

(NASA-TM-X-73208-Vol-3) AEROX: COMPUTER  
PROGRAM FOR TRANSONIC AIRCRAFT AERODYNAMICS  
TO HIGH ANGLES OF ATTACK. VOLUME 3: AEROX  
COMPUTER PROGRAM LISTING (NASA) 55 p  
HC A04/MF A01

N77-20024

Unclass  
22811

CSCCL 11A G3/02

# NASA TECHNICAL MEMORANDUM

NASA TM X-73,208

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AEROX - COMPUTER PROGRAM FOR TRANSONIC AIRCRAFT  
AERODYNAMICS TO HIGH ANGLES OF ATTACK  
VOLUME III - AEROX COMPUTER PROGRAM LISTING

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February 1977

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1. Report No. TM X-73,208		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle AEROX — COMPUTER PROGRAM FOR TRANSONIC AIRCRAFT AERODYNAMICS TO HIGH ANGLES OF ATTACK VOLUME III — AEROX COMPUTER PROGRAM LISTING				5. Report Date	
				6. Performing Organization Code	
7. Author(s) John A. Axelson				8. Performing Organization Report No. A-6927	
9. Performing Organization Name and Address Ames Research Center Moffett Field, Calif. 94035				10. Work Unit No. 505-06-19	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D. C. 20546				13. Type of Report and Period Covered Technical Memorandum	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract <p>The theory, users' guide, test cases, and program listing are presented in the three volumes. The AEROX program estimates lift, induced-drag and pitching moments to high angles of attack (typ. 60°) for wings and for wing-body combinations with or without an aft horizontal tail. Minimum drag coefficients are not estimated, but may be input for inclusion in the total aerodynamic parameters which are output in listed and plotted formats.</p>					
17. Key Words (Suggested by Author(s)) Aerodynamics Computer programming and software				18. Distribution Statement Unlimited STAR Categories — 61	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 54	22. Price* \$4.25

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100 C MAIN DRIVER PROGRAM
200 C
300 C NEW VERSION CREATED ON 6/10/76
400 C
500 COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CKUSW,TCRW,TCTW,TCWP,=
600 ITCW,SOW,SWPW,SWPWE,XOMAC,CSHOC,SEXT,XEXT,FLEX,TUIF,FINI,DELX
700 COMMON /DISPLY/ LDISP(6),DDISP(4),TITLE(14),PPLOT
800 COMMON /FWING/ CLW(20,20),CDW(20,20),CLWU(20,20),CLWL(20,20),=
900 ICDFP(20,20),CLOS,DL(20,20),CLALF(20,20),CMU(20),CDU(20),CLM,CLMU,=
1000 2DLMU,CPLIM,CP2,CPMXS
1100 COMMON /FTOTAL/ CL(20,20),CDL(20,20)
1200 COMMON /NOSE/ BDMAX,ASECT,APLAN,XLN,CLN(20,20),CDN(20,20),=
1300 ICNDF(20,20),XLB,CLOB(20),CMOB(20),CDUB(20)
1400 COMMON /TAIL/ SHOR,SHOSW,AQHUR,YHOR,CLH(20,20),CUH(20,20),SQW,ARW,=
1500 IAFTR(20,20)
1600 COMMON /FLOW/ SMN(20),NSMN,RNLUC(20),I6A,I6H,I6C,Z(20,20),AMC
1700 COMMON /AFUIL/ ALELJ,XCD,SHK,RUC
1800 COMMON /TRIM/ CLT,CLT,I,K,LL,ALPHA,DCNTR(20,20),DALTR(20,20),=
1900 ICM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XCG,CLALFA,=
2000 2IT,DEXP,LE,LT,ED,ITKIM(20),RETAM,SA,CA,CENX,IXCD,IFLEX,ICDU
2100 COMMON /TRQIT/ STM(20,20),DFLH(20,20),DWASH(20,20),DWASHK(20,20)
2200 DIMENSION FOILID(10),TRIMID(4),XCDID(4),FLEXID(4),CDUID(4),X(4),=
2300 ICLOD(20,20),CDTOT(20,20)
2400 INTEGFR ALELJ,Z,DDISP,PPLOT,ALELJI
2500 REAL MNARW,MXARW,INARW,MNTRW,MXTRW,INTRW,MNSQW,MXSQW,INSQW,MNALF,=
2600 IMXALF,INALF,MNXCD,MXXCD,INXCD,LE,LT,IT
2700 DATA FOILID/4HSHAR,4HP ,4H23U,,4H00XX,4H6 SE,4HKIES,4HSLAB,4H =
2800 I ,4HRNC ,4HSPEC/,BLANK/4H /
2900 DATA TRIMID/4HUNTR,4HIM) ,4HTRIM,4HMED)/
3000 DATA XCDID/4HCONS,4HTANT,4HVARI,4HABLE/
3100 DATA FLEXID/4HSLFN,4HDER ,4HRE=F,4HNTRY/
3200 DATA CDUID/4HCDD,4HV.O ,4HCDD ,4HDEF /
3300 DATA RAD/57.29578/
3400 NAMELIST /ARRAYS/ NSMN,SMN,ICDD,CDU,CMU,CLUB,CUOB,CMUB,ITRIM
3500 NAMELIST /WINGIN/ ALELJ,MNARW,MXARW,INARW,MNTRW,MXTRW,INTRW,MNSQW,=
3600 IMXSQW,INSQW,CLU,SWING,SPANW,CROOT,CTIP,TCRW,TCTW,XOMAC,CHARK,RUC,=
3700 2SEXT,XEXT,IFLEX
3800 NAMELIST /NOSEIN/ BDMAX,XLN,XLB,XCG

