     1    2.54471,    .04977,   2.56262,    .04856,   2.58052,   100000000
     1     .04728,   2.59842,    .04592,   2.61631,    .04451,   100100000
     1    2.63420,    .04304,   2.65209,    .04154,   2.66997,   100200000
     1     .04000,   2.68785,    .03844,   2.70573,    .03687,   100300000
     1    2.72362,    .03530,   2.76541,    .03165,   2.80720,   100400000
     1     .02804,   2.84899,    .02446,   2.89079,    .02091,   100500000
     1    2.93259,    .01739,   2.97439,    .01389,   3.01619,   100600000
     1     .01040,   3.05799,    .00693,   3.09979,    .00346,   100700000
     1    3.14159,   0.00000/                                    100800000
000005       DO 201 J=1,201                                      100900000
000006       PHI(J)=FLOAT(J-1)*3.14592654/200.                   101000000
000013   201 CALL FTLOP(PHI(J),EPS(J),2,251,PHILD,EPSLD)         101100000
000024       RETURN                                              101200000
000025       END                                                 101300000
```

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                SUBROUTINE PHEP65(PHI,EPS)                                                    101400000
000005          DIMENSION PHI(1),EPS(1)                                                       101500000
000005          DIMENSION PHILD(251),EPSLD(251)                                               101600000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                                             101700000
               1   0.00000,   0.00000,    .01484,    .00156,    .02967,                      101800000
               1    .00312,    .04451,    .00466,    .05935,    .00618,                      101900000
               1    .07420,    .00767,    .08904,    .00913,    .10389,                      102000000
               1    .01054,    .11875,    .01191,    .13361,    .01322,                      102100000
               1    .14848,    .01446,    .15175,    .01473,    .15503,                      102200000
               1    .01499,    .15830,    .01524,    .16157,    .01549,                      102300000
               1    .16485,    .01572,    .16812,    .01595,    .17140,                      102400000
               1    .01616,    .17468,    .01636,    .17795,    .01655,                      102500000
               1    .18123,    .01671,    .18623,    .01693,    .19123,                      102600000
               1    .01712,    .19623,    .01727,    .20123,    .01740/                      102700000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                                             102800000
               1    .20623,    .01750,    .21124,    .01759,    .21624,                      102900000
               1    .01766,    .22124,    .01773,    .22625,    .01780,                      103000000
               1    .23125,    .01788,    .24072,    .01804,    .25018,                      103100000
               1    .01822,    .25964,    .01842,    .26910,    .01863,                      103200000
               1    .27855,    .01884,    .28802,    .01903,    .29748,                      103300000
               1    .01920,    .30694,    .01934,    .31640,    .01945,                      103400000
               1    .32586,    .01950,    .33918,    .01949,    .35250,                      103500000
               1    .01938,    .36582,    .01919,    .37915,    .01895,                      103600000
               1    .39247,    .01866,    .40580,    .01836,    .41912,                      103700000
               1    .01805,    .43245,    .01775,    .44577,    .01749/                      103800000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                                             103900000
               1    .45910,    .01728,    .46962,    .01716,    .48015,                      104000000
               1    .01708,    .49068,    .01703,    .50120,    .01702,                      104100000
               1    .51173,    .01704,    .52226,    .01708,    .53278,                      104200000
               1    .01714,    .54331,    .01722,    .55384,    .01731,                      104300000
               1    .56436,    .01741,    .57344,    .01751,    .58252,                      104400000
               1    .01760,    .59160,    .01771,    .60068,    .01782,                      104500000
               1    .60976,    .01794,    .61884,    .01806,    .62792,                      104600000
               1    .01820,    .63700,    .01834,    .64607,    .01850,                      104700000
               1    .65515,    .01867,    .67086,    .01898,    .68656,                      104800000
               1    .01933,    .70226,    .01971,    .71797,    .02012/                      104900000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                                            105000000
               1    .73367,    .02055,    .74937,    .02100,    .76508,                      105100000
               1    .02147,    .78078,    .02196,    .79648,    .02246,                      105200000
               1    .81218,    .02298,    .82590,    .02343,    .83962,                      105300000
               1    .02390,    .85333,    .02437,    .86705,    .02485,                      105400000
               1    .88077,    .02534,    .89448,    .02584,    .90820,                      105500000
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     1    .02636,    .92192,    .02689,    .93563,    .02744,   105600000
     1    .94934,    .02800,    .96192,    .02853,    .97449,   105700000
     1    .02907,    .98706,    .02963,    .99964,    .03020,   105800000
     1   1.01221,    .03078,   1.02478,    .03137,   1.03735,   105900000
     1    .03198,   1.04992,    .03259,   1.06249,    .03321/   106000000
000005       DATA (PHILD(I),EPSLD(I),I=101,125)/                106100000
     1   1.07506,    .03385,   1.08689,    .03445,   1.09872,   106200000
     1    .03506,   1.11055,    .03568,   1.12238,    .03631,   106300000
     1   1.13421,    .03694,   1.14603,    .03759,   1.15786,   106400000
     1    .03824,   1.16969,    .03890,   1.18151,    .03957,   106500000
     1   1.19334,    .04025,   1.20469,    .04091,   1.21605,   106600000
     1    .04158,   1.22740,    .04225,   1.23876,    .04294,   106700000
     1   1.25011,    .04363,   1.26146,    .04434,   1.27281,   106800000
     1    .04505,   1.28416,    .04577,   1.29551,    .04650,   106900000
     1   1.30686,    .04724,   1.31793,    .04798,   1.32900,   107000000
     1    .04872,   1.34007,    .04947,   1.35114,    .05023/   107100000
000005       DATA (PHILD(I),EPSLD(I),I=126,150)/                107200000
     1   1.36221,    .05099,   1.37328,    .05177,   1.38434,   107300000
     1    .05255,   1.39541,    .05334,   1.40648,    .05414,   107400000
     1   1.41754,    .05495,   1.42845,    .05575,   1.43935,   107500000
     1    .05655,   1.45025,    .05737,   1.46116,    .05819,   107600000
     1   1.47206,    .05901,   1.48296,    .05984,   1.49387,   107700000
     1    .06067,   1.50477,    .06150,   1.51567,    .06233,   107800000
     1   1.52657,    .06316,   1.53737,    .06399,   1.54816,   107900000
     1    .06481,   1.55896,    .06563,   1.56975,    .06645,   108000000
     1   1.58055,    .06727,   1.59134,    .06808,   1.60214,   108100000
     1    .06889,   1.61293,    .06969,   1.62373,    .07049/   108200000
000005       DATA (PHILD(I),EPSLD(I),I=151,175)/                108300000
     1   1.63452,    .07127,   1.64525,    .07205,   1.65598,   108400000
     1    .07282,   1.66671,    .07358,   1.67744,    .07433,   108500000
     1   1.68817,    .07507,   1.69890,    .07580,   1.70963,   108600000
     1    .07651,   1.72036,    .07722,   1.73109,    .07792,   108700000
     1   1.74182,    .07861,   1.75254,    .07928,   1.76325,   108800000
     1    .07994,   1.77396,    .08058,   1.78468,    .08121,   108900000
     1   1.79539,    .08182,   1.80611,    .08242,   1.81683,   109000000
     1    .08299,   1.82754,    .08355,   1.83826,    .08408,   109100000
     1   1.84898,    .08459,   1.85972,    .08508,   1.87046,   109200000
     1    .08555,   1.88120,    .08599,   1.89194,    .08641/   109300000
000005       DATA (PHILD(I),EPSLD(I),I=176,200)/                109400000
     1   1.90268,    .08680,   1.91343,    .08718,   1.92417,   109500000
     1    .08754,   1.93491,    .08787,   1.94566,    .08819,   109600000
     1   1.95640,    .08848,   1.96732,    .08876,   1.97823,   109700000
     1    .08903,   1.98915,    .08927,   2.00006,    .08949,   109800000
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     1   2.01098,    .08969,   2.02190,    .08988,   2.03282,    109900000
     1    .09004,   2.04373,    .09019,   2.05465,    .09031,    110000000
     1   2.06557,    .09041,   2.07682,    .09050,   2.08806,    110100000
     1    .09056,   2.09931,    .09061,   2.11056,    .09062,    110200000
     1   2.12180,    .09061,   2.13305,    .09058,   2.14429,    110300000
     1    .09052,   2.15554,    .09043,   2.16679,    .09032/    110400000
000005       DATA (PHILD(I),EPSLD(I),I=201,225)/                 110500000
     1   2.17803,    .09017,   2.18979,    .08999,   2.20155,    110600000
     1    .08977,   2.21330,    .08953,   2.22506,    .08925,    110700000
     1   2.23681,    .08894,   2.24856,    .08861,   2.26032,    110800000
     1    .08824,   2.27207,    .08785,   2.28382,    .08743,    110900000
     1   2.29557,    .08698,   2.30822,    .08647,   2.32088,    111000000
     1    .08593,   2.33353,    .08536,   2.34618,    .08477,    111100000
     1   2.35883,    .08414,   2.37148,    .08348,   2.38412,    111200000
     1    .08279,   2.39677,    .08208,   2.40942,    .08134,    111300000
     1   2.42206,    .08056,   2.43618,    .07967,   2.45029,    111400000
     1    .07872,   2.46440,    .07772,   2.47851,    .07666/    111500000
000005       DATA (PHILD(I),EPSLD(I),I=226,251)/                 111600000
     1   2.49260,    .07552,   2.50669,    .07429,   2.52077,    111700000
     1    .07297,   2.53483,    .07155,   2.54888,    .07000,    111800000
     1   2.56292,    .06833,   2.57978,    .06615,   2.59661,    111900000
     1    .06380,   2.61343,    .06132,   2.63024,    .05873,    112000000
     1   2.64704,    .05606,   2.66383,    .05334,   2.68062,    112100000
     1    .05060,   2.69740,    .04788,   2.71420,    .04519,    112200000
     1   2.73100,    .04258,   2.77185,    .03664,   2.81276,    112300000
     1    .03122,   2.85373,    .02628,   2.89475,    .02176,    112400000
     1   2.93582,    .01759,   2.97693,    .01371,   3.01807,    112500000
     1    .01008,   3.05923,    .00662,   3.10041,    .00328,    112600000
     1   3.14159,   0.00000/                                     112700000
000005       DO 201 J=1,201                                      112800000
000006       PHI(J)=FLOAT(J-1)*3.141592654/200.                  112900000
000013   201 CALL FTLUP(PHI(J),EPS(J),2,251,PHILD,EPSLD)         113000000
000024       RETURN                                              113100000
000025       END                                                 113200000
```

```
                SUBROUTINE PHEP65A(PHI,EPS)                                                    113300000
000005          DIMENSION PHI(1),EPS(1)                                                        113400000
000005          DIMENSION PHILD(251),EPSLD(251)                                                113500000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                                              113600000
               1    0.00000,    0.00000,    .01453,    .00137,    .02907,                     113700000
               1     .00274,     .04360,    .00410,    .05814,    .00545,                     113800000
               1     .07267,     .00679,    .08721,    .00811,    .10175,                     113900000
               1     .00941,     .11630,    .01070,    .13084,    .01195,                     114000000
               1     .14539,     .01318,    .14877,    .01346,    .15214,                     114100000
               1     .01374,     .15552,    .01401,    .15889,    .01427,                     114200000
               1     .16227,     .01453,    .16564,    .01477,    .16902,                     114300000
               1     .01500,     .17240,    .01521,    .17578,    .01541,                     114400000
               1     .17916,     .01559,    .18436,    .01583,    .18956,                     114500000
               1     .01602,     .19477,    .01618,    .19997,    .01630/                     114600000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                                              114700000
               1     .20518,     .01640,    .21039,    .01648,    .21559,                     114800000
               1     .01654,     .22080,    .01660,    .22601,    .01665,                     114900000
               1     .23122,     .01671,    .24077,    .01683,    .25032,                     115000000
               1     .01698,     .25987,    .01715,    .26941,    .01732,                     115100000
               1     .27896,     .01749,    .28851,    .01766,    .29805,                     115200000
               1     .01782,     .30760,    .01796,    .31714,    .01807,                     115300000
               1     .32669,     .01814,    .33996,    .01819,    .35322,                     115400000
               1     .01816,     .36649,    .01807,    .37976,    .01793,                     115500000
               1     .39302,     .01775,    .40629,    .01755,    .41956,                     115600000
               1     .01732,     .43283,    .01708,    .44610,    .01684/                     115700000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                                              115800000
               1     .45937,     .01661,    .46976,    .01644,    .48015,                     115900000
               1     .01628,     .49054,    .01614,    .50093,    .01601,                     116000000
               1     .51132,     .01589,    .52171,    .01578,    .53210,                     116100000
               1     .01569,     .54249,    .01561,    .55288,    .01554,                     116200000
               1     .56327,     .01549,    .57223,    .01546,    .58118,                     116300000
               1     .01543,     .59014,    .01541,    .59909,    .01541,                     116400000
               1     .60805,     .01541,    .61700,    .01542,    .62596,                     116500000
               1     .01544,     .63491,    .01547,    .64387,    .01551,                     116600000
               1     .65282,     .01555,    .66829,    .01565,    .68376,                     116700000
               1     .01577,     .69923,    .01590,    .71470,    .01607/                     116800000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                                             116900000
               1     .73017,     .01625,    .74564,    .01645,    .76110,                     117000000
               1     .01668,     .77657,    .01693,    .79204,    .01720,                     117100000
               1     .80750,     .01750,    .82106,    .01778,    .83461,                     117200000
               1     .01807,     .84816,    .01837,    .86172,    .01869,                     117300000
               1     .87527,     .01902,    .88882,    .01936,    .90237,                     117400000
```

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     1    .01970,    .91593,    .02005,    .92948,    .02040,  117500000
     1    .94303,    .02076,    .95538,    .02108,    .96772,  117600000
     1    .02141,    .98007,    .02174,    .99242,    .02207,  117700000
     1   1.00476,    .02240,   1.01711,    .02274,   1.02945,  117800000
     1    .02309,   1.04180,    .02344,   1.05415,    .02381/  117900000
000005       DATA (PHILD(I),EPSLD(I),I=101,125)/               118000000
     1   1.06649,    .02418,   1.07810,    .02454,   1.08971,  118100000
     1    .02491,   1.10132,    .02528,   1.11293,    .02567,  118200000
     1   1.12454,    .02607,   1.13615,    .02647,   1.14776,  118300000
     1    .02689,   1.15937,    .02731,   1.17098,    .02775,  118400000
     1   1.18259,    .02819,   1.19373,    .02863,   1.20486,  118500000
     1    .02907,   1.21600,    .02952,   1.22713,    .02998,  118600000
     1   1.23827,    .03044,   1.24940,    .03091,   1.26054,  118700000
     1    .03138,   1.27167,    .03185,   1.28281,    .03232,  118800000
     1   1.29394,    .03280,   1.30473,    .03326,   1.31552,  118900000
     1    .03371,   1.32631,    .03417,   1.33711,    .03463/  119000000
000005       DATA (PHILD(I),EPSLD(I),I=126,150)/               119100000
     1   1.34790,    .03510,   1.35869,    .03557,   1.36946,  119200000
     1    .03604,   1.38027,    .03652,   1.39106,    .03701,  119300000
     1   1.40185,    .03750,   1.41248,    .03800,   1.42312,  119400000
     1    .03851,   1.43375,    .03902,   1.44438,    .03954,  119500000
     1   1.45501,    .04007,   1.46564,    .04060,   1.47628,  119600000
     1    .04114,   1.48691,    .04169,   1.49754,    .04224,  119700000
     1   1.50817,    .04279,   1.51872,    .04335,   1.52927,  119800000
     1    .04391,   1.53983,    .04447,   1.55038,    .04502,  119900000
     1   1.56093,    .04558,   1.57148,    .04614,   1.58203,  120000000
     1    .04669,   1.59258,    .04723,   1.60314,    .04777/  120100000
000005       DATA (PHILD(I),EPSLD(I),I=151,175)/               120200000
     1   1.61369,    .04830,   1.62418,    .04882,   1.63467,  120300000
     1    .04933,   1.64516,    .04984,   1.65565,    .05033,  120400000
     1   1.66614,    .05082,   1.67663,    .05130,   1.68712,  120500000
     1    .05177,   1.69762,    .05224,   1.70811,    .05270,  120600000
     1   1.71860,    .05316,   1.72914,    .05361,   1.73967,  120700000
     1    .05406,   1.75020,    .05449,   1.76074,    .05493,  120800000
     1   1.77127,    .05535,   1.78181,    .05577,   1.79234,  120900000
     1    .05618,   1.80288,    .05657,   1.81341,    .05696,  121000000
     1   1.82395,    .05734,   1.83460,    .05771,   1.84526,  121100000
     1    .05807,   1.85591,    .05842,   1.86657,    .05876/  121200000
000005       DATA (PHILD(I),EPSLD(I),I=176,200)/               121300000
     1   1.87722,    .05908,   1.88788,    .05939,   1.89853,  121400000
     1    .05969,   1.90919,    .05997,   1.91985,    .06023,  121500000
     1   1.93050,    .06049,   1.94138,    .06073,   1.95225,  121600000
     1    .06095,   1.96313,    .06116,   1.97401,    .06135,  121700000
```

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     1    1.98488,     .06153,    1.99576,     .06170,    2.00664,    121800000
     1     .06185,    2.01751,     .06199,    2.02839,     .06212,    121900000
     1    2.03927,     .06224,    2.04786,     .06232,    2.05645,    122000000
     1     .06240,    2.06504,     .06247,    2.07363,     .06254,    122100000
     1    2.08222,     .06259,    2.09081,     .06264,    2.09940,    122200000
     1     .06268,    2.10799,     .06272,    2.11658,     .06274/    122300000
000005       DATA (PHILD(I),EPSLD(I),I=201,225)/                      122400000
     1    2.12517,     .06276,    2.13979,     .06277,    2.15441,    122500000
     1     .06275,    2.16903,     .06271,    2.18365,     .06264,    122600000
     1    2.19826,     .06255,    2.21288,     .06242,    2.22750,    122700000
     1     .06226,    2.24211,     .06207,    2.25673,     .06185,    122800000
     1    2.27134,     .06159,    2.28424,     .06134,    2.29714,    122900000
     1     .06106,    2.31003,     .06075,    2.32292,     .06042,    123000000
     1    2.33582,     .06007,    2.34871,     .05970,    2.36160,    123100000
     1     .05932,    2.37449,     .05891,    2.38739,     .05850,    123200000
     1    2.40028,     .05807,    2.41490,     .05756,    2.42952,    123300000
     1     .05704,    2.44413,     .05650,    2.45875,     .05592/    123400000
000005       DATA (PHILD(I),EPSLD(I),I=226,251)/                      123500000
     1    2.47336,     .05531,    2.48798,     .05466,    2.50259,    123600000
     1     .05397,    2.51719,     .05323,    2.53180,     .05244,    123700000
     1    2.54640,     .05159,    2.56435,     .05046,    2.58229,    123800000
     1     .04925,    2.60023,     .04795,    2.61816,     .04659,    123900000
     1    2.63610,     .04517,    2.65402,     .04370,    2.67195,    124000000
     1     .04220,    2.68987,     .04065,    2.70779,     .03909,    124100000
     1    2.72571,     .03751,    2.76731,     .03383,    2.80891,    124200000
     1     .03013,    2.85050,     .02640,    2.89209,     .02266,    124300000
     1    2.93368,     .01891,    2.97526,     .01514,    3.01684,    124400000
     1     .01136,    3.05843,     .00758,    3.10001,     .00379,    124500000
     1    3.14159,    0.00000/                                        124600000
000005       DO 201 J=1,201                                           124700000
000006       PHI(J)=FLOAT(J-1)*3.14592654/200.                        124800000
000013   201 CALL FTLUP(PHI(J),EPS(J),2,251,PHILD,EPSLD)              124900000
000024       RETURN                                                   125000000
000025       END                                                      125100000
```

```
                SUBROUTINE PHEP66(PHI,EPS)                                      125200000
000005          DIMENSION PHI(1),EPS(1)                                         125300000
000005          DIMENSION PHILD(201),EPSLD(201)                                 125400000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                               125500000
               1   0.00000,   0.00000,    .01570,    .00145,    .03139,        125600000
               1    .00290,    .04709,    .00433,    .06279,    .00574,        125700000
               1    .07849,    .00712,    .09420,    .00847,    .10991,        125800000
               1    .00978,    .12563,    .01105,    .14135,    .01225,        125900000
               1    .15708,    .01340,    .17277,    .01447,    .18847,        126000000
               1    .01547,    .20417,    .01638,    .21987,    .01719,        126100000
               1    .23559,    .01789,    .25130,    .01847,    .26701,        126200000
               1    .01893,    .28273,    .01924,    .29844,    .01940,        126300000
               1    .31416,    .01940,    .32987,    .01924,    .34558,        126400000
               1    .01893,    .36129,    .01850,    .37699,    .01799/        126500000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                               126600000
               1    .39270,    .01741,    .40841,    .01679,    .42411,        126700000
               1    .01616,    .43982,    .01556,    .45553,    .01499,        126800000
               1    .47124,    .01450,    .48694,    .01410,    .50265,        126900000
               1    .01379,    .51836,    .01356,    .53406,    .01340,        127000000
               1    .54977,    .01331,    .56548,    .01327,    .58119,        127100000
               1    .01328,    .59690,    .01333,    .61261,    .01340,        127200000
               1    .62832,    .01350,    .64403,    .01361,    .65974,        127300000
               1    .01373,    .67545,    .01387,    .69116,    .01402,        127400000
               1    .70686,    .01419,    .72257,    .01438,    .73828,        127500000
               1    .01458,    .75399,    .01480,    .76969,    .01504/        127600000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                               127700000
               1    .78540,    .01530,    .80111,    .01558,    .81682,        127800000
               1    .01588,    .83253,    .01620,    .84824,    .01654,        127900000
               1    .86394,    .01689,    .87965,    .01726,    .89536,        128000000
               1    .01765,    .91107,    .01805,    .92677,    .01847,        128100000
               1    .94248,    .01890,    .95819,    .01934,    .97390,        128200000
               1    .01980,    .98961,    .02026,   1.00532,    .02074,        128300000
               1   1.02103,    .02124,   1.03673,    .02174,   1.05244,        128400000
               1    .02226,   1.06815,    .02279,   1.08385,    .02334,        128500000
               1   1.09956,    .02390,   1.11527,    .02447,   1.13098,        128600000
               1    .02506,   1.14669,    .02566,   1.16240,    .02627/        128700000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                              128800000
               1   1.17811,    .02690,   1.19381,    .02754,   1.20952,        128900000
               1    .02819,   1.22523,    .02885,   1.24093,    .02952,        129000000
               1   1.25664,    .03020,   1.27235,    .03089,   1.28806,        129100000
               1    .03160,   1.30377,    .03231,   1.31948,    .03304,        129200000
               1   1.33519,    .03378,   1.35090,    .03453,   1.36660,        129300000
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     1    .03530,   1.38231,    .03608,   1.39802,    .03688,                129400000
     1   1.41372,    .03770,   1.42943,    .03853,   1.44514,                129500000
     1    .03938,   1.46085,    .04025,   1.47656,    .04113,                129600000
     1   1.49227,    .04202,   1.50798,    .04293,   1.52368,                129700000
     1    .04386,   1.53939,    .04479,   1.55510,    .04574/                129800000
000005      DATA (PHILD(I),EPSLD(I),I=101,125)/                               129900000
     1   1.57080,    .04670,   1.58651,    .04767,   1.60223,                130000000
     1    .04866,   1.61794,    .04966,   1.63365,    .05067,                130100000
     1   1.64936,    .05171,   1.66507,    .05277,   1.68077,                130200000
     1    .05386,   1.69648,    .05498,   1.71218,    .05612,                130300000
     1   1.72788,    .05730,   1.74359,    .05851,   1.75931,                130400000
     1    .05976,   1.77501,    .06103,   1.79072,    .06231,                130500000
     1   1.80643,    .06362,   1.82214,    .06493,   1.83784,                130600000
     1    .06625,   1.85355,    .06758,   1.86925,    .06889,                130700000
     1   1.88496,    .07020,   1.90066,    .07149,   1.91636,                130800000
     1    .07277,   1.93206,    .07402,   1.94776,    .07524/                130900000
000005      DATA (PHILD(I),EPSLD(I),I=126,150)/                               131000000
     1   1.96347,    .07644,   1.97918,    .07760,   1.99489,                131100000
     1    .07872,   2.01060,    .07979,   2.02632,    .08082,                131200000
     1   2.04204,    .08180,   2.05773,    .08272,   2.07343,                131300000
     1    .08359,   2.08913,    .08440,   2.10484,    .08515,                131400000
     1   2.12054,    .08585,   2.13625,    .08649,   2.15196,                131500000
     1    .08708,   2.16768,    .08761,   2.18339,    .08808,                131600000
     1   2.19911,    .08850,   2.21482,    .08886,   2.23052,                131700000
     1    .08916,   2.24623,    .08941,   2.26194,    .08959,                131800000
     1   2.27765,    .08972,   2.29336,    .08978,   2.30906,                131900000
     1    .08978,   2.32477,    .08972,   2.34048,    .08959/                132000000
000005      DATA (PHILD(I),EPSLD(I),I=151,175)/                               132100000
     1   2.35619,    .08940,   2.37191,    .08914,   2.38762,                132200000
     1    .08882,   2.40333,    .08843,   2.41905,    .08797,                132300000
     1   2.43476,    .08745,   2.45046,    .08687,   2.46617,                132400000
     1    .08622,   2.48187,    .08551,   2.49757,    .08474,                132500000
     1   2.51327,    .08390,   2.52900,    .08300,   2.54473,                132600000
     1    .08203,   2.56045,    .08101,   2.57616,    .07991,                132700000
     1   2.59188,    .07875,   2.60758,    .07752,   2.62328,                132800000
     1    .07622,   2.63898,    .07485,   2.65467,    .07341,                132900000
     1   2.67035,    .07190,   2.68609,    .07031,   2.70183,                133000000
     1    .06864,   2.71756,    .06691,   2.73328,    .06510/                133100000
000005      DATA (PHILD(I),EPSLD(I),I=176,201)/                               133200000
     1   2.74899,    .06323,   2.76469,    .06129,   2.78039,                133300000
     1    .05928,   2.79608,    .05722,   2.81176,    .05509,                133400000
     1   2.82743,    .05290,   2.84317,    .05064,   2.85891,                133500000
     1    .04833,   2.87463,    .04596,   2.89035,    .04354,                133600000
```

