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

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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

$$\left(\frac{dy}{dx}\right)_1 = \frac{\tan\delta\sec\delta - \left(\frac{dy}{dx}\right)_t + \left(\frac{y}{c}\right)_t\left(\frac{d\delta}{dx}\right)\tan\delta}{\sec\delta + \left(\frac{dy}{dx}\right)_t\tan\delta + \left(\frac{y}{c}\right)_t\left(\frac{d\delta}{dx}\right)}$$

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), TANTHO(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
```

```
000336          G=-(A*A*(.5*ALOG(A)-0.25)+0.25)/(1.-A)
000346          Q=1.0
000350          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G
000362          Z=.5*(A-U)*AMXL-.5*(1.-U)*OMXL-.25*(A-U)**2+.25*(1.-U)**2
000377          Z1=.5*((A-U)*AMXL1-AMXL-(1.-U)*OMXL1+OMXL+(A-U)-(1.-U))
000414          Z2=.5*(A-U)*AMXL2-AMXL1-.5*(1.-U)*OMXL2+OMXL1
000427       80 CONTINUE
000427          IF (A.LT.E) GO TO 90
000432          IF (ABS(A-1.).LT.E) GO TO 100
000436       90 H=-.5
000437          Q=1.0
000441          Z1=U*ALOG(U)-.5*U-.5*(1.-U)*OMXL1+.5*OMXL-.5
000453          GO TO 110
000454      100 H=0.0
000455          Q=H
000456          Z1=-OMXL1
000460          GO TO 110
000461      110 TANTHO(L)=CLI*(Z1/(1.-Q*A)-1.-ALOG(U)-H)/PI/(A+1.)/2.0
000500          IF (ICKY.GT.1.AND.L.LT.ICKY) GO TO 70
000510          IF (ICKY.EQ.1) GO TO 130
000511          DO 120 J=2,ICKY
000512      120 TANTHO(1)=TANTHO(1)+TANTHO(J)
000516      130 CONTINUE
          C       SLOPE OF PROFILE AT ORIGIN, UPPER AND LOWER
000516          YP=10.**10
000520          YPP=10.**10
000522          YUP=-1/TANTHO
000524          YLP=-1/TANTHO
          C       FIRST STATION AFT OF ORIGIN ON UNCAMBERED PROFILE
000526          I=1
000527          X=.00025
          C       START LOOP FOR X INCREMENT
000531      140 CONTINUE
          C       SKIP THICKNESS COMPUTATION AFTER FIRST PASS
000531          IF (I.GT.1) GO TO 240
          C       SELECT SERIES
000535          IF (SERIET.EQ.10H          63) CALL PHEP63 (PHI,EPS)
000541          IF (SERIET.EQ.10H          64) CALL PHEP64 (PHI,EPS)
000545          IF (SERIET.EQ.10H          65) CALL PHEP65 (PHI,EPS)
000551          IF (SERIET.EQ.10H          66) CALL PHEP66 (PHI,EPS)
000555          IF (SERIET.EQ.10H          67) CALL PHEP67 (PHI,EPS)
000561          IF (SERIET.EQ.10H          63) CALL PHPS63 (PHI,PSI)
000565          IF (SERIET.EQ.10H          64) CALL PHPS64 (PHI,PSI)
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A 850     8500000
A 860     8600000
A 870     8700000
A 880     8800000
A 890     8900000
A 900     9000000
A 910     9100000
A 920     9200000
A 930     9300000
A 940     9400000
A 950     9500000
A 960     9600000
A 970     9700000
A 980     9800000
A 990     9900000
A1000    10000000
A1010    10100000
A1020    10200000
A1030    10300000
A1040    10400000
A1050    10500000
A1060    10600000
A1070    10700000
A1080    10800000
A1090    10900000
A1100    11000000
A1110    11100000
A1120    11200000
A1130    11300000
A1140    11400000
A1150    11500000
A1160    11600000
A1170    11700000
A1180    11800000
A1190    11900000
A1200    12000000
A1210    12100000
A1220    12200000
A1230    12300000
A1240    12400000
A1250    12500000
A1260    12600000
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 FTLUP (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
001024      190 SF=RAT
001025          IF (TOC.LT.E) SF=0.0
001031          IF (I.GT.1) GO TO 210
001035          DO 200 J=1,201
001036          XT(J)=(XT(J)-XO)/(XL-XO)
          C       SCALE LINEARLY TO EXACT THICKNESS
001041          YT(J)=SF*YT(J)/(XL-XO)
001045          YTP(J)=SF*YTP(J)
001046          YTPP(J)=SF*YTPP(J)*(XL-XO)
001051      200 CONTINUE
001053      210 CONTINUE
001053          XTP=(XTP-XO)/(XL-XO)
001056          YMAX=YMAX*SF/(XL-XO)
001061          YM=YM*SF/(XL-XO)
001063          XYM=(XYM-XO)/(XL-XO)
001066          XL(1)=0.0
001066          IF (TOC.LE.E) GO TO 230
          C       FIT TILTED ELLIPSE AT ELEVENTH PROFILE POINT
001071          CN=2.*YTP(11)-YT(11)/XT(11)+0.1
001076          AN=XT(11)*(YTP(11)*XT(11)-YT(11))/(XT(11)*(2.*YTP(11)-CN)-YT(11))
001105          BN=SQRT((YT(11)-CN*XT(11))**2/(1.-(XT(11)-AN)**2/AN**2))
001117          DO 220 J=1,10
001120          YT(J)=BN*SQRT(1.-(XT(J)-AN)**2/AN**2)+CN*XT(J)
001134          IF (XT(J).LE.E) GO TO 220
001137          YTP(J)=BN**2*(AN-XT(J))/AN**2/(YT(J)-CN*XT(J))+CN
001153          YTPP(J)=-BN**4/AN**2/(YT(J)-CN*XT(J))**3
001162      220 CONTINUE
001164          RNP=BN**2/AN
001166          IF (I.EQ.1) PRINT 520, XYM,YMAX,XTP,YM,XT(11),YT(11),YTP(11),RNP,R
               1AT,ACRAT,IT
001222      230 CONTINUE
001222          X=0.0
001223          ALI=ABS(CLI(1))
          C       PRINT UNCAMBERED COLUMN HEADINGS AND ORIGIN POINT
001225          IF (ALI.LE.E.AND.ICKY.EQ.1) PRINT 480
001242          IF (ALI.LE.E.AND.ICKY.EQ.1) PRINT 550, X,Y,YP,YPP,XC,YC
          C       PRINT CAMBERED COLUMN HEADINGS AND ORIGIN POINT
001273          IF (ALI.GT.E.OR.ICKY.GT.1) PRINT 490
001311          IF (ALI.GT.E.OR.ICKY.GT.1) PRINT 540, X,XU(I),YU(I),XUC,YUC,YUP,XL
               1(I),YL(I),XLC,YLC,YLP
001355          X=0.00025
001356          XL(1)=0.0
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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                                                   A2570   25700000
001674      280 CONTINUE                                                    A2580   25800000
001674          G=-(A**2*(.5*ALOG(A)-0.25)+0.25)/(1.-A)                     A2590   25900000
001705          H=(0.5*(1.-A)**2*ALOG(1.-A)-0.25*(1.-A)**2)/(1.-A)+G        A2600   26000000
001717          Z=.5*(A-1.)**2*ALOG(ABS(A-1.))-0.25*(A-1.)**2               A2610   26100000
001731          Z1=-(A-1.)*ALOG(ABS(A-1.))                                  A2620   26200000
001741          Z2=-10.**10                                                 A2630   26300000
001744          GO TO 320                                                   A2640   26400000
001744      290 G=0.0                                                       A2650   26500000
001745          H=G                                                         A2660   26600000
001746          Q=G                                                         A2670   26700000
001747          Z=-(1.-X)*ALOG(1.-X)                                        A2680   26800000
001756          Z1=ALOG(1.-X)+1.                                            A2690   26900000
001763          Z2=-1./(1.-X)                                               A2700   27000000
001766          GO TO 320                                                   A2710   27100000
001766      300 G=0.0                                                       A2720   27200000
001767          H=G                                                         A2730   27300000
001770          Q=G                                                         A2740   27400000
001771          Z=0.0                                                       A2750   27500000
001772          Z1=-10.**10                                                 A2760   27600000
001775          Z2=-10.**10                                                 A2770   27700000
001777          GO TO 320                                                   A2780   27800000
002000      310 G=-.25                                                      A2790   27900000
002001          H=-.5                                                       A2800   28000000
002003          Q=1.0                                                       A2810   28100000
002004          Z=-.25                                                      A2820   28200000
002005          Z1=0.0                                                      A2830   28300000
002006          Z2=-10.**10                                                 A2840   28400000
002011          GO TO 320                                                   A2850   28500000
002012      320 YCMB(L)=CLI*(Z/(1.-Q*A)-XLL+G-H*X)/PI/(A+1.)/2.             A2860   28600000
002030          XSV=X                                                       A2870   28700000
002031          IF (X.LT.0.005) X=0.005                                     A2880   28800000
002034          TANTH(L)=CLI*(Z1/(1.-Q*A)-1.-ALOG(X)-H)/PI/(A+1.)/2.0       A2890   28900000
002053          X=XSV                                                       A2900   29000000
002054          IF (IF6XA(L).EQ.1) TANTH(L)=-5.0                            A2910   29100000
002061          IF (X.GT.0.005) GO TO 330                                   A2920   29200000
002065          YCP2(L)=0.0                                                 A2930   29300000
002066          GO TO 350                                                   A2940   29400000
002066      330 CONTINUE                                                    A2950   29500000
002066          IF (ABS(1.-X).GT.E) GO TO 340                               A2960   29600000
002074          YCP2(L)=1./E                                                A2970   29700000
002075          GO TO 350                                                   A2980   29800000
002076      340 PIA=PI*(A+1.)*2.                                            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*F+YP-TANTH*Y*THP)/(F-YP*TANTH-Y*THP)             A3540   35500000
002342          YLP=(TANTH*F-YP+TANTH*Y*THP)/(F+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 (3A10/2A10/6F10.0)                                   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 (116HOUNCAMBERED                                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    IFBXA  -  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    TANTHO -  007762    THP    -  010144
TITLE1 -  000005C01 TUC    -  010053    TR     -  010130    U      -  010076
```

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 NOTATE (XX,YLABEL,HGT,3HX/C,0.,3)
000156          YLABEL=YLABEL-1.5*HGT
000161          CALL NOTATE (0.0,YLABEL,HGT,TITLE1,.0,80)
000165          YS=YSTART(K)+1.0
000170          CALL NOTATE (-.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
```

```
        C       RELOCATE ORIGIN                                  B 430   44600000
000174        CALL CALPLT (0.0,YSTART(K),-3)                     B 440   44700000
000201        LAP=0                                              B 450   44800000
        C       PLOT PROFILE                                     B 460   44900000
000202        CALL LINPLT (X,Y,M,1,LAP,0,1,0)                    B 470   45000000
000212        CALL CALPLT (0.0,-YSTART(K),-3)                    B 480   45100000
        C       ADVANCE FRAME EVERY THIRD PLOT                   B 490   45200000
000217        IF (K.LT.3) GO TO 20                               B 500   45300000
000225        K=0                                                B 510   45400000
000225        CALL NFRAME                                        B 520   45500000
000226     20 CONTINUE                                           B 530   45600000
000226        RETURN                                             B 540   45700000
        C                                                        B 550   45800000
000227     30 FORMAT (8A10)                                      B 560   45900000
000227        END                                                B 570-  46000000
```

```
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 FUNCTICN 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=01777000000000000000                                            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
```

```
000114          A=A*T                                   C 430    50300000
000116          C=C+1./T                                C 440    50400000
000120       40 CONTINUE                                C 450    50500000
000123          DIF=A*B+Y(K)*C                          C 460    50600000
000127          RETURN                                  C 470    50700000
000130          END                                     C 480-   50800000
```

```
DIF

SUBPROGRAM LENGTH
000213

FUNCTION ASSIGNMENTS

STATEMENT ASSIGNMENTS
10      -  000052    30      -  000103    40      -  000120

BLOCK NAMES AND LENGTHS

VARIABLE ASSIGNMENTS
A       -  000205    B       -  000206    C       -  000207    DIF     -  000147
I       -  000211    J       -  000203    K       -  000201    MJ      -  000204
MX      -  000202    M1      -  000177    M2      -  000200    N       -  000176
P       -  000210    T       -  000212    X       -  000150    Y       -  000163

START OF CONSTANTS
000132

START OF TEMPORARIES
000135

START OF INDIRECTS
000143

UNUSED COMPILER SPACE
036000
```

```
                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
```

```
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
000211          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
               1I5,/31H X TABLE IS STORED IN LOCATION ,O6,//(8G15.8))       D 720   58000000
000276          END                                                         D 730-  58100000
```

```
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
```

```
                SUBROUTINE PHEP63(PHI,EPS)                                          58200000
000005          DIMENSION PHI(1),EPS(1)                                             58300000
000005          DIMENSION PHILD(201),EPSLD(201)                                     58400000
000005          DATA (PHILD(I),EPSLD(I),I=1,25 )/                                   58500000
               1   0.00000,   0.00000,    .01569,    .00164,    .03139,             58600000
               1    .00327,    .04708,    .00487,    .06278,    .00641,             58700000
               1    .07848,    .00789,    .09419,    .00928,    .10990,             58800000
               1    .01057,    .12562,    .01174,    .14135,    .01278,             58900000
               1    .15708,    .01367,    .17277,    .01439,    .18846,             59000000
               1    .01497,    .20416,    .01542,    .21987,    .01576,             59100000
               1    .23558,    .01601,    .25129,    .01619,    .26701,             59200000
               1    .01632,    .28273,    .01642,    .29844,    .01651,             59300000
               1    .31416,    .01661,    .32987,    .01673,    .34559,             59400000
               1    .01688,    .36130,    .01705,    .37700,    .01725/             59500000
000005          DATA (PHILD(I),EPSLD(I),I=26,50)/                                   59600000
               1    .39271,    .01747,    .40842,    .01771,    .42412,             59700000
               1    .01797,    .43983,    .01824,    .45553,    .01853,             59800000
               1    .47124,    .01884,    .48695,    .01916,    .50266,             59900000
               1    .01949,    .51837,    .01984,    .53407,    .02020,             60000000
               1    .54978,    .02058,    .56549,    .02097,    .58120,             60100000
               1    .02137,    .59691,    .02179,    .61261,    .02223,             60200000
               1    .62832,    .02268,    .64403,    .02315,    .65974,             60300000
               1    .02363,    .67545,    .02413,    .69116,    .02464,             60400000
               1    .70687,    .02517,    .72257,    .02571,    .73828,             60500000
               1    .02628,    .75399,    .02683,    .76969,    .02741/             60600000
000005          DATA (PHILD(I),EPSLD(I),I=51,75)/                                   60700000
               1    .78540,    .02801,    .80111,    .02862,    .81682,             60800000
               1    .02924,    .83253,    .02988,    .84824,    .03052,             60900000
               1    .86395,    .03118,    .87965,    .03185,    .89536,             61000000
               1    .03253,    .91107,    .03323,    .92677,    .03393,             61100000
               1    .94248,    .03465,    .95819,    .03538,    .97390,             61200000
               1    .03611,    .98961,    .03686,   1.00532,    .03762,             61300000
               1   1.02103,    .03839,   1.03673,    .03917,   1.05244,             61400000
               1    .03995,   1.06815,    .04075,   1.08385,    .04156,             61500000
               1   1.09956,    .04237,   1.11527,    .04319,   1.13098,             61600000
               1    .04402,   1.14669,    .04486,   1.16240,    .04571/             61700000
000005          DATA (PHILD(I),EPSLD(I),I=76,100)/                                  61800000
               1   1.17811,    .04657,   1.19381,    .04743,   1.20952,             61900000
               1    .04831,   1.22523,    .04919,   1.24093,    .05008,             62000000
               1   1.25664,    .05098,   1.27235,    .05189,   1.28806,             62100000
               1    .05280,   1.30376,    .05372,   1.31947,    .05464,             62200000
               1   1.33518,    .05556,   1.35089,    .05648,   1.36659,             62300000
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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   1.72738,    .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
```