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3900      NAMELIST /TAIL IN/ SHOR,XQHUR,ARH,SOH,YHUR,IT
4000      NAMELIST /FLOWIN/ MNALF,MXALF,INALF,MNXCD,MXXCD,INXCD,IXCD,SHK,
4100      IALTV
4200      NAMELIST /FACTOR/ FTOTL,FTOTD,FCM
4300      NAMELIST /OUTPUT/ IDATA,ITABL,IPLOT,PPLOT,LDISP,DDISP
4400      DO 20 JJ=1,20
4500      DO 20 II=1,20
4600      DWASH(II,JJ)=0.
4700      20 DELH(II,JJ)=0.
4800      DO 30 II=1,14
4900      30 TITLE(II)=BLANK
5000      C
5100      C
5200      C      ITRIM=01 CALCULATES UNTRIMMED CHARACTERISTICS
5300      C      ITRIM=11 CALCULATES UNTRIMMED AND TRIMMED CHARACTERISTICS
5400      C
5500      C      LDISP(1)=11 HOR. TAIL LIFT COEFF. IS PLOTTED
5600      C      LDISP(2)=11 NOSE          ?      ?      ?      ?
5700      C      LDISP(3)=11 LOWER WING  ?      ?      ?      ?
5800      C      LDISP(4)=11 UPPER WING  ?      ?      ?      ?
5900      C      LDISP(5)=11 TOTAL WING  ?      ?      ?      ?
6000      C      LDISP(6)=11 TOTAL AIRCRAFT ?      ?      ?
6100      C
6200      C      DDISP(1)=11 NOSE          DRAG COEFFICIENT IS PLOTTED
6300      C      DDISP(2)=11 SEPARATION  ?      ?      ?
6400      C      DDISP(3)=11 TOTAL WING  ?      ?      ?      ?
6500      C      DDISP(4)=11 TOTAL AIRCRAFT ?      ?      ?
6600      C
6700      C
6800      C      LTABL = 1 : A TABLE OF THE GEOMETRY INPUTS IS PRINTED
6900      C      0 : NO TABLE IS PRINTED
7000      C
7100      C      LSTOUT = 1: AN OUTPUT LISTING OF FORCE COEFFICIENTS IS PRODUCED
7200      C      0: NO OUTPUT TABLE IS PRODUCED
7300      C
7400      C
7500      READ (5,120) TITLE
7600      READ (5,ARRAYS)
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7700 READ (5,WINGIN)
7800 READ (5,NUSEIN)
7900 READ (5,TAILIN)
8000 READ (5,FLOWIN)
8100 READ (5,FACTOR)
8200 READ (5,OUTPUT)
8300 CALL AT62 (ALTY,X)
8400 CLOS=CLD
8500 T=X(3)*1.8
8600 IF (T.GE.225.) VISC=2.27E-8*SQRT(T**3)/(T+198.6)
8700 IF (T.LT.225.) VISC=.8038E-9*T
8800 DO 40 I=1,NSMN
8900 V=SMN(I)*X(4)
9000 RNLOC(I)=X(1)*V/VISC
9100 40 CONTINUE
9200 I1A=INT(MNARW*100.+01)
9300 I1B=INT(MXARW*100.+01)
9400 I1C=INT(INARW*100.+01)
9500 I3A=INT(MNSQW*1000.+5)
9600 I3B=INT(MXSQW*1000.+5)
9700 I3C=INT(INSQW*1000.+5)
9800 I4A=INT(MNTRW*1000.+5)
9900 I4B=INT(MXTRW*1000.+5)
10000 I4C=INT(INTRW*1000.+5)
10100 I5A=INT(MNXCD*1000.+01)
10200 I5B=INT(MXXCD*1000.+01)
10300 I5C=INT(INXCD*1000.+01)
10400 I6A=INT(MNALF*100.+01)
10500 I6B=INT(MXALF*100.+01)
10600 I6C=INT(INALF*100.+01)
10700 IPAGE=1
10800 NPLDT=1
10900 C
11000 C*****WING ASPECT RATIO=ARW
11100 C
11200 DO 110 I1=I1A,I1B,I1C
11300 ARW=FLOAT(I1)/100.
11400 C
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11500 C*****WING SWEEP OF QUARTER CHORD--SQW
11600 C
11700 DO 110 I3=I3A,I3B,I3C
11800 SQW=FLOAT(I3)/1000.
11900 IF (SQW.GT.89.95) SQW=89.95
12000 SWPW=SQW/RAD
12100 IF (SWPW.EQ.0.) SWPW=0.01
12200 C
12300 C*****TAPER RATIO=TRW
12400 C
12500 DO 110 I4=I4A,I4B,I4C
12600 TRW=FLOAT(I4)/1000.
12700 IF (TRW.GT.1.) TRW=1.
12800 CALL GEOM1
12900 C
13000 C*****CHORDWISE SHOCK LOCATION=XCD
13100 C
13200 DO 110 I5=I5A,I5B,I5C
13300 XCD=FLOAT(I5)/1000.
13400 IF (XCD.GT.1.) XCD=1.
13500 CALL AXE
13600 ISMN=1
13700 DO 100 I=1,NSMN
13800 IF (ITABL.EQ.0) GO TO 50
13900 ALELJI=ALELJ*2-1
14000 IDTRIM=(ITRIM(I)+1)*2-1
14100 IDXCD=(IXCD+1)*2-1
14200 IDFLEX=(IFLEX+1)*2-1
14300 IDCDO=(ICDO+1)*2-1
14400 RN106=RNLOC(I)/1.F6
14500 WRITE (6,130) TITLE,IPAGE,ALELJ,FOILID(ALFLJI),FOILID(ALELJI+1)
14600 WRITE (6,140) ARW,CDU(I),XCG,ARH,SMN(I),SWING,CLU,XLB,SHUR,
14700 ITRIM(I),TRIMID(IDTRIM),TRIMID(IDTRIM+1)
14800 WRITE (6,150) SPANW,CMO(I),BUMAX,XQMOR,IXCD,XCDID(IDXCD), XCDIU=
14900 I(IDXCD+1),CROOT,SEXT,XLN,YHOR,ICDO,CDID(IDCDO),CDID(IDCDO+1)
15000 WRITE (6,160) CTIP,XEXT,ASECT,SMH,IFLEX,FLEXID(IDFLEX),
15100 IFLEXID(IDFLEX+1),TRW,XOMAC,APLAN,IT,ALTV
15200 WRITE (6,170) SQW,CBARW,CLUB(I),LT,RN106,SWPWLE,SHK,COUB(I),LE,AMC
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15300      WRITE (6,180) TCRW,XCD,CMOB(I),TCTW
15400      50 IF (IDATA.EQ.0) GO TO 70
15500      IF (ITABL.EQ.0) WRITE (6,190) IPAGE
15600      WRITE (6,200)
15700      DO 60 I6=I6A,I6B,I6C
15800      K=(I6-I6A)/I6C+1
15900      CDTOT(I,K)=CDL(I,K)+CDO(I)
16000      CLOD(I,K)=CL(I,K)/CDTOT(I,K)
16100      ALPHA=FLOAT(I6)/100.
16200      WRITE (6,210) ALPHA,CL(I,K),CDTOT(I,K),CLW(I,K),CDW(I,K),CLWU(I,K)=
16300      1,CLWL(I,K),CLN(I,K),CDN(I,K),CLH(I,K),CDH(I,K),DWASH(I,K),
16400      2,CDSEP(I,K),CLALF(I,K),Z(I,K),CM(I,K),CLOD(I,K),DELH(I,K),
16500      3,DALTR(I,K),ALFTR(I,K)
16600      60 CONTINUE
16700      IF ((ITRIM(I).EQ.0) GO TO 70
16800      WRITE (6,220) ISMN
16900      ISMN=ISMN+1
17000      C.....PRINT ON OUTPUT FILE: CORRECTED COEFFICIENTS
17100      70 IF (FTOTL.EQ.1.0.AND.FTOTD.EQ.1.0.AND.FCM.EQ.1.0) GO TO 90
17200      IF (IDATA.NE.0) WRITE (6,230) TITLE,SQW,FTOTL,IT,FTOTD,SMN(I),FCM,=
17300      1XCD
17400      DO 80 I6=I6A,I6B,I6C
17500      K=(I6-I6A)/I6C+1
17600      ALPHA=FLOAT(I6)/100.
17700      CL(I,K)=CL(I,K)*FTOTL
17800      CDL(I,K)=CDL(I,K)*FTOTD
17900      CM(I,K)=CM(I,K)*FCM
18000      IF (ITABL.NE.0) WRITE (6,240) ALPHA,CL(I,K),CDL(I,K),CM(I,K),
18100      1ALFTR(I,K)
18200      80 CONTINUE
18300      90 IF (ITRIM(I).NE.0) GO TO 100
18400      IF (IPLT.EQ.1) CALL PLOT (NPLT)
18500      IPAGE=IPAGE+1
18600      NPLT=NPLT+1
18700      100 CONTINUE
18800      IF (ITRIM(I).NE.1) GO TO 110
18900      IF (IPLT.EQ.1) CALL MPLIT (NPLT)
19000      IPAGE=IPAGE+1
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19100      NPLOT=NPL0T+1
19200      110 CONTINUE
19300      STOP
19400      C
19500      120 FORMAT (14A4)
19600      130 FORMAT (1H1,150,20HGEOMETRY DATA ; ,14A4,T129,T2///T25,4HWING,=
19700      1T61,9HBODY/NOSE,T85,15HMORIZONTAL TAIL,T112,15HFLOW PARAMETERS// =
19800      2T17,8HALELJ = ,11,2H (,2A4,1H)/)
19900      140 FORMAT (T4,9HARM = ,F6,3,T28,8HCDD = ,F6,4,T56,8HXCG = , =
20000      1F7,3,3H FT,T82,8HARM = ,F5,3,T108,8HSMN = ,F6,3,5H MACH/T4, =
20100      29HSWING = ,F6,1,6H SQ FT,T28,8HCLO = ,F5,3,T56,8HXLB = ,F7,3,=
20200      33H FT,T82,8HSHOR = ,F6,1,6H SQ FT,T108,8HITRIM = ,11,2H (,2A4) =
20300      150 FORMAT (T4,9HSPANW = ,F6,2,3H FT,T28,8HCMU = ,F5,3,T56, =
20400      18HBDMAX = ,F6,3,3H FT,T82,8HXQUR = ,F6,2,3H FT,T108,8MIXCD = ,11=
20500      2,2H (,2A4,1H)/T4,9HCRODT = ,F6,3,3H FT,T28,8HSEXT = ,F6,2, =
20600      36H SQ FT,T56,8HXLN = ,F6,3,3H FT,T82,8HYHUR = ,F7,3,3H FT,T108,=
20700      48HCDD = ,11,2H (,2A4,1H))
20800      160 FORMAT (T4,9HCTIP = ,F6,3,3H FT,T28,8HXEXT = ,F6,3,3H FT,T56, =
20900      18HASECT = ,F6,2,6H SQ FT,T82,8HSQH = ,F5,2,4H DEG,T108, =
21000      28HIFLFX = ,11,2H (,2A4,1H)/T4,9HTRW = ,F6,4,T28,8HXQMAC = , =
21100      3F6,2,3H FT,T56,8HAPLAN = ,F6,1,6H SQ FT,T82,8HIT = ,F6,2,4H DEG=
21200      4,T108,8HALTV = ,F7,0,3H FT)
21300      170 FORMAT (T4,9HSQW = ,F5,2,4H DEG,T28,8HCHARW = ,F6,3,3H FT,T56, =
21400      18HCLOB = ,F6,4,T82,8HLT = ,F6,2,3H FT,T108,8HRNLUC = ,F8,6, =
21500      27HE6 1/FT/T4,9HSWPWLE = ,F5,3,4H RAD,T28,8HSHK = ,F6,4,4H RAD, =
21600      3T56,8HCDD8 = ,F6,4,T82,8HLE = ,F6,2,3H FT,T108,8HAMC = ,F5,2=
21700      4,4H DEG)
21800      180 FORMAT (T4,9HTCRW = ,F6,4,T28,8HXCD = ,F5,3,9H OF CHURD,T56, =
21900      18HCMOB = ,F6,4/T108,T4,9HTCIW = ,F6,4)
22000      190 FORMAT (1H1,T129,12)
22100      200 FORMAT (///T55,26HFORCE COEFFICIENTS TABLE///13,13HALPHA CLTOT =
22200      163H CDTOT CLW CDW CLWU CLWL CLN CDN CLMUR CDMUR =
22300      2,54HOWASH CDSEP DLWING ? CM L/D DELH DALTR ALFTR/)
22400      210 FORMAT (3X,F4,1,1X,10(F6,4,1X),F5,2,1X,F6,4,1X,F7,4,1X,11,1X,F6,3,=
22500      11X,F6,3,1X,F5,1,1X,F5,2,1X,F4,1)
22600      220 FORMAT (T66,1H(,11,1H))
22700      230 FORMAT (1H1/T36,14A4///T25,14HGEOMETRY DATA,T54,7HFACTURS///T21, =
22800      18HSOW = ,F5,2,8H DEGREES,T50,1UHFTOL = ,F6,3/T21,7HIT = , =
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22900 2F6.2,8H DEGREES,T50,10HFTOTD ■ ,F6.3/T21,8HSMN ■ ,F6.3,5H MACH=  
23000 3,T50,10HFCM ■ ,F6.3/T21,8HXCD ■ ,F5.3,9H UF CHORD,////T32, ■  
23100 422HCORRECTED COEFFICIENTS///T17,5HALPHA,129,5HCLTOT,T41,5HCDTU! ■  
23200 5T54,2HCM,T63,5HALFTR/1  
23300 240 FOMAT (17X,F4.1,2(4X,F8.4),5X,F7.3,6X,F4.1)  
23400 END

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100      SUBROUTINE AT62 (ZFT,ANS)
200      DIMENSION HT(8),TH(8),THD(8),PH(8),ANS(4),PZ(13)
300      DIMENSION TZ(13),TZD(13),TZD(13),HZ(13),A(13),B(13)
400      DIMENSION WA(13),WB(13),WC(13),DI(13),DZ(13),O3(13)
500      DATA HT/0.,11.,20.,32.,47.,52.,61.,79./
600      DATA TH/288.15,216.65,216.65,228.65,270.65,270.65,252.65,180.65/
700      DATA THD/-6.5,0.,1.,2.8,0.,-2.,-4.,0./
800      DATA PH/101325.,22632.0638,5474.88855,868.018647,110.906298,
900      159.0009367,18.2100724,1.03771164/
1000     DATA TZ/90.,100.,110.,120.,150.,160.,170.,190.,230.,300.,400.,500.,
1100     1,600./
1200     DATA TZ/180.65,210.65,260.65,360.65,460.65,1110.65,1210.65,1350.65=
1300     1,1550.65,1830.65,2160.65,2420.65,2590.65/
1400     DATA TZD/3.,5.,10.,20.,15.,10.,7.,5.,4.,3.3,2.6,1.7,1.1/
1500     DATA HZ/88.7422565,98.4509829,108.128578,117.776280,146.541401,
1600     1156.070901,165.571187,184.484657,221.966870,286.476269,376.312415,=
1700     2463.526097,548.230014/
1800     DATA A/.99999916.,.99999897.,.99999877.,.99999832.,.99999776.,.99999746=
1900     1.,.99999698.,.99999592.,.99999355.,.99998378.,.99998131.,.99997196,
2000     2.99996075/
2100     DATA R/.00015734766.,.00015734953.,.00015735140.,.00015735513,
2200     1.00015735887.,.00015736074.,.00015736355.,.00015736915.,.00015737943,
2300     2.000157939532.,.00015741401.,.00015743271.,.00015745140/
2400     DATA WA/21.998808,15.798995,31.044527,40.387675,29.538575,
2500     132.268971,27.789444,32.166670,30.241635,34.561172,36.099504,
2600     238.195672,8.258073/
2700     DATA WB/.15479092.,.27878720.,.0015957013.,.15412343.,.0094687678,
2800     1.,.043598715.,.0091016009.,.036974463.,.020235026.,.049031942,
2900     2.,.056723605.,.065108273.,.0013503901/
3000     DATA WC/-.8599496E-3.,.1479931E-2.,.2199696E-3.,.4288601E-3,
3100     1.,.5332209E-4.,.5333399E-4.,.1016669E-3.,.1958587E-4.,.1680421E-4,
3200     2.,.3119065E-4.,.4080523E-4.,.491899E-4.,.6192324E-5/
3300     DATA DI/.0017834765.,.0010656122.,.00053055610.,.00026454351,
3400     1.00035360997.,.00053348782.,.00076836496.,.0010889831.,.0013783559,
3500     2.0016975137.,.0022189663.,.0037023997.,.0067578185/
3600     DATA DZ/-11.281753,-6.7098914,-3.3278396,-1.6546388,-2.2,71667,
3700     1-3.3643151,-4.8850055,-7.0083025,-8.9810162,-11.235530,-15.122423,=
3800     2.520411,-59.311259/