APPENDIX

```
000005      1   2.90606,    .04108,   2.92176,    .03856,   2.93746,
000006      1    .03601,   2.95315,    .03341,   2.96883,    .03077,
000010      1   2.98451,    .02810,   3.00023,    .02539,   3.01595,
000014      1    .02264,   3.03167,    .01987,   3.04738,    .01707,
000015      1   3.06309,    .01426,   3.07879,    .01143,   3.09449,
            1    .00858,   3.11019,    .00573,   3.12589,    .00287,
            1   3.14159,   0.00000/
                DO 201 J=1,201
                PHI(J)=PHILD(J)
            201 EPS(J)=EPSLD(J)
                RETURN
                END
```

```
133700000
133800000
133900000
134000000
134100000
134200000
134300000
134400000
134500000
134600000
134700000
134800000
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000005          SUBROUTINE PHEP67(PHI,EPS)                                      134900000
000005          DIMENSION PHI(1),EPS(1)                                         135000000
000005          DIMENSION PHILD(251),EPSLD(251)                                 135100000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                               135200000
               1   0.00000,   0.00000,    .01495,    .00161,    .02990,        135300000
               1    .00322,    .04485,    .00482,    .05980,    .00640,        135400000
               1    .07476,    .00796,    .08971,    .00949,    .10468,        135500000
               1    .01100,    .11964,    .01246,    .13461,    .01388,        135600000
               1    .14959,    .01525,    .15280,    .01554,    .15601,        135700000
               1    .01582,    .15922,    .01610,    .16243,    .01637,        135800000
               1    .16565,    .01664,    .16886,    .01690,    .17207,        135900000
               1    .01714,    .17529,    .01738,    .17850,    .01761,        136000000
               1    .18172,    .01782,    .18687,    .01813,    .19201,        136100000
               1    .01841,    .19716,    .01865,    .20231,    .01888/        136200000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                               136300000
               1    .20747,    .01908,    .21262,    .01927,    .21777,        136400000
               1    .01945,    .22293,    .01962,    .22808,    .01979,        136500000
               1    .23323,    .01996,    .24276,    .02029,    .25229,        136600000
               1    .02063,    .26182,    .02097,    .27135,    .02131,        136700000
               1    .28088,    .02164,    .29041,    .02195,    .29994,        136800000
               1    .02224,    .30947,    .02249,    .31900,    .02269,        136900000
               1    .32853,    .02285,    .34180,    .02298,    .35507,        137000000
               1    .02301,    .36834,    .02296,    .38162,    .02284,        137100000
               1    .39489,    .02267,    .40817,    .02245,    .42144,        137200000
               1    .02220,    .43472,    .02194,    .44799,    .02168/        137300000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                               137400000
               1    .46127,    .02143,    .47164,    .02125,    .48201,        137500000
               1    .02108,    .49238,    .02093,    .50274,    .02079,        137600000
               1    .51311,    .02067,    .52348,    .02055,    .53385,        137700000
               1    .02045,    .54422,    .02035,    .55458,    .02026,        137800000
               1    .56495,    .02017,    .57385,    .02010,    .58275,        137900000
               1    .02004,    .59165,    .01998,    .60055,    .01992,        138000000
               1    .60945,    .01987,    .61835,    .01983,    .62725,        138100000
               1    .01979,    .63615,    .01975,    .64505,    .01972,        138200000
               1    .65395,    .01970,    .66928,    .01967,    .68461,        138300000
               1    .01966,    .69994,    .01967,    .71527,    .01969/        138400000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                              138500000
               1    .73060,    .01973,    .74593,    .01978,    .76126,        138600000
               1    .01985,    .77658,    .01992,    .79191,    .02001,        138700000
               1    .80724,    .02010,    .82061,    .02019,    .83397,        138800000
               1    .02029,    .84734,    .02039,    .86070,    .02051,        138900000
               1    .87407,    .02062,    .88743,    .02075,    .90080,        139000000
```

APPENDIX

```
      1    .02088,    .91416,    .02102,    .92753,    .02117,  139100000
      1    .94089,    .02133,    .95309,    .02148,    .96530,  139200000
      1    .02164,    .97750,    .02180,    .98970,    .02198,  139300000
      1   1.00190,    .02216,   1.01410,    .02234,   1.02630,  139400000
      1    .02254,   1.03850,    .02274,   1.05070,    .02295/  139500000
000005  DATA (PHILD(I),EPSLD(I),I=101,125)/                     139600000
      1   1.06289,    .02316,   1.07435,    .02337,   1.08580,  139700000
      1    .02359,   1.09726,    .02381,   1.10871,    .02404,  139800000
      1   1.12017,    .02427,   1.13162,    .02451,   1.14308,  139900000
      1    .02476,   1.15453,    .02501,   1.16599,    .02527,  140000000
      1   1.17744,    .02553,   1.18840,    .02579,   1.19936,  140100000
      1    .02606,   1.21033,    .02632,   1.22129,    .02660,  140200000
      1   1.23225,    .02688,   1.24321,    .02716,   1.25417,  140300000
      1    .02745,   1.26513,    .02775,   1.27609,    .02805,  140400000
      1   1.28706,    .02836,   1.25770,    .02866,   1.30835,  140500000
      1    .02897,   1.31900,    .02928,   1.32965,    .02960/  140600000
000005  DATA (PHILD(I),EPSLD(I),I=126,150)/                     140700000
      1   1.34030,    .02992,   1.35094,    .03025,   1.36159,  140800000
      1    .03059,   1.37224,    .03093,   1.38289,    .03128,  140900000
      1   1.39353,    .03163,   1.40401,    .03199,   1.41450,  141000000
      1    .03235,   1.42498,    .03271,   1.43546,    .03309,  141100000
      1   1.44594,    .03346,   1.45642,    .03385,   1.46690,  141200000
      1    .03424,   1.47738,    .03464,   1.48786,    .03505,  141300000
      1   1.49834,    .03546,   1.50878,    .03588,   1.51921,  141400000
      1    .03630,   1.52965,    .03673,   1.54008,    .03717,  141500000
      1   1.55052,    .03762,   1.56095,    .03807,   1.57139,  141600000
      1    .03852,   1.58182,    .03899,   1.59226,    .03945/  141700000
000005  DATA (PHILD(I),EPSLD(I),I=151,175)/                     141800000
      1   1.60269,    .03993,   1.61319,    .04041,   1.62369,  141900000
      1    .04090,   1.63420,    .04139,   1.64470,    .04190,  142000000
      1   1.65520,    .04241,   1.66570,    .04293,   1.67620,  142100000
      1    .04346,   1.68670,    .04400,   1.69720,    .04455,  142200000
      1   1.70770,    .04511,   1.71841,    .04570,   1.72913,  142300000
      1    .04629,   1.73984,    .04690,   1.75056,    .04752,  142400000
      1   1.76127,    .04815,   1.77199,    .04880,   1.78270,  142500000
      1    .04945,   1.79341,    .05011,   1.80413,    .05078,  142600000
      1   1.81484,    .05145,   1.82589,    .05216,   1.83694,  142700000
      1    .05288,   1.84799,    .05360,   1.85904,    .05434/  142800000
000005  DATA (PHILD(I),EPSLD(I),I=176,200)/                     142900000
      1   1.87009,    .05509,   1.88113,    .05584,   1.89218,  143000000
      1    .05661,   1.90323,    .05739,   1.91427,    .05818,  143100000
      1   1.92531,    .05899,   1.93688,    .05985,   1.94844,  143200000
      1    .06072,   1.95999,    .06160,   1.97155,    .06250,  143300000
```

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     1    1.98311,    .06340,    1.99467,    .06432,    2.00622,  143400000
     1     .06524,   2.01778,     .06617,   2.02933,     .06711,  143500000
     1    2.04089,    .06805,    2.05305,    .06905,    2.06522,  143600000
     1     .07005,   2.07739,     .07105,   2.08956,     .07204,  143700000
     1    2.10172,    .07302,    2.11389,    .07398,    2.12606,  143800000
     1     .07493,   2.13824,     .07586,   2.15041,     .07677/  143900000
000005       DATA (PHILD(I),EPSLD(I),I=201,225)/                  144000000
     1    2.16259,    .07765,    2.17534,    .07854,    2.18810,  144100000
     1     .07939,   2.20085,     .08020,   2.21361,     .08097,  144200000
     1    2.22637,    .08171,    2.23914,    .08240,    2.25190,  144300000
     1     .08305,   2.26467,     .08365,   2.27744,     .08421,  144400000
     1    2.29021,    .08471,    2.30376,    .08520,    2.31733,  144500000
     1     .08563,   2.33089,     .08601,   2.34445,     .08634,  144600000
     1    2.35802,    .08662,    2.37159,    .08685,    2.38516,  144700000
     1     .08703,   2.39874,     .08716,   2.41232,     .08726,  14480000C
     1    2.42590,    .08731,    2.44078,    .08731,    2.45566,  144900000
     1     .08725,   2.47054,     .08710,   2.48542,     .08684/  145000000
000005       DATA (PHILD(I),EPSLD(I),I=226,251)/                  145100000
     1    2.50029,    .08646,    2.51515,    .08594,    2.53000,  145200000
     1     .08525,   2.54483,     .08439,   2.55965,     .08333,  145300000
     1    2.57444,    .08205,    2.59147,    .08029,    2.60847,  145400000
     1     .07826,   2.62544,     .07599,   2.64239,     .07351,  145500000
     1    2.65933,    .07088,    2.67625,    .06811,    2.69317,  145600000
     1     .06526,   2.71007,     .06235,   2.72698,     .05943,  145700000
     1    2.74389,    .05653,    2.78356,    .04995,    2.82326,  145800000
     1     .04366,   2.86298,     .03763,   2.90274,     .03183,  145900000
     1    2.94251,    .02623,    2.98231,    .02079,    3.02211,  146000000
     1     .01548,   3.06193,     .01026,   3.10176,     .00511,  146100000
     1    3.14159,   0.00000/                                     146200000
000005       DO 201 J=1,201                                       146300000
000006       PHI(J)=FLOAT(J-1)*3.14159265/200.                    146400000
000013   201 CALL FTLJP(PHI(J),EPS(J),2,251,PHILD,EPSLD)          146500000
000024       RETURN                                               146600000
000025       END                                                  146700000
```

```
      SUBROUTINE PHPS63(PHI,PSI)                                        146800000
000005 DIMENSION PHI(1),PSI(1)                                          146900000
000005 DIMENSION PHILD(201),PSILD(201)                                  147000000
000005 DATA (PHILD(I),PSILD(I),I=1,25 )/                                147100000
     1   0.00000,    .15066,    .01571,    .15058,    .03142,          147200000
     1    .15035,    .04713,    .14999,    .06284,    .14950,          147300000
     1    .07855,    .14891,    .09426,    .14823,    .10997,          147400000
     1    .14748,    .12567,    .14668,    .14138,    .14583,          147500000
     1    .15708,    .14497,    .17279,    .14410,    .18850,          147600000
     1    .14323,    .20420,    .14238,    .21991,    .14155,          147700000
     1    .23561,    .14074,    .25132,    .13998,    .26703,          147800000
     1    .13927,    .28274,    .13862,    .29845,    .13804,          147900000
     1    .31416,    .13753,    .32986,    .13711,    .34556,          148000000
     1    .13676,    .36127,    .13648,    .37698,    .13627/          148100000
000005 DATA (PHILD(I),PSILD(I),I=26,50)/                                148200000
     1    .39268,    .13610,    .40839,    .13598,    .42411,          148300000
     1    .13590,    .43982,    .13584,    .45553,    .13579,          148400000
     1    .47124,    .13576,    .48695,    .13573,    .50266,          148500000
     1    .13570,    .51837,    .13567,    .53408,    .13564,          148600000
     1    .54978,    .13561,    .56549,    .13558,    .58120,          148700000
     1    .13555,    .59691,    .13552,    .61261,    .13550,          148800000
     1    .62832,    .13547,    .64403,    .13544,    .65974,          148900000
     1    .13542,    .67544,    .13539,    .69115,    .13536,          149000000
     1    .70686,    .13533,    .72257,    .13529,    .73828,          149100000
     1    .13525,    .75398,    .13521,    .76969,    .13516/          149200000
000005 DATA (PHILD(I),PSILD(I),I=51,75)/                                149300000
     1    .78540,    .13511,    .80111,    .13505,    .81682,          149400000
     1    .13499,    .83252,    .13491,    .84823,    .13483,          149500000
     1    .86394,    .13475,    .87965,    .13465,    .89536,          149600000
     1    .13454,    .91106,    .13442,    .92677,    .13428,          149700000
     1    .94248,    .13414,    .95819,    .13398,    .97390,          149800000
     1    .13381,    .98961,    .13363,   1.00531,    .13343,          149900000
     1   1.02102,    .13321,   1.03673,    .13299,   1.05244,          150000000
     1    .13275,   1.06815,    .13249,   1.08385,    .13222,          150100000
     1   1.09956,    .13194,   1.11527,    .13164,   1.13098,          150200000
     1    .13133,   1.14669,    .13100,   1.16240,    .13065/          150300000
000005 DATA (PHILD(I),PSILD(I),I=76,100)/                               150400000
     1   1.17811,    .13028,   1.19381,    .12988,   1.20952,          150500000
     1    .12947,   1.22523,    .12903,   1.24093,    .12857,          150600000
     1   1.25664,    .12808,   1.27235,    .12756,   1.28807,          150700000
     1    .12702,   1.30378,    .12644,   1.31949,    .12584,          150800000
     1   1.33520,    .12521,   1.35090,    .12455,   1.36661,          150900000
```

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     1    .12385,   1.38231,    .12313,   1.39802,    .12238,   151000000
     1   1.41372,    .12160,   1.42944,    .12079,   1.44515,   151100000
     1    .11994,   1.46086,    .11907,   1.47657,    .11817,   151200000
     1   1.49228,    .11724,   1.50799,    .11628,   1.52369,   151300000
     1    .11529,   1.53940,    .11428,   1.55510,    .11324/   151400000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/               151500000
     1   1.57080,    .11218,   1.58652,    .11109,   1.60223,   151600000
     1    .10998,   1.61794,    .10884,   1.63365,    .10768,   151700000
     1   1.64936,    .10650,   1.66507,    .10530,   1.68077,   151800000
     1    .10407,   1.69648,    .10283,   1.71218,    .10157,   151900000
     1   1.72788,    .10029,   1.74359,    .09899,   1.75931,   152000000
     1    .09767,   1.77502,    .09634,   1.79073,    .09499,   152100000
     1   1.80644,    .09363,   1.82214,    .09224,   1.83785,   152200000
     1    .09085,   1.85355,    .08944,   1.86926,    .08801,   152300000
     1   1.88496,    .08657,   1.90067,    .08512,   1.91638,   152400000
     1    .08365,   1.93209,    .08217,   1.94780,    .08068/   152500000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/               152600000
     1   1.96351,    .07917,   1.97922,    .07766,   1.99493,   152700000
     1    .07614,   2.01063,    .07461,   2.02634,    .07307,   152800000
     1   2.04204,    .07153,   2.05775,    .06998,   2.07346,   152900000
     1    .06842,   2.08916,    .06687,   2.10487,    .06530,   153000000
     1   2.12058,    .06374,   2.13628,    .06217,   2.15199,   153100000
     1    .06060,   2.16770,    .05904,   2.18340,    .05747,   153200000
     1   2.19911,    .05591,   2.21481,    .05435,   2.23052,   153300000
     1    .05280,   2.24623,    .05125,   2.26193,    .04970,   153400000
     1   2.27764,    .04817,   2.29335,    .04664,   2.30906,   153500000
     1    .04512,   2.32477,    .04362,   2.34048,    .04213/   153600000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/               153700000
     1   2.35619,    .04065,   2.37189,    .03919,   2.38759,   153800000
     1    .03774,   2.40330,    .03631,   2.41900,    .03490,   153900000
     1   2.43471,    .03350,   2.45042,    .03213,   2.46613,   154000000
     1    .03077,   2.48184,    .02943,   2.49755,    .02811,   154100000
     1   2.51327,    .02682,   2.52897,    .02555,   2.54467,   154200000
     1    .02430,   2.56037,    .02308,   2.57608,    .02188,   154300000
     1   2.59179,    .02071,   2.60749,    .01956,   2.62321,   154400000
     1    .01844,   2.63892,    .01735,   2.65463,    .01630,   154500000
     1   2.67035,    .01527,   2.68605,    .01428,   2.70175,   154600000
     1    .01331,   2.71745,    .01239,   2.73316,    .01149/   154700000
000005       DATA (PHILD(I),PSILD(I),I=176,201)/               154800000
     1   2.74887,    .01062,   2.76458,    .00979,   2.78029,   154900000
     1    .00899,   2.79600,    .00823,   2.81171,    .00750,   155000000
     1   2.82743,    .00680,   2.84313,    .00614,   2.85884,   155100000
     1    .00551,   2.87454,    .00491,   2.89025,    .00435,   155200000
```

APPENDIX

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155300000
155400000
155500000
155600000
155700000
155800000
155900000
156000000
156100000
156200000
156300000
156400000
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     1   2.90596,    .00382,   2.92167,    .00332,   2.93737,
     1    .00286,   2.95309,    .00244,   2.96880,    .00205,
     1   2.98451,    .00169,   3.00022,    .00137,   3.01592,
     1    .00108,   3.03163,    .00083,   3.04734,    .00061,
     1   3.06305,    .00042,   3.07875,    .00027,   3.09446,
     1    .00015,   3.11017,    .00007,   3.12588,    .00002,
     1   3.14159,   0.00000/
000005       DO 202 J=1,201
000006       CALL FTLUP(PHI(J),PSI(J),2,2C1,PHILD,PSILD)
000014   202 CONTINUE
000020       RETURN
000021       END
```