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

```
                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   2.04288,    .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)*3.141592654/200.                          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,
                 1    .09004,   2.04373,    .09019,   2.05465,    .09031,
                 1   2.06557,    .09041,   2.07682,    .09050,   2.08806,
                 1    .09056,   2.09931,    .09061,   2.11056,    .09062,
                 1   2.12180,    .09061,   2.13305,    .09058,   2.14429,
                 1    .09052,   2.15554,    .09043,   2.16679,    .09032/
000005            DATA (PHILD(I),EPSLD(I),I=201,225)/
                 1   2.17803,    .09017,   2.18979,    .08999,   2.20155,
                 1    .08977,   2.21330,    .08953,   2.22506,    .08925,
                 1   2.23681,    .08894,   2.24856,    .08861,   2.26032,
                 1    .08824,   2.27207,    .08785,   2.28382,    .08743,
                 1   2.29557,    .08698,   2.30822,    .08647,   2.32088,
                 1    .08593,   2.33353,    .08536,   2.34618,    .08477,
                 1   2.35883,    .08414,   2.37148,    .08348,   2.38412,
                 1    .08279,   2.39677,    .08208,   2.40942,    .08134,
                 1   2.42206,    .08056,   2.43618,    .07967,   2.45029,
                 1    .07872,   2.46440,    .07772,   2.47851,    .07666/
000005            DATA (PHILD(I),EPSLD(I),I=226,251)/
                 1   2.49260,    .07552,   2.50669,    .07429,   2.52077,
                 1    .07297,   2.53483,    .07155,   2.54888,    .07000,
                 1   2.56292,    .06833,   2.57978,    .06615,   2.59661,
                 1    .06380,   2.61343,    .06132,   2.63024,    .05873,
                 1   2.64704,    .05606,   2.66383,    .05334,   2.68062,
                 1    .05060,   2.69740,    .04788,   2.71420,    .04519,
                 1   2.73100,    .04258,   2.77185,    .03664,   2.81276,
                 1    .03122,   2.85373,    .02628,   2.89475,    .02176,
                 1   2.93582,    .01759,   2.97693,    .01371,   3.01807,
                 1    .01008,   3.05923,    .00662,   3.10041,    .00328,
                 1   3.14159,   0.00000/
000005            DO 201 J=1,201
000006            PHI(J)=FLOAT(J-1)*3.141592654/200.
000013        201 CALL FTLUP(PHI(J),EPS(J),2,251,PHILD,EPSLD)
000024            RETURN
000025            END
```

```
                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,   1.36948,    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)*3.141592654/200.                               124800000
000013        201 CALL FTLUP(PHI(J),EPS(J),2,251,PHILD,EPSLD)                      124900000
000024            RETURN                                                           125000000
000025            END                                                              125100000
```