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3900 DATA D3/.016920782,.024329051,.039545102,.057409044,.016199137, -
4000 1.0093014845,.0059339235,.0037645169,.0026065966,.0018120459, -
4100 2.0011923023,.00064736059,.00033627561/
4200 DATA PZ/.16438012,.030079034,.0073545270,.0025216927,.00050617890,-
4300 1.00036943532,.00027926462,.00016852498,.6960537E-4,.1883878E-4, -
4400 2.4030432E-5,.1095696E-5,.3450261E-6/
4500 ALT=ZFT*0.3048
4600 Z=ALT/1000.
4700 IF (Z.LT.=5.) Z=-5.
4800 IF (Z.GT.700.) Z=700.
4900 IF (Z.GT.90.) GO TO 80
5000 DEN=1.0+0.00015733831*Z
5100 H=Z/DEN
5200 GMW=28.9644
5300 IF (H.GE.47.) GO TO 30
5400 IF (H.GE.20.) GO TO 20
5500 J=1
5600 IF (H.GT.11.) J=2
5700 GO TO 50
5800 20 J=3
5900 IF (H.GE.32.) J=4
6000 GO TO 50
6100 30 IF (H.GE.61.) GO TO 40
6200 J=5
6300 IF (H.GE.52.) J=6
6400 GO TO 50
6500 40 J=7
6600 IF (H.GE.79.) J=8
6700 50 TM=TH(J)+THD(J)+(H-HT(J))
6800 IF (THD(J).EQ.0.) GO TO 60
6900 PLUG=-34.163195*ALOG(TM/TH(J))/THD(J)
7000 GO TO 70
7100 60 PLUG=-34.163195*(H-HT(J))/TM
7200 70 PB=PH(J)
7300 GO TO 140
7400 80 IF (Z.LT.170.) GO TO 110
7500 IF (Z.LT.300.) GO TO 100
7600 IF (Z.LT.500.) GO TO 90
```

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```
7700      J=13
7800      IF (Z.LT.600.) J=12
7900      GO TO 130
8000      90 J=11
8100      IF (Z.LT.400.) J=10
8200      GO TO 130
8300      100 J=9
8400      IF (Z.LT.230.) J=8
8500      IF (Z.LT.190.) J=7
8600      GO TO 130
8700      110 IF (Z.LT.120.) GO TO 120
8800      J=6
8900      IF (Z.LT.160.) J=5
9000      IF (Z.LT.150.) J=4
9100      GO TO 130
9200      120 J=3
9300      IF (Z.LT.110.) J=2
9400      IF (Z.LT.100.) J=1
9500      130 GMW=WA(J)+Z*(WB(J)+Z*WC(J))
9600      TM=TZ(J)+TZD(J)*(Z-ZT(J))
9700      DEN=A(J)+Z*B(J)
9800      H=Z/DEN
9900      DELTAH=H-HZ(J)
10000     PLOG=D1(J)*DELTAH+D2(J)*ALOG(1.0+D3(J)*DELTAH)
10100     PR=PZ(J)
10200     140 P=PR*EXP(PLOG)
10300     ANS(1)=6.759448E-6*P/TM
10400     ANS(2)=P*0.020885434
10500     ANS(3)=GMW*TM/28.9644
10600     ANS(4)=894.50046
10700     ARG1=4325.73899*TM
10800     IF (ZFT.LT.300000.) ANS(4)=SQRT(ARG1)
10900     RETURN
11000     END
```

10

```

100      SUBROUTINE GEOM1
200      C
300      C      NEW VERSION CREATED ON 5/19/76
400      C
500      COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CROSW,TCRW,TCTW,TCWP,=
600      1TCW,SOW,SWPW,SWPWE,XQMAC,CSWOC,SEXT,XEXT,FLEX,TDIF,FINI,DELX
700      COMMON /NOSE/ BDMAX,ASECT,APLAN,XLN,CLN(20,20),CDN(20,20),
800      1CMNSF(20,20),XLB,CLOB(20),CMOB(20),CDOB(20)
900      COMMON /TAIL/ SHOR,SHOSW,XQHUR,YHOR,CLM(20,20),CDM(20,20),SOW,ARH,=
1000     1ALFTR(20,20)
1100     COMMON /FLOW/ SMN(20),NSMN,RNLOC(20),I6A,I6H,I6C,Z(20,20),AMC
1200     COMMON /TRIM/ CL1,CLY,I,K,LL,ALPHA,DCDTR(20,20),DALTR(20,20),
1300     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XCG,CLALFA,=
1400     2IT,DEXP,LE,LT,ED,ITKIM(20),RETAM,SA,CA,CEXN,IXCD,IFLEX,ICDU
1500     REAL LE,LT
1600     INTEGER Z
1700     PI=3.1415927
1800     IF (SWING.EQ.0.) GO TO 10
1900     IF (SPANW.LE.0.) SPANW=SQRT(SWING*ARW)
2000     IF (CROOT.LE.0.) CROOT=2.*SWING/((1.+TRW)*SPANW)
2100     IF (CTIP.LE.0.) CTIP=TRW*CROOT
2200     CB1=CROOT+CTIP
2300     CR2=CROOT*CTIP/CB1
2400     IF (CBARW.LE.0.) CBARW=2.*(CB1-CB2)/3.
2500     YBAR=SPANW*(1.+TRW-2.*TRW*TRW)/(6.*(1.-TRW*TRW))
2600     IF (XQMAC.LE.0.) XQMAC=CROOT/4.+YBAR*ATAN(SWPW)
2700     IF (XCG.LE.0.) XCG=XQMAC
2800     SHOSW=SHOR/SWING
2900     SWPWE=ATAN(TAN(SWPW)+(1.-TRW)/((1.+TRW)*ARW))
3000     A=(1.+2.*TRW)/(3.*(1.+TRW))
3100     R=TCRW+A*(TRW*TCTW-TCRW)
3200     TCW=1.5*R*(1.+TRW)/(1.+TRW+TRW*TRW)
3300     TCWP=TCW/COS(SWPW)
3400     10 LE=XQHUR-XCG
3500     LT=XQHUR-XQMAC
3600     ED=XQMAC-XCG
3700     IF (SWING.EQ.0.) GO TO 20
3800     FLEX=SEXT/SWING*.7

```

GEOM16 02/25/77 12:03:34

```
3900      FDELX1=(TAN(SWPW)-(1.-TRW)/(ARW*(1.+TRW)))
4000      BNS=BDMAX/SPANW
4100      TRX=TRW/(1.-(1.-TRW)*BUS)
4200      YCB=SPANW*(1.+TRW-2.*TRW*TRW)/(6.*(1.-TRW*TRW))
4300      YCX=(SPANW-BDMAX)*(1.+TRX-2.*TRX*TRX)/(6.*(1.-TRX*TRX))+BDMAX/2.
4400      DELYX=YCX-YCB
4500      DELX=DELYX*FDELX1
4600      IF (ABS(BDMAX).LT..001) GO TO 30
4700 20  ASECT=(PI*BDMAX**2)/4.
4800      APLAN=.7*XLN*BDMAX
4900      RETURN
5000 30  ASECT=0.
5100      APLAN=0.
5200      RETURN
5300      END
```

AXES .02/25/77 12:03:57

```
100      SUBROUTINE AXE
200      C
300      C      NEW VERSION CREATED ON 6/15/76
400      C
500      COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CROSW,TCRW,TCTW,TCWP,=
600      ITCW,SON,SWPW,SWPWLE,XOMAC,CSWUC,SEXT,XEXT,FLEX,TDIF,FINI,DELX
700      COMMON /FWING/ CLW1(20,20),CUW1(20,20),CLWU1(20,20),CLWL1(20,20),=
800      1CDSEP(20,20),CLOS,DL1(20,20),CLALF(20,20),CMU(20),CDU(20),CLM,CLMU=
900      2,DLMU,CPLIM,CP2,CPMXS
1000     COMMON /FTOTAL/ CI(20,20),CDL(20,20)
1100     COMMON /NOSE/ BDMAX,ASELT,APLAN,XLN,CLN(20,20),CDN(20,20),=
1200     1CMNOSE(20,20),XLB,CLOB(20),CMUB(20),CDOB(20)
1300     COMMON /TAIL/ SHOR,SHOSW,XQHUR,YHOR,CLH(20,20),CDH(20,20),SUN,ARM,=
1400     1ALFTR(20,20)
1500     COMMON /FLOW/ SMN(20),NSMN,RNLUC(20),I6A,I6B,I6C,Z(20,20),AMC
1600     COMMON /AFOIL/ ALELJ,XCD,SHK,RUC
1700     COMMON /TRIM/ CLI,CLT,I,K,LL,ALPHA,DCDTR(20,20),DALTR(20,20),=
1800     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XCG,CLALFA,=
1900     2IT,DEXP,LE,LT,ED,ITRIM(20),BETAM,SA,CA,CEXN,IXCD,IFLEX,ICDU
2000     INTEGER Z,ALELJ
2100     REAL MACH,LE,LT
2200     DATA PI,RAD,EPS,GAM2/3,14159,57,29578,001,1.4285717/
2300     FEXP=0.78
2400     AMC=40.0
2500     AMCR=AMC/RAD
2600     PIARW=PI*ARW
2700     CLALFA=2.*PI/RAD
2800     DU 730 I=1,NSMN
2900     DO 720 I6=I6A,I6B,I6C
3000     ALPHA=FLOAT(I6)/100.
3100     ALPHAS=ALPHA
3200     K=(I6-I6A)/I6C+1
3300     MACH=SMN(I)
3400     SMNSQ=MACH**2
3500     SMNSR=1./SMNSQ
3600     BETAM=SQRT(AHS(1.-SMNSQ))
3700     CDSEP(I,K)=U.
3800     CLU=CLOS
```