```
                SUBROUTINE PHPS63A(PHI,PSI)                                                    156500000
000005          DIMENSION PHI(1),PSI(1)                                                        156600000
000005          DIMENSION PHILD(251),PSILD(251)                                                156700000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                                              156800000
               1    0.00000,     .15517,     .01461,     .15507,     .02922,                  156900000
               1     .15478,     .04383,     .15431,     .05843,     .15368,                  157000000
               1     .07303,     .15290,     .08763,     .15199,     .10222,                  157100000
               1     .15097,     .11680,     .14984,     .13138,     .14863,                  157200000
               1     .14594,     .14735,     .14925,     .14705,     .15257,                  157300000
               1     .14675,     .15588,     .14645,     .15919,     .14615,                  157400000
               1     .16250,     .14585,     .16582,     .14555,     .16913,                  157500000
               1     .14525,     .17244,     .14496,     .17576,     .14468,                  157600000
               1     .17907,     .14440,     .18420,     .14397,     .18933,                  157700000
               1     .14357,     .19447,     .14318,     .19960,     .14281/                  157800000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                                              157900000
               1     .20474,     .14245,     .20987,     .14210,     .21501,                  158000000
               1     .14177,     .22015,     .14145,     .22529,     .14115,                  158100000
               1     .23043,     .14086,     .24001,     .14035,     .24958,                  158200000
               1     .13987,     .25916,     .13944,     .26875,     .13904,                  158300000
               1     .27833,     .13867,     .28791,     .13833,     .29750,                  158400000
               1     .13802,     .30708,     .13773,     .31667,     .13746,                  158500000
               1     .32626,     .13722,     .33980,     .13690,     .35335,                  158600000
               1     .13662,     .36690,     .13637,     .38045,     .13614,                  158700000
               1     .39401,     .13594,     .40756,     .13577,     .42111,                  158800000
               1     .13562,     .43466,     .13548,     .44821,     .13537/                  158900000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                                              159000000
               1     .46176,     .13527,     .47241,     .13520,     .48306,                  159100000
               1     .13514,     .49371,     .13509,     .50436,     .13504,                  159200000
               1     .51501,     .13500,     .52566,     .13496,     .53631,                  159300000
               1     .13492,     .54696,     .13489,     .55761,     .13486,                  159400000
               1     .56826,     .13483,     .57741,     .13481,     .58655,                  159500000
               1     .13478,     .59570,     .13476,     .60485,     .13474,                  159600000
               1     .61399,     .13471,     .62314,     .13469,     .63229,                  159700000
               1     .13467,     .64143,     .13464,     .65058,     .13462,                  159800000
               1     .65973,     .13460,     .67541,     .13456,     .69110,                  159900000
               1     .13452,     .70679,     .13447,     .72248,     .13442/                  160000000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                                             160100000
               1     .73817,     .13438,     .75386,     .13432,     .76955,                  160200000
               1     .13427,     .78524,     .13420,     .80093,     .13414,                  160300000
               1     .81662,     .13406,     .83032,     .13400,     .84402,                  160400000
               1     .13392,     .85772,     .13384,     .87142,     .13376,                  160500000
               1     .88512,     .13367,     .89882,     .13357,     .91253,                  160600000
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     1    .13347,    .92623,    .13336,    .93993,    .13324,    160700000
     1    .95363,    .13312,    .96612,    .13299,    .97860,    160800000
     1    .13287,    .99109,    .13274,   1.00358,    .13260,    160900000
     1   1.01607,    .13245,   1.02855,    .13230,   1.04104,    161000000
     1    .13214,   1.05353,    .13197,   1.06602,    .13180/    161100000
000005      DATA (PHILD(I),PSILD(I),I=101,125)/                  161200000
     1   1.07850,    .13162,   1.09023,    .13145,   1.10196,    161300000
     1    .13127,   1.11369,    .13108,   1.12541,    .13089,    161400000
     1   1.13714,    .13068,   1.14887,    .13047,   1.16059,    161500000
     1    .13024,   1.17232,    .13001,   1.18405,    .12976,    161600000
     1   1.19577,    .12950,   1.20699,    .12923,   1.21821,    161700000
     1    .12896,   1.22943,    .12867,   1.24064,    .12837,    161800000
     1   1.25186,    .12806,   1.26308,    .12774,   1.27429,    161900000
     1    .12741,   1.28551,    .12706,   1.29672,    .12670,    162000000
     1   1.30794,    .12634,   1.31876,    .12597,   1.32959,    162100000
     1    .12560,   1.34041,    .12521,   1.35124,    .12481/    162200000
000005      DATA (PHILD(I),PSILD(I),I=126,150)/                  162300000
     1   1.36206,    .12440,   1.37289,    .12398,   1.38371,    162400000
     1    .12355,   1.39453,    .12310,   1.40535,    .12264,    162500000
     1   1.41617,    .12217,   1.42675,    .12170,   1.43733,    162600000
     1    .12121,   1.44790,    .12072,   1.45847,    .12021,    162700000
     1   1.46905,    .11969,   1.47962,    .11916,   1.49019,    162800000
     1    .11862,   1.50077,    .11807,   1.51134,    .11750,    162900000
     1   1.52191,    .11693,   1.53232,    .11636,   1.54274,    163000000
     1    .11577,   1.55316,    .11518,   1.56357,    .11458,    163100000
     1   1.57399,    .11397,   1.58440,    .11335,   1.59481,    163200000
     1    .11272,   1.60523,    .11208,   1.61564,    .11143/    163300000
000005      DATA (PHILD(I),PSILD(I),I=151,175)/                  163400000
     1   1.62605,    .11078,   1.63637,    .11012,   1.64670,    163500000
     1    .10945,   1.65702,    .10878,   1.66734,    .10810,    163600000
     1   1.67766,    .10741,   1.68798,    .10671,   1.69830,    163700000
     1    .10601,   1.70862,    .10530,   1.71894,    .10458,    163800000
     1   1.72926,    .10385,   1.73961,    .10312,   1.74996,    163900000
     1    .10238,   1.76031,    .10164,   1.77067,    .10089,    164000000
     1   1.78101,    .10013,   1.79136,    .09936,   1.80171,    164100000
     1    .09860,   1.81206,    .09782,   1.82241,    .09704,    164200000
     1   1.83276,    .09625,   1.84322,    .09545,   1.85369,    164300000
     1    .09465,   1.86415,    .09384,   1.87461,    .09302/    164400000
000005      DATA (PHILD(I),PSILD(I),I=176,200)/                  164500000
     1   1.88508,    .09220,   1.89554,    .09137,   1.90600,    164600000
     1    .09054,   1.91646,    .08971,   1.92692,    .08887,    164700000
     1   1.93738,    .08802,   1.94807,    .08716,   1.95875,    164800000
     1    .08629,   1.96943,    .08541,   1.98012,    .08454,    164900000
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     1    1.99080,    .08366,   2.00148,    .08278,   2.01216,   165000000
     1     .08189,   2.02284,    .08100,   2.03353,    .08012,   165100000
     1    2.04421,    .07923,   2.05529,    .07830,   2.06637,   165200000
     1     .07738,   2.07744,    .07646,   2.08852,    .07553,   165300000
     1    2.09960,    .07461,   2.11068,    .07369,   2.12176,   165400000
     1     .07278,   2.13284,    .07186,   2.14392,    .07095/   165500000
000005       DATA (PHILD(I),PSILD(I),I=201,225)/                 165600000
     1    2.15500,    .07005,   2.16671,    .06910,   2.17841,   165700000
     1     .06815,   2.19012,    .06721,   2.20183,    .06628,   165800000
     1    2.21354,    .06535,   2.22525,    .06443,   2.23696,   165900000
     1     .06351,   2.24867,    .06259,   2.26038,    .06168,   166000000
     1    2.27209,    .06078,   2.28483,    .05980,   2.29757,   166100000
     1     .05882,   2.31031,    .05785,   2.32305,    .05688,   166200000
     1    2.33579,    .05593,   2.34854,    .05497,   2.36128,   166300000
     1     .05403,   2.37402,    .05309,   2.38676,    .05216,   166400000
     1    2.39951,    .05123,   2.41401,    .05019,   2.42851,   166500000
     1     .04916,   2.44302,    .04813,   2.45752,    .04711/   166600000
000005       DATA (PHILD(I),PSILD(I),I=226,251)/                 166700000
     1    2.47203,    .04608,   2.48653,    .04506,   2.50103,   166800000
     1     .04403,   2.51554,    .04299,   2.53004,    .04195,   166900000
     1    2.54455,    .04090,   2.56241,    .03958,   2.58028,   167000000
     1     .03826,   2.59814,    .03694,   2.61601,    .03563,   167100000
     1    2.63388,    .03435,   2.65175,    .03311,   2.66962,   167200000
     1     .03191,   2.68750,    .03077,   2.70537,    .02970,   167300000
     1    2.72325,    .02871,   2.76503,    .02675,   2.80682,   167400000
     1     .02524,   2.84864,    .02412,   2.89046,    .02333,   167500000
     1    2.93230,    .02282,   2.97414,    .02253,   3.01600,   167600000
     1     .02240,   3.05786,    .02238,   3.09973,    .02241,   167700000
     1    3.14159,    .02243/                                    167800000
000005       DO 202 J=1,201                                      167900000
000006       CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)         168000000
000014   202 CONTINUE                                            168100000
000020       RETURN                                              168200000
000021       END                                                 168300000
```

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                SUBROUTINE PHPS64(PHI,PSI)                                      168400000
000005          DIMENSION PHI(1),PSI(1)                                         168500000
000005          DIMENSION PHILD(201),PSILD(201)                                 168600000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                               168700000
               1    0.00000,    .25269,    .01573,    .25265,    .03145,       168800000
               1     .25251,    .04717,    .25227,    .06289,    .25193,       168900000
               1     .07861,    .25147,    .09432,    .25090,    .11002,       169000000
               1     .25020,    .12572,    .24937,    .14140,    .24841,       169100000
               1     .15708,    .24730,    .17280,    .24605,    .18851,       169200000
               1     .24467,    .20422,    .24321,    .21992,    .24170,       169300000
               1     .23562,    .24016,    .25132,    .23864,    .26702,       169400000
               1     .23715,    .28272,    .23573,    .29844,    .23442,       169500000
               1     .31416,    .23325,    .32984,    .23224,    .34553,       169600000
               1     .23138,    .36122,    .23066,    .37693,    .23006/       169700000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                               169800000
               1     .39264,    .22956,    .40836,    .22916,    .42408,       169900000
               1     .22884,    .43980,    .22858,    .45552,    .22836,       170000000
               1     .47124,    .22818,    .48695,    .22802,    .50266,       170100000
               1     .22788,    .51837,    .22775,    .53408,    .22764,       170200000
               1     .54979,    .22755,    .56549,    .22747,    .58120,       170300000
               1     .22740,    .59691,    .22736,    .61261,    .22732,       170400000
               1     .62832,    .22730,    .64403,    .22729,    .65973,       170500000
               1     .22730,    .67544,    .22731,    .69115,    .22733,       170600000
               1     .70686,    .22736,    .72257,    .22739,    .73827,       170700000
               1     .22742,    .75398,    .22745,    .76969,    .22748/       170800000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                               170900000
               1     .78540,    .22751,    .80111,    .22753,    .81682,       171000000
               1     .22755,    .83252,    .22756,    .84823,    .22756,       171100000
               1     .86394,    .22755,    .87965,    .22753,    .89536,       171200000
               1     .22751,    .91106,    .22747,    .92677,    .22742,       171300000
               1     .94248,    .22736,    .95819,    .22729,    .97390,       171400000
               1     .22720,    .98961,    .22709,   1.00531,    .22697,       171500000
               1    1.02102,    .22683,   1.03673,    .22668,   1.05244,       171600000
               1     .22650,   1.06815,    .22630,   1.08385,    .22608,       171700000
               1    1.09956,    .22584,   1.11527,    .22557,   1.13098,       171800000
               1     .22528,   1.14669,    .22497,   1.16240,    .22462/       171900000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                              172000000
               1    1.17811,    .22426,   1.19381,    .22386,   1.20952,       172100000
               1     .22345,   1.22523,    .22300,   1.24093,    .22253,       172200000
               1    1.25664,    .22203,   1.27236,    .22150,   1.28808,       172300000
               1     .22094,   1.30379,    .22034,   1.31951,    .21969,       172400000
               1    1.33522,    .21899,   1.35093,    .21823,   1.36663,       172500000
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     1    .21741,    1.38233,    .21652,    1.39803,    .21554,    172600000
     1   1.41372,     .21449,   1.42946,     .21334,   1.44519,    172700000
     1    .21211,    1.46091,    .21080,    1.47663,    .20940,    172800000
     1   1.49234,     .20794,   1.50804,     .20641,   1.52374,    172900000
     1    .20481,    1.53943,    .20315,    1.55512,    .20143/    173000000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/                   173100000
     1   1.57080,     .19966,   1.58653,     .19784,   1.60226,    173200000
     1    .19596,    1.61798,    .19405,    1.63370,    .19209,    173300000
     1   1.64941,     .19008,   1.66511,     .18804,   1.68081,    173400000
     1    .18596,    1.69651,    .18384,    1.71220,    .18169,    173500000
     1   1.72788,     .17950,   1.74361,     .17727,   1.75933,    173600000
     1    .17501,    1.77505,    .17273,    1.79076,    .17041,    173700000
     1   1.80647,     .16806,   1.82218,     .16569,   1.83788,    173800000
     1    .16329,    1.85357,    .16087,    1.86927,    .15843,    173900000
     1   1.88496,     .15596,   1.90068,     .15347,   1.91640,    174000000
     1    .15095,    1.93211,    .14842,    1.94782,    .14587/    174100000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/                   174200000
     1   1.96353,     .14330,   1.97924,     .14072,   1.99494,    174300000
     1    .13812,    2.01064,    .13551,    2.02634,    .13288,    174400000
     1   2.04204,     .13024,   2.05775,     .12759,   2.07346,    174500000
     1    .12492,    2.08917,    .12225,    2.10488,    .11957,    174600000
     1   2.12059,     .11688,   2.13629,     .11418,   2.15200,    174700000
     1    .11149,    2.16770,    .10878,    2.18341,    .10608,    174800000
     1   2.19911,     .10338,   2.21481,     .10068,   2.23051,    174900000
     1    .09798,    2.24622,    .09529,    2.26192,    .09260,    175000000
     1   2.27763,     .08992,   2.29334,     .08725,   2.30905,    175100000
     1    .08459,    2.32476,    .08195,    2.34047,    .07932/    175200000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/                   175300000
     1   2.35619,     .07671,   2.37188,     .07412,   2.38757,    175400000
     1    .07156,    2.40327,    .06901,    2.41897,    .06649,    175500000
     1   2.43468,     .06399,   2.45039,     .06152,   2.46610,    175600000
     1    .05908,    2.48182,    .05667,    2.49754,    .05428,    175700000
     1   2.51327,     .05193,   2.52895,     .04962,   2.54464,    175800000
     1    .04734,    2.56034,    .04510,    2.57604,    .04289,    175900000
     1   2.59174,     .04073,   2.60745,     .03860,   2.62317,    176000000
     1    .03651,    2.63889,    .03447,    2.65462,    .03247,    176100000
     1   2.67035,     .03051,   2.68603,     .02861,   2.70172,    176200000
     1    .02675,    2.71741,    .02494,    2.73311,    .02318/    176300000
000005       DATA (PHILD(I),PSILD(I),I=176,201)/                   176400000
     1   2.74882,     .02148,   2.76453,     .01983,   2.78024,    176500000
     1    .01825,    2.79597,    .01672,    2.81170,    .01525,    176600000
     1   2.82743,     .01385,   2.84312,     .01252,   2.85881,    176700000
     1    .01125,    2.87451,    .01006,    2.89021,    .00892,    176800000
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               1     2.90591,      .00786,     2.92163,      .00686,     2.93734,
               1      .00593,     2.95306,      .00506,     2.96878,      .00426,
               1     2.98451,      .00353,     3.00021,      .00287,     3.01591,
               1      .00227,     3.03162,      .00174,     3.04732,      .00128,
               1     3.06303,      .00089,     3.07874,      .00057,     3.09445,
               1      .00032,     3.11016,      .00014,     3.12588,      .00004,
               1     3.14159,     0.00000/
000005          DO 202 J=1,201
000006          CALL  FTLUP(PHI(J),PSI(J),2,201,PHILD,PSILD)
000014     202  CONTINUE
000020          RETURN
000021          END
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                SUBROUTINE PHPS64A(PHI,PSI)                                     178100000
000005          DIMENSION PHI(1), PSI(1)                                        178200000
000005          DIMENSION PHILD(251),PSILD(251)                                 178300000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                               178400000
               1   0.00000,    .15365,    .01470,    .15355,    .02940,        178500000
               1    .15324,    .04410,    .15275,    .05880,    .15209,        178600000
               1    .07349,    .15129,    .08818,    .15035,    .10286,        178700000
               1    .14930,    .11753,    .14816,    .13220,    .14693,        178800000
               1    .14686,    .14565,    .15019,    .14535,    .15352,        178900000
               1    .14505,    .15685,    .14475,    .16019,    .14444,        179000000
               1    .16352,    .14414,    .16685,    .14384,    .17018,        179100000
               1    .14353,    .17351,    .14323,    .17684,    .14293,        179200000
               1    .18017,    .14263,    .18528,    .14218,    .19040,        179300000
               1    .14174,    .19551,    .14130,    .20063,    .14087/        179400000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                               179500000
               1    .20574,    .14044,    .21086,    .14003,    .21598,        179600000
               1    .13963,    .22109,    .13924,    .22621,    .13886,        179700000
               1    .23133,    .13849,    .24088,    .13783,    .25044,        179800000
               1    .13722,    .26000,    .13665,    .26956,    .13612,        179900000
               1    .27912,    .13562,    .28869,    .13516,    .29825,        180000000
               1    .13473,    .30782,    .13432,    .31739,    .13395,        180100000
               1    .32695,    .13359,    .34039,    .13313,    .35384,        180200000
               1    .13271,    .36728,    .13233,    .38072,    .13199,        180300000
               1    .39416,    .13167,    .40761,    .13139,    .42105,        180400000
               1    .13113,    .43450,    .13090,    .44794,    .13069/        180500000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                               180600000
               1    .46139,    .13051,    .47194,    .13037,    .48249,        180700000
               1    .13024,    .49303,    .13013,    .50358,    .13003,        180800000
               1    .51413,    .12993,    .52468,    .12985,    .53523,        180900000
               1    .12977,    .54578,    .12971,    .55633,    .12966,        181000000
               1    .56688,    .12961,    .57595,    .12958,    .58502,        181100000
               1    .12955,    .59409,    .12953,    .60317,    .12952,        181200000
               1    .61224,    .12951,    .62131,    .12950,    .63038,        181300000
               1    .12949,    .63945,    .12949,    .64852,    .12949,        181400000
               1    .65759,    .12949,    .67316,    .12948,    .68874,        181500000
               1    .12947,    .70431,    .12947,    .71989,    .12946/        181600000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                              181700000
               1    .73546,    .12945,    .75103,    .12944,    .76661,        181800000
               1    .12943,    .78218,    .12942,    .79776,    .12941,        181900000
               1    .81333,    .12940,    .82695,    .12939,    .84057,        182000000
               1    .12939,    .85418,    .12938,    .86780,    .12937,        182100000
               1    .88142,    .12936,    .89504,    .12934,    .90866,        182200000
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     1    .12932,    .92228,    .12930,    .93589,    .12927,          182300000
     1    .94951,    .12923,    .96194,    .12920,    .97436,          182400000
     1    .12915,    .98679,    .12910,    .99922,    .12905,          182500000
     1   1.01164,    .12899,   1.02407,    .12892,   1.03650,          182600000
     1    .12885,   1.04892,    .12878,   1.06135,    .12869/          182700000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/                       182800000
     1   1.07377,    .12861,   1.08546,    .12852,   1.09714,          182900000
     1    .12843,   1.10882,    .12833,   1.12050,    .12822,          183000000
     1   1.13218,    .12811,   1.14386,    .12800,   1.15554,          183100000
     1    .12788,   1.16723,    .12775,   1.17891,    .12761,          183200000
     1   1.19059,    .12747,   1.20180,    .12733,   1.21301,          183300000
     1    .12718,   1.22422,    .12702,   1.23543,    .12685,          183400000
     1   1.24665,    .12668,   1.25786,    .12650,   1.26907,          183500000
     1    .12631,   1.28028,    .12611,   1.29149,    .12590,          183600000
     1   1.30270,    .12569,   1.31357,    .12547,   1.32444,          183700000
     1    .12524,   1.33531,    .12500,   1.34618,    .12475/          183800000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/                       183900000
     1   1.35705,    .12448,   1.36792,    .12420,   1.37879,          184000000
     1    .12390,   1.38966,    .12358,   1.40052,    .12325,          184100000
     1   1.41139,    .12289,   1.42204,    .12252,   1.43269,          184200000
     1    .12212,   1.44334,    .12171,   1.45398,    .12128,          184300000
     1   1.46463,    .12083,   1.47528,    .12036,   1.48592,          184400000
     1    .11988,   1.49657,    .11938,   1.50721,    .11887,          184500000
     1   1.51785,    .11834,   1.52835,    .11781,   1.53884,          184600000
     1    .11727,   1.54933,    .11672,   1.55982,    .11615,          184700000
     1   1.57030,    .11557,   1.58079,    .11499,   1.59128,          184800000
     1    .11439,   1.60177,    .11378,   1.61225,    .11316/          184900000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/                       185000000
     1   1.62274,    .11253,   1.63312,    .11189,   1.64350,          185100000
     1    .11125,   1.65388,    .11059,   1.66426,    .10993,          185200000
     1   1.67464,    .10925,   1.68502,    .10857,   1.69540,          185300000
     1    .10788,   1.70578,    .10719,   1.71615,    .10648,          185400000
     1   1.72653,    .10577,   1.73693,    .10505,   1.74732,          185500000
     1    .10433,   1.75772,    .10360,   1.76812,    .10286,          185600000
     1   1.77851,    .10212,   1.78891,    .10137,   1.79931,          185700000
     1    .10061,   1.80970,    .09985,   1.82009,    .09908,          185800000
     1   1.83049,    .09831,   1.84100,    .09752,   1.85151,          185900000
     1    .09672,   1.86202,    .09592,   1.87253,    .09512/          186000000
000005       DATA (PHILD(I),PSILD(I),I=176,200)/                       186100000
     1   1.88304,    .09431,   1.89354,    .09349,   1.90405,          186200000
     1    .09267,   1.91456,    .09184,   1.92507,    .09101,          186300000
     1   1.93557,    .09017,   1.94631,    .08931,   1.95704,          186400000
     1    .08845,   1.96777,    .08758,   1.97850,    .08670,          186500000
```