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                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
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                1   2.90606,    .04108,   2.92176,    .03856,   2.93746,                133700000
                1    .03601,   2.95315,    .03341,   2.96883,    .03077,                133800000
                1   2.98451,    .02810,   3.00023,    .02539,   3.01595,                133900000
                1    .02264,   3.03167,    .01987,   3.04738,    .01707,                134000000
                1   3.06309,    .01426,   3.07879,    .01143,   3.09449,                134100000
                1    .00858,   3.11019,    .00573,   3.12589,    .00287,                134200000
                1   3.14159,   0.00000/                                                  134300000
000005           DO 201 J=1,201                                                          134400000
000006           PHI(J)=PHILD(J)                                                         134500000
000010       201 EPS(J)=EPSLD(J)                                                         134600000
000014           RETURN                                                                  134700000
000015           END                                                                     134800000
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                 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
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                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,    1.29770,     .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
                                                                            144000000
000005            DATA (PHILD(I),EPSLD(I),I=201,225)/
                 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,   144800000
                 1   2.42590,    .08731,   2.44078,    .08731,   2.45566,   144900000
                 1    .08725,   2.47054,    .08710,   2.48542,    .08684/   145000000
                                                                            145100000
000005            DATA (PHILD(I),EPSLD(I),I=226,251)/
                 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)*3.141592654/200.                        146400000
000013        201 CALL FTLJP(PHI(J),EPS(J),2,251,PHILD,EPSLD)               146500000
000024            RETURN                                                    146600000
000025            END                                                       146700000
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                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
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                1   2.90596,    .00382,   2.92167,    .00332,   2.93737,          155300000
                1    .00286,   2.95309,    .00244,   2.96880,    .00205,          155400000
                1   2.98451,    .00169,   3.00022,    .00137,   3.01592,          155500000
                1    .00108,   3.03163,    .00083,   3.04734,    .00061,          155600000
                1   3.06305,    .00042,   3.07875,    .00027,   3.09446,          155700000
                1    .00015,   3.11017,    .00007,   3.12588,    .00002,          155800000
                1   3.14159,   0.00000/                                           155900000
000005           DO 202 J=1,201                                                  156000000
000006           CALL FTLUP(PHI(J),PSI(J),2,201,PHILD,PSILD)                     156100000
000014       202 CONTINUE                                                        156200000
000020           RETURN                                                          156300000
000021           END                                                             156400000
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                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,   176900000
                1    .00593,   2.95306,    .00506,   2.96878,    .00426,   177000000
                1   2.98451,    .00353,   3.00021,    .00287,   3.01591,   177100000
                1    .00227,   3.03162,    .00174,   3.04732,    .00128,   177200000
                1   3.06303,    .00089,   3.07874,    .00057,   3.09445,   177300000
                1    .00032,   3.11016,    .00014,   3.12588,    .00004,   177400000
                1   3.14159,   0.00000/                                   177500000
000005           DO 202 J=1,201                                            177600000
000006           CALL FTLUP(PHI(J),PSI(J),2,201,PHILD,PSILD)               177700000
000014       202 CONTINUE                                                  177800000
000020           RETURN                                                    177900000
000021           END                                                       178000000
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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
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                 1   1.98923,    .08583,   1.99996,    .08495,   2.01069,          186600000
                 1    .08406,   2.02142,    .08318,   2.03215,    .08229,          186700000
                 1   2.04288,    .08140,   2.05401,    .08048,   2.06514,          186800000
                 1    .07955,   2.07627,    .07863,   2.08740,    .07770,          186900000
                 1   2.09852,    .07678,   2.10965,    .07585,   2.12078,          187000000
                 1    .07493,   2.13191,    .07401,   2.14304,    .07309/          187100000
000005            DATA (PHILD(I),PSILD(I),I=201,225)/                              187200000
                 1   2.15416,    .07217,   2.16592,    .07120,   2.17767,          187300000
                 1    .07023,   2.18942,    .06927,   2.20117,    .06831,          187400000
                 1   2.21293,    .06735,   2.22468,    .06639,   2.23643,          187500000
                 1    .06545,   2.24819,    .06450,   2.25994,    .06356,          187600000
                 1   2.27169,    .06262,   2.28447,    .06161,   2.29724,          187700000
                 1    .06060,   2.31001,    .05960,   2.32278,    .05861,          187800000
                 1   2.33556,    .05762,   2.34833,    .05664,   2.36111,          187900000
                 1    .05567,   2.37388,    .05470,   2.38666,    .05375,          188000000
                 1   2.39943,    .05279,   2.41396,    .05172,   2.42849,          188100000
                 1    .05066,   2.44302,    .04960,   2.45754,    .04855/          188200000
000005            DATA (PHILD(I),PSILD(I),I=226,251)/                              188300000
                 1   2.47207,    .04749,   2.48660,    .04644,   2.50113,          188400000
                 1    .04538,   2.51566,    .04432,   2.53019,    .04324,          188500000
                 1   2.54471,    .04216,   2.56260,    .04081,   2.58049,          188600000
                 1    .03945,   2.59837,    .03809,   2.61626,    .03675,          188700000
                 1   2.63415,    .03543,   2.65203,    .03414,   2.66993,          188800000
                 1    .03291,   2.68782,    .03173,   2.70572,    .03061,          188900000
                 1   2.72362,    .02958,   2.76535,    .02751,   2.80711,          189000000
                 1    .02589,   2.84888,    .02465,   2.89067,    .02374,          189100000
                 1   2.93247,    .02312,   2.97428,    .02273,   3.01610,          189200000
                 1    .02252,   3.05793,    .02243,   3.09976,    .02242,          189300000
                 1   3.14159,    .02243/                                          189400000
000005            DO 202 J=1,201                                                   189500000
000006            CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)                      189600000
000014        202 CONTINUE                                                         189700000
000020            RETURN                                                           189800000
000021            END                                                              189900000
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                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,    .17469,    .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
000005          DIMENSION PHI(1), PSI(1)                                             202000000
000005          DIMENSION PHILD(251),PSILD(251)                                      202100000
000005          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
000005          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
000005          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
000005          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
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                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,          222300000
                1    .00740,   2.95305,    .00631,   2.96878,    .00531,          222400000
                1   2.98451,    .00439,   3.00020,    .00356,   3.01590,          222500000
                1    .00281,   3.03160,    .00216,   3.04731,    .00159,          222600000
                1   3.06302,    .00110,   3.07873,    .00071,   3.09444,          222700000
                1    .00040,   3.11016,    .00018,   3.12587,    .00004,          222800000
                1   3.14159,   0.00000/                                           222900000
000005           DO 202 J=1,201                                                   223000000
000006           CALL FTLUP(PHI(J),PSI(J),2,201,PHILD,PSILD)                      223100000
000014       202 CONTINUE                                                         223200000
000020           RETURN                                                           223300000
000021           END                                                              223400000
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                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
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                 1   1.98312,    .14279,   1.99468,    .14227,   2.00623,   232000000
                 1    .14171,   2.01779,    .14111,   2.02934,    .14048,   232100000
                 1   2.04039,    .13981,   2.05308,    .13905,   2.06526,   232200000
                 1    .13825,   2.07745,    .13739,   2.08962,    .13648,   232300000
                 1   2.10180,    .13551,   2.11397,    .13449,   2.12613,   232400000
                 1    .13341,   2.13829,    .13227,   2.15044,    .13106/   232500000
000005            DATA (PHILD(I),PSILD(I),I=201,225)/                       232600000
                 1   2.16259,    .12980,   2.17538,    .12839,   2.18816,   232700000
                 1    .12692,   2.20093,    .12538,   2.21370,    .12380,   232800000
                 1   2.22646,    .12216,   2.23922,    .12048,   2.25197,   232900000
                 1    .11876,   2.26472,    .11700,   2.27746,    .11523,   233000000
                 1   2.29021,    .11343,   2.30379,    .11150,   2.31737,   233100000
                 1    .10955,   2.33095,    .10758,   2.34453,    .10559,   233200000
                 1   2.35810,    .10358,   2.37167,    .10154,   2.38523,   233300000
                 1    .09948,   2.39879,    .09738,   2.41235,    .09526,   233400000
                 1   2.42590,    .09310,   2.44078,    .09070,   2.45566,   233500000
                 1    .08825,   2.47053,    .08576,   2.48539,    .08324/   233600000
000005            DATA (PHILD(I),PSILD(I),I=226,251)/                       233700000
                 1   2.50025,    .08068,   2.51510,    .07808,   2.52995,   233800000
                 1    .07545,   2.54478,    .07278,   2.55962,    .07008,   233900000
                 1   2.57444,    .06735,   2.59138,    .06420,   2.60831,   234000000
                 1    .06102,   2.62523,    .05782,   2.64216,    .05463,   234100000
                 1   2.65909,    .05145,   2.67603,    .04830,   2.69297,   234200000
                 1    .04518,   2.70993,    .04212,   2.72690,    .03912,   234300000
                 1   2.74389,    .03620,   2.78335,    .02979,   2.82290,   234400000
                 1    .02391,   2.86255,    .01859,   2.90227,    .01386,   234500000
                 1   2.94205,    .00977,   2.98189,    .00635,   3.02178,   234600000
                 1    .00362,   3.06170,    .00163,   3.10164,    .00041,   234700000
                 1   3.14159,   0.00000/                                    234800000
000005            DO 202 J=1,201                                            234900000
000006            CALL FTLUP(PHI(J),PSI(J),2,251,PHILD,PSILD)               235000000
000014        202 CONTINUE                                                  235100000
000020            RETURN                                                    235200000
000021            END                                                       235300000
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TABLE I