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```
3900      CLW=0.
4000      CDLW=0.
4100      CLWU=0.
4200      CLWL=0.
4210      ARD=ALPHA/RAD
4220      SA=SIN(ARD)
4230      CA=COS(ARD)
4240      TA=TAN(ARD)
4300      Z(I,K)=1
4400      IF (SWING.EQ.0.) CLALFA = 0.
4500      IF (SWING.EQ.0.) GO TO 680
4600      CDCAM=CLU/20.
4700      IF (ICDO.EQ.1) CDCAM=2.*CLU*(SQRT(CDO(I)/(PI*ARW)))
4800      IF (ALPHA.G!.EPS.OR.CLO.GT.0.) GO TO 20
4900      SA=0.001
5000      CA=1.0
5100      TA=0.001
5200      GO TO 680
5700      20 CISO=SA**4.+CA*CA-2.*SA*SA-3.*SA*SA*CA*CA/2.
5800      FISU=1.-3A*3A/2.
5900      TAM=(1.528-0.695*SMNSQ)
6000      IF (TAM.LE.0.0) TAM=0.0
6100      AMT=(SQRT(!AM))/MACH
6200      ALER=0.
6300      ALERM1=0.
6400      IF (ARW.L1.2.0) GO TO 90
6500      C
6600      C      CALCULATE ANGLE OF ATTACK FOR LEADING EDGE LIMIT
6700      C
6800      C      ALELJ = 1  SHARP AND NEAR SHARP AIRFOILS
6900      C      ALELJ = 2  230-XX AND 0VXX AIRFOILS
7000      C      ALELJ = 3  6 SERIES AIRFOILS
7100      C      ALELJ = 4  FLAT AIRFOILS WITH ROUNDED LEADING EDGE
7200      C      ALELJ = 5  LEADING EDGE RADIUS TO CHORD RATIO SPECIFIED
7300      C
7400      GO TO (30,40,50,60,70), ALELJ
7500      30 GO TO 90
7600      40 DTC=1.+1.35/TCWP
```

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```
7700 ALER=AMT/DTC
7800 ALERM1=0.913/DTC
7900 GO TO 80
8000 50 DTC=1.+1.68/TCWP
8100 ALER=AMT/DTC
8200 ALERM1=0.913/DTC
8300 GO TO 80
8400 60 DTC=1.+2./SQRT(TCWP)
8500 ALER=AMT/DTC
8600 ALERM1=0.913/DTC
8700 GO TO 80
8800 70 FROC=SQRT(2./ROC)
8900 ALER=AMT/(1.+FROC)
9000 80 IF (ALER.LT.0.) ALER=0.
9100 IF (ALERM1.LT.0.) ALERM1=0.
9200 C
9300 C DEFINITION OF FLOW CONDITIONS
9400 C
9500 C Z = 1 INCOMPRESSIBLE
9600 C Z = 2 COMPRESSIBLE
9700 C Z = 3 LEADING EDGE MACH LIMITED
9800 C Z = 4 SURFACE MACH LIMITED
9900 C Z = 5 SUPERSONIC SHARP LEADING EDGE, ATTACHED SHOCK
10000 C Z = 6 SUPERSONIC LEADING EDGE, DETACHED SHOCK
10100 C
10200 90 CONTINUE
10300 SQAR=ARD/AMCR
10400 IF (SQAR.GT.1.) SQAR=1.
10500 BOS=BDMAX/SPANW
10600 BOSQ=(1.+BOS)**2
10700 FINI=(1.+(1.-SQAR)**2.*BOS)**2.
10800 IF (MACH.LE.1.) GO TO 100
10900 FINI=(1.+(1.-SQAR*(1.4-MACH)/0.4)**2.*BOS)**2
11000 IF (MACH.GT.1.4) FINI=(1.+BOS)**2
11100 100 SINT=(2.*MACH-1.)*SMNSR
11200 IF (IFLEX.EQ.1) SINT=0.5*(1.+SMNSR*SMNSR)
11300 BOSAR2=BDMAX/SQRT(2.*SWING)
11400 DNBL=MACH**(2./3.)
```

```

11500      IF (MACH.GT.1.77) DNBL=BETAM
11600      CSWQC=CUS(SWPW)
11700      SSWQC=SIN(SWPW)
11800      CSHLE=COS(SWPWLE)
11900      SSWLE=SIN(SWPWLE)
12000      TSWLE=TAN(SWPWLE)
12100      TSWTE=TSWLE-4.*(1.-TRW)/(ARW*(1.+TRW))
12200      ARWC=ARW/(ARW+2.)
12300      ARM2=MACH/(MACH+1.)
12400      ESQW=ARSIN(SSWQC*CA)
12500      FSLEW=ARSIN(SSWLE*CA)
12600      SFSQW=SIN(ESQW)
12700      CESQW=COS(ESQW)
12800      CESLEW=COS(ESLEW)
12900      SOCESL=CESLEW*CESLEW
13000      AM1=(1.+2*SMNSQ)**3.5
13100      CONST=GAM2/SMNSQ
13200      CPSTAG=1.0
13300      IF (MACH.LT.1.0) GO TO 110
13400      STAG1=(1.2*SMNSQ)**3.5
13500      STAG2=(2.4/(2.8*SMNSQ-0.4))**2.5
13600      CPSTAG=CONST*(STAG1*STAG2-1.0)
13700      110 IF (MACH.GT..98) GO TO 120
13800      FCEXN=0.5
13900      XC=XCD
14000      GO TO 130
14100      120 CFXN=((MACH-.98)/(1./CSWLE-.98))**2.
14200      FCEXN=(1.-CEXN)/2.
14300      XC=XCD+(1.-XCD)*CFXN
14400      IF (XC.GT.1.) XC=1.
14500      130 IF (IXCD.EQ.1) GO TO 140
14600      CONC=ARW*(1.+TRW)
14700      SXC=ATAN(TAN(SWPWLE)-4.*XC*(1.-TRW)/CONC)
14800      SUCSXC=COS(SXC)**2
14900      SQSSXC=SIN(SXC)**2
15000      BM1=(1.+2*SMNSQ*SUCSXC)**3.5
15100      AM2=2.2+SMNSQ*SQSSXC
15200      AM3=(1.+2*AM2)**3.5

```

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15300 RR1=1.16667\*AM2\*SQCSXC=.16667  
15400 CPLIMS=(BM1/3.58-1.)\*CONST  
15500 CPDS=CONST\*(RR1\*AM1/AM2=1.)  
15600 CPDST=CPDS\*(1.-XC)/2.  
15700 GO TO 150  
15800 140 TSHK=TAN(SHK)  
15900 SQCSHK=COS(SHK)\*COS(SHK)  
16000 SOSSHK=SIN(SHK)\*SIN(SHK)  
16100 BM1S=(1.+2\*SMNSQ\*SQCSHK)\*\*3.5  
16200 AM2S=2.2\*SMNSQ\*SQSSHK  
16300 AM3S=(1.+2\*AM2S)\*\*3.5  
16400 RR1S=1.16667\*AM2S\*SQCSHK=.16667  
16500 CPLIMS=(BM1S/3.58-1.)\*CONST  
16600 CP2=CONST\*(RR1S\*AM1/AM3S=1.)  
16700 IF (MACH.GT.08) TSHK=TSHK+(TSHTE-TSHK)\*CFXN  
16800 TDIF=TSWLE-TSHK  
16900 150 IF (CPLIMS.GT.0.) CPLIMS=0.  
17000 CPLIM=CPLIMS  
17100 IF (MACH.LE.1.) GO TO 160  
17200 CLIM=SMNSR\*(1.-.32/MACH\*\*2.5)  
17300 IF (CLIM.GT.ABS(CPLIMS)) CPLIM=CLIM  
17400 SULIM=CPLIM\*CA  
17500 160 DEXP=1.5\*SMNSQ\*CESLEW/4.  
17600 IF (MACH.LE.1.) DEXP=1.5\*MACH\*CESLEW/4.  
17700 IF (DEXP.LT.1.) DEXP=1.  
17800 A2=CESQW\*CA  
17900 SXOS=1.-(BOS\*2./(1.+TRW))\*(1.-BOS\*(1.-TRW)/2.)  
18000 ARWX=ARW\*BOSQ/SXOS  
18100 ARMX=ARWX/(ARWX+2./MACH)  
18200 SXOS2=1.-BOSAR2\*2./(1.+TRW)\*(1.-BOSAR2\*(1.-TRW)/2.)  
18300 ARWX2=2.\*BOSQ/SXOS2  
18400 ARM2X=ARWX2/(ARWX2+2./MACH)  
18500 TEST1=MACH\*CESLEW  
18600 IF (TEST1.GT.1.) GO TO 200  
18700 AMXS=(1.+2\*FINT\*SMNSQ\*SQCESL)\*\*3.5  
18800 CPMXS=CONST\*(AMXS-1.)/SQCESL  
18900 IF (ARW.GE.2.0) GO TO 210  
19000 170 TRIG1=2.-9.\*SA\*SA+5.\*SA\*\*4.