APPENDIX

```
      1  1.98923,    .08583,   1.99996,    .08495,   2.01069,
      1   .08406,   2.02142,    .08318,   2.03215,    .08229,
      1  2.04288,    .08140,   2.05401,    .08048,   2.06514,
      1   .07955,   2.07627,    .07863,   2.08740,    .07770,
      1  2.09852,    .07678,   2.10965,    .07585,   2.12078,
      1   .07493,   2.13191,    .07401,   2.14304,    .07309/
      DATA (PHILD(I),PSILD(I),I=201,225)/
      1  2.15416,    .07217,   2.16592,    .07120,   2.17767,
      1   .07023,   2.18942,    .06927,   2.20117,    .06831,
      1  2.21293,    .06735,   2.22468,    .06639,   2.23643,
      1   .06543,   2.24819,    .06450,   2.25994,    .06356,
      1  2.27169,    .06262,   2.28447,    .06161,   2.29724,
      1   .06060,   2.31001,    .05960,   2.32278,    .05861,
      1  2.33556,    .05762,   2.34833,    .05664,   2.36111,
      1   .05567,   2.37388,    .05470,   2.38666,    .05375,
      1  2.39943,    .05279,   2.41396,    .05172,   2.42849,
      1   .05066,   2.44302,    .04960,   2.45754,    .04855/
      DATA (PHILD(I),PSILD(I),I=226,251)/
      1  2.47207,    .04749,   2.48660,    .04644,   2.50113,
      1   .04538,   2.51566,    .04432,   2.53019,    .04324,
      1  2.54471,    .04216,   2.56260,    .04081,   2.58049,
      1   .03945,   2.59837,    .03809,   2.61626,    .03675,
      1  2.63415,    .03543,   2.65203,    .03414,   2.66993,
      1   .03291,   2.68782,    .03173,   2.70572,    .03061,
      1  2.72362,    .02958,   2.76535,    .02751,   2.80711,
      1   .02589,   2.84888,    .02465,   2.89067,    .02374,
      1  2.93247,    .02312,   2.97428,    .02273,   3.01610,
      1   .02252,   3.05793,    .02243,   3.09976,    .02242,
      1  3.14159,    .02243/
      DO 202 J=1,201
      CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)
  202 CONTINUE
      RETURN
      END
```

```
                SUBROUTINE PHPS65(PHI,PSI)                                      190000000
000005          DIMENSION PHI(1), PSI(1)                                        190100000
000005          DIMENSION PHILD(251),PSILD(251)                                 190200000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                               190300000
               1    0.00000,    .17464,    .01486,    .17457,    .02972,       190400000
               1     .17437,    .04458,    .17404,    .05944,    .17360,       190500000
               1     .07429,    .17303,    .08914,    .17236,    .10398,       190600000
               1     .17159,    .11882,    .17073,    .13365,    .16977,       190700000
               1     .14848,    .16872,    .15176,    .16848,    .15503,       190800000
               1     .16824,    .15831,    .16799,    .16159,    .16773,       190900000
               1     .16486,    .16747,    .16814,    .16721,    .17141,       191000000
               1     .16694,    .17409,    .16666,    .17796,    .16638,       191100000
               1     .18123,    .16609,    .18624,    .16563,    .19124,       191200000
               1     .16516,    .19624,    .16468,    .20124,    .16420/       191300000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                               191400000
               1     .20624,    .16371,    .21124,    .16321,    .21625,       191500000
               1     .16272,    .22125,    .16223,    .22625,    .16175,       191600000
               1     .23125,    .16127,    .24070,    .16041,    .25015,       191700000
               1     .15959,    .25960,    .15881,    .26906,    .15808,       191800000
               1     .27852,    .15740,    .28798,    .15676,    .29744,       191900000
               1     .15616,    .30691,    .15562,    .31638,    .15512,       192000000
               1     .32586,    .15468,    .33917,    .15413,    .35249,       192100000
               1     .15368,    .36581,    .15331,    .37913,    .15301,       192200000
               1     .39246,    .15278,    .40578,    .15261,    .41911,       192300000
               1     .15249,    .43244,    .15241,    .44577,    .15237/       192400000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                               192500000
               1     .45910,    .15235,    .46962,    .15235,    .48015,       192600000
               1     .15236,    .49068,    .15238,    .50121,    .15241,       192700000
               1     .51173,    .15245,    .52226,    .15251,    .53279,       192800000
               1     .15257,    .54331,    .15264,    .55384,    .15272,       192900000
               1     .56436,    .15281,    .57344,    .15289,    .58252,       193000000
               1     .15298,    .59160,    .15308,    .60068,    .15318,       193100000
               1     .60976,    .15328,    .61884,    .15339,    .62791,       193200000
               1     .15350,    .63699,    .15361,    .64607,    .15372,       193300000
               1     .65515,    .15383,    .67085,    .15402,    .68656,       193400000
               1     .15422,    .70226,    .15440,    .71796,    .15459/       193500000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                              193600000
               1     .73366,    .15477,    .74937,    .15496,    .76507,       193700000
               1     .15513,    .78077,    .15531,    .79648,    .15548,       193800000
               1     .81218,    .15564,    .82590,    .15578,    .83961,       193900000
               1     .15592,    .85333,    .15605,    .86704,    .15618,       194000000
               1     .88076,    .15630,    .89448,    .15642,    .90819,       194100000
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     1    .15653,    .92191,    .15663,    .93563,    .15673,                194200000
     1    .94934,    .15682,    .96192,    .15690,    .97449,                194300000
     1    .15697,    .98706,    .15704,    .99963,    .15709,                194400000
     1   1.01220,    .15714,   1.02477,    .15719,   1.03734,                194500000
     1    .15723,   1.04992,    .15726,   1.06249,    .15728/                194600000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/                             194700000
     1   1.07506,    .15730,   1.08689,    .15731,   1.09872,                194800000
     1    .15731,   1.11054,    .15730,   1.12237,    .15729,                194900000
     1   1.13420,    .15727,   1.14603,    .15724,   1.15786,                195000000
     1    .15721,   1.16968,    .15716,   1.18151,    .15711,                195100000
     1   1.19334,    .15704,   1.20469,    .15697,   1.21604,                195200000
     1    .15689,   1.22740,    .15680,   1.23875,    .15671,                195300000
     1   1.25010,    .15660,   1.26145,    .15648,   1.27281,                195400000
     1    .15636,   1.28416,    .15623,   1.29551,    .15609,                195500000
     1   1.30686,    .15594,   1.31793,    .15578,   1.32900,                195600000
     1    .15562,   1.34007,    .15544,   1.35114,    .15526/                195700000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/                             195800000
     1   1.36221,    .15506,   1.37327,    .15484,   1.38434,                195900000
     1    .15462,   1.39541,    .15437,   1.40647,    .15411,                196000000
     1   1.41754,    .15383,   1.42845,    .15354,   1.43935,                196100000
     1    .15322,   1.45026,    .15289,   1.46116,    .15254,                196200000
     1   1.47207,    .15216,   1.48297,    .15177,   1.49387,                196300000
     1    .15135,   1.50477,    .15091,   1.51567,    .15046,                196400000
     1   1.52657,    .14998,   1.53737,    .14948,   1.54817,                196500000
     1    .14896,   1.55897,    .14842,   1.56977,    .14785,                196600000
     1   1.58057,    .14726,   1.59136,    .14665,   1.60215,                196700000
     1    .14602,   1.61295,    .14536,   1.62374,    .14467/                196800000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/                             196900000
     1   1.63452,    .14396,   1.64526,    .14323,   1.65600,                197000000
     1    .14247,   1.66673,    .14169,   1.67746,    .14088,                197100000
     1   1.68820,    .14005,   1.69892,    .13920,   1.70965,                197200000
     1    .13833,   1.72038,    .13744,   1.73110,    .13652,                197300000
     1   1.74182,    .13559,   1.75255,    .13464,   1.76327,                197400000
     1    .13367,   1.77399,    .13268,   1.78471,    .13167,                197500000
     1   1.79542,    .13065,   1.80614,    .12961,   1.81685,                197600000
     1    .12856,   1.82756,    .12749,   1.83828,    .12641,                197700000
     1   1.84898,    .12531,   1.85973,    .12420,   1.87048,                197800000
     1    .12307,   1.88122,    .12194,   1.89197,    .12079/                197900000
000005       DATA (PHILD(I),PSILD(I),I=176,200)/                             198000000
     1   1.90271,    .11962,   1.91345,    .11845,   1.92419,                198100000
     1    .11726,   1.93493,    .11606,   1.94567,    .11485,                198200000
     1   1.95640,    .11363,   1.96732,    .11237,   1.97824,                198300000
     1    .11111,   1.98916,    .10983,   2.00008,    .10854,                198400000
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     1    2.01100,    .10725,   2.02191,    .10594,   2.03283,  198500000
     1     .10463,   2.04374,    .10332,   2.05466,    .10199,  198600000
     1    2.06557,    .10066,   2.07682,    .09929,   2.08807,  198700000
     1     .09791,   2.09932,    .09652,   2.11056,    .09513,  198800000
     1    2.12181,    .09374,   2.13305,    .09234,   2.14430,  198900000
     1     .09094,   2.15554,    .08953,   2.16679,    .08811/  199000000
000005       DATA (PHILD(I),PSILD(I),I=201,225)/                199100000
     1    2.17803,    .08669,   2.18979,    .08520,   2.20154,  199200000
     1     .08370,   2.21330,    .08220,   2.22505,    .08070,  199300000
     1    2.23680,    .07919,   2.24856,    .07768,   2.26031,  199400000
     1     .07617,   2.27206,    .07465,   2.28382,    .07314,  199500000
     1    2.29557,    .07163,   2.30822,    .07000,   2.32086,  199600000
     1     .06838,   2.33351,    .06675,   2.34616,    .06514,  199700000
     1    2.35881,    .06352,   2.37146,    .06191,   2.38411,  199800000
     1     .06030,   2.39676,    .05870,   2.40941,    .05710,  199900000
     1    2.42206,    .05551,   2.43614,    .05374,   2.45023,  200000000
     1     .05199,   2.46431,    .05024,   2.47839,    .04850/  200100000
000005       DATA (PHILD(I),PSILD(I),I=226,251)/                200200000
     1    2.49248,    .04677,   2.50656,    .04504,   2.52065,  200300000
     1     .04333,   2.53474,    .04162,   2.54883,    .03992,  200400000
     1    2.56292,    .03824,   2.57971,    .03624,   2.59651,  200500000
     1     .03426,   2.61330,    .03230,   2.63010,    .03037,  200600000
     1    2.64691,    .02848,   2.66372,    .02662,   2.68053,  200700000
     1     .02431,   2.69735,    .02305,   2.71417,    .02134,  200800000
     1    2.73100,    .01970,   2.77194,    .01597,   2.81292,  200900000
     1     .01263,   2.85393,    .00968,   2.89497,    .00712,  201000000
     1    2.93604,    .00495,   2.97712,    .00317,   3.01823,  201100000
     1     .00178,   3.05934,    .00079,   3.10046,    .00020,  201200000
     1    3.14159,   0.00000/                                   201300000
000005       DO 202 J=1,201                                     201400000
000006       CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)        201500000
000014   202 CONTINUE                                           201600000
000020       RETURN                                             201700000
000021       END                                                201800000
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```
                SUBROUTINE PHPS65A(PHI,PSI)                                                    201900000
                DIMENSION PHI(1), PSI(1)                                                       202000000
                DIMENSION PHILD(251),PSILD(251)                                                202100000
                DATA (PHILD(I),PSILD(I),I=1,25 )/                                              202200000
               1    0.00000,     .14761,     .01455,     .14748,     .02910,                   202300000
               1     .14709,     .04364,     .14649,     .05819,     .14570,                   202400000
               1     .07273,     .14476,     .08727,     .14369,     .10181,                   202500000
               1     .14253,     .11634,     .14131,     .13087,     .14007,                   202600000
               1     .14539,     .13882,     .14877,     .13854,     .15214,                   202700000
               1     .13826,     .15552,     .13798,     .15890,     .13770,                   202800000
               1     .16227,     .13743,     .16565,     .13716,     .16903,                   202900000
               1     .13690,     .17240,     .13665,     .17578,     .13640,                   203000000
               1     .17916,     .13616,     .18436,     .13581,     .18956,                   203100000
               1     .13547,     .19477,     .13515,     .19997,     .13484/                   203200000
                DATA (PHILD(I),PSILD(I),I=26,50)/                                              203300000
               1     .20518,     .13455,     .21039,     .13426,     .21560,                   203400000
               1     .13398,     .22080,     .13371,     .22601,     .13345,                   203500000
               1     .23122,     .13318,     .24077,     .13270,     .25032,                   203600000
               1     .13221,     .25986,     .13172,     .26941,     .13124,                   203700000
               1     .27896,     .13075,     .28850,     .13026,     .29805,                   203800000
               1     .12976,     .30760,     .12926,     .31714,     .12876,                   203900000
               1     .32669,     .12825,     .33995,     .12753,     .35322,                   204000000
               1     .12681,     .36648,     .12610,     .37974,     .12541,                   204100000
               1     .39301,     .12475,     .40628,     .12415,     .41955,                   204200000
               1     .12359,     .43282,     .12311,     .44609,     .12270/                   204300000
                DATA (PHILD(I),PSILD(I),I=51,75)/                                              204400000
               1     .45937,     .12239,     .46975,     .12221,     .48014,                   204500000
               1     .12209,     .49053,     .12202,     .50092,     .12199,                   204600000
               1     .51131,     .12199,     .52170,     .12203,     .53210,                   204700000
               1     .12209,     .54249,     .12216,     .55288,     .12224,                   204800000
               1     .56327,     .12233,     .57223,     .12240,     .58118,                   204900000
               1     .12246,     .59014,     .12253,     .59909,     .12259,                   205000000
               1     .60805,     .12265,     .61700,     .12271,     .62596,                   205100000
               1     .12277,     .63491,     .12283,     .64387,     .12289,                   205200000
               1     .65282,     .12295,     .66829,     .12305,     .68376,                   205300000
               1     .12316,     .69923,     .12326,     .71470,     .12337/                   205400000
                DATA (PHILD(I),PSILD(I),I=76,100)/                                             205500000
               1     .73016,     .12348,     .74563,     .12359,     .76110,                   205600000
               1     .12370,     .77657,     .12381,     .79204,     .12391,                   205700000
               1     .80750,     .12401,     .82106,     .12410,     .83461,                   205800000
               1     .12418,     .84816,     .12426,     .86171,     .12434,                   205900000
               1     .87527,     .12441,     .88882,     .12448,     .90237,                   206000000
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     1    .12455,    .91592,    .12461,    .92948,    .12467,    206100000
     1    .94303,    .12472,    .95538,    .12477,    .96772,    206200000
     1    .12482,    .98007,    .12486,    .99241,    .12489,    206300000
     1   1.00476,    .12492,   1.01711,    .12495,   1.02945,    206400000
     1    .12498,   1.04180,    .12500,   1.05414-    .12501/    206500000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/                 206600000
     1   1.06649,    .12502,   1.07810,    .12503,   1.08971,    206700000
     1    .12503,   1.10132,    .12502,   1.11293,    .12501,    206800000
     1   1.12454,    .12500,   1.13615,    .12498,   1.14776,    206900000
     1    .12495,   1.15937,    .12492,   1.17098,    .12489,    207000000
     1   1.18259,    .12485,   1.19372,    .12481,   1.20486,    207100000
     1    .12476,   1.21599,    .12471,   1.22713,    .12465,    207200000
     1   1.23827,    .12459,   1.24940,    .12452,   1.26054,    207300000
     1    .12445,   1.27167,    .12437,   1.28281,    .12428,    207400000
     1   1.29394,    .12419,   1.30473,    .12409,   1.31552,    207500000
     1    .12398,   1.32631,    .12387,   1.33710,    .12375/    207600000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/                 207700000
     1   1.34790,    .12362,   1.35869,    .12349,   1.36948,    207800000
     1    .12334,   1.38027,    .12319,   1.39106,    .12303,    207900000
     1   1.40185,    .12286,   1.41248,    .12268,   1.42311,    208000000
     1    .12249,   1.43375,    .12229,   1.44438,    .12208,    208100000
     1   1.45501,    .12186,   1.46564,    .12163,   1.47628,    208200000
     1    .12138,   1.48691,    .12113,   1.49754,    .12085,    208300000
     1   1.50817,    .12057,   1.51872,    .12027,   1.52928,    208400000
     1    .11996,   1.53983,    .11964,   1.55038,    .11930,    208500000
     1   1.56094,    .11894,   1.57149,    .11857,   1.58204,    208600000
     1    .11818,   1.59259,    .11778,   1.60314,    .11736/    208700000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/                 208800000
     1   1.61369,    .11693,   1.62418,    .11648,   1.63468,    208900000
     1    .11602,   1.64517,    .11554,   1.65566,    .11504,    209000000
     1   1.66616,    .11453,   1.67665,    .11400,   1.68714,    209100000
     1    .11346,   1.69763,    .11291,   1.70811,    .11234,    209200000
     1   1.71860,    .11175,   1.72914,    .11115,   1.73968,    209300000
     1    .1054,    1.75021,    .10991,   1.76075,    .10928,    209400000
     1   1.77128,    .10863,   1.78182,    .10797,   1.79235,    209500000
     1    .10730,   1.80289,    .10662,   1.81342,    .10594,    209600000
     1   1.82395,    .10524,   1.83461,    .10453,   1.84527,    209700000
     1    .10381,   1.85592,    .10308,   1.86658,    .10235/    209800000
000005       DATA (PHILD(I),PSILD(I),I=176,200)/                 209900000
     1   1.87723,    .10161,   1.88789,    .10086,   1.89854,    210000000
     1    .10010,   1.90920,    .09933,   1.91985,    .09856,    210100000
     1   1.93050,    .09778,   1.94138,    .09698,   1.95226,    210200000
     1    .09617,   1.96314,    .09535,   1.97402,    .09452,    210300000
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     1    1.98489,     .09369,    1.99577,     .09285,    2.00664,    210400000
     1     .09201,    2.01752,     .09116,    2.02839,     .09030,    210500000
     1    2.03927,     .08943,    2.05056,     .08853,    2.06185,    210600000
     1     .08763,    2.07314,     .08671,    2.08444,     .08579,    210700000
     1    2.09573,     .08487,    2.10702,     .08394,    2.11831,    210800000
     1     .08301,    2.12960,     .08207,    2.14089,     .08113/    210900000
000005        DATA (PHILD(I),PSILD(I),I=201,225)/                      211000000
     1    2.15217,     .08019,    2.16409,     .07919,    2.17601,    211100000
     1     .07818,    2.18793,     .07717,    2.19985,     .07616,    211200000
     1    2.21176,     .07515,    2.22368,     .07413,    2.23560,    211300000
     1     .07311,    2.24751,     .07209,    2.25943,     .07106,    211400000
     1    2.27134,     .07004,    2.28424,     .06892,    2.29713,    211500000
     1     .06781,    2.31002,     .06670,    2.32292,     .06559,    211600000
     1    2.33581,     .06448,    2.34870,     .06338,    2.36159,    211700000
     1     .06229,    2.37449,     .06119,    2.38738,     .06011,    211800000
     1    2.40028,     .05904,    2.41489,     .05783,    2.42950,    211900000
     1     .05664,    2.44411,     .05545,    2.45872,     .05427/    212000000
000005        DATA (PHILD(I),PSILD(I),I=226,251)/                      212100000
     1    2.47334,     .05309,    2.48795,     .05191,    2.50256,    212200000
     1     .05072,    2.51717,     .04953,    2.53178,     .04834,    212300000
     1    2.54640,     .04713,    2.56432,     .04564,    2.58225,    212400000
     1     .04413,    2.60018,     .04263,    2.61810,     .04114,    212500000
     1    2.63603,     .03967,    2.65396,     .03823,    2.67189,    212600000
     1     .03683,    2.68983,     .03549,    2.70777,     .03421,    212700000
     1    2.72571,     .03300,    2.76723,     .03052,    2.80877,    212800000
     1     .02844,    2.85033,     .02675,    2.89190,     .02539,    212900000
     1    2.93350,     .02434,    2.97510,     .02355,    3.01671,    213000000
     1     .02301,    3.05834,     .02266,    3.09996,     .02248,    213100000
     1    3.14159,     .02242/                                         213200000
000005        DO 202 J=1,201                                           213300000
000006        CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)              213400000
000014    202 CONTINUE                                                 213500000
000020        RETURN                                                   213600000
000021        END                                                      213700000
```

```
                SUBROUTINE PHPS66(PHI,PSI)                                      213800000
000005          DIMENSION PHI(1),PSI(1)                                         213900000
000005          DIMENSION PHILD(201),PSILD(201)                                 214000000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                               214100000
               1   0.00000,    .16457,    .01573,    .16455,    .03145,        214200000
               1    .16449,    .04718,    .16437,    .06290,    .16416,        214300000
               1    .07862,    .16386,    .09433,    .16345,    .11003,        214400000
               1    .16292,    .12572,    .16223,    .14141,    .16139,        214500000
               1    .15708,    .16037,    .17280,    .15916,    .18851,        214600000
               1    .15779,    .20422,    .15631,    .21992,    .15475,        214700000
               1    .23562,    .15316,    .25131,    .15157,    .26701,        214800000
               1    .15002,    .28272,    .14856,    .29844,    .14722,        214900000
               1    .31416,    .14604,    .32984,    .14506,    .34552,        215000000
               1    .14427,    .36122,    .14364,    .37693,    .14316/        215100000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                               215200000
               1    .39264,    .14281,    .40835,    .14257,    .42407,        215300000
               1    .14242,    .43980,    .14235,    .45552,    .14233,        215400000
               1    .47124,    .14236,    .48696,    .14241,    .50267,        215500000
               1    .14248,    .51838,    .14257,    .53409,    .14267,        215600000
               1    .54979,    .14280,    .56550,    .14294,    .58121,        215700000
               1    .14310,    .59691,    .14327,    .61262,    .14346,        215800000
               1    .62832,    .14366,    .64403,    .14387,    .65973,        215900000
               1    .14410,    .67544,    .14433,    .69115,    .14457,        216000000
               1    .70686,    .14481,    .72257,    .14506,    .73827,        216100000
               1    .14530,    .75398,    .14554,    .76969,    .14578/        216200000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                               216300000
               1    .78540,    .14601,    .80111,    .14623,    .81682,        216400000
               1    .14645,    .83252,    .14665,    .84823,    .14685,        216500000
               1    .86394,    .14704,    .87965,    .14722,    .89536,        216600000
               1    .14740,    .91106,    .14757,    .92677,    .14774,        216700000
               1    .94248,    .14790,    .95819,    .14806,    .97390,        216800000
               1    .14821,    .98960,    .14835,   1.00531,    .14849,        216900000
               1   1.02102,    .14862,   1.03673,    .14875,   1.05244,        217000000
               1    .14886,   1.06814,    .14897,   1.08385,    .14908,        217100000
               1   1.09956,    .14917,   1.11527,    .14925,   1.13098,        217200000
               1    .14933,   1.14668,    .14940,   1.16239,    .14945/        217300000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                              217400000
               1   1.17810,    .14950,   1.19381,    .14954,   1.20952,        217500000
               1    .14957,   1.22522,    .14959,   1.24093,    .14961,        217600000
               1   1.25664,    .14961,   1.27235,    .14960,   1.28806,        217700000
               1    .14959,   1.30376,    .14956,   1.31947,    .14953,        217800000
               1   1.33518,    .14948,   1.35089,    .14943,   1.36660,        217900000
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     1    .14936,   1.38230,    .14928,   1.39801,    .14918,   218000000
     1   1.41372,    .14908,   1.42943,    .14896,   1.44514,   218100000
     1    .14883,   1.46085,    .14869,   1.47655,    .14853,   218200000
     1   1.49226,    .14835,   1.50797,    .14816,   1.52368,   218300000
     1    .14796,   1.53939,    .14774,   1.55509,    .14750/   218400000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/               218500000
     1   1.57080,    .14725,   1.58651,    .14698,   1.60222,   218600000
     1    .14669,   1.61793,    .14638,   1.63364,    .14606,   218700000
     1   1.64934,    .14571,   1.66505,    .14533,   1.68076,   218800000
     1    .14494,   1.69647,    .14452,   1.71217,    .14407,   218900000
     1   1.72788,    .14360,   1.74360,    .14310,   1.75932,   219000000
     1    .14256,   1.77504,    .14198,   1.79075,    .14135,   219100000
     1   1.80647,    .14067,   1.82217,    .13992,   1.83788,   219200000
     1    .13910,   1.85358,    .13820,   1.86927,    .13722,   219300000
     1   1.88496,    .13615,   1.90070,    .13498,   1.91642,   219400000
     1    .13371,   1.93214,    .13236,   1.94786,    .13093/   219500000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/               219600000
     1   1.96357,    .12942,   1.97927,    .12786,   1.99497,   219700000
     1    .12623,   2.01067,    .12456,   2.02636,    .12284,   219800000
     1   2.04204,    .12108,   2.05777,    .11929,   2.07349,   219900000
     1    .11746,   2.08920,    .11561,   2.10492,    .11373,   220000000
     1   2.12062,    .11182,   2.13633,    .10987,   2.15203,   220100000
     1    .10790,   2.16773,    .10590,   2.18342,    .10386,   220200000
     1   2.19911,    .10180,   2.21483,    .09970,   2.23055,   220300000
     1    .09758,   2.24626,    .09542,   2.26197,    .09325,   220400000
     1   2.27768,    .09106,   2.29338,    .08885,   2.30909,   220500000
     1    .08662,   2.32479,    .08439,   2.34049,    .08214/   220600000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/               220700000
     1   2.35619,    .07989,   2.37190,    .07763,   2.38761,   220800000
     1    .07537,   2.40331,    .07311,   2.41902,    .07085,   220900000
     1   2.43473,    .06859,   2.45043,    .06633,   2.46614,   221000000
     1    .06407,   2.48185,    .06182,   2.49756,    .05957,   221100000
     1   2.51327,    .05733,   2.52897,    .05510,   2.54467,   221200000
     1    .05287,   2.56037,    .05066,   2.57607,    .04846,   221300000
     1   2.59178,    .04627,   2.60749,    .04411,   2.62320,   221400000
     1    .04196,   2.63891,    .03983,   2.65463,    .03773,   221500000
     1   2.67035,    .03566,   2.68604,    .03362,   2.70173,   221600000
     1    .03161,   2.71742,    .02964,   2.73312,    .02770/   221700000
000005       DATA (PHILD(I),PSILD(I),I=176,201)/               221800000
     1   2.74882,    .02580,   2.76453,    .02395,   2.78025,   221900000
     1    .02215,   2.79597,    .02039,   2.81170,    .01869,   222000000
     1   2.82743,    .01705,   2.84311,    .01547,   2.85880,   222100000
     1    .01396,   2.87449,    .01250,   2.89019,    .01112,   222200000
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              1   2.90590,     .00981,    2.92161,     .00857,    2.93733,
              1    .00740,    2.95305,     .00631,    2.96878,     .00531,
              1   2.98451,     .00439,    3.00020,     .00356,    3.01590,
              1    .00281,    3.03160,     .00216,    3.04731,     .00159,
              1   3.06302,     .00110,    3.07873,     .00071,    3.09444,
              1    .00040,    3.11016,     .00018,    3.12587,     .00004,
              1   3.14159,    0.00000/
000005          DO 202 J=1,201
000006          CALL FTLUP(PHI(J),PSI(J),2,201,PHILD,PSILD)
000014      202 CONTINUE
000020          RETURN
000021          END
```

```
                SUBROUTINE PHPS67(PHI,PSI)                                      223500000
000005          DIMENSION PHI(1), PSI(1)                                        223600000
000005          DIMENSION PHILD(251),PSILD(251)                                 223700000
000005          DATA (PHILD(I),PSILD(I),I=1,25 )/                               223800000
               1   0.00000,     .18028,     .01499,     .18026,     .02998,    223900000
               1    .18018,     .04497,     .18002,     .05995,     .17976,    224000000
               1    .07492,     .17938,     .08988,     .17885,     .10483,    224100000
               1    .17815,     .11976,     .17725,     .13468,     .17614,    224200000
               1    .14959,     .17480,     .15280,     .17447,     .15601,    224300000
               1    .17414,     .15923,     .17380,     .16244,     .17345,    224400000
               1    .16565,     .17310,     .16886,     .17276,     .17208,    224500000
               1    .17241,     .17529,     .17207,     .17850,     .17174,    224600000
               1    .13172,     .17141,     .18686,     .17092,     .19201,    224700000
               1    .17045,     .19716,     .17001,     .20231,     .16959/    224800000
000005          DATA (PHILD(I),PSILD(I),I=26,50)/                               224900000
               1    .20746,     .16918,     .21262,     .16879,     .21777,    225000000
               1    .16840,     .22293,     .16802,     .22808,     .16764,    225100000
               1    .23323,     .16726,     .24277,     .16653,     .25229,    225200000
               1    .16578,     .26182,     .16502,     .27135,     .16426,    225300000
               1    .28088,     .16349,     .29041,     .16272,     .29993,    225400000
               1    .16196,     .30946,     .16121,     .31899,     .16048,    225500000
               1    .32853,     .15978,     .34178,     .15885,     .35505,    225600000
               1    .15798,     .36832,     .15717,     .38159,     .15641,    225700000
               1    .39486,     .15572,     .40814,     .15507,     .42142,    225800000
               1    .15449,     .43470,     .15396,     .44798,     .15348/    225900000
000005          DATA (PHILD(I),PSILD(I),I=51,75)/                               226000000
               1    .46127,     .15306,     .47164,     .15277,     .48200,    226100000
               1    .15251,     .49237,     .15228,     .50274,     .15207,    226200000
               1    .51311,     .15188,     .52348,     .15171,     .53384,    226300000
               1    .15156,     .54421,     .15142,     .55458,     .15129,    226400000
               1    .56495,     .15116,     .57385,     .15105,     .58275,    226500000
               1    .15095,     .59165,     .15085,     .60055,     .15075,    226600000
               1    .60945,     .15066,     .61835,     .15057,     .62725,    226700000
               1    .15049,     .63615,     .15041,     .64505,     .15034,    226800000
               1    .65395,     .15027,     .66928,     .15016,     .68461,    226900000
               1    .15007,     .69994,     .15000,     .71527,     .14994/    227000000
000005          DATA (PHILD(I),PSILD(I),I=76,100)/                              227100000
               1    .73060,     .14990,     .74593,     .14986,     .76125,    227200000
               1    .14984,     .77658,     .14982,     .79191,     .14982,    227300000
               1    .80724,     .14982,     .82061,     .14982,     .83397,    227400000
               1    .14983,     .84734,     .14985,     .86070,     .14986,    227500000
               1    .87407,     .14988,     .88743,     .14991,     .90080,    227600000
```