SAMPLE COMPUTER PRINTOUT OF ORDINATES FOR SYMMETRIC AIRFOIL

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 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	UPPER SURFACE VALUES					LOWER SURFACE VALUES				
X/C	XU/C	YU/C	XU	YU	DYU/DXU	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

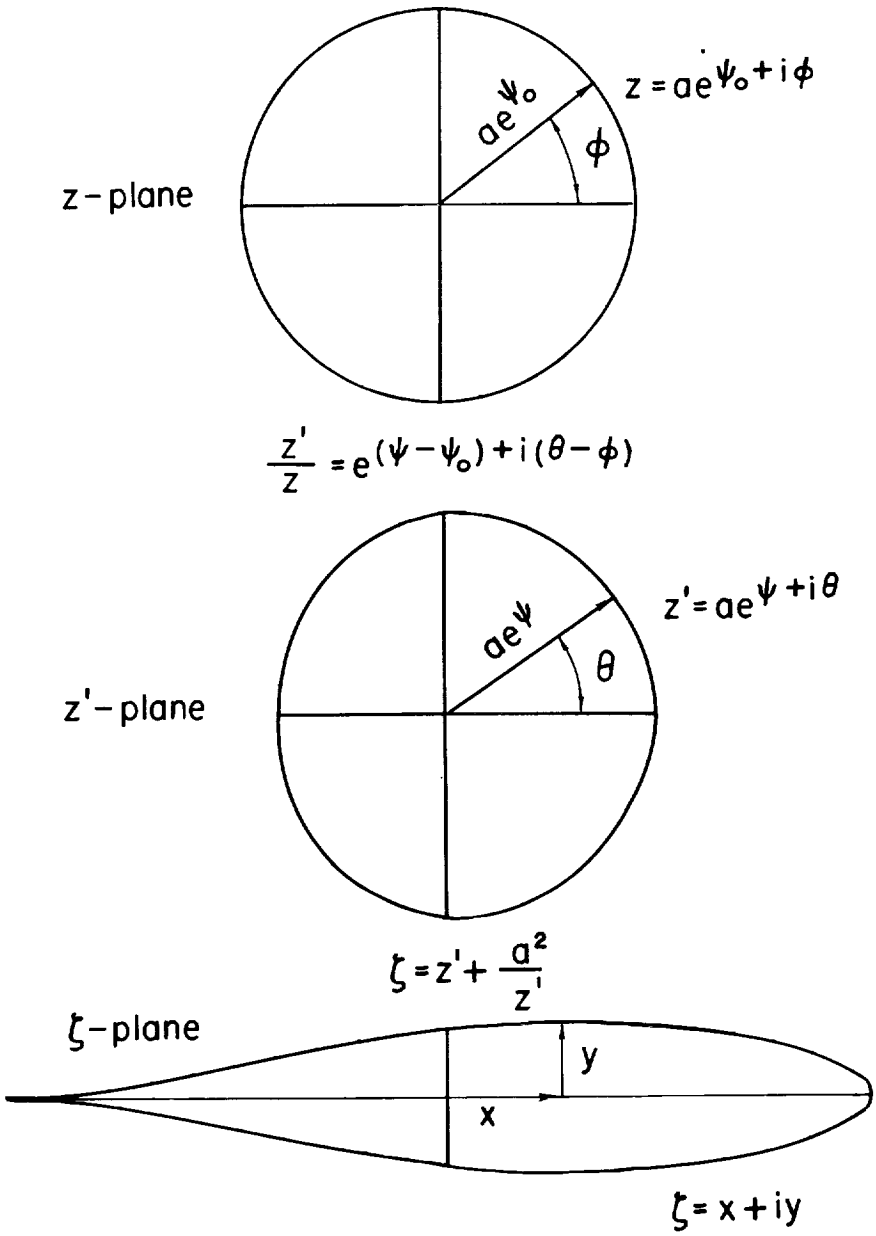


Figure 1.- Illustration of transformations used to derive airfoils and calculate pressure distribution. (From ref. 1.)

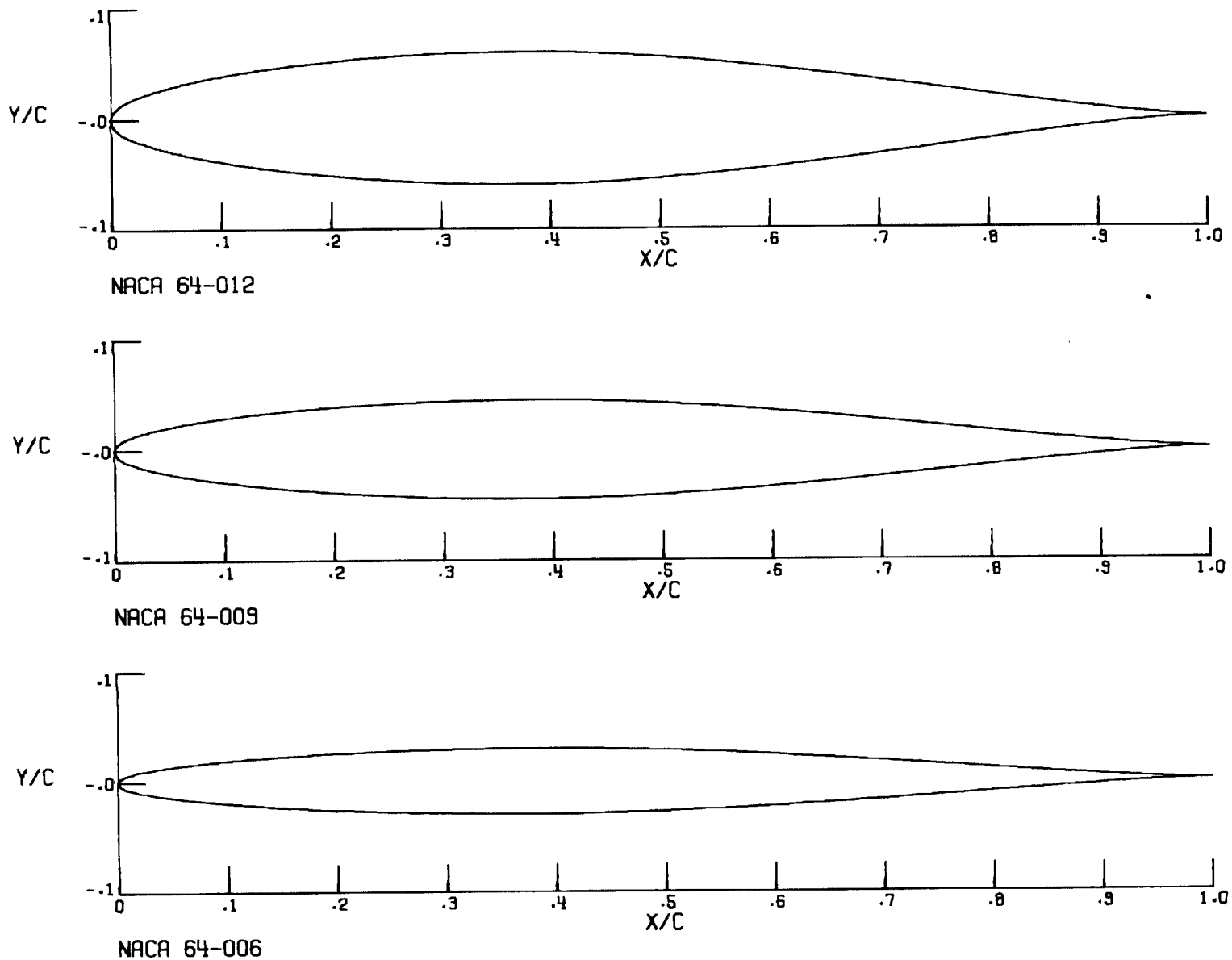


Figure 2.- Variation of thickness-chord ratio for NACA 64-series airfoils.