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```
19100 TRIG2=4.-10.*SA*SA+5.*SA**4.
19200 CLWU=(SORT(ARWX)+(2.+ARWX)*TA)*SA*CA*CA*FISO*SXUS*FINT/2.
19300 CLWL=CLWU
19400 DLALFA=(SORT(ARWX)*CA*TRIG1+(2.+ARWX)*SA*TRIG2)*FINT*SXUS/2.
19500 IF (MACH.LE.2.) GO TO 180
19600 CLWU=(CLWU*1.73205)/BETAM
19700 DLALFA=DLALFA*(0.5+(.866025/BETAM))
19800 180 IF (ARW.GT.1.75) GO TO 190
19900 CLM=CLWU+CLWL
20000 CLALFA=DLALFA/RAD
20100 CDLW=CLW*TA
20200 GO TO 680
20300 190 CLUP=CLWU
20400 CLLP=CLWL
20500 CLP=CLUP+CLLP
20600 CDP=CLP*TA
20700 DLP=DLALFA
20800 TARX=4.*ARW-7.
20900 GO TO 210
21000 200 IF (MACH.GE.1.0.AND.MACH.LT.1.9) ARDET=.41*(MACH-1.)
21100 IF (MACH.GE.1.9.AND.MACH.LT.4.) ARDET=.8-.382/(MACH-1.)
21200 IF (MACH.GT.4.) ARDET=ARSIN(.71429*SQRT(1.-4./SMNSQ))
21300 IF (ARW.LT.2.0) GO TO 170
21400 210 IF (ALELJ.GT.1) GO TO 510
21500 C
21600 C SHARP LEADING EDGE
21700 C
21800 FUJ1=1.0
21900 IF (MACH.LT.1.0) FUJ1=1./(2.0-MACH)**FEXP
22000 IF (ARW.GE.2.0) GO TO 220
22100 FCLIL2=PI*A2*SA*CA*FISO*(1.+FLEX)/2.
22200 CLIL2=FCLIL2+CLO/2.
22300 CLIU2=CLIL2
22400 CLI2=2.*CLIL2
22500 OLI2=PI*A2*CISO*(1.+FLEX)
22600 CDI2=CLI2*TA**DEXP+CLI2*CLI2/(2.*PI)+CDCAM
22700 DLI2=OLI2*(1.+CPMXS)/2.
22800 CLIU=CLUP+(CLIU2-CLUP)*TARX
```

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```
22900      DLI=DLP+(DLI2-DLP)*TARX
23000      CDI=CDP+(CDI2-CDP)*TARX
23100      GO TO 230
23200      220 CLIL=PI*ARWC*A2*SA*CA*FISQ
23300      CLIU=CLIL
23400      CLI=(CLIU+CLIL)*(1.+FLEX)
23500      DLIL=PI*A2*CISO*ARWC
23600      DLIU=DLIL
23700      230 IF (MACH.LE.1) GO TO 280
23800      IF (TEST1.GT.1.) GO TO 260
23900      IF (IXCD.EQ.0.) GO TO 240
24000      CPDIF=CP2=2.*CPLIM*(1.+FLEX)
24100      XCSH=XC/(1.+TRW)
24200      CLMU=CA*(CPDIF*(XCSH=TDIF*ARW/B.)-CP2/2.)
24300      DLMU=-SA*(CPDIF*(XCSH=TDIF*ARW/B.)-CP2/2.)
24400      GO TO 250
24500      240 CONMS=CPLIMS*XC+CPDST
24600      IF (MACH.GT.1.) CONMS=CPLIM*XC+CPDST
24700      CLMU=-CONMS*CA
24800      DLMU=CONMS*SA
24900      IF (ARW.GE.2.0) GO TO 250
25000      CLCL2=CPMXS*FLIL2+CLN*FLFXN
25100      DLCL2=CPMXS*DLI2/2.
25200      CLCL=CLLP+(CLCL2-CLLP)*TARX
25300      Z(I,K)=4
25400      CLUM2=CLIU2/(1.+FLEX)+CLO*FCEXN
25500      IF (CLMU.GT.CLUM2) Z(I,K)=3
25600      GO TO 270
25700      250 CLCI=CPMXS*CLIL
25800      DLCL=CPMXS*DLIL
25900      Z(I,K)=4
26000      CLUCAM=CLIU+CLU/2.
26100      IF (CLMU.GT.CLUCAM) Z(I,K)=3
26200      GO TO 270
26300      260 Z(I,K)=5
26400      IF (ARD.GE.ARDET) Z(I,K)=6
26500      270 IF (MACH.GE.2.) FLEX=(SQRT(1.-1./MACH))*SEXT/SWING
26600      INDEX=Z(I,K)
```

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```
26700      GO TO (280,300,300,340,360,460), INDEX
26800      C
26900      C      INCOMPRESSIBLE SHARP LEADING EDGE (Z=1)
27000      C
27100      280 IF (ARW.GE.2.0) GO TO 290
27200      CLIL=CLIU
27300      CLI=2.*CLIU
27400      CLW=CLI
27500      CDLW=CDI
27600      CLALFA=DLI/RAD
27700      CLWU=CLIU+CLU/2.
27800      CLWL=CLWU
27900      GO TO 680
28000      290 CLI=(CLIU+CLIL)*(1.+FLEX)
28100      DLI=(DLIU+DLIL)*(1.+FLEX)
28200      CDI=CLI*TARX*DEXP+CLI*CLI/PIARW
28300      CLW=CLI+CLU
28400      CDLW=CDI+CDCAM
28500      CLALFA=DLI/RAD
28600      CLWU=CLIU*(1.+FLEX)+CLU/2.
28700      CLWL=CLIL*(1.+FLEX)+CLU/2.
28800      GO TO 680
28900      C
29000      C      COMPRESSIBLE AND SHARP LEADING EDGE MACH LIMITED (Z=2 & Z=3)
29100      C
29200      300 IF (ARW.GE.2.0) GO TO 330
29300      IF (MACH.GT.1.0) GO TO 310
29400      CLCU2=FCLIL2*FUJ1+CLU/2.
29500      CLC2=CLCL2+CLCU2
29600      DLC2=DLI2*(FUJ1+CPMXS)/2.
29700      GO TO 320
29800      310 CLCU2=FCLIL2
29900      CLC2=FCLIL2*(1.+CPMXS)
30000      DLC2=DLI2*(1.+CPMXS)/2.
30100      320 DLC=DLP+(DLC2-DLP)*TARX
30200      CLALFA=DLC/RAD
30300      CLC=CLP+(CLC2-CLP)*TARX
30400      CLWU=CLUP+(CLCU2-CLUP)*TARX
```

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ORIGINAL PAGE IS  
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30500 CLWL=CLCL  
30600 CDC2=CLC2\*TA\*\*DEXP+CLC2\*CLC2/(2.\*PI)+CDCAM  
30700 CDC=CDP+(CDC2=CDP)\*TARX  
30800 CLW=CLC  
30900 CDLW=CDC  
31000 GO TO 680  
31100 330 CLCU=CLIU\*FUJ1  
31200 CLC=(CLCU+CLCL)\*(1.+FLEX)  
31300 DLC=(DLIU\*FUJ1+DLCL)\*(1.+FLEX)  
31400 CDC=CLC\*TA\*\*DEXP+CLC\*CLC/PIARW  
31500 CLW=CLC+CLO  
31600 CDLW=CDC+CDCAM  
31700 CLALFA=DLC/RAD  
31800 CLWU=CLCU\*(1.+FLEX)+CLO/2.  
31900 CLWL=CLCL\*(1.+FLEX)+CLO/2.  
32000 GO TO 680  
32100 C  
32200 C SURFACE MACH LIMITED (Z=4)  
32300 C  
32400 340 IF (ARW.GE.2.0) GO TO 350  
32500 CLM2=CLMU\*(1.+FLEX)+CLCL2  
32600 DLM2=DLMU\*(1.+FLEX)+DLCL2  
32700 CLM=CLP+(CLM2-CLP)\*TARX  
32800 DLM=DLP+(DLM2-DLP)\*TARX  
32900 CDM2=CLM2\*CLM2/(2.\*PI)+CLM2\*TA\*\*UEXP  
33000 CDM=CDP+(CDM2=CDP)\*TARX  
33100 CLW=CLM  
33200 CLWU=CLMU\*(1.+FLEX\*TARX)  
33300 CLWL=CLW=CLWU  
33400 CDLW=CDM  
33500 CLALFA=DLM/RAD  
33600 GO TO 680  
33700 350 CLM=(CLMU+CLCL)\*(1.+FLEX)  
33800 DLM=(DLMU+DLCL)\*(1.+FLEX)  
33900 CDM=CIM\*CLM/PIARW+CIM\*TA\*\*DEXP  
34000 CLW=CIM+CLI\*FCEN  
34100 CDLW=CDM+CDCAM\*FCEN  
34200 CLWU=CLMU\*(1.+FLEX)

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34300      CLWL=CLCL*(1.+FLEX)+CL0*FCEXN
34400      CLALFA=DLM/RAD
34500      GO TO 680
34600      C
34700      C      SUPERSONIC SHARP LEADING EDGE, ATTACHED SHOCK (Z=5)
34800      C
34900      360 FLAX=(1.+HUS)**2
35000      RTHA=0.
35100      RTLA=0.
35200      FLAX2=(1.+B0SAR2)**2
35300      FCLAM=0.65/MACH+FLAX*(1.-0.65/MACH)
35400      FCLAMU=0.65/(MACH+FCLAM)
35500      FCLAML=FLAX*(1.-0.65/MACH)/FCLAM
35600      CL0=0.
35700      IF (ARM.GE.2.0) GO TO 390
35800      FCLA2=2.*PI*SA*CA*CA*ARM2X*SXUS2*FISU*(1.+FLEX)
35900      FCLAM2=0.65/MACH+FLAX2*(1.-0.65/MACH)
36000      CLA2=FCLA2*FCLAM2
36100      IF (MACH.GT.1.414) CLA2=CLA2/BETAM
36200      IF (MACH.LE.3.) GO TO 380
36300      IF (ALPHA.LE.16.) GO TO 370
36400      HYPH=1.-4.*SMNSR-1.96*SA*SA
36500      IF (HYPH.LE.0.) HYPH=0.01
36600      RTHA=SQRT(HYPH)
36700      CLA2=5.*(1.+1.4*SA*SA-CA*RTHA)*CA*ARM2X/6.
36800      GO TO 380
36900      370 HYP1=1.-4.*SMNSR*ALPHA/16.=1.96*SA*SA
37000      RTLA=SQRT(HYPL)
37100      CLA2=5.*(1.+1.4*SA*SA-CA*RTLA)*CA*ARM2X/6.
37200      380 IF (ARD.GT.0.008726) GO TO 420
37300      DL2=4.*SXOS2*FCLAM2*(1.+FLEX)/BETAM
37400      GO TO 430
37500      390 FCLA=2.*PI*SA*CA*CA*ARMX*(1.+FLEX)*SXOS*FISU
37600      CLA=FCLA*FCLAM
37700      IF (MACH.GT.1.414) CLA=CLA/BETAM
37800      IF (MACH.LE.3.) GO TO 410
37900      IF (ALPHA.LE.16.) GO TO 400
38000      HYPH=1.-4.*SMNSR-1.96*SA*SA

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38100      IF (HYPH.LE.0.) HYPH=0.01
38200      RTHA=SQRT(HYPH)
38300      CLA=5.*(1.+1.4*SA*SA-CA*RTHA)+CA*ARMX*SXUS/6.
38400      GO TO 410
38500 400  HYPL=1.-4.*SMNSR*ALPHA/16.-1.96*SA*SA
38600      RTLA=SQRT(HYPL)
38700      CLA=5.*(1.+1.4*SA*SA-CA*RTLA)+CA*ARMX*SXUS/6.
38800 410  IF (ARD.GT..008726) GO TO 440
38900      DLA=4.*(1.+FLEX)*SXUS*FCLAM/HETAM
39000      GO TO 450
39100 420  DLA2=2.*PI*CISQ*CA*ARM2X*SXUS2*FCLAM2*(1.+FLEX)
39200      IF (MACH.GT.1.414) DLA2=DLA2/BETAM
39300      IF (MACH.LE.3.) GO TO 430
39400      IF (RTHA.EQ.0.) RTHA=RTLA
39500      IF (RTLA.EQ.0.) RTLA=RTHA
39600      DLA2=(ARM2X*5.*(2.8*SA*CA*CA+SA*CA*RTLA+1.96*SA*CA*CA*CA/RTLA)/
39700      16.-CLA2*TA)*SXUS2
39800 430  DLA=DLP/DNBL+(DLA2=DLP/DNBL)*TARX
39900      CLA=CLP/DNBL+(CLA2=CLP/DNBL)*TARX
40000      GO TO 450
40100 440  DLA=2.*PI*CISQ*CA*ARMX*(1.+FLEX)*SXUS*FCLAM
40200      IF (MACH.GT.1.414) DLA=DLA/BETAM
40300      IF (MACH.LE.3.) GO TO 450
40400      IF (RTHA.EQ.0.) RTHA=RTLA
40500      IF (RTLA.EQ.0.) RTLA=RTHA
40600      DLA=(ARMX*5.*(2.8*SA*CA*CA+SA*CA*RTHA+1.96*SA*CA*CA*CA/RTHA)/
40700      16.-CLA*TA)*SXUS
40800 450  CDA=CLA*TA
40900      CLW=CLA
41000      CDLW=CDA
41100      CLALFA=DLA/RAD
41200      CLWI=CLA*FCLAMU
41300      CLWL=CLA*FCLAMI
41400      GO TO 680
41500      C
41600      C      SUPERSONIC LEADING EDGE DETACHED SHOCK (Z=6)
41700      C
41800 460  FLAX=(1.+B(S))*2.
```