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     1    .14993,    .91416,    .14996,    .92753,    .14999,                227700000
     1    .94089,    .15002,    .95309,    .15005,    .96529,                227800000
     1    .15008,    .97749,    .15011,    .98969,    .15014,                227900000
     1   1.00189,    .15018,   1.01409,    .15021,   1.02629,                228000000
     1    .15024,   1.03849,    .15028,   1.05069,    .15031/                228100000
000005       DATA (PHILD(I),PSILD(I),I=101,125)/                             228200000
     1   1.06289,    .15035,   1.07435,    .15038,   1.08580,                228300000
     1    .15042,   1.09726,    .15045,   1.10871,    .15048,                228400000
     1   1.12017,    .15052,   1.13162,    .15056,   1.14308,                228500000
     1    .15059,   1.15453,    .15063,   1.16599,    .15067,                228600000
     1   1.17744,    .15070,   1.18840,    .15074,   1.19936,                228700000
     1    .15077,   1.21032,    .15081,   1.22129,    .15084,                228800000
     1   1.23225,    .15088,   1.24321,    .15091,   1.25417,                228900000
     1    .15094,   1.26513,    .15096,   1.27609,    .15099,                229000000
     1   1.28706,    .15101,   1.29770,    .15103,   1.30835,                229100000
     1    .15104,   1.31900,    .15106,   1.32965,    .15107/                229200000
000005       DATA (PHILD(I),PSILD(I),I=126,150)/                             229300000
     1   1.34029,    .15108,   1.35094,    .15108,   1.36159,                229400000
     1    .15109,   1.37224,    .15109,   1.38289,    .15110,                229500000
     1   1.39353,    .15110,   1.40401,    .15110,   1.41449,                229600000
     1    .15110,   1.42498,    .15110,   1.43546,    .15109,                229700000
     1   1.44594,    .15109,   1.45642,    .15108,   1.46690,                229800000
     1    .15107,   1.47738,    .15106,   1.48786,    .15104,                229900000
     1   1.49834,    .15102,   1.50878,    .15100,   1.51921,                230000000
     1    .15097,   1.52965,    .15094,   1.54008,    .15090,                230100000
     1   1.55052,    .15086,   1.56095,    .15081,   1.57139,                230200000
     1    .15076,   1.58182,    .15071,   1.59226,    .15065/                230300000
000005       DATA (PHILD(I),PSILD(I),I=151,175)/                             230400000
     1   1.60269,    .15059,   1.61319,    .15053,   1.62369,                230500000
     1    .15046,   1.63419,    .15038,   1.64469,    .15030,                230600000
     1   1.65519,    .15022,   1.66569,    .15013,   1.67619,                230700000
     1    .15003,   1.68669,    .14993,   1.69719,    .14982,                230800000
     1   1.70770,    .14970,   1.71841,    .14957,   1.72912,                230900000
     1    .14943,   1.73984,    .14929,   1.75055,    .14914,                231000000
     1   1.76127,    .14897,   1.77198,    .14880,   1.78270,                231100000
     1    .14862,   1.79341,    .14842,   1.80412,    .14822,                231200000
     1   1.81484,    .14800,   1.82589,    .14776,   1.83694,                231300000
     1    .14752,   1.84798,    .14725,   1.85903,    .14698/                231400000
000005       DATA (PHILD(I),PSILD(I),I=176,200)/                             231500000
     1   1.87008,    .14669,   1.88113,    .14639,   1.89218,                231600000
     1    .14607,   1.90322,    .14574,   1.91427,    .14539,                231700000
     1   1.92531,    .14502,   1.93688,    .14462,   1.94844,                231800000
     1    .14420,   1.96000,    .14376,   1.97156,    .14329,                231900000
```

APPENDIX

```
000005      DATA (PHILD(I),PSILD(I),I=201,225)/
     1    2.16259,    .12980,    2.17538,    .12839,    2.18816,
     1    .12692,    2.20093,    .12538,    2.21370,    .12380,
     1    2.22646,    .12216,    2.23922,    .12048,    2.25197,
     1    .11876,    2.26472,    .11700,    2.27746,    .11523,
     1    2.29021,    .11343,    2.30379,    .11150,    2.31737,
     1    .10955,    2.33095,    .10758,    2.34453,    .10559,
     1    2.35810,    .10358,    2.37167,    .10154,    2.38523,
     1    .09948,    2.39879,    .09738,    2.41235,    .09526,
     1    2.42590,    .09310,    2.44078,    .09070,    2.45566,
     1    .08825,    2.47053,    .08576,    2.48539,    .08324/
000005      DATA (PHILD(I),PSILD(I),I=226,251)/
     1    2.50025,    .08068,    2.51510,    .07808,    2.52995,
     1    .07545,    2.54478,    .07278,    2.55962,    .07008,
     1    2.57444,    .06735,    2.59138,    .06420,    2.60831,
     1    .06102,    2.62523,    .05782,    2.64216,    .05463,
     1    2.65909,    .05145,    2.67603,    .04830,    2.69297,
     1    .04518,    2.70993,    .04212,    2.72690,    .03912,
     1    2.74389,    .03620,    2.78335,    .02979,    2.82290,
     1    .02391,    2.86255,    .01859,    2.90227,    .01386,
     1    2.94205,    .00977,    2.98189,    .00635,    3.02178,
     1    .00362,    3.06170,    .00163,    3.10164,    .00041,
     1    3.14159,    0.CC000/
000005      DO 202 J=1,201
000006      CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)
000014  202 CONTINUE
000020      RETURN
000021      END
```

```
232000000
232100000
232200000
232300000
232400000
232500000
232600000
232700000
232800000
232900000
233000000
233100000
233200000
233300000
233400000
233500000
233600000
233700000
233800000
233900000
234000000
234100000
234200000
234300000
234400000
234500000
234600000
234700000
234800000
234900000
235000000
235100000
235200000
235300000
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TABLE I

SAMPLE COMPUTER PRINTOUT OF ORDINATES FOR SYMMETRIC AIRFOIL

```
 NACA 64-012

TOC=    .120000 RLE=    .010400 CHD=   4.000000
CLI=   0.000000
  A=   0.000000
RAT( 1)=    1.00000
RAT( 2)=     .58127
RAT( 3)=     .98427
RAT( 4)=     .99970


PEAK IS AT X/C=    .375985
MAXIMUM Y/C IS     .059999
SLOPE CHANGES SIGN AT X/C, Y/C =     .374809    .060000
X/C FIT OF ELLIPSE     .005524
Y/C FIT OF ELLIPSE     .010230
SLOPE FIT OF ELLIPSE     .875570
RADIUS AT ORIGIN OF ELLIPSE THRU XT(11)/C,YT(11)/C    .009993
RATIO OF T/C INPUT TO T/C COMPUTED IS     .999994
CUMULATIVE SCALING OF EPS,PSI     .571956
NUMBER OF ITERATIONS=          4
        X/C             Y/C          DY/DX       D2Y/DX2                    X          Y

    0.000000      0.000000*00000.000000*00000.000000              0.000000   0.000000
     .000250       .002255     4.131807 -1285.416924               .001000    .009018
     .000500       .003156     3.121326 -3039.995834               .002000    .012626
     .000750       .003879     2.440607  -861.366352               .003000    .015517
     .001000       .004459     2.175085 -1012.816131               .004000    .017834
     .001250       .004964     1.971195  -835.047477               .005000    .019857
     .001500       .005441     1.775869  -594.256452               .006000    .021765
     .001750       .005873     1.632783  -456.780804               .007000    .023490
     .002000       .006263     1.534051  -403.760988               .008000    .025052
     .002250       .006639     1.435421  -329.337913               .009000    .026557
     .002500       .006982     1.365550  -295.964554               .010000    .027927
     .002750       .007317     1.293897  -253.258692               .011000    .029270
     .003000       .007636     1.231598  -219.588876               .012000    .030546
     .003250       .007932     1.184026  -201.449334               .013000    .031729
     .003500       .008224     1.135046  -179.341768               .014000    .032896
     .003750       .008505     1.090799  -160.686953               .015000    .034019
```

X/C	Y/C	DY/DX	D2Y/DX2	X	Y
.004000	.008774	1.051285	-145.484888	.016000	.035096
.004250	.009028	1.019076	-133.893193	.017000	.036113
.004500	.009280	.985605	-125.386881	.018000	.037121
.004750	.009525	.954728	-120.202245	.019000	.038098
.005000	.009761	.926444	-118.339285	.020000	.039043
.005250	.009985	.902544	-129.996495	.021000	.039941
.005500	.010209	.877865	-125.754737	.022000	.040836
.005750	.010427	.854758	-119.018470	.023000	.041708
.006000	.010639	.833224	-109.787694	.024000	.042556
.006250	.010842	.814898	-86.834845	.025000	.043366
.006500	.011044	.795887	-76.897514	.026000	.044174
.006750	.011241	.777840	-68.640810	.027000	.044965
.007000	.011434	.760757	-62.064732	.028000	.045738
.007250	.011623	.744640	-57.169281	.029000	.046493
.007500	.011804	.730398	-58.902952	.030000	.047217
.007750	.011986	.715929	-55.844655	.031000	.047942
.008000	.012164	.702151	-52.974043	.032000	.048654
.008250	.012338	.689063	-50.291118	.033000	.049353
.008500	.012510	.676666	-47.795879	.034000	.050039
.008750	.012678	.664958	-45.488326	.035000	.050712
.009000	.012840	.655005	-43.462929	.036000	.051362
.009250	.013003	.644229	-41.490895	.037000	.052013
.009500	.013164	.633848	-39.680346	.038000	.052654
.009750	.013321	.623861	-38.031281	.039000	.053285
.010000	.013477	.614270	-36.543701	.040000	.053906
.010250	.013629	.605074	-35.217606	.041000	.054517
.010500	.013777	.596668	-34.650014	.042000	.055109
.010750	.013926	.588122	-33.435851	.043000	.055703
.011000	.014072	.579881	-32.245275	.044000	.056289
.011250	.014217	.571944	-31.078285	.045000	.056867
.011500	.014359	.564310	-29.934882	.046000	.057437
.011750	.014500	.556981	-28.815066	.047000	.057999
.012000	.014636	.550450	-27.501208	.048000	.058543
.012250	.014773	.543634	-26.470002	.049000	.059091
.012500	.014908	.537033	-25.501899	.050000	.059633
.015000	.016180	.482103	-18.897974	.060000	.064720
.017500	.017331	.440913	-14.046042	.070000	.069326
.020000	.018393	.411037	-10.489436	.080000	.073573
.022500	.019391	.387965	-8.134129	.090000	.077563
.025000	.020337	.369531	-6.740138	.100000	.081348
.027500	.021241	.353858	-5.815760	.110000	.084963
.030000	.022108	.340228	-5.194567	.120000	.088432
.032500	.022943	.327704	-4.774443	.130000	.091771

X/C	Y/C	DY/DX	D2Y/DX2	X	Y
.035000	.023747	.316500	-4.194250	.140000	.094990
.037500	.024526	.306615	-3.792967	.150000	.098105
.040000	.025281	.297336	-3.586336	.160000	.101125
.042500	.026013	.288436	-3.513660	.170000	.104053
.045000	.026724	.279882	-3.306920	.180000	.106895
.047500	.027413	.271930	-3.068947	.190000	.109652
.050000	.028084	.264427	-2.908264	.200000	.112335
.052500	.028736	.257318	-2.803309	.210000	.114944
.055000	.029370	.250411	-2.674179	.220000	.117481
.057500	.029988	.243965	-2.527467	.230000	.119953
.060000	.030591	.237860	-2.362769	.240000	.122363
.062500	.031178	.232097	-2.180705	.250000	.124711
.065000	.031751	.227000	-1.985979	.260000	.127006
.067500	.032313	.222050	-1.907873	.270000	.129251
.070000	.032862	.217258	-1.947578	.280000	.131448
.072500	.033399	.212405	-1.813280	.290000	.133595
.075000	.033925	.208054	-1.666697	.300000	.135699
.077500	.034440	.204286	-1.487686	.310000	.137758
.080000	.034946	.200488	-1.457313	.320000	.139783
.082500	.035443	.196758	-1.530565	.330000	.141771
.085000	.035929	.192922	-1.444017	.340000	.143716
.087500	.036407	.189428	-1.353455	.350000	.145629
.090000	.036877	.186315	-1.241184	.360000	.147509
.092500	.037339	.183221	-1.186846	.370000	.149357
.095000	.037793	.180206	-1.180733	.380000	.151172
.097500	.038240	.177275	-1.173892	.390000	.152960
.100000	.038680	.174422	-1.177135	.400000	.154720
.110000	.040368	.163661	-.965403	.440000	.161471
.120000	.041954	.153671	-.952923	.480000	.167816
.130000	.043445	.144668	-.847987	.520000	.173780
.140000	.044850	.136293	-.838410	.560000	.179401
.150000	.046174	.128546	-.768840	.600000	.184694
.160000	.047420	.120926	-.740197	.640000	.189680
.170000	.048593	.113979	-.630416	.680000	.194372
.180000	.049701	.107394	-.697222	.720000	.198803
.190000	.050741	.100967	-.582839	.760000	.202964
.200000	.051721	.094992	-.633926	.800000	.206883
.210000	.052639	.088681	-.595725	.840000	.210556
.220000	.053498	.083071	-.559363	.880000	.213992
.230000	.054302	.077619	-.578859	.920000	.217206
.240000	.055048	.071700	-.570007	.960000	.220191
.250000	.055739	.066482	-.525489	1.000000	.222954
.260000	.056376	.060998	-.567896	1.040000	.225506