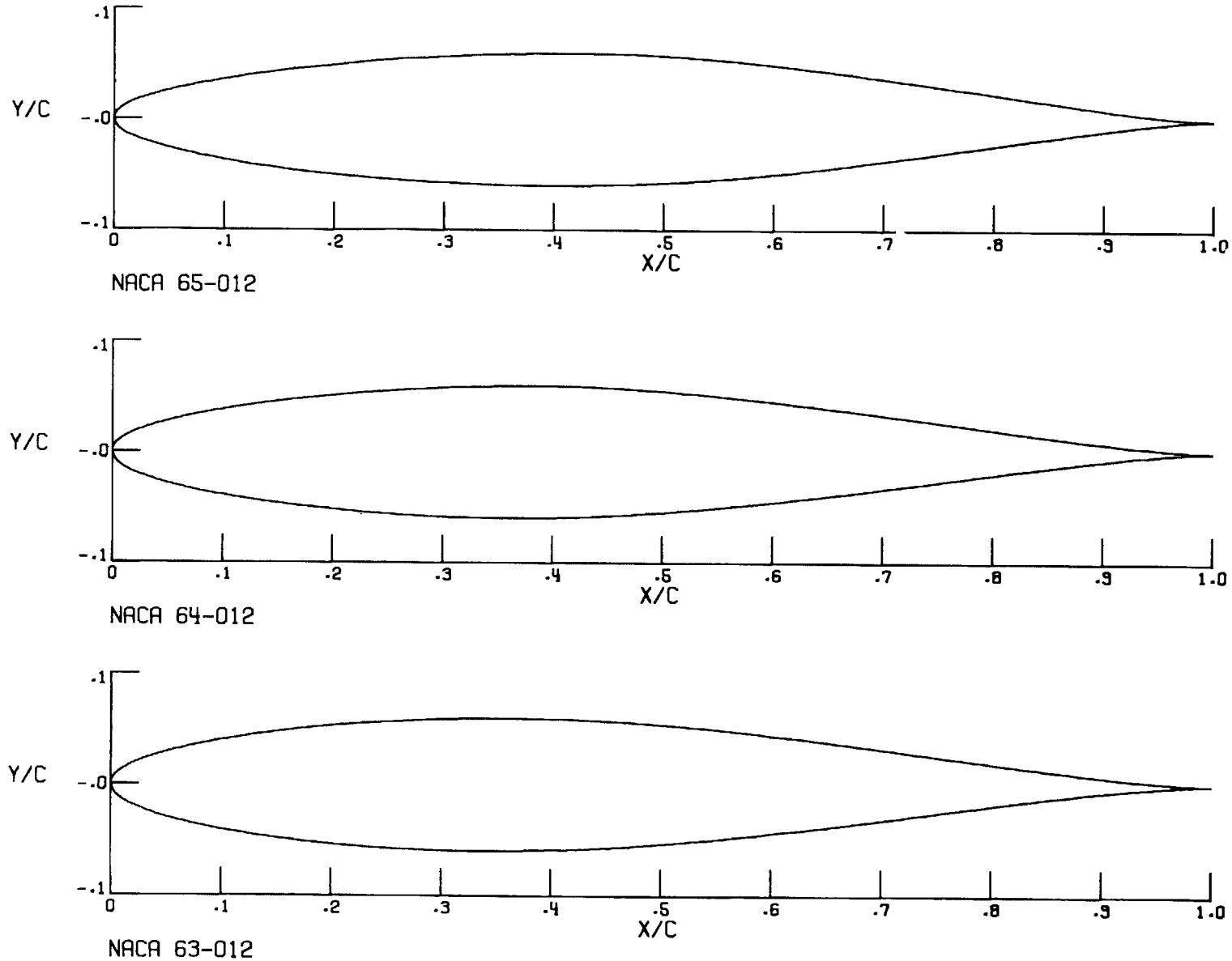
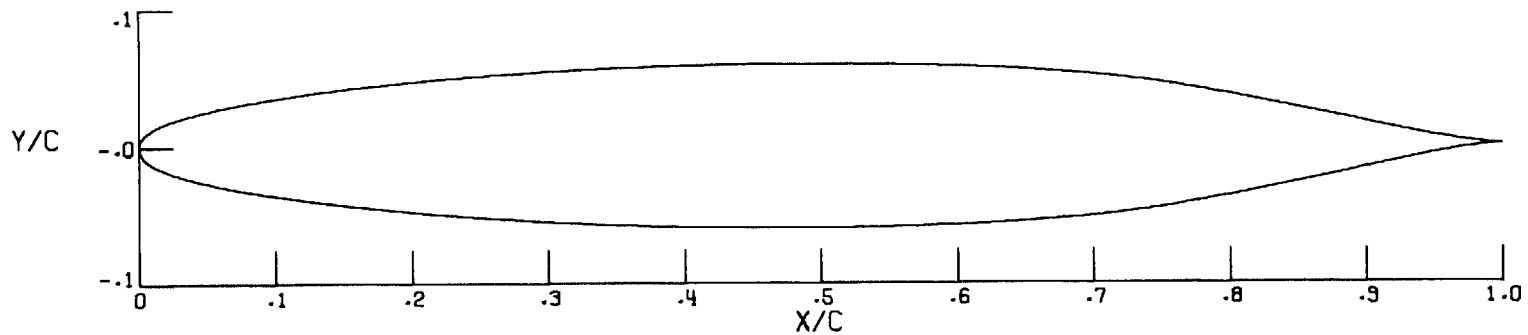


Figure 3.- NACA 6-series family variations for 12-percent-thick airfoils.



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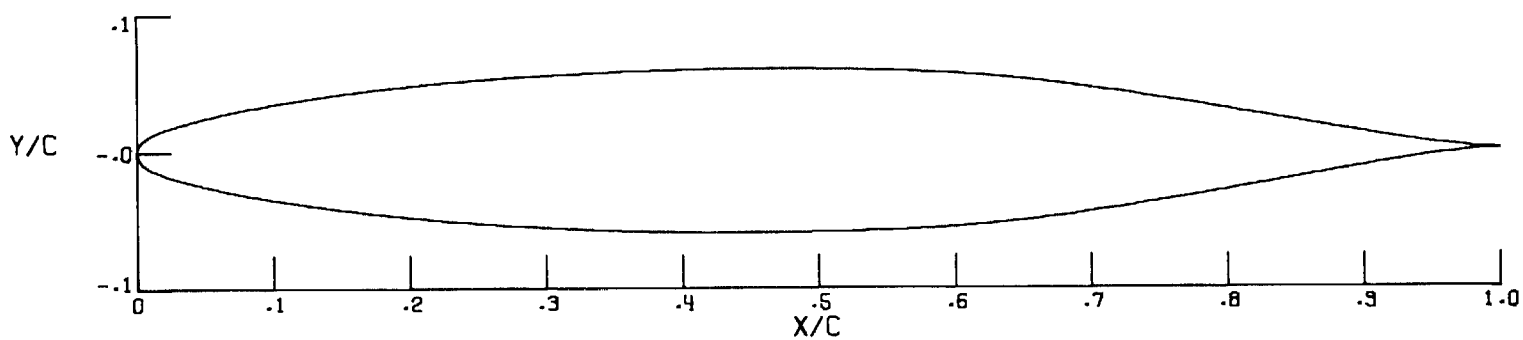

NACA 66-012

Figure 3.- Concluded.