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41900 FLAX2=(1.+BOSAR2)**2.
42000 FMOMU=1.0
42100 IF (MACH.GT.1.2) FMOMU=1./(MACH=0.2)
42200 FMOML=1.6-0.6*MACH
42300 IF (MACH.GT.1.5) FMOML=0.7
42400 IF (MACH.GT.2.2) FMOML=0.1+1./(MACH=.55)
42500 IF (IFLEX.EQ.1.AND.MACH.LT.4.) FMOML=FMOML*(.6+(MACH=1.)/10.)
42600 IF (SQW.LE.50.) GO TO 470
42700 IF (ALPHA.LE.24.) GO TO 470
42800 FWAZ6=1-(SQW=50.)*(1.-0.4*CO TAN(ARD))/20.
42900 IF (FWAZ6.LT.0.5) FWAZ6=0.5
43000 FMOML=FMOML*FWAZ6
43100 470 TRIG3=2.*CA*CA-SA*SA
43200 CLIMP=CPSTAG*SA*SA*CA
43300 DLIMP=CPSTAG*SA*TRIG3
43400 IF (ARM.GE.2.0) GO TO 490
43500 CLDU22=FMOMU*PI*SA*CA*CA*FISU*ARM2/DNBL
43600 CLDU2=CLDU22*SXOS2*(1.+FLEX)
43700 CLDL2=(CPSTAG*FMOML*PI*SA*CA*CA*FISU*ARM2*SXUS2*FLAX2/UNBL+CLIMP)*
43800 1*(1.+FLEX)
43900 DLD2=(PI*CA*CISS*ARM2*SXUS2*(FMOMU)+FMOML*FLAX2*CPSTAG)/DNBL+DLIMP)*
44000 1*(1.+FLEX)
44100 IF (SULIM.GT.CLDU2) GO TO 480
44200 CLDU2=CA*CLIM*SXOS2*(1.+FLEX)
44300 DLD2=(CPSTAG*PI*FMOML*CA*CISS*ARM2*SXUS2*FLAX2/DNBL+SULIM*TA
44400 1*SXUS2+DLIMP)*(1.+FLEX)
44500 480 CLDU=CLUP/DNBL+(CLDU2-CLUP/DNBL)*TARX
44600 CLDL=CLLP/DNBL+(CLDL2-CLLP/DNBL)*TARX
44700 DLD=DLP+(DLD2-DLP)*TARX
44800 GO TO 500
44900 490 FLZ6=PI*SA*CA*CA*FISU*ARMX/UNBL
45000 CLDU2=FMOMU*FLZ6
45100 CLDU=CLDU2*SXUS*(1.+FLEX)
45200 CLDL=CPSTAG*FMOML*FLZ6*SXOS*FLAX*(1.+FLEX)+CLIMP*(1.+FLEX)
45300 DLD1=ARMX*SXUS*(1.+FLEX)/DNBL
45400 DLD=DLD1*(FMOMU+FMOML*FLAX*CPSTAG)*PI*CA*CISS+DLIMP*(1.+FLEX)
45500 IF (SULIM.GT.CLDU2) GO TO 500
45600 CLDU=CA*CLIM*(1.+FLEX)*SXOS

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45700      FOLD=SULIM*TA*(1.+FLEX)*SXUS
45800      DLD=ARMX*SX*(IS*FLA*(1.+FLEX)*FMUML*CPSTAG*PI*CA*CISU/DNBL-FULD)+
45900      1DLIMP*(1.+FLEX)
46000      500 CLD=CLDU+CLDL
46100      CDD=CLD*TA
46200      CLM=CLD
46300      CDLW=CDD
46400      CLWI=CLDU
46500      CLWL=CLDL
46600      CLALFA=DLU/RAD
46700      GO TO 680
46800      C
46900      C      BLUNT LEADING EDGE
47000      C
47100      510 SQUAD=SQAR*SQAR
47200      SOALE=(ALER/AMCR)**2
47300      SOALI=(ALERM1/AMCR)**2
47400      CALFR=COS(ALER)
47500      SALER=SIN(ALER)
47600      SALER1=SIN(ALERM1)
47700      SOCFOW=CESOW*CESOW
47800      SOCOW=CSWOC*CSWOC
47900      ESQFR=ARSIN(SSWOC*CALFR)
48000      CESOR=COS(ESQER)
48100      SESOR=SIN(ESQER)
48200      SOCEOR=CESOR*CESOR
48300      F1=(ARD+ALER)/2.
48400      CF1=COS(F1)
48500      SF1=SIN(F1)
48600      CISDF1=SF1**4.+CF1*CF1-2.+SF1*SF1-3.+SF1*SF1*CF1*CF1/2.
48700      AMCR2=2./(AMCR*AMCR)
48800      TARD=ARD*AMCR2
48900      IF(TARD.GT.0.17) TARD=0.17
49000      CLIL=PI*ARWC*SA*CFOW
49100      CLI=CLIL*2.
49200      DLIL=PI*A2*ARWC
49300      IF (MACH.LE.1) GO TO 590
49400      IF (TEST1.GT.1.) GO TO 560
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49500      CTWQC=CSWQC/SSWQC
49600      IF (CTWQC.GT.4.) CTWQC=4.
49700      CTESQW=CESQW/SESQW
49800      IF (CTESQW.GT.4.) CTESQW=4.
49900      CTESQR=CESQR/SESQR
50000      IF (CTESQR.GT.4.) CTESQR=4.
50100      CLCUM1=PI*SA*CTESQW*ARWC*FINT*(1.-(1.-SESQW)*SQARD)
50200      CLUEM1=PI*ARWC*FINT*SALER1*CTESQR*(1.-(1.-SESQR)*SQAL1)
50300      AT2=(1.-(1.-SESQW)*SQARD)*CA*(1.-SESQW*TARD)*SA
50400      DLCUM1=AT2*PI*ARWC*FINT*CTESQW
50500      BETALE=SQRT(ABS(1.-SMNSQ*SUCEQR))
50600      IF (BETALE.LE..25) BETALE=.25
50700      BETAMA=SQRT(ABS(1.-SMNSQ*SUCEQW))
50800      IF (BETAMA.LE..25) BETAMA=.25
50900      D4=1.-BETAMA
51000      D5=CESQW/BETAMA
51100      D2=(1.-D4*SQARD)*SA*D5
51200      G1=(1.-D4*SQARD)*CA-D4*TARD*SA
51300      CLCU=PI*ARWC*D2*FINT
51400      IF (MACH.GT.1.) CLCU=CLCUM1*SINT
51500      E3=1.-BETALE
51600      E1=(1.-E3*SOALE)*SALER
51700      E2=E1*CFSQR/BETALE
51800      CLUES=PI*ARWC*FINT*E2
51900      IF (MACH.GT.1.) CLUES=CLUEM1*SINT
52000      CLUBS=PI*(ARD=ALER)*CF1*ARWC*CESQW*CISOF1
52100      CLEU=CLUES+CLUBS
52200      CLEUJ1=PI*ARWC*A2*SA*CA*FISO
52300      IF (CLEU.LT.CLEUJ1) CLEU=CLEUJ1
52400      IF (MACH.LE.1.3) GO TO 520
52500      FUZ3=1.-1.1*MACH*CSWLF*CSWLF*SQRT(MACH-1.3)
52600      CLEI=CLEU*FUZ3
52700      520) CLCL=CPMXS*CLIL
52800      DLCL=PI*A2*CPMXS*ARWC
52900      CLLES=CPMXS*PI*ARWC*CESQR*SALER
53000      DLEL=0.5*CPMXS*PI*A2*CISU*ARWC
53100      CLEL=CLLES+DLEL*(ARD=ALER)
53200      CLJ1EL=CPMXS*PI*ARWC*A2*SA*CA*FISO

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53300 DLJIEL=CPMXS*PI*A2*ARWC*CTSQ
53400 IF (CLJIEL.GT.CLEL) CLEL=CLJIEL
53500 IF (CLJIEL.GT.CLEL) DLEL=2.*DLEL
53600 CONMS=CPLIMS*XC+CPDST
53700 TCWW=TCWP*CSWOC
53800 FTC=1.-16.*TCWW**2
53900 IF (FTC.LT.0.) FTC=0.
54000 IF (MACH.GE.1.) CONMS=CPLIM*XC+CPDST
54100 IF (IXCN.EQ.0) GO TO 530
54200 CPDIF=CP2-2.*CPLIM*(1.+FLEX)
54300 XCSH=XC/(1.+TRW)
54400 CLMU=CA*(CPDIF*(XCSH-TDIF*ARW/8.)-CP2/2.)
54500 DLMU=SA*(CPDIF*(XCSH-TDIF*ARW/8.)-CP2/2.)
54600 GO TO 540
54700 530 CLMU=CONMS*CA*FTC
54800 DLMU=CONMS*SA
54900 540 IF (ARD.GE.ALER) GO TO 550
55000 Z(I,K)=2
55100 CLUCAM=CLCU+CLD/2.
55200 IF (CLMU.LT.CLUCAM) Z(I,K)=4
55300 GO TO 570
55400 550 Z(I,K)=4
55500 CLUEAM=CLUE+CLD/2.
55600 IF (CLUEAM.LT.CLMU) Z(I,K)=3
55700 GO TO 570
55800 560 Z(I,K)=6
55900 570 IF (MACH.GE.2.) FLEX=(SQRT(1.-1./MACH))+SEXT/SWING
56000 IF (IFLEX.EQ.0) GO TO 580
56100 IF (Z(I,K).LE.4) FLEX=(SQAR)*.7*SEXT/SWING
56200 IF (MACH.GE.6.) GO TO 580
56300 IF (Z(I,K).GT.4) FLEX=(SEXT/SWING)*(SQRT(1.-1./MACH))*(2.+MACH)/8.
56400 580 INDEX=Z(I,K)
56500 GO TO (590,610,630,650,670,670). INDEX
56600 C
56700 C INCOMPRESSIBLE (Z=1)
56800 C
56900 590 IF (ARW.GE.2.0) GO TO 600
57000 CLIL2=PI*SA*CE*OW*(1.+FLEX)+CLD/2.