X/C	Y/C	DY/DX	D2Y/DX2	X	Y
.270000	.056959	.055975	-.510045	1.080000	.227838
.280000	.057492	.050372	-.553912	1.120000	.229969
.290000	.057972	.045436	-.513047	1.160000	.231886
.300000	.058399	.040450	-.469088	1.200000	.233597
.310000	.058780	.035427	-.502003	1.240000	.235121
.320000	.059112	.030787	-.465131	1.280000	.236446
.330000	.059394	.025770	-.499237	1.320000	.237576
.340000	.059628	.020868	-.535935	1.360000	.238511
.350000	.059808	.015195	-.584615	1.400000	.239233
.360000	.059931	.009286	-.622033	1.440000	.239725
.370000	.059993	.003005	-.618603	1.480000	.239970
.380000	.059991	-.003787	-.739954	1.520000	.239964
.390000	.059916	-.010984	-.691783	1.560000	.239664
.400000	.059771	-.018318	-.774198	1.600000	.239084
.410000	.059549	-.025535	-.697321	1.640000	.238197
.420000	.059258	-.032895	-.734415	1.680000	.237031
.430000	.058895	-.039294	-.579401	1.720000	.235581
.440000	.058473	-.045415	-.635778	1.760000	.233893
.450000	.057989	-.051295	-.549696	1.800000	.231957
.460000	.057449	-.056766	-.503231	1.840000	.229795
.470000	.056857	-.061438	-.470018	1.880000	.227427
.480000	.056218	-.066406	-.487960	1.920000	.224873
.490000	.055532	-.070483	-.427034	1.960000	.222130
.500000	.054804	-.075248	-.480101	2.000000	.219217
.510000	.054031	-.079248	-.347595	2.040000	.216124
.520000	.053220	-.083100	-.396654	2.080000	.212882
.530000	.052370	-.086782	-.350193	2.120000	.209481
.540000	.051485	-.090449	-.376789	2.160000	.205939
.550000	.050561	-.094095	-.324739	2.200000	.202246
.560000	.049605	-.097024	-.277649	2.240000	.198420
.570000	.048620	-.100224	-.363088	2.280000	.194479
.580000	.047599	-.103419	-.259920	2.320000	.190397
.590000	.046552	-.106151	-.304461	2.360000	.186208
.600000	.045476	-.108979	-.240520	2.400000	.181903
.610000	.044375	-.111386	-.262069	2.440000	.177500
.620000	.043248	-.113849	-.231948	2.480000	.172992
.630000	.042098	-.116246	-.241424	2.520000	.168393
.640000	.040925	-.118227	-.201310	2.560000	.163698
.650000	.039732	-.120453	-.208074	2.600000	.158926
.660000	.038518	-.122137	-.162269	2.640000	.154072
.670000	.037287	-.123971	-.162453	2.680000	.149150
.680000	.036040	-.125576	-.178035	2.720000	.144161
.690000	.034776	-.127189	-.125694	2.760000	.139102

X/C	Y/C	DY/DX	D2Y/DX2	X	Y
.700000	.033498	-.128526	-.163267	2.800000	.133993
.710000	.032206	-.129741	-.080172	2.840000	.128824
.720000	.030905	-.130622	-.141180	2.880000	.123620
.730000	.029593	-.131871	-.058873	2.920000	.118372
.740000	.028272	-.132163	-.054710	2.960000	.113089
.750000	.026946	-.133067	-.015654	3.000000	.107782
.760000	.025616	-.132976	-.012197	3.040000	.102465
.770000	.024284	-.133401	.005723	3.080000	.097136
.780000	.022951	-.133128	.027803	3.120000	.091803
.790000	.021620	-.133042	.050847	3.160000	.086480
.800000	.020293	-.132317	.069279	3.200000	.081173
.810000	.018973	-.131472	.108890	3.240000	.075893
.820000	.017663	-.130418	.110927	3.280000	.070654
.830000	.016366	-.129108	.165715	3.320000	.065465
.840000	.015084	-.127349	.149801	3.360000	.060337
.850000	.013819	-.125568	.213344	3.400000	.055275
.860000	.012574	-.123352	.232909	3.440000	.050297
.870000	.011354	-.120612	.244717	3.480000	.045416
.880000	.010159	-.118133	.347474	3.520000	.040637
.890000	.008996	-.114882	.325847	3.560000	.035982
.900000	.007865	-.111323	.356857	3.600000	.031459
.910000	.006772	-.107115	.394637	3.640000	.027087
.920000	.005721	-.102727	.556129	3.680000	.022883
.930000	.004719	-.097782	.525721	3.720000	.018877
.940000	.003771	-.091872	.584132	3.760000	.015083
.950000	.002884	-.085025	.742857	3.800000	.011536
.960000	.002073	-.076778	.835825	3.840000	.008293
.970000	.001351	-.066920	.980104	3.880000	.005404
.980000	.000739	-.055011	1.385235	3.920000	.002955
.990000	.000263	-.039270	2.054028	3.960000	.001054
1.000000	.000000	-.001845	20.958633	4.000000	.000000

TABLE II

SAMPLE COMPUTER PRINTOUT OF ORDINATES FOR CAMBERED AIRFOIL

NACA 64-412

TOC= .120000 RLE= .010400 CHD= 4.000000
CLI= .400000
A= 1.000000
RAT(1)= 1.00000
RAT(2)= .58127
RAT(3)= .98427
RAT(4)= .99970

PEAK IS AT X/C= .375985
MAXIMUM Y/C IS .059999
SLOPE CHANGES SIGN AT X/C, Y/C = .374809 .060000
X/C FIT OF ELLIPSE .005524
Y/C FIT OF ELLIPSE .010230
SLOPE FIT OF ELLIPSE .875570
RADIUS AT ORIGIN OF ELLIPSE THRU XT(11)/C,YT(11)/C .009993
RATIO OF T/C INPUT TO T/C COMPUTED IS .999994
CUMULATIVE SCALING OF EPS,PSI .571956
NUMBER OF ITERATIONS= 4

UNCAMBERED	UPPER SURFACE VALUES					LOWER SURFACE VALUES				
X/C	XU/C	YU/C	XU	YU	DYU/DXU	XL/C	YL/C	XL	YL	DYL/DXL
0.000000	0.000000	0.000000	0.000000	0.000000	-5.935031	0.000000	0.000000	0.000000	0.000000	-5.935031
.000250	-.000125	.002297	-.000500	.009188	13.559855	.000625	-.002149	.002500	-.008597	-2.315002
.000500	-.000025	.003249	-.000099	.012997	6.749988	.001025	-.002976	.004099	-.011902	-1.915185
.000750	.000105	.004021	.000420	.016083	4.334156	.001395	-.003630	.005580	-.014518	-1.591954
.001000	.000259	.004648	.001035	.018593	3.624101	.001741	-.004145	.006965	-.016579	-1.451314
.001250	.000425	.005201	.001698	.020804	3.142186	.002075	-.004589	.008302	-.018358	-1.336971
.001500	.000595	.005724	.002381	.022895	2.724023	.002405	-.005007	.009619	-.020030	-1.221811
.001750	.000774	.006200	.003095	.024801	2.441357	.002726	-.005382	.010905	-.021526	-1.133720
.002000	.000959	.006635	.003835	.026540	2.256836	.003041	-.005717	.012165	-.022866	-1.070991
.002250	.001146	.007055	.004585	.028220	2.080457	.003354	-.006039	.013415	-.024155	-1.006665
.002500	.001339	.007441	.005358	.029764	1.960029	.003661	-.006328	.014642	-.025314	-.960058
.002750	.001534	.007819	.006135	.031277	1.840240	.003966	-.006612	.015865	-.026449	-.911335
.003000	.001731	.008180	.006923	.032721	1.739003	.004269	-.006880	.017077	-.027520	-.868189
.003250	.001932	.008518	.007727	.034071	1.663454	.004568	-.007126	.018273	-.028504	-.834743
.003500	.002133	.008851	.008533	.035404	1.587210	.004867	-.007368	.019467	-.029474	-.799841
.003750	.002337	.009172	.009347	.036689	1.519637	.005163	-.007600	.020653	-.030402	-.767897
.004000	.002542	.009482	.010168	.037928	1.460310	.005458	-.007822	.021832	-.031288	-.739033
.004250	.002750	.009776	.010999	.039106	1.412643	.005750	-.008029	.023001	-.032116	-.715268
.004500	.002958	.010068	.011832	.040273	1.363756	.006042	-.008234	.024168	-.032937	-.690338
.004750	.003167	.010352	.012670	.041407	1.319231	.006333	-.008432	.025330	-.033730	-.667128
.005000	.003378	.010627	.013513	.042509	1.278920	.006622	-.008623	.026487	-.034492	-.645687
.005250	.003606	.010893	.014424	.043572	1.172685	.006894	-.008805	.027576	-.035221	-.672394
.005500	.003834	.011158	.015335	.044631	1.139211	.007166	-.008987	.028665	-.035947	-.653717
.005750	.004062	.011416	.016249	.045665	1.108142	.007438	-.009163	.029751	-.036651	-.636104
.006000	.004292	.011669	.017168	.046674	1.079408	.007708	-.009334	.030832	-.037334	-.619589
.006250	.004523	.011911	.018092	.047645	1.055010	.007977	-.009495	.031908	-.037981	-.605543
.006500	.004754	.012153	.019017	.048612	1.029966	.008246	-.009657	.032983	-.038626	-.590809
.006750	.004986	.012390	.019944	.049560	1.006346	.008514	-.009814	.034056	-.039256	-.576747
.007000	.005219	.012622	.020874	.050490	.984116	.008781	-.009967	.035126	-.039869	-.563373

UNCAMBERED X/C	UPPER SURFACE VALUES XU/C	YU/C	XU	YU	DYU/DXU	LOWER SURFACE VALUES XL/C	YL/C	XL	YL	DYL/DXL
.007250	.005452	.012850	.021807	.051401	.963247	.009048	-.010117	.036193	-.040466	-.550702
.007500	.005686	.013070	.022745	.052280	.944827	.009314	-.010258	.037255	-.041033	-.539516
.007750	.005920	.013290	.023682	.053159	.926255	.009580	-.010400	.038318	-.041602	-.528063
.008000	.006155	.013506	.024621	.054024	.908642	.009845	-.010540	.039379	-.042159	-.517121
.008250	.006391	.013719	.025562	.054875	.891972	.010109	-.010676	.040438	-.042704	-.506696
.008500	.006626	.013928	.026505	.055712	.876230	.010374	-.010809	.041495	-.043237	-.496799
.008750	.006862	.014134	.027450	.056536	.861403	.010638	-.010940	.042550	-.043759	-.487437
.009000	.007100	.014334	.028398	.057335	.848734	.010900	-.011064	.043602	-.044257	-.479541
.009250	.007337	.014534	.029346	.058135	.835163	.011163	-.011190	.044654	-.044759	-.470885
.009500	.007574	.014731	.030295	.058924	.822128	.011426	-.011313	.045705	-.045251	-.462526
.009750	.007812	.014925	.031246	.059702	.809622	.011688	-.011434	.046754	-.045735	-.454467
.010000	.008050	.015117	.032198	.060469	.797640	.011950	-.011552	.047802	-.046209	-.446714
.010250	.008288	.015306	.033152	.061226	.786173	.012212	-.011668	.048848	-.046673	-.439269
.010500	.008527	.015491	.034108	.061962	.775677	.012473	-.011780	.049892	-.047120	-.432482
.010750	.008766	.015675	.035064	.062700	.765064	.012734	-.011892	.050936	-.047569	-.425543
.011000	.009005	.015857	.036021	.063430	.754847	.012995	-.012003	.051979	-.048011	-.418842
.011250	.009245	.016038	.036979	.064150	.745022	.013255	-.012112	.053021	-.048446	-.412382
.011500	.009484	.016216	.037938	.064862	.735586	.013516	-.012219	.054062	-.048874	-.406164
.011750	.009724	.016391	.038898	.065566	.726534	.013776	-.012324	.055102	-.049295	-.400192
.012000	.009965	.016563	.039860	.066251	.718428	.014035	-.012425	.056140	-.049698	-.394908
.012250	.010206	.016735	.040822	.066939	.710027	.014294	-.012527	.057178	-.050106	-.389350
.012500	.010446	.016905	.041785	.067620	.701900	.014554	-.012627	.058215	-.050508	-.383962
.015000	.012864	.018517	.051455	.074069	.634450	.017136	-.013559	.068545	-.054237	-.339131
.017500	.015296	.019996	.061184	.079985	.584021	.019704	-.014385	.078816	-.057540	-.305570
.020000	.017739	.021374	.070955	.085498	.547089	.022261	-.015133	.089045	-.060532	-.281646
.022500	.020189	.022678	.080755	.090712	.518278	.024811	-.015827	.099245	-.063308	-.263500
.025000	.022644	.023921	.090577	.095686	.494998	.027356	-.016479	.109423	-.065916	-.249282
.027500	.025105	.025114	.100418	.100457	.475091	.029895	-.017096	.119582	-.068386	-.237331
.030000	.027569	.026263	.110275	.105052	.457696	.032431	-.017685	.129725	-.070740	-.227040
.032500	.030036	.027372	.120144	.109489	.441756	.034964	-.018248	.139856	-.072991	-.217566
.035000	.032507	.028445	.130027	.113782	.427447	.037493	-.018787	.149973	-.075148	-.209152
.037500	.034980	.029487	.139920	.117947	.414726	.040020	-.019306	.160080	-.077225	-.201832
.040000	.037456	.030499	.149822	.121995	.402815	.042544	-.019807	.170178	-.079228	-.194943
.042500	.039933	.031483	.159734	.125930	.391456	.045067	-.020290	.180266	-.081161	-.188286
.045000	.042413	.032440	.169654	.129760	.380594	.047587	-.020757	.190346	-.083026	-.181844
.047500	.044896	.033372	.179582	.133486	.370480	.050104	-.021207	.200418	-.084826	-.175877
.050000	.047379	.034280	.189517	.137120	.360941	.052621	-.021642	.210483	-.086569	-.170251
.052500	.049865	.035166	.199460	.140664	.351908	.055135	-.022064	.220540	-.088255	-.164922
.055000	.052352	.036030	.209409	.144120	.343172	.057648	-.022471	.230591	-.089885	-.159709
.057500	.054841	.036874	.219363	.147496	.334993	.060159	-.022866	.240637	-.091465	-.154876
.060000	.057331	.037699	.229324	.150794	.327238	.062669	-.023249	.250676	-.092998	-.150310
.062500	.059822	.038504	.239290	.154017	.319901	.065178	-.023621	.260710	-.094483	-.146018
.065000	.062315	.039293	.249260	.157173	.313310	.067685	-.023982	.270740	-.095928	-.142326
.067500	.064809	.040067	.259235	.160267	.306923	.070191	-.024334	.280765	-.097337	-.138728
.070000	.067303	.040825	.269214	.163299	.300749	.072697	-.024677	.290786	-.098710	-.135238
.072500	.069799	.041567	.279196	.166270	.294562	.075201	-.025012	.300804	-.100046	-.131645
.075000	.072296	.042296	.289183	.169185	.288931	.077704	-.025338	.310817	-.101350	-.128505
.077500	.074793	.043011	.299173	.172043	.283937	.080207	-.025655	.320827	-.102621	-.125904
.080000	.077291	.043714	.309166	.174856	.278948	.082709	-.025967	.330834	-.103868	-.123237
.082500	.079790	.044406	.319161	.177623	.274064	.085210	-.026273	.340839	-.105090	-.120606
.085000	.082290	.045084	.329160	.180335	.269107	.087710	-.026570	.350840	-.106279	-.117840
.087500	.084790	.045751	.339162	.183004	.264528	.090210	-.026862	.360838	-.107446	-.115382
.090000	.087291	.046408	.349166	.185631	.260366	.092709	-.027148	.370834	-.108591	-.113274
.092500	.089793	.047054	.359172	.188216	.256249	.095207	-.027428	.380828	-.109712	-.111159
.095000	.092295	.047690	.369181	.190758	.252240	.097705	-.027703	.390819	-.110810	-.109100
.097500	.094798	.048316	.379192	.193265	.248339	.100202	-.027973	.400808	-.111891	-.107099

UNCAMBERED		UPPER SURFACE VALUES				LOWER SURFACE VALUES				
X/C	XU/C	YU/C	XU	YU	DYU/DXU	XL/C	YL/C	XL	YL	DYL/DXL
.100000	.097301	.048934	.389205	.195734	.244541	.102699	-.028238	.410795	-.112952	-.105155
.110000	.107319	.051308	.429278	.205234	.230218	.112681	-.029249	.450722	-.116995	-.097830
.120000	.117345	.053549	.469378	.214198	.216964	.122655	-.030190	.490622	-.120761	-.090998
.130000	.127376	.055665	.509504	.222659	.204947	.132624	-.031067	.530496	-.124267	-.084921
.140000	.137413	.057666	.549651	.230664	.193767	.142587	-.031885	.570349	-.127540	-.079277
.150000	.147454	.059559	.589818	.238234	.183393	.152546	-.032648	.610182	-.130592	-.074095
.160000	.157501	.061349	.630002	.245397	.173298	.162499	-.033359	.649998	-.133436	-.068897
.170000	.167551	.063043	.670202	.252170	.164009	.172449	-.034020	.689798	-.136080	-.064246
.180000	.177604	.064648	.710416	.258591	.155197	.182396	-.034638	.729584	-.138552	-.059847
.190000	.187661	.066164	.750642	.264656	.146647	.192339	-.035210	.769358	-.140840	-.055510
.200000	.197720	.067599	.790880	.270395	.138638	.202280	-.035742	.809120	-.142969	-.051538
.210000	.207782	.068952	.831128	.275808	.130375	.212218	-.036232	.848872	-.144930	-.047152
.220000	.217846	.070227	.871386	.280907	.122885	.222154	-.036683	.888614	-.146731	-.043400
.230000	.227913	.071427	.911652	.285708	.115617	.232087	-.037096	.928348	-.148383	-.039743
.240000	.237982	.072552	.951926	.290209	.107943	.242018	-.037469	.968074	-.149877	-.035560
.250000	.248052	.073604	.992208	.294417	.101022	.251948	-.037805	1.007792	-.151220	-.032030
.260000	.258124	.074586	1.032496	.298345	.093884	.261876	-.038104	1.047504	-.152417	-.028185
.270000	.268198	.075497	1.072790	.301986	.087251	.271802	-.038365	1.087210	-.153461	-.024762
.280000	.278272	.076341	1.113090	.305362	.080080	.281728	-.038592	1.126910	-.154368	-.020715
.290000	.288348	.077115	1.153394	.308461	.073610	.291652	-.038781	1.166606	-.155124	-.017304
.300000	.298426	.077822	1.193702	.311290	.067124	.301574	-.038934	1.206298	-.155734	-.013810
.310000	.308503	.078468	1.234014	.313871	.060632	.311497	-.039055	1.245986	-.156219	-.010250
.320000	.318582	.079048	1.274329	.316194	.054548	.321418	-.039141	1.285671	-.156563	-.007048
.330000	.328661	.079565	1.314646	.318262	.048115	.331339	-.039192	1.325354	-.156769	-.003441
.340000	.338741	.080019	1.354965	.320077	.041820	.341259	-.039210	1.365035	-.156838	.000072
.350000	.348822	.080406	1.395287	.321622	.034781	.351178	-.039188	1.404713	-.156751	.004383
.360000	.358903	.080720	1.435610	.322880	.027527	.361097	-.039122	1.444390	-.156489	.008951
.370000	.368984	.080959	1.475935	.323837	.019922	.371016	-.039009	1.484065	-.156035	.013911
.380000	.379065	.081122	1.516261	.324487	.011826	.380935	-.038846	1.523739	-.155384	.019401
.390000	.389147	.081197	1.556588	.324787	.003342	.390853	-.038623	1.563412	-.154492	.025314
.400000	.399229	.081189	1.596915	.324754	-.005265	.400771	-.038343	1.603085	-.153373	.031377
.410000	.409310	.081090	1.637241	.324361	-.013745	.410690	-.038000	1.642759	-.152001	.037331
.420000	.419391	.080909	1.677565	.323636	-.022359	.420609	-.037600	1.682435	-.150401	.043439
.430000	.429472	.080644	1.717887	.322574	-.030012	.430528	-.037142	1.722113	-.148570	.048584
.440000	.439551	.080305	1.758205	.321221	-.037383	.440449	-.036638	1.761795	-.146551	.053454
.450000	.449630	.079892	1.798518	.319568	-.044512	.450370	-.036084	1.801482	-.144335	.058086
.460000	.459707	.079410	1.838827	.317638	-.051232	.460293	-.035486	1.841173	-.141945	.062309
.470000	.469783	.078863	1.879130	.315450	-.057156	.470217	-.034850	1.880870	-.139400	.065727
.480000	.479857	.078256	1.919427	.313025	-.063375	.480143	-.034180	1.920573	-.136720	.069445
.490000	.489929	.077590	1.959717	.310358	-.068708	.490071	-.033475	1.960283	-.133901	.072265
.500000	.500000	.076868	2.000000	.307472	-.074727	.500000	-.032741	2.000000	-.130963	.075777
.510000	.510069	.076088	2.040275	.304352	-.079987	.509931	-.031974	2.039725	-.127895	.078515
.520000	.520136	.075258	2.080542	.301033	-.085105	.519864	-.031182	2.079458	-.124729	.081102
.530000	.530200	.074376	2.120801	.297505	-.090059	.529800	-.030364	2.119199	-.121455	.083514
.540000	.540263	.073446	2.161051	.293782	-.095002	.539737	-.029522	2.158949	-.118090	.085905
.550000	.550323	.072465	2.201292	.289858	-.099933	.549677	-.028656	2.198708	-.114625	.088268
.560000	.560381	.071437	2.241523	.285749	-.104157	.559619	-.027770	2.238477	-.111078	.089903
.570000	.570436	.070368	2.281745	.281473	-.108660	.569564	-.026867	2.278255	-.107469	.091803
.580000	.580489	.069251	2.321956	.277005	-.113168	.579511	-.025942	2.318044	-.103770	.093686
.590000	.590539	.068094	2.362157	.272375	-.117226	.589461	-.025004	2.357843	-.100015	.095095
.600000	.600587	.066895	2.402348	.267578	-.121393	.599413	-.024049	2.397652	-.096197	.096588
.610000	.610632	.065657	2.442527	.262630	-.125153	.609368	-.023084	2.437473	-.092335	.097645
.620000	.620674	.064380	2.482695	.257522	-.128984	.619326	-.022105	2.477305	-.088419	.098745
.630000	.630713	.063068	2.522852	.252270	-.132766	.629287	-.021117	2.517148	-.084468	.099763
.640000	.640749	.061717	2.562998	.246867	-.136151	.639251	-.020119	2.557002	-.080475	.100346
.650000	.650783	.060333	2.603131	.241331	-.139799	.649217	-.019115	2.596869	-.076460	.101157