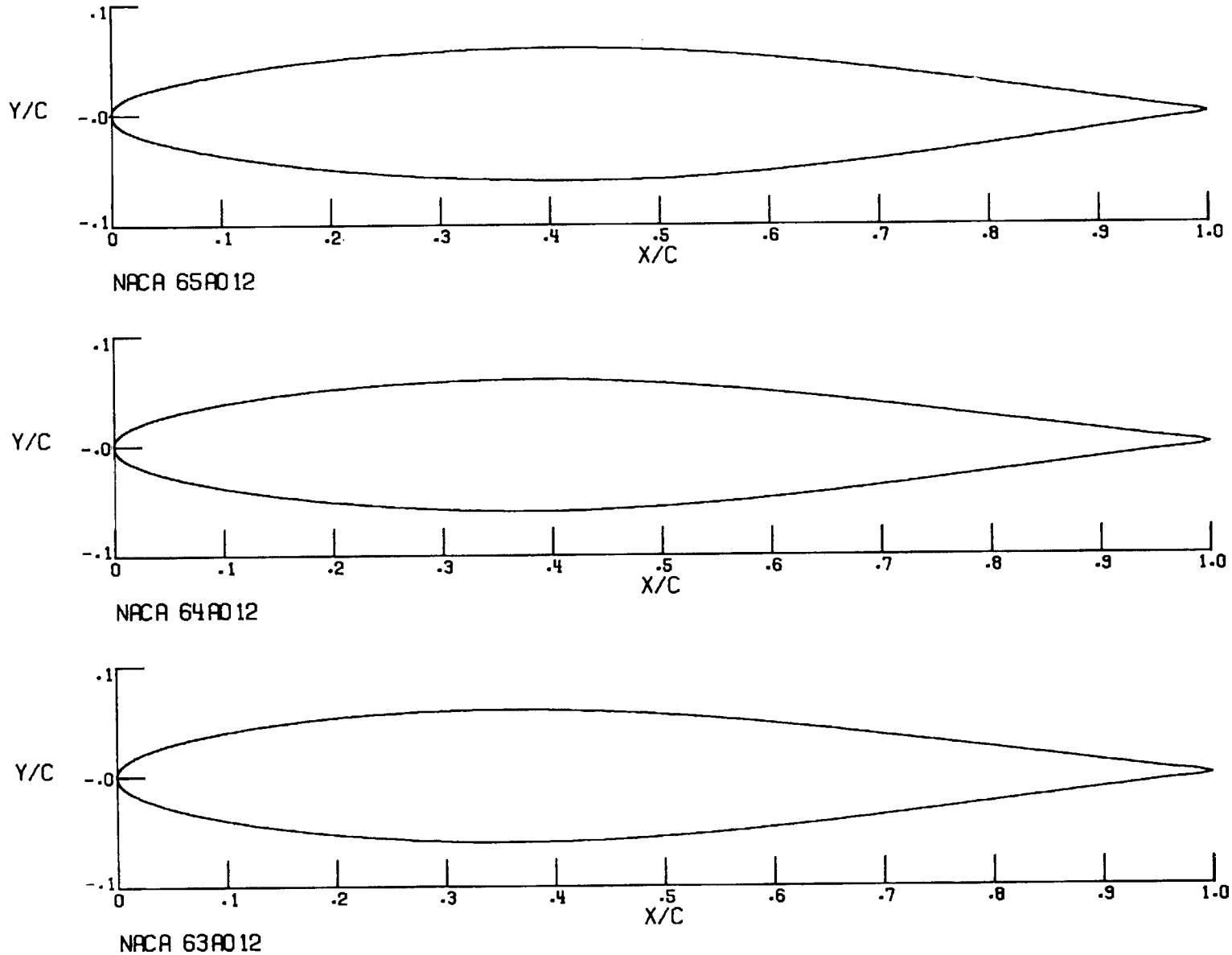

Figure 4.- NACA 6A-series family variations for 12-percent-thick airfoils.

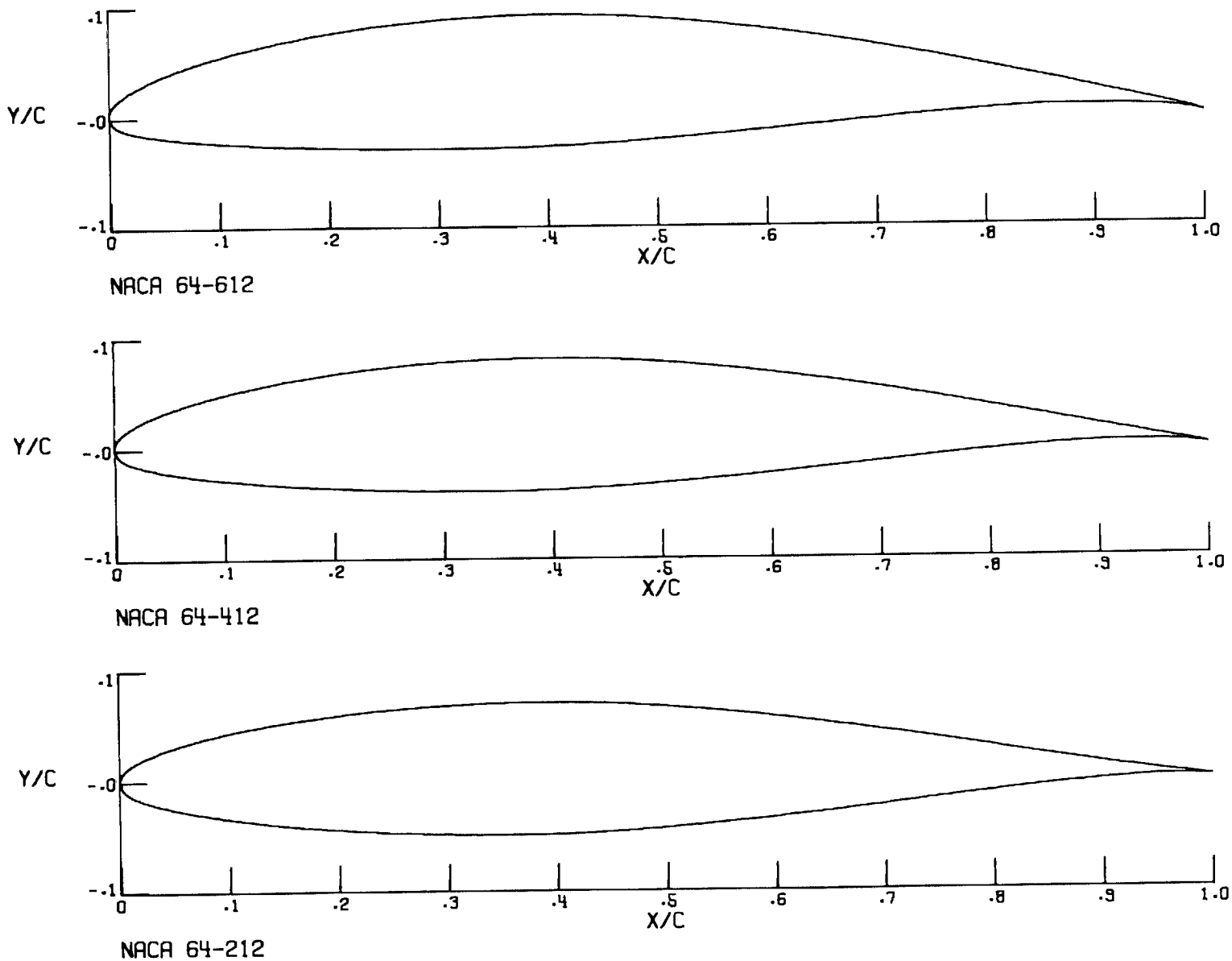

Figure 5.- Variation of design lift coefficient for NACA 64-series 12-percent-thick airfoils.