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57100      CL12=CL1L2*2.
57200      DL12=PI*A2*(1.+FLEX)
57300      CD12=CL12*CL12/(2.*PI)+CDCAM+(CL12*(TA**DEXP))
57400      CL1=CLP+(CL12-CLP)*TARX
57500      DL1=DLP+(DL12-DLP)*TARX
57600      CD1=CDP+(CD12-CDP)*TARX
57700      CL1L=CL1/2.
57800      CL1U=CL1L
57900      CL1W=CL1U
58000      CL1L=CL1L
58100      CLW=CL1
58200      CDLW=CD1
58300      CLALFA=DL1/RAD
58400      GO TO 680
58500      600 CL1=2.*CL1L*(1.+FLEX)
58600      DL1=2.*DL1L*(1.+FLEX)
58700      CD1=CL1*CL1/PIARW
58800      IF (ARW.LI.3.) CD1=(CL1*CL1/PIARW)+(CL1*(TA**DEXP)*(3.-ARW))
58900      CLW=CL1+CLU
59000      CDLW=CD1+CDCAM
59100      CLALFA=DL1/RAD
59200      CLW11=CL1L*(1.+FLEX)+CL0/2.
59300      CLWL=CL1L*(1.+FLEX)+CL0/2.
59400      GO TO 680
59500      C
59600      C      COMPRESSIBLE (Z=2)
59700      C
59800      610 IF (ARW.GE.2.0) GO TO 620
59900      CLCU2=PI*D2*FINT*(1.+FLEX)/2.+CLU/2.
60000      IF (MACH.GT.1.0) CLCU2=CLCUM1*(1.+FLEX)/(ARWC*2.)
60100      DLCU2=G1*PI*CESQW*FINT*(1.+FLEX)/(2.*PETAMA)
60200      IF (MACH.GT.1.0) DLCU2=DLCUM1*(1.+FLEX)/(ARWC*2.)
60300      DLCL2=PI*A2*CPMXS*(1.+FLEX)/2.
60400      DLC2=DLCL2+DLCU2
60500      DLC=DLP+(DLC2-DLP)*TARX
60600      CLCL2=CPMXS*PI*SA*CLSOW*(1.+FLEX)/2.+CLU/2.
60700      CLC2=CLCL2+CLCU2
60800      CLC=CLP+(CLC2-CLP)*TARX
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60900      CNC2=CLC2*CLC2/(PI*2.)+CDCAM+CLC2*(TA**DEXP)
61000      CDC=CDP+(CDC2-CDP)*TARX
61100      CLCU=CLUP+(CLCU2-CLUP)*TARX
61200      CLCL=CLLP+(CLCL2-CLLP)*TARX
61300      CIWU=CLCU
61400      CLWL=CLCL
61500      CLW=CLCU+CLCL
61600      CDLW=CDC
61700      CLALFA=DLC/RAD
61800      GO TO 680
61900      620 CLC=(CLCU+CLCL)*(1.+FLEX)
62000      DLC=(G)*PI*CESQW*ARWC/HETAMA*FINT
62100      IF (MACH.GT.1.) DLCU=DLCUM1*SINT
62200      DLC=(DLCU+DLCL)*(1.+FLEX)
62300      CDC=CLC*CLC/PIARW
62400      IF (ARW.LI.3.) CDC=(CLC*CLC/PIARW)+(CLC*(TA**DEXP)*(3.-ARW))
62500      CLW=CLC+CLU
62600      CDLW=CDC+CDCAM
62700      CLALFA=DLC/RAD
62800      CIWU=CLCU*(1.+FLEX)+CLO/2.
62900      CLWL=CLCL*(1.+FLEX)+CLO/2.
63000      GO TO 680
63100      C
63200      C LEADING EDGE MACH LIMITED (L=3)
63300      C
63400      630 IF (ARW.GE.2.0) GO TO 640
63500      CLUFM2=CLUEM1/(ARWC*2.)
63600      CLUES2=CLUES/(ARWC*2.)
63700      IF (MACH.GT.1.0) CLUES2=CLUEM2*SINT
63800      CLUBS2=CLUBS/(ARWC*2.)
63900      CLFU2=CLUES2+CLUBS2
64000      IF (MACH.GT.1.3) CLFU2=CLFU2*FUZ3
64100      CLLES2=CLLES/(ARWC*2.)
64200      DLLEL2=DLLEL/(ARWC*2.)
64300      CLLEL2=CLLES2+DLLEL2*(ARD=ALER)
64400      CLJL2=CLJLEL/(ARWC*2.)
64500      IF (CLJL2.GT.CLEL2) CLEL2=CLJL2
64600      IF (CLJL2.GT.CLEL2) DLLEL2=2.*DLLEL2
68300      DLM=DLP+(DLM2-DLP)*TARX
68400      CIW=CI M
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68500      CLWU=CLMU*(1.+FLEX*TARX)
68600      CLWL=CLM-CLWU
68700      CDLW=CDM
68800      CLALFA=DLM/RAD
68900      GO TO 680
69000      660 CLM=(CLMU+CLJIEL)*(1.+FLEX)
69100      DLM=(DLMU+DLJIEL)*(1.+FLEX)
69200      CDM=CLM*CLM/PIARW+CLM*TA**DEXP
69300      CLW=CLM+CLD*FCFXN
69400      CDLW=CDM+CDCAM*FCFXN
69500      CLALFA=DLM/RAD
69600      CLWU=CLMU*(1.+FLEX)
69700      CLWL=CLJIEL*(1.+FLEX)+CLD*FCFXN
69800      GO TO 680
69900      C
70000      C      SUPERSONIC BLUNT LEADING EDGE, DETACHED SHUCK (Z=6)
70100      C
70200      670 CLU=0.
70300      GO TO 460
70400      C
70500      C      LIFT AND DRAG OF BODY NOSE AND LIFT AND DRAG DUE TO LIFT
70600      C      OF THE HORIZONTAL TAIL
70700      C
70800      680 CALL RCLCD1
70900      IF (SWING.NE.0.) GO TO 690
71000      CL(I,K) = CLN(I,K)
71100      CDL(I,K) = CDN(I,K)
71200      GO TO 710
71300      690 IF (Z(I,K).NE.4) GO TO 700
71400      CDSEP(I,K)=(1-XC)*(SA/2)*(SPANW=BDMAX)*CBARW/SWING
71500      700 LL=1
71600      CLW1(I,K)=CLW
71700      CDW1(I,K)=CDLW
71800      CLWU1(I,K)=CLWU
71900      CLWL1(I,K)=CLWL
72000      DL1(I,K)=CLALFA*RAD
72100      CLALF(I,K)=DL1(I,K)/RAD
72200      710 CALL TRIMDG

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72300      IF (SWING.EQ.0.) GO TO 720
72400      CL1=CLM+CLH(I,K)+CLN(I,K)
72500      LL=2
72600      CALL TRIMDG
72700      CDL1=(CDLM+CDH(I,K)+CDN(I,K)+CDSEP(I,K)+D(DTR(I,K)))
72800      IF (ALPHAS.GT.25.OR.DALTR(I,K).EQ.0.) CL1=CL1+DCLTR(I,K)
72900      CL(I,K)=CL1
73000      CDL(I,K)=CDL1
73100      IF(ALPHA.LE.45.) GO TO 720
73200      CDFP=1.2+SMNSQ/2.
73300      IF(MACH.GT.1.) CDFP=0.9+0.8/(SMNSQ*MACH)
73400      CDL2=CDFP*(2.*SA*SA-1.)*(SXOS+SHUSW)
73500      CDL(I,K)=CDL1+CDL2
73600      720 CONTINUE
73700      730 CONTINUE
73800      RETURN
73900      END

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100      SUBROUTINE BCLC01
200      C
300      C      CALCULATES CL, CD AND CM FOR BODY NOSE BASED UPON
400      C
500      C      NEW VERSION CREATED ON 5/19/76
600      C
700      COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CROSSW,TCRW,TCTW,TCWP,
800      1TCW,SQW,SWPW,SWPWL,XOMAC,CSWUC,SEXT,XEXT,FLEX,TDIF,FINT,DELX
900      COMMON /NOSE/ BDMAX,ASECT,APLAN,XLN,CLN(20,20),CDN(20,20),
1000     1CMNOSE(20,20),XLB,CLOB(20),CMOB(20),CDUB(20)
1100     COMMON /FLW/ SMN(20),NSMN,RNLOC(20),I6A,I6B,I6C,Z(20,20),AMC
1200     COMMON /TRIM/ CLJ,CLT,I,K,LL,ALPHA,DCDTR(20,20),DALTR(20,20),
1300     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XLG,CLALFA,
1400     2IT,DEXP,LE,I,T,ED,ITRIM(20),HETAM,SA,CA,CENX,IXCU,IFLEX,ICDU
1500     LOGICAL RNC1ST
1600     REAL MACH
1700     INTEGER Z
1800     FLNOSE=1.
1900     FDNOSF=1.
2000     LREF = CBARW
2100     SREF = SWING
2200     IF (SWING.NE.0.) GO TO 70
2300     SREF = ASECT
2400     LREF = BDMAX
2500     70 CONTINUE
2600     C      THE CROSSFLOW MACH NUMBER CONDITIONS.
2700     IF (BDMAX.NE.0.0) ETAN=.0125*XLN/BDMAX+.55
2800     MACH=SMN(I)
2900     CLN(I,K)=0.0
3000     CDN(I,K)=0.0
3100     CMNOSE(I,K)=0.0
3200     IF (BDMAX.LE.0.001) GO TO 60
3300     ARD=ALPHA/57.29578
3400     SMNSU=SMN(I)**2
3500     SZA=2.*SA*CA
3600     CAZ=COS(ARD/2.)
3700     CMN=SMN(I)*SA
3800     RNC=RNLOC(I)*BDMAX*SA