UNCAMBERED X/C	UPPER SURFACE VALUES XU/C	YU/C	XU	YU	DYU/DXU	LOWER SURFACE VALUES XL/C	YL/C	XL	YL	DYL/DXL
.660000	.660813	.058914	2.643252	.235657	-.142927	.659187	-.018105	2.636748	-.072419	.101404
.670000	.670840	.057464	2.683361	.229858	-.146226	.669160	-.017091	2.676639	-.068366	.101779
.680000	.680864	.055984	2.723458	.223935	-.149323	.679136	-.016076	2.716542	-.064304	.101903
.690000	.690885	.054471	2.763542	.217884	-.152454	.689115	-.015058	2.756458	-.060231	.102008
.700000	.700903	.052931	2.803613	.211722	-.155337	.699097	-.014042	2.796387	-.056167	.101809
.710000	.710918	.051360	2.843670	.205440	-.158129	.709082	-.013026	2.836330	-.052103	.101459
.720000	.720929	.049765	2.883715	.199061	-.160621	.719071	-.012017	2.876285	-.048067	.100742
.730000	.730936	.048144	2.923746	.192575	-.163518	.729064	-.011012	2.916254	-.044049	.100357
.740000	.740941	.046497	2.963763	.185990	-.165494	.739059	-.010016	2.956237	-.040062	.098978
.750000	.750942	.044829	3.003767	.179315	-.168130	.749058	-.009029	2.996233	-.036117	.098168
.760000	.760939	.043140	3.043757	.172562	-.169811	.759061	-.008058	3.036243	-.032231	.096319
.770000	.770933	.041432	3.083733	.165727	-.172064	.769067	-.007100	3.076267	-.028401	.094934
.780000	.780924	.039704	3.123696	.158817	-.173672	.779076	-.006160	3.116304	-.024641	.092801
.790000	.790911	.037961	3.163644	.151842	-.175530	.789089	-.005241	3.156356	-.020964	.090791
.800000	.800895	.036202	3.203578	.144808	-.176812	.799105	-.004345	3.196422	-.017381	.088079
.810000	.810875	.034430	3.243499	.137720	-.178051	.809125	-.003476	3.236501	-.013904	.085174
.820000	.820852	.032648	3.283406	.130592	-.179163	.819148	-.002638	3.276594	-.010552	.081979
.830000	.830825	.030857	3.323300	.123427	-.180112	.829175	-.001834	3.316700	-.007336	.078436
.840000	.840795	.029058	3.363180	.116234	-.180713	.839205	-.001068	3.356820	-.004273	.074342
.850000	.850762	.027253	3.403047	.109012	-.181413	.849238	-.000342	3.396953	-.001370	.070108
.860000	.860725	.025444	3.442901	.101775	-.181813	.859275	.000337	3.437099	.001348	.065307
.870000	.870686	.023632	3.482743	.094530	-.181840	.869314	.000966	3.477257	.003863	.059829
.880000	.880643	.021819	3.522572	.087274	-.182318	.879357	.001541	3.517428	.006162	.054427
.890000	.890597	.020006	3.562389	.080022	-.182233	.889403	.002054	3.557611	.008217	.048045
.900000	.900549	.018193	3.602195	.072773	-.182096	.899451	.002502	3.597805	.010008	.041099
.910000	.910497	.016384	3.641989	.065534	-.181618	.909503	.002877	3.638011	.011506	.033198
.920000	.920443	.014577	3.681774	.058308	-.181350	.919557	.003170	3.678226	.012680	.024730
.930000	.930387	.012777	3.721549	.051107	-.181016	.929613	.003370	3.718451	.013481	.015216
.940000	.940329	.010981	3.761316	.043924	-.180356	.939671	.003468	3.758684	.013873	.004097
.950000	.950269	.009190	3.801076	.036761	-.179640	.949731	.003448	3.798924	.013790	-.008838
.960000	.960209	.007409	3.840835	.029634	-.178799	.959791	.003283	3.839165	.013132	-.024454
.970000	.970149	.005632	3.880594	.022527	-.178376	.969851	.002946	3.879406	.011785	-.043715
.980000	.980091	.003854	3.920363	.015415	-.179623	.979909	.002388	3.919637	.009550	-.068757
.990000	.990038	.002043	3.960153	.008173	-.186149	.989962	.001522	3.959847	.006088	-.106771
1.000000	1.000000	.000000	4.000000	.000000	*374.653276	1.000000	.000000	4.000000	.000000	*565.663101

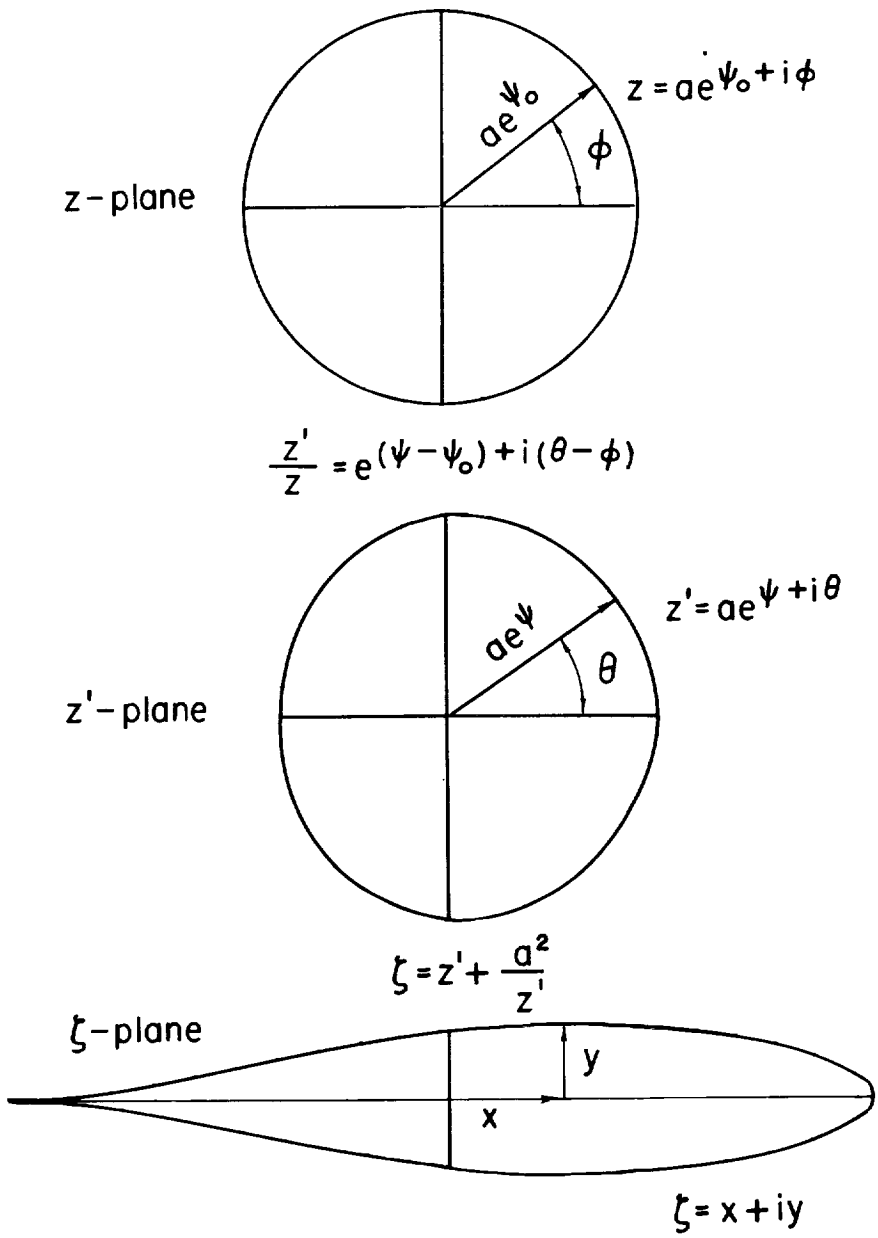

Figure 1.- Illustration of transformations used to derive airfoils and calculate pressure distribution. (From ref. 1.)

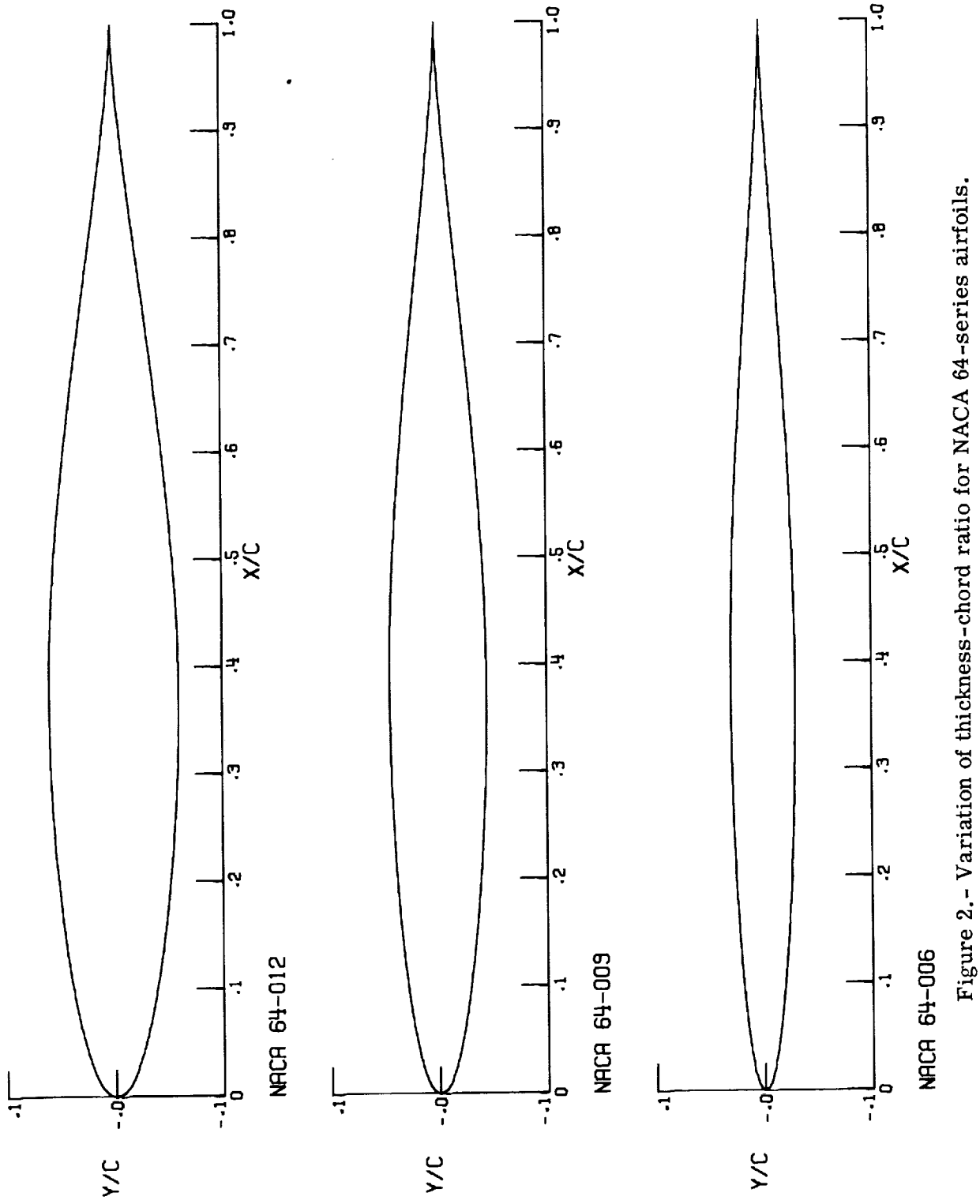

Figure 2.- Variation of thickness-chord ratio for NACA 64-series airfoils.

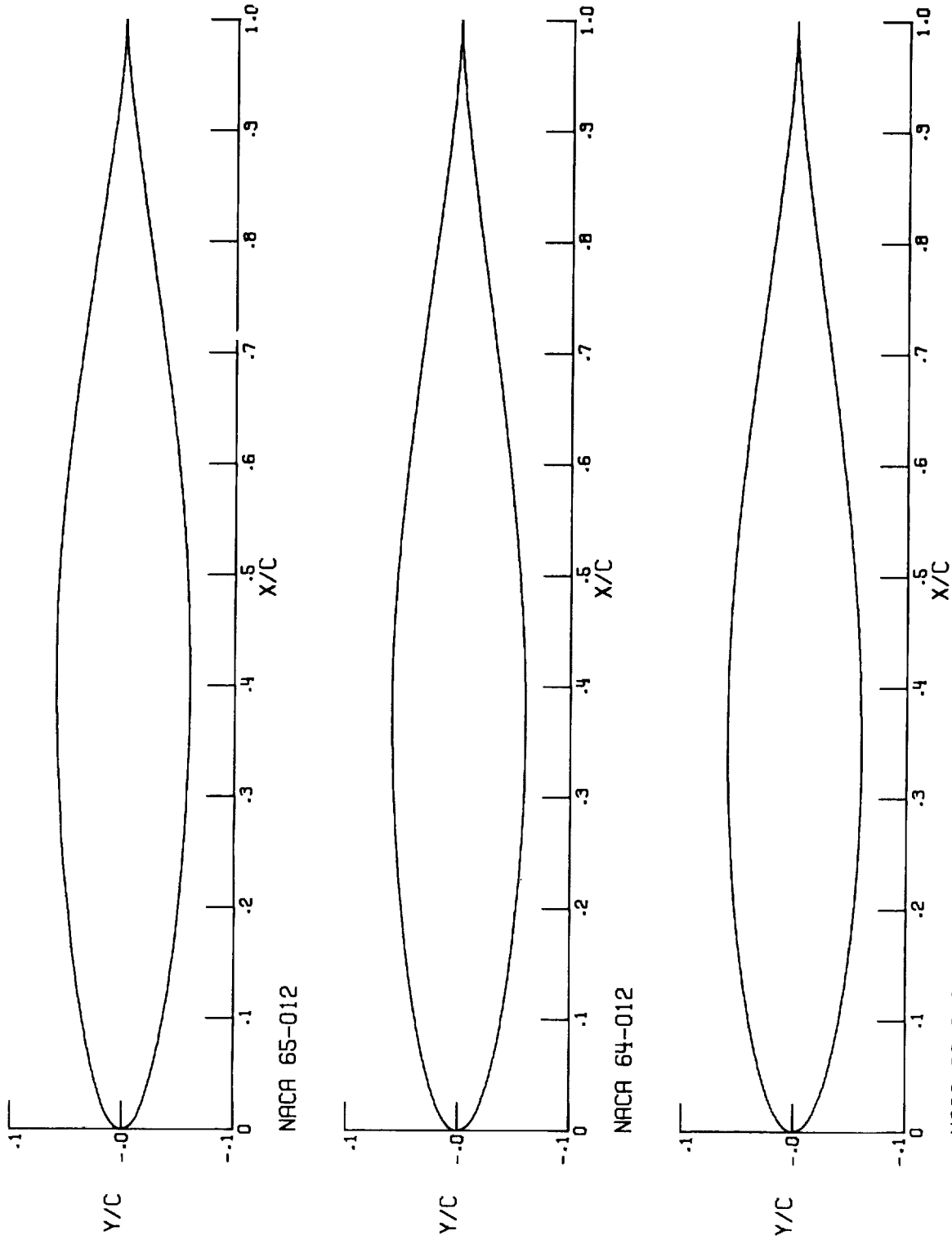

Figure 3.- NACA 6-series family variations for 12-percent-thick airfoils.

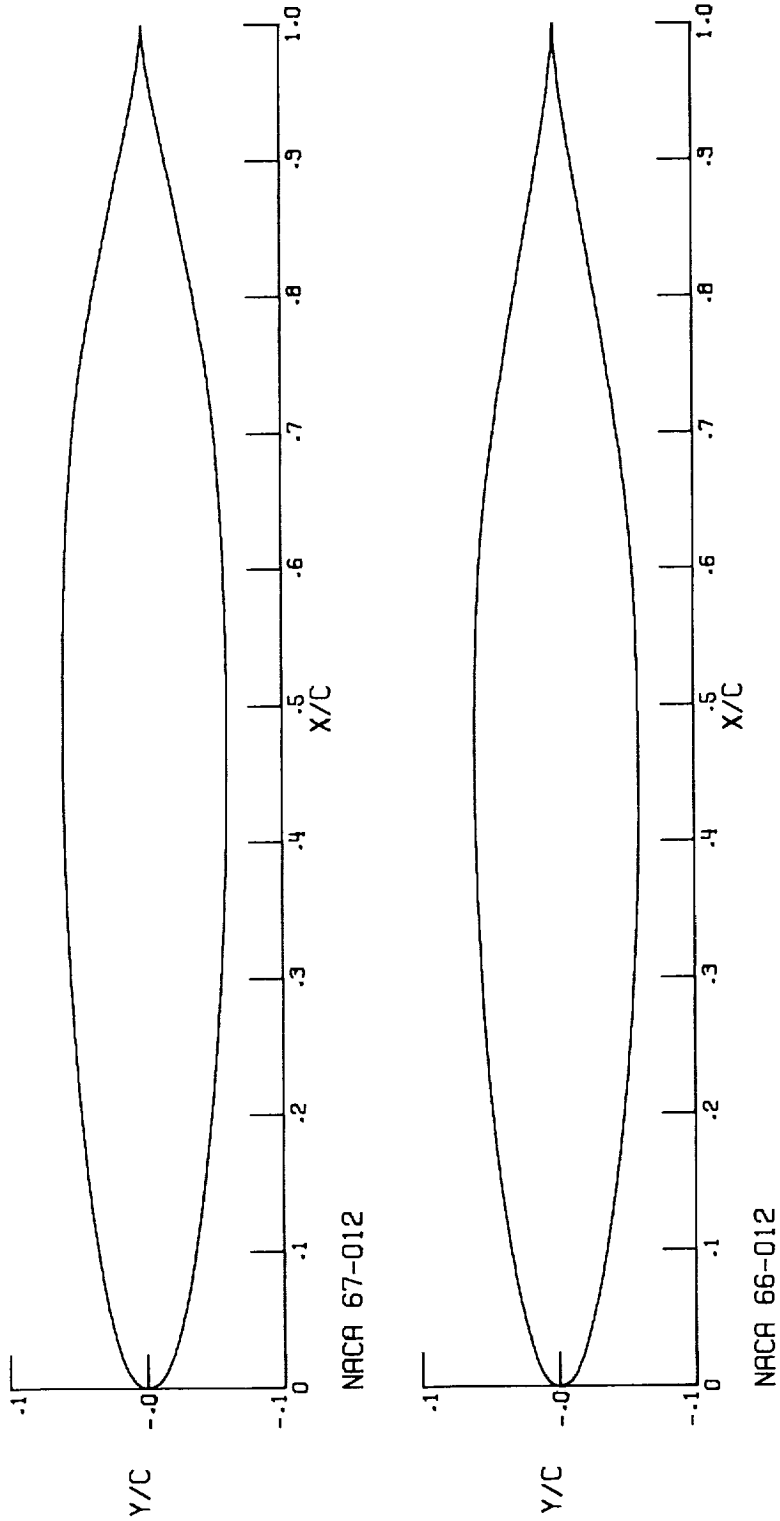

Figure 3.- Concluded.

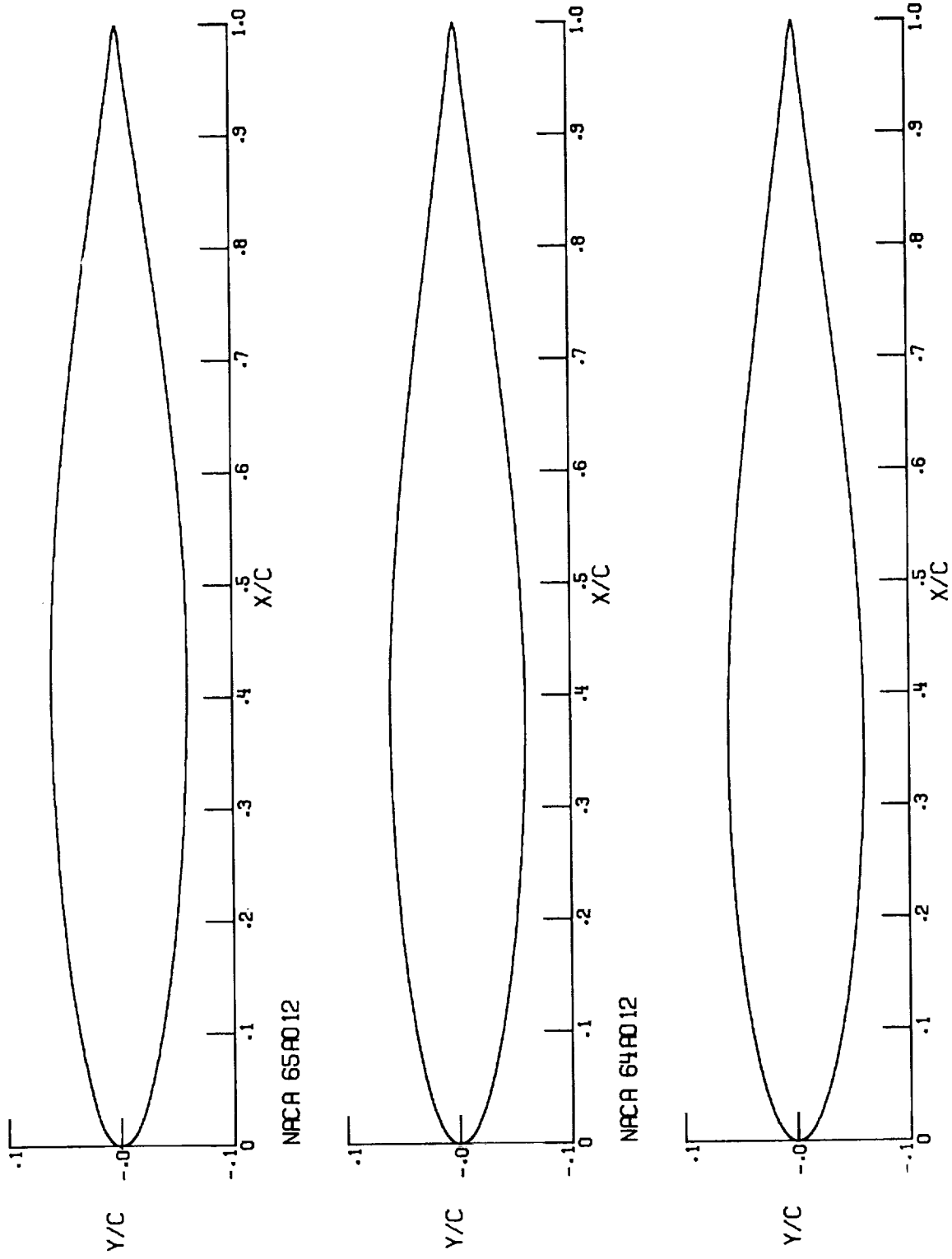

Figure 4.- NACA 6A-series family variations for 12-percent-thick airfoils.