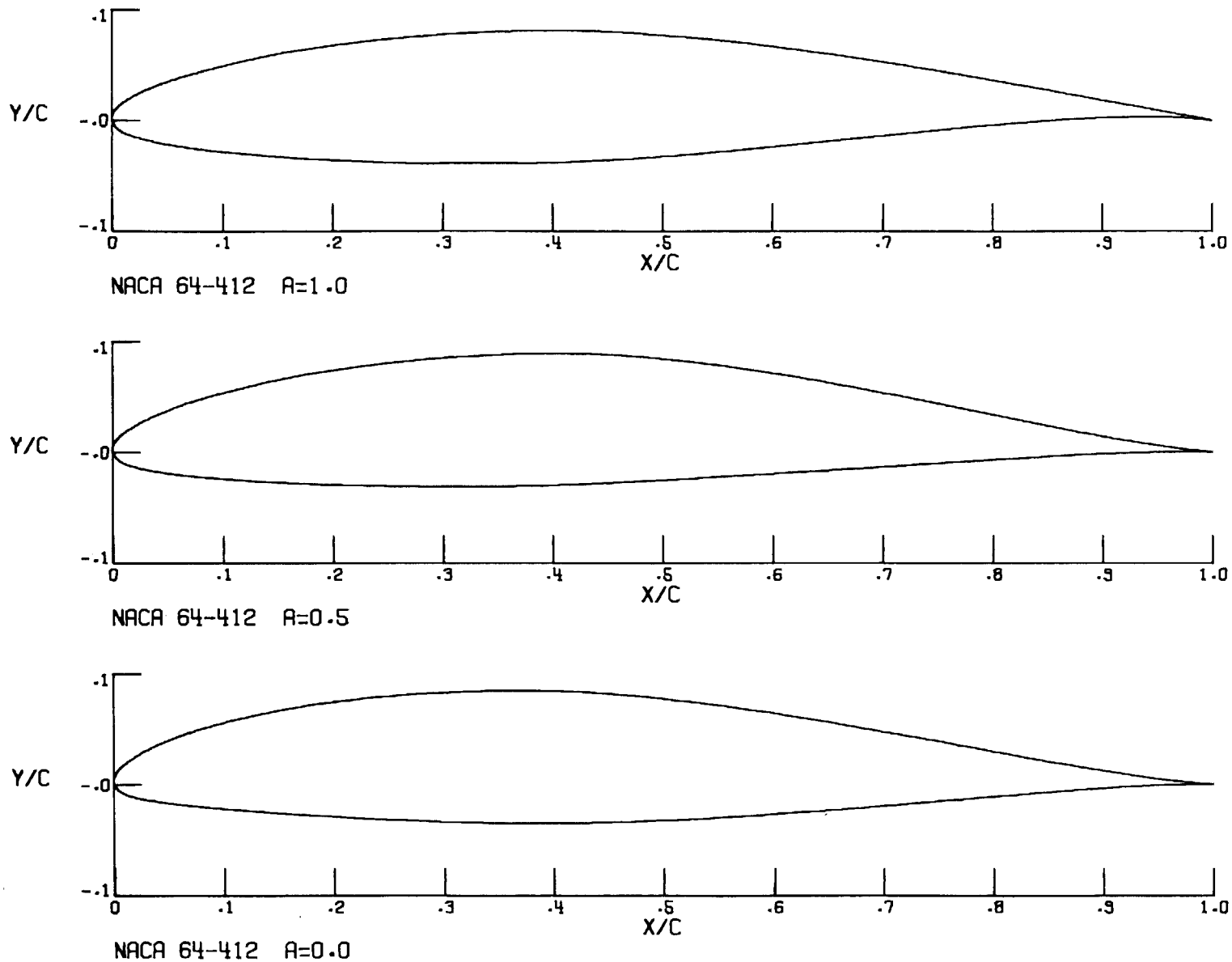

Figure 6.- Variation of mean line loading for NACA 64-412 airfoil.

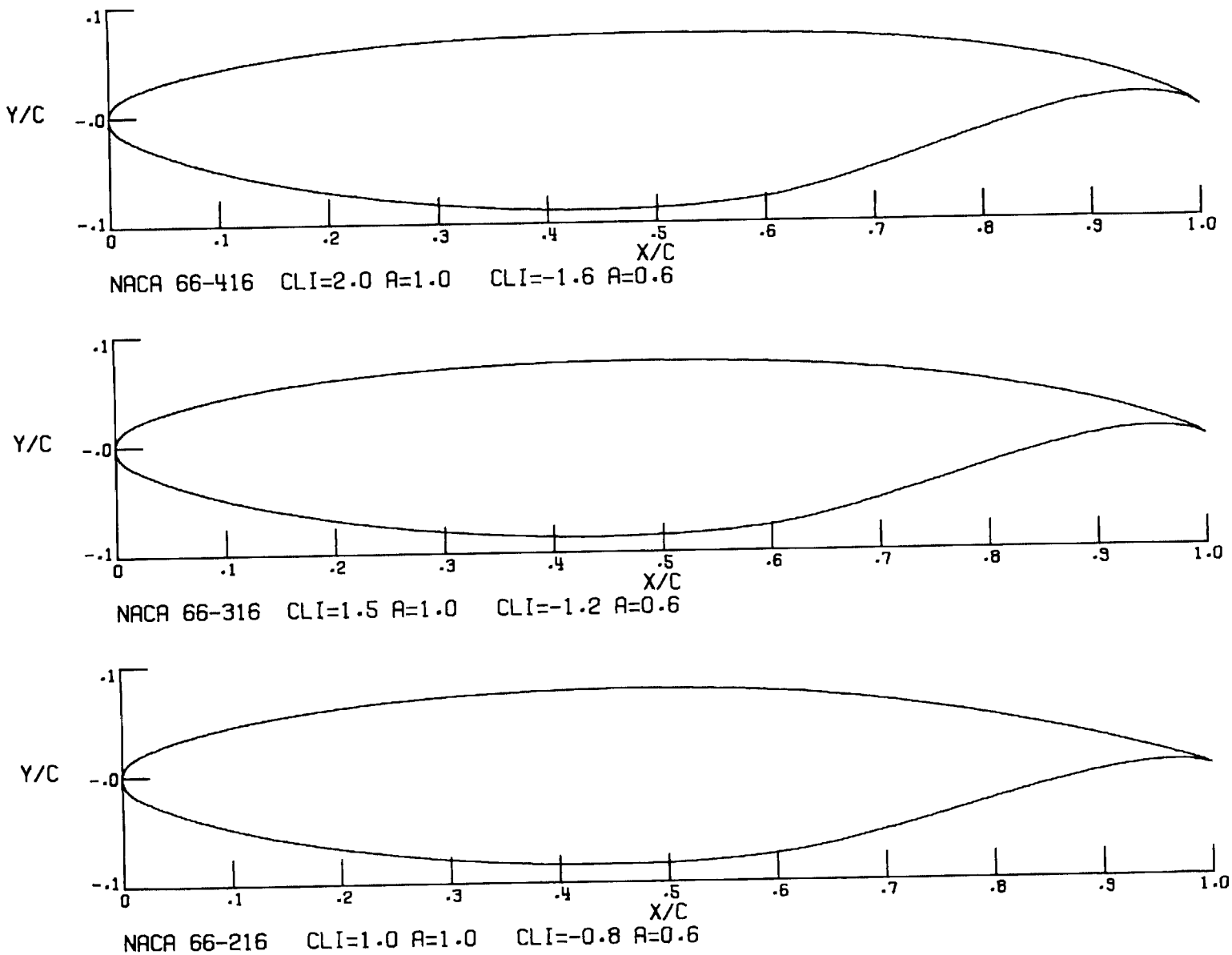

Figure 7.- Combinations of mean lines for NACA 66-series 16-percent-thick airfoils.

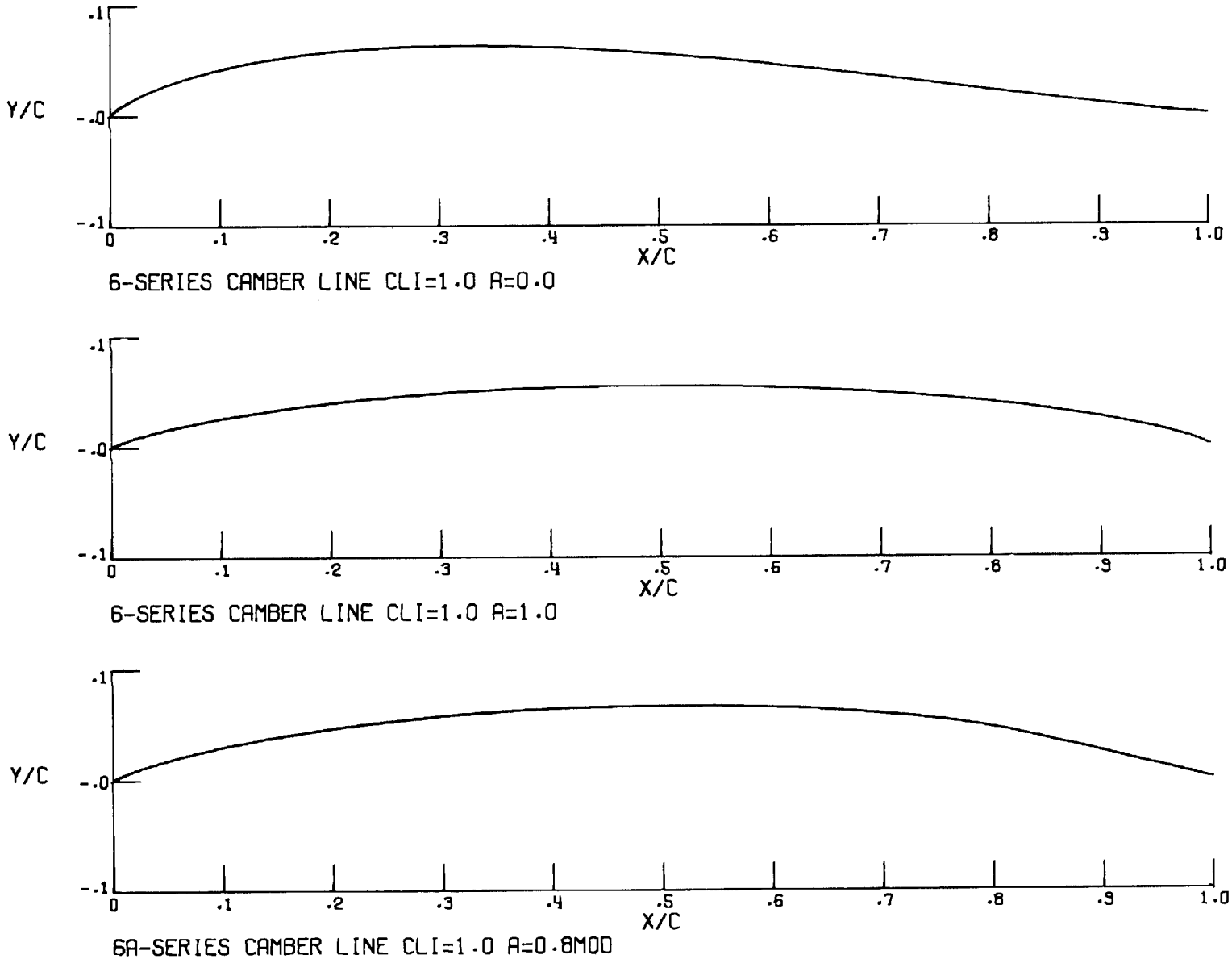

Figure 8.- Mean lines for NACA 6- and 6A-series airfoils.