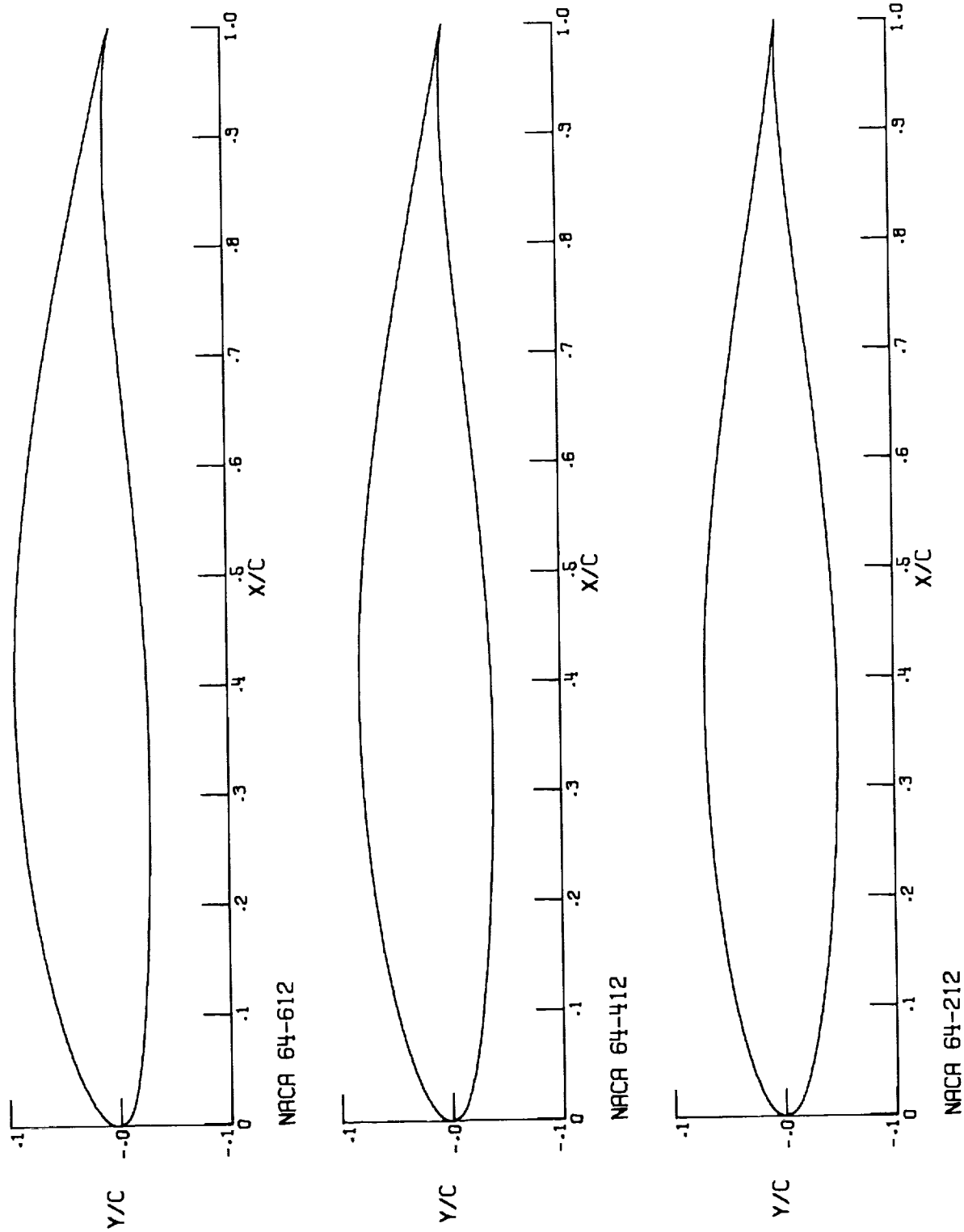

Figure 5.- Variation of design lift coefficient for NACA 64-series 12-percent-thick airfoils.

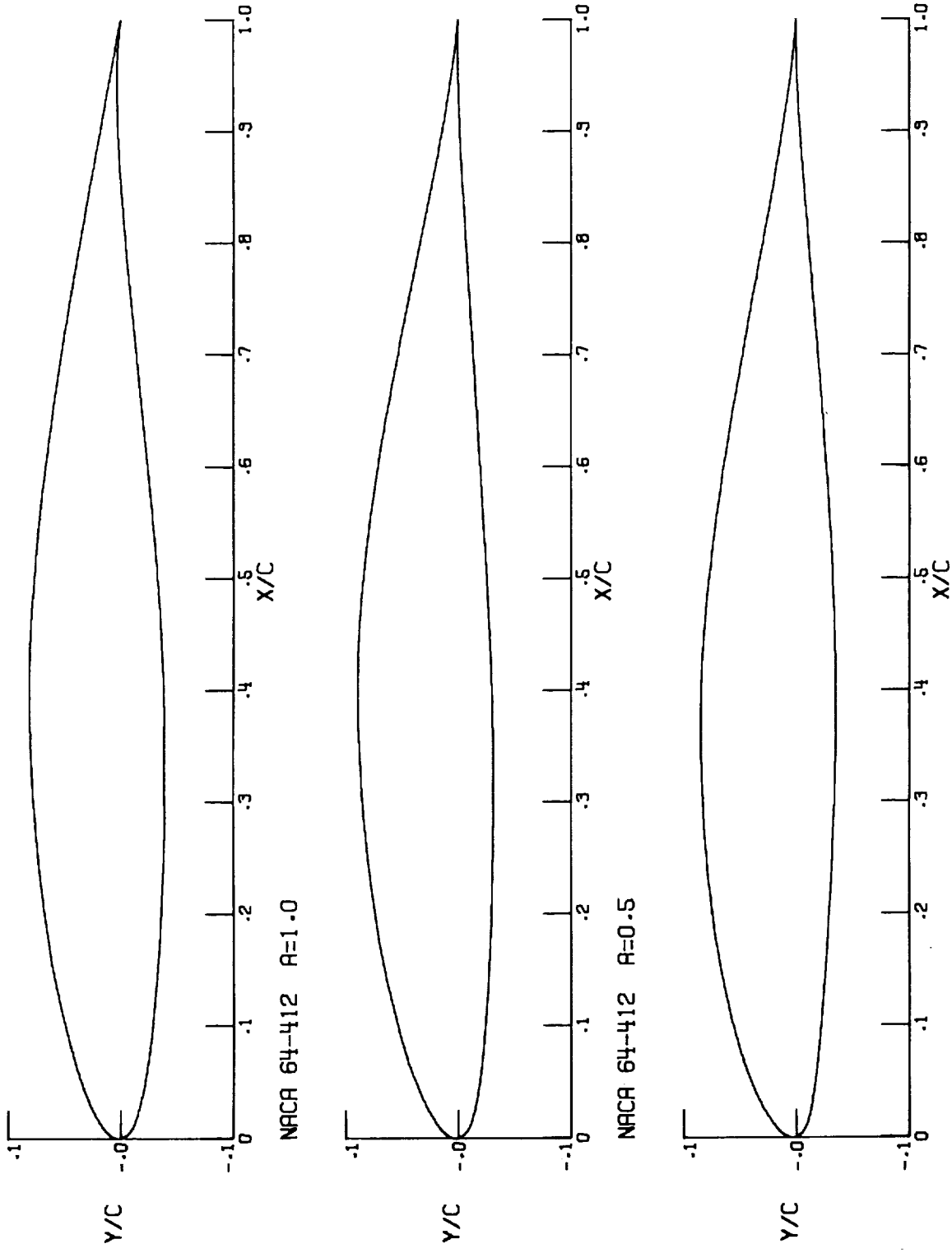

Figure 6.- Variation of mean line loading for NACA 64-412 airfoil.

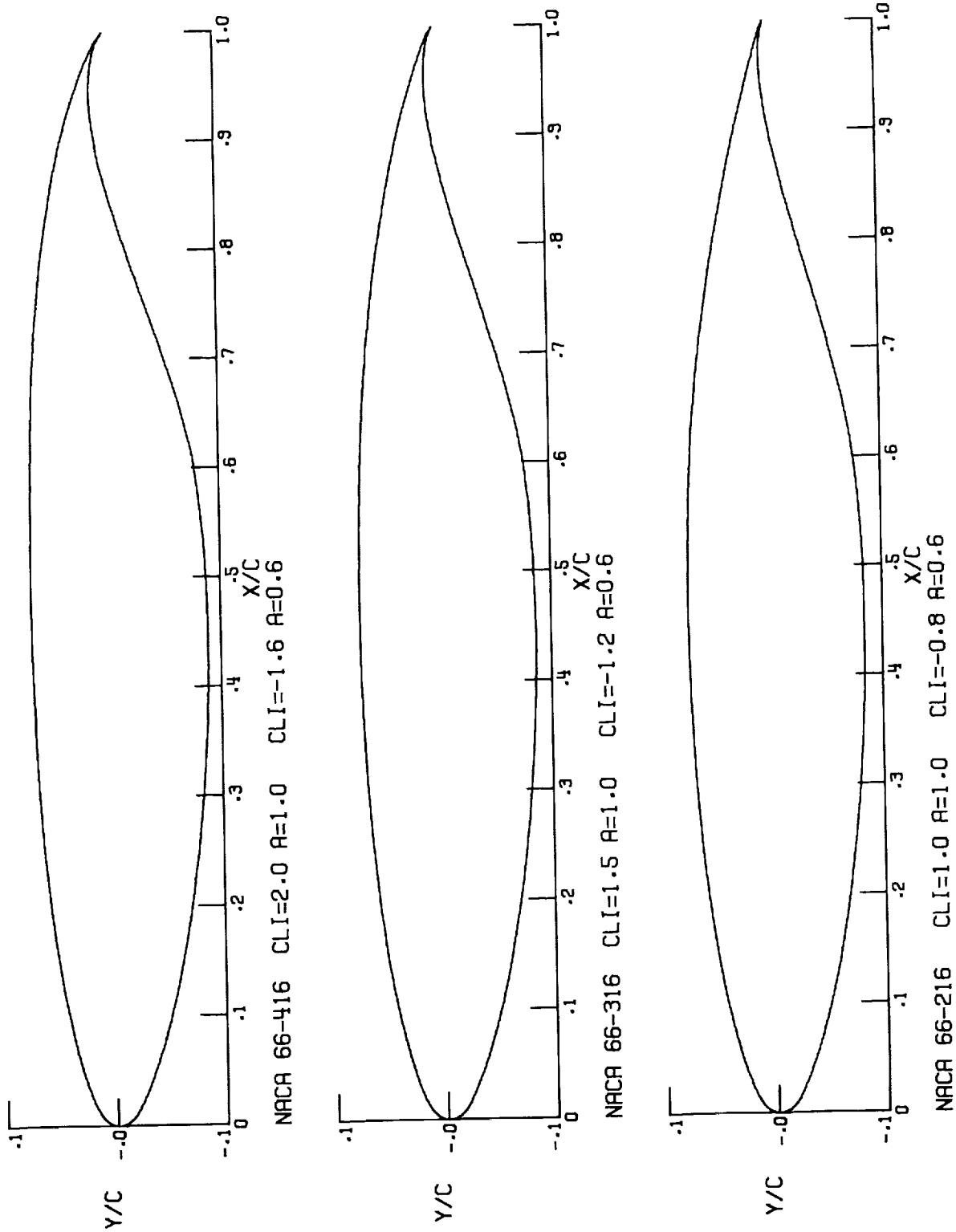

Figure 7.- Combinations of mean lines for NACA 66-series 16-percent-thick airfoils.

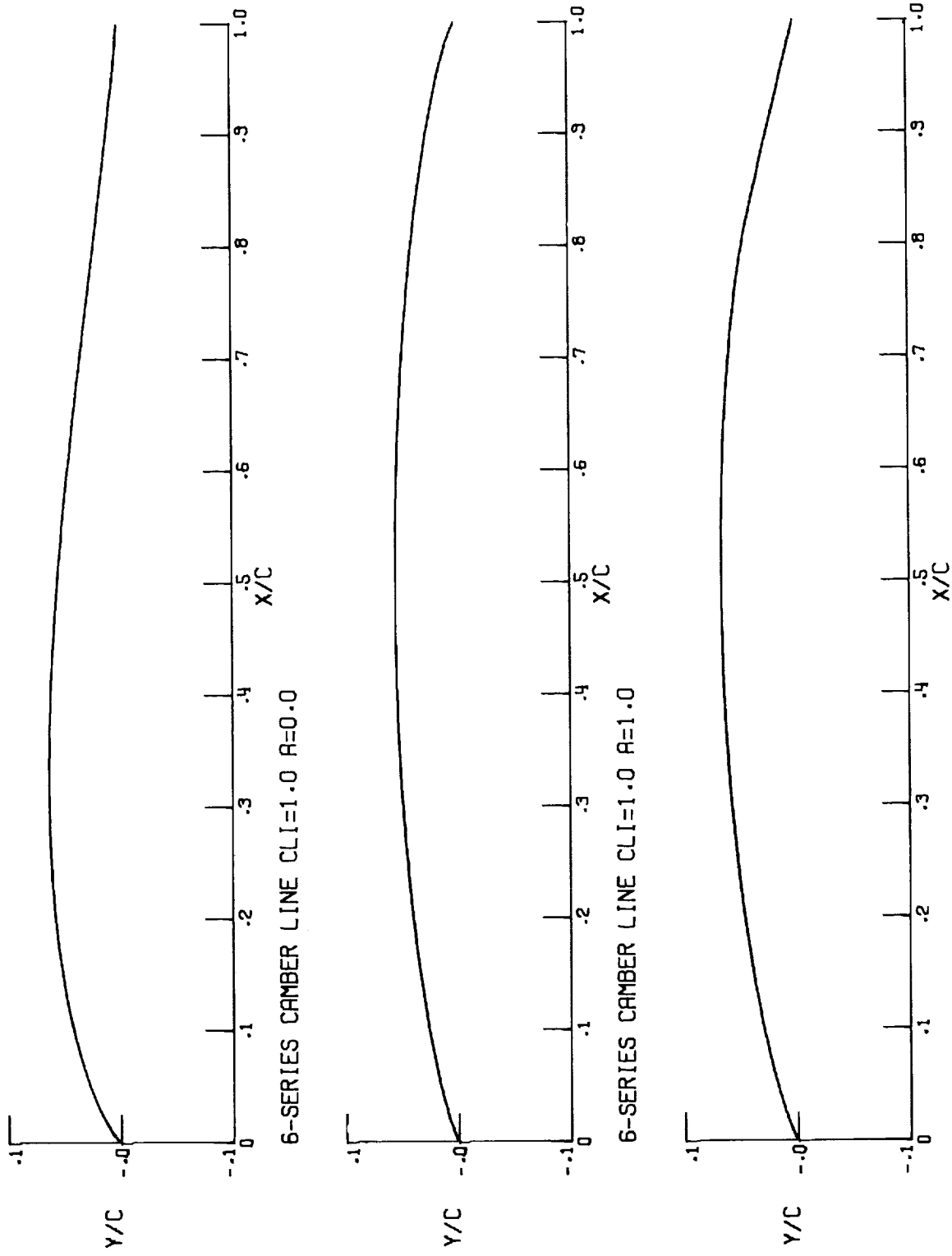

Figure 8.- Mean lines for NACA 6- and 6A-series airfoils.

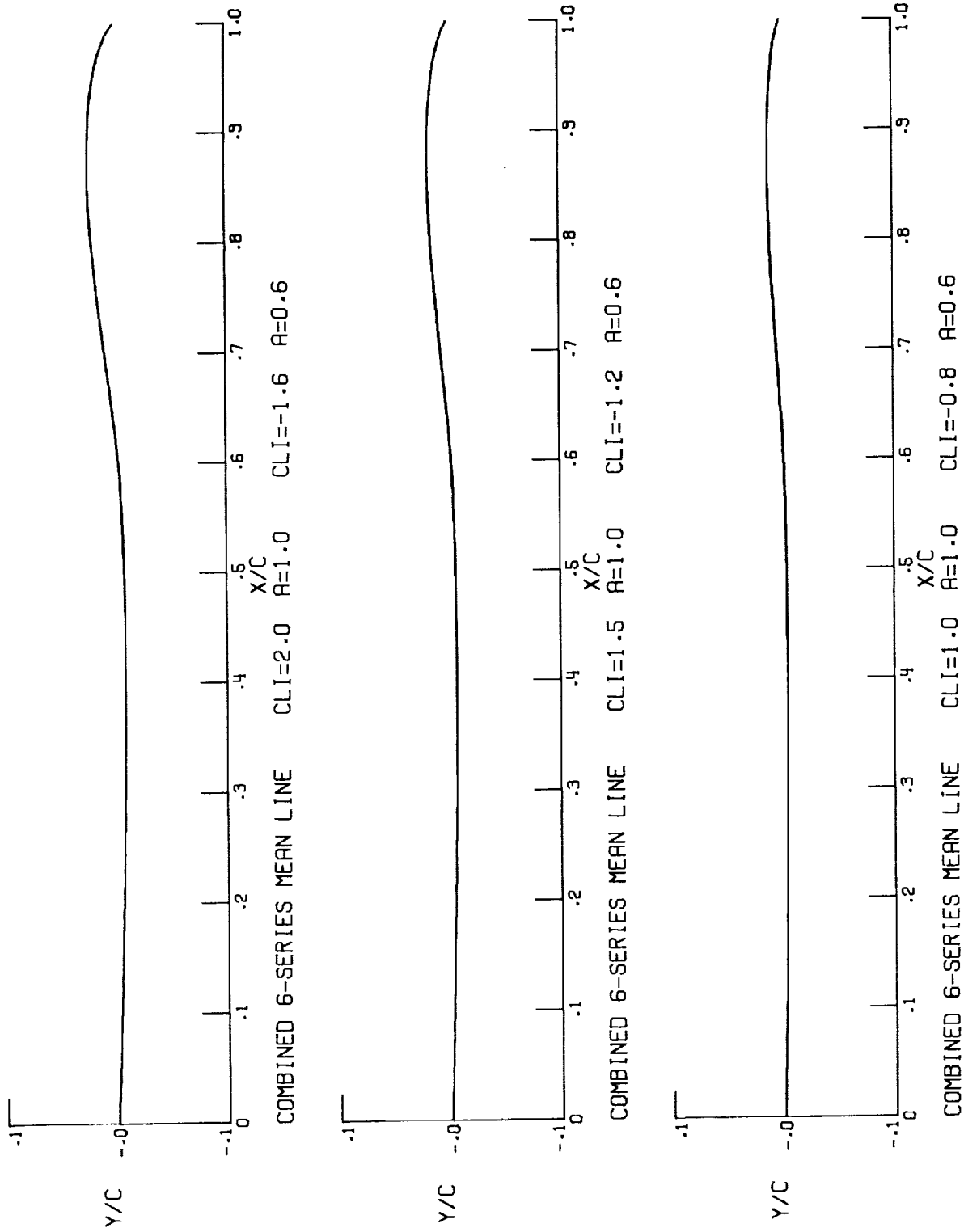

Figure 9.- Combinations of mean lines for NACA 6-series airfoils.

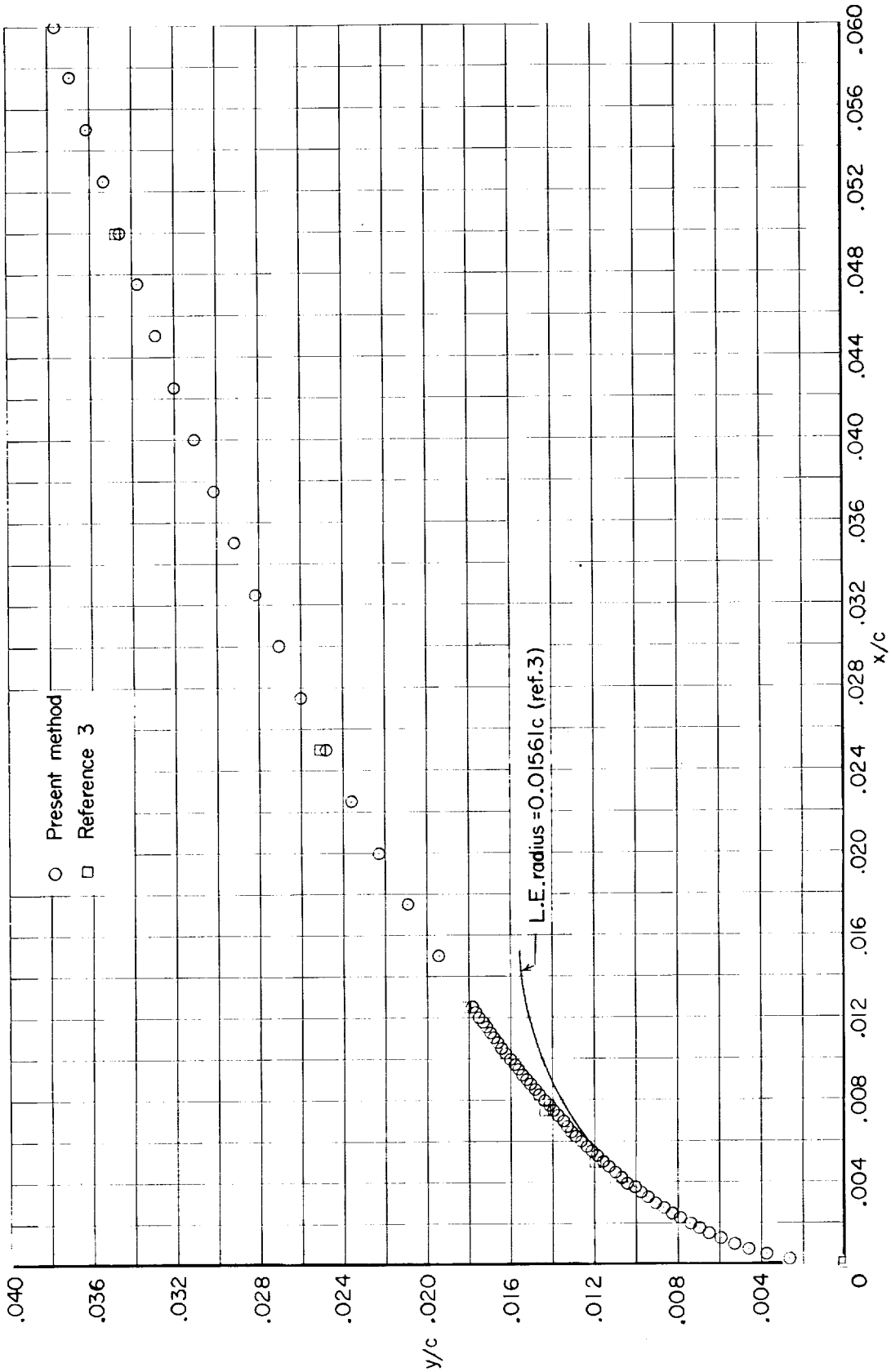

Figure 10.- Comparison of computer-generated ordinates and previously published ordinates for leading-edge region of an NACA 64A015 airfoil section.