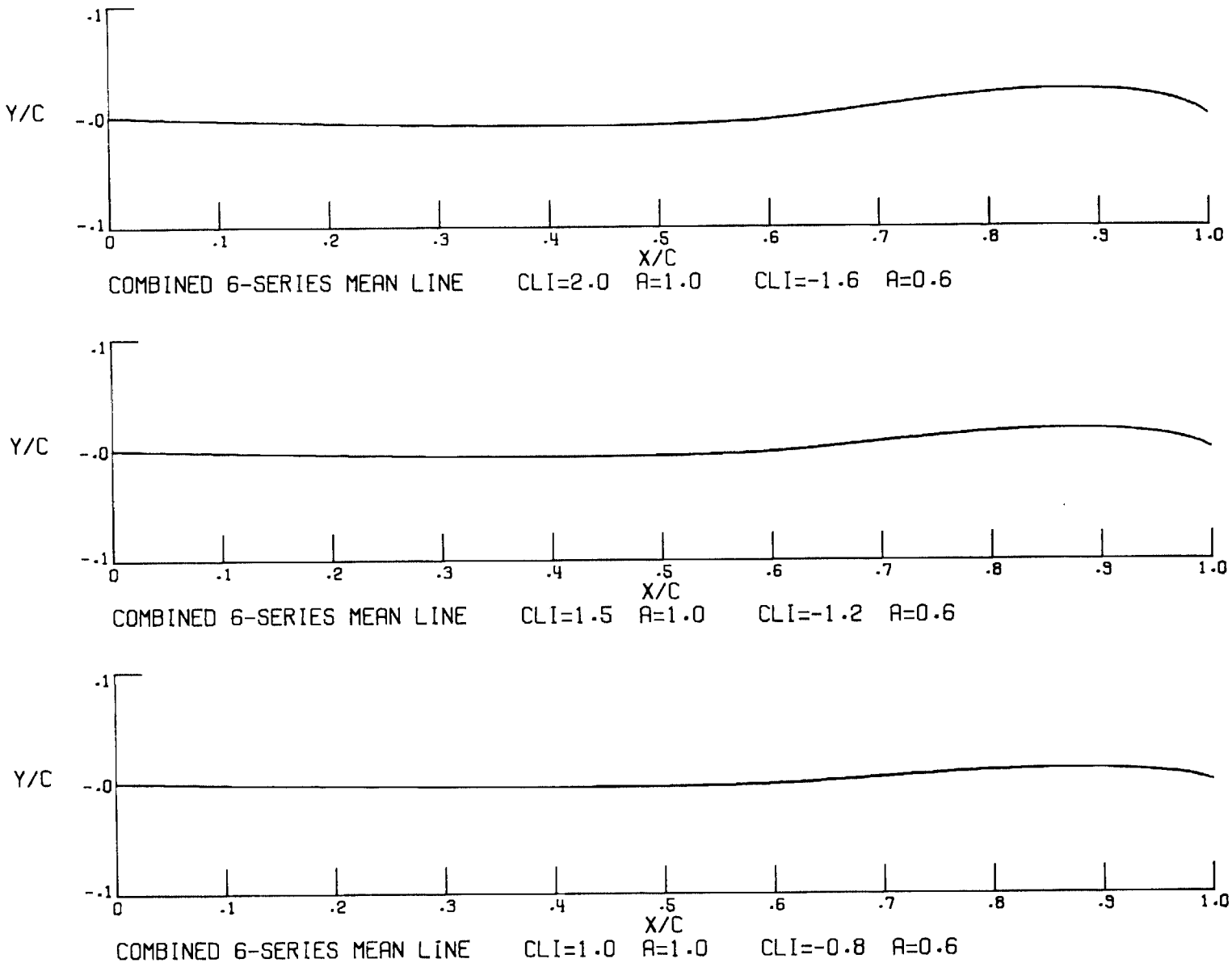

Figure 9.- Combinations of mean lines for NACA 6-series airfoils.

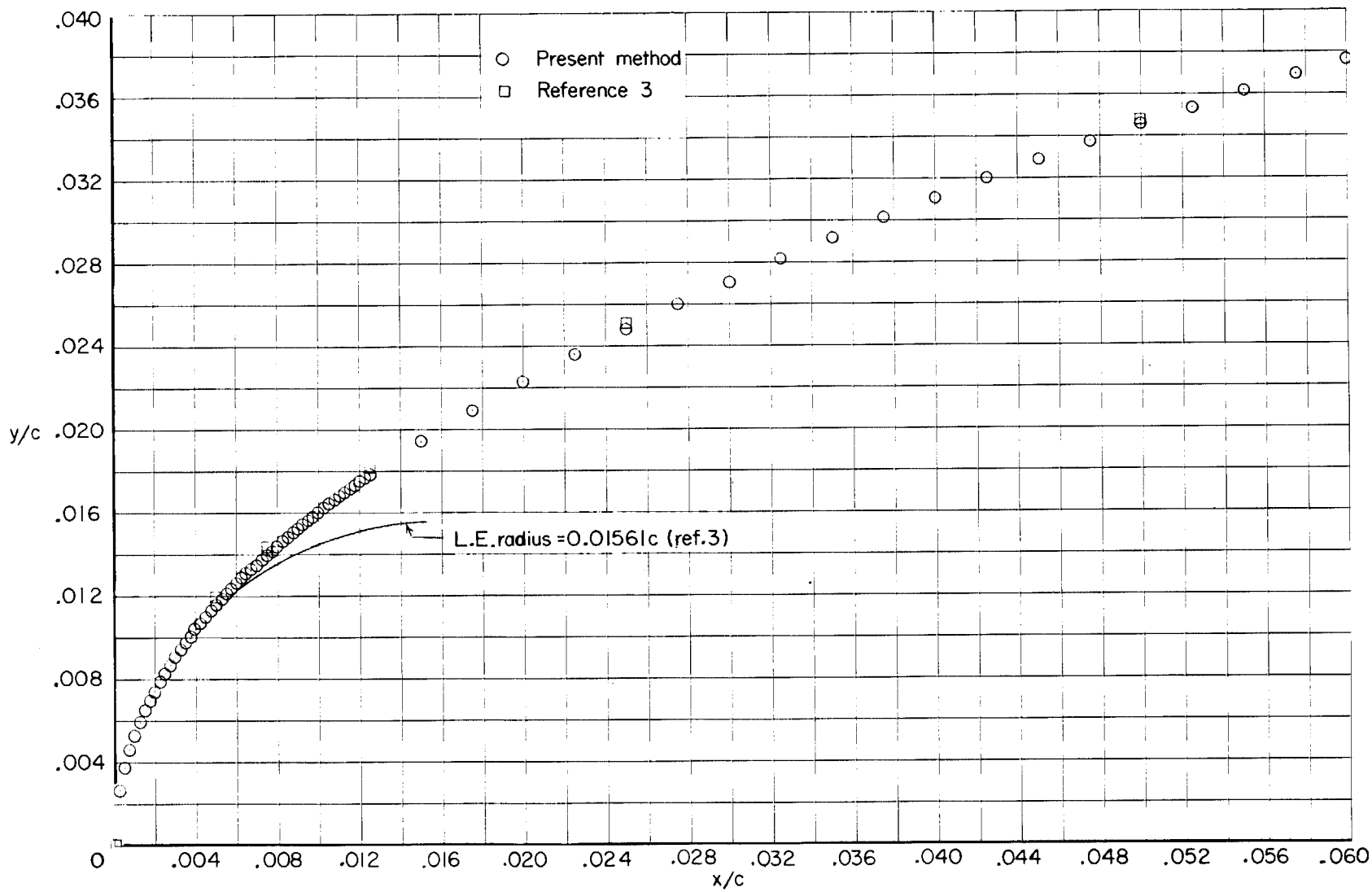

Figure 10.- Comparison of computer-generated ordinates and previously published ordinates for leading-edge region of an NACA 64A015 airfoil section.

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