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BCLCD15 .02/25/77 12:06:05

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3900      CON=2.5*CMN-1.5
4000      CON1=ABS(CON)**(.66667)
4100      CON2=CON/CON1
4200      IF (CMN.GE..3) GO TO 20
4300      CDC=1.2
4400      IF ((RNC.GE.2.E5).AND.(RNC.LT.5.E5)) CDC=1.88-3.4E-6*RNC
4500      IF ((RNC.GE.5.E5).AND.(RNC.LT.5.E6)) CDC=.125+.11E-6*RNC
4600      IF (RNC.GE.5.E6) CDC=.675
4700      GO TO 40
4800      20 IF (CMN.LT..4) GO TO 30
4900      IF (CMN.LT.1.) CDC=1.5+.33*CON2
5000      IF (CMN.GE.1.) CDC=1.24+.59/SMNSQ
5100      GO TO 40
5200      30 CDC=1.5+.33*CON2
5300      RNCTST=((RNC.GE.2.E5).AND.(RNC.LT.5.E5))
5400      IF (RNCTST) CDC=(34.E-6*RNC-6.42)*CMN-13.6E-6*RNC+3.806
5500      RNCTST=((RNC.GE.5.E5).AND.(RNC.LT.5.E6))
5600      IF (RNCTST) CDC=(11.13-1.1E-6*RNC)*CMN+.44E-6*RNC-3.214
5700      IF (RNC.GE.5.E6) CDC=5.63*CMN-1.014
5800      40 CNNNOSE=(S2A*CA2*ASECT+CDC*ETAN**2*SA*APLAN)/SREF
5900      IF (Z(I,K).LE.4) GO TO 50
6000      IF (SWING.EQ.0.) GO TO 50
6100      DXAFT=XLB-XLN-CBARW
6200      CNBODY=CNNNOSE*(1.+(DXAFT/XLN)*(MACH-1.)/MACH)
6300      CLN(I,K)=CNBODY*CA*FLNOSE+CLUB(I)
6400      CDN(I,K)=CNBODY*SA*FDNOSE+CDUH(I)
6500      FCMNSE=(CNBODY-CNNNOSE)*(XLB-DXAFT/2.-XCG)
6600      CMNSE(I,K)=(CNNNOSE*(XCG=0.0.*XLN)-FCMNSE)/LREF+CMDB(I)
6700      GO TO 60
6800      50 CLN(I,K)=CNNNOSE*CA*FLNOSE+CLUB(I)
6900      CDN(I,K)=CNNNOSE*SA*FDNOSE+CDUH(I)
7000      CMNSE(I,K)=CNNNOSE*(XCG=0.6*XLN)/LREF+CMDB(I)
7100      60 CONTINUE
7200      RETURN
7300      END
```

TRIMDG\$ ,02/25/77 12:06:25

```
100      SUBROUTINE TRIMDG
200      C
300      C      NEW VERSION CREATED ON 4/26/76
400      C
500      COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CROSW,TCRW,TCIW,TCWP,=
600      ITCW,SOH,SWPW,SWPWLE,XOMAC,CSWQC,SEXT,XEXT,FLEX,TDIF,FINT,DELX
700      COMMON /FWING/ CLW(20,20),CDW(20,20),CLWU(20,20),CLWL(20,20),
800      1CDSEP(20,20),CLOS,DL1(20,20),CLALF(20,20),CMO(20),CDU(20),CLM,
900      2CLMU,DLMU,CPLIM,CP2,CPMS
1000     COMMON /FTOTAL/ CL(20,20),CDL(20,20)
1100     COMMON /NOSE/ HDMAX,ASECT,APLAN,XLN,CLN(20,20),CDN(20,20),
1200     1CMNOSE(20,20),XLB,CLOB(20),CMUB(20),CDUB(20)
1300     COMMON /TAIL/ SHDR,SHOSW,XOHUR,YHOR,CLH(20,20),CDH(20,20),SOH,ARM,=
1400     1ALFTR(20,20)
1500     COMMON /FLOW/ SMN(20),NSMN,RNLUC(20),I6A,I6B,I6C,Z(20,20),AMC
1600     COMMON /AFOIL/ ALELJ,XCD,SHK,ROC
1700     COMMON /TRIM/ CLI,CLT,I,K,LL,ALPHA,DCDTR(20,20),DALTR(20,20),
1800     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XCG,CLALFA,=
1900     2IT,DEXP,LF,LT,ED,ITRIM(20),BETAM,SA,CA,CERN,IXCD,IFLEX,ICND
2000     COMMON /TROUT/ STM(20,20),DELH(20,20),DWASH(20,20),DWASHR(20,20)
2100     REAL LT,LE,IT,MACH
2200     INTGFR ALELJ,Z,W
2300     DATA RAD,PI,PI2/57.29578,3.14159,6.28318/
2400     IF (LL.EQ.2) GO TO 170
2500     MACH=SMN(I)
2600     CLO=CLOS
2700     CM(I,K)=CMU(I)
2800     DCLTR(I,K)=0.
2900     DALTR(I,K)=0.
3000     DCDTR(I,K)=0.
3100     ALFTR(I,K)=ALPHA
3200     CMCL(I,K)=-9.
3300     FTRIM=1.
3400     CLH(I,K)=0.
3500     CDH(I,K)=0.
3600     STM(I,K)=9.
3700     CLAFHT = 0.
3800     CLAFHR = 0.
```

TRIMDG\* .02/25/77 12:06:25

```
3900      DEPDA = 0.
4000      IF (SWING.NE.0.) GO TO 5
4100      CM(I,K) = CMNSE(I,K)
4200      RETURN
4300      5 CONTINUE
4400      IF (CLW(I,K).EQ.0.) RETURN
4500      FCEXN=0.5
4600      IF (MACH.GT..98) FCEXN=(1.-CEXN)/2.
4700      IF (LT.LE.0.) GO TO 30
4800      ARWC=ARW/(ARW+2.)
4900      SPAH=PI*ARH*SHOSH
5000      SWPH=SQH/RAD
5100      CSH=C(S(SWPH)
5200      ALPHAS=ALPHA
5300      SQAR=ALPHA/AMC
5400      IF (SQAR.GT.1.) SQAR=1.
5500      AZ3=SQRT(SQAR)
5600      SPANL=.5*SPANW/LT
5700      OSPNL=1./SPANL
5800      ALR=ALPHA/RAD
5900      CLALF(1)=2.*PI*CSWQC*ARWC
6000      ALCAM=ALR*CLD/CLALF(1)
6100      IF (ARW.GT.1.75) GO TO 30
6200      CSWLE=C(S(SWPHLE)
6300      TEST1=MACH*CSWLE
6400      IF (TEST1.LT.1.0) GO TO 20
6500      EBAR=ED+DELX+0.2*CBARW
6600      GO TO 90
6700      20 EBAR=ED+DELX+0.2*CBARW*TEST1**2
6800      GO TO 90
6900      30 W=Z(I,K)
7000      GO TO (40,50,50,60,70,80), W
7100      40 EBAR=ED
7200      GO TO 90
7300      50 EBAR=ED+MACH**2*CBARW/10.
7400      IF (MACH.GT.1.5) EBAR=ED+.225*CBARW-.15*A/3*CBARW
7500      GO TO 90
7600      60 EU=ED+CBARW*(.5*XC-.25)
```

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```
7700 EL=ED+MACH**2*CBARW/10.
7800 IF (MACH.GT.1.5) FL=ED+.225*CBARW
7900 CLWA=CLW(I,K)-CLO*FCEXM
8000 IF (CLWA.EQ.0.0) CLWA=0.001
8100 EBAR=(CLWU(I,K)*EU+CLWL(I,K)*EL)/CLWA
8200 GO TO 90
8300 70 EBAR=ED+.25*CBARW+DFLX
8400 GO TO 90
8500 80 EBAR=ED+.2*CBARW+DELX
8600 IF (IFLEX.EQ.0) GO TO 90
8700 EBAR=ED+.1*CBARW+DELX
8800 IF (MACH.GE.6.) EBAR=ED+.2*CBARW+DELX
8900 IF (MACH.GT.4.0.AND.MACH.LT.6.0) EBAR=ED+(0.1+(MACH-4.)/20.)
9000 1*CBARW+DELX
```

C  
C  
C

AVERAGE WAKE DOWNWASH ANGLE (RADIAN)

```
90 IF (LT.LE.0.) GO TO 140
9500 T1=2./ARW
9600 T2=SQR(2.*SPANW/(3.*CBARW))
9700 T3=SQR(SPANL)
9800 CONAR=.333333
9900 IF (ARW.NE.3.) CONAR=1./(3.*ARW** (ARW-3))
10000 T4=(1.3-CONAR)/SQR(1.+TRW)
10100 IF (MACH.LE.1.) EPSD=ALCAM*T4*(T1+.1*(T2+T3))
10200 IF (MACH.GT.1.) EPSD=ALR*T4*(T1+.1*(T2+T3))
```

C  
C  
C  
C

ABSOLUTE VALUE OF NONDIMENSIONAL DISTANCE BETWEEN  
WAKE AND THE HORIZONTAL TAIL

```
10700 V1=2.*YHHR/SPANW
10800 YDSS=(NSPNL=1.5/ARW)*SIN(EPSD)-USPNL*SA
10900 AYDSS=ABS(V1+YDSS)
```

C  
C  
C  
C

DOWNWASH ANGLE AT THE HORIZONTAL TAIL (RADIAN)  
AND DOWNWASH DERIVATIVE: DEPDA

```
11300 W1=.2/SQR(NSPNL)
11400
```

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```
11500      W2=(2.+COS(2.25*ALR))/3.
11600      W3=1.-1.5*AYOSS
11700      W4=.75*ALR+SIN(2.25*ALR)
11800      W5=W2-W4
11900      IF (MACH.LE.1.) EPS1=ALCAM*T4*(W1+T1)*W2*W3
12000      IF (MACH.GT.1.) EPS1=ALR*T4*(W1+T1)*W2*W3
12100      DEPDA1=T4*(W1+T1)*W5*W3
12200      ATENF=1.
12300      IF (MACH.GT.1.) GO TO 100
12400      GO TO 110
12500 100  ATENF=1.-.1*BETAM*(1.+TAN(SHPWLE)/(T1+OSPNI))
12600      IF (ATENF.LT.0.) ATENF=0.
12700 110  DWASHR(I,K)=EPS1*ATENF
12800      IF (DWASHR(I,K).GT.ALCAM) DWASHR(I,K)=ALCAM
12900      IF (DWASHR(I,K).LT.0.) DWASHR(I,K)=0.
13000      DWASH(I,K)=DWASHR(I,K)*RAD
13100      DEPDA=DEPDA1*ATENF
13200      CEPS=CUS(DWASHR(I,K))
13300      C
13400      C  HORIZONTAL TAIL CALCULATIONS.
13500      C
13600      IF (SHDR.EQ.0.0) GO TO 140
13700      ALPHAH=ALR-DWASHR(I,K)+IT/RAD
13800      ALFAHD=ALR+IT/RAD
13900      TAHDR=TAN(ALFAHD)
14000      SAH=SIN(ALPHAH)
14100      CAH=COS(ALPHAH)
14200      TAH=TAN(ALPHAH)
14300      IF (TAH.EQ.0.0) TAH=0.001
14400      FISH=1.-SAH*SAH/2.
14500      X3=ARH/(ARH+2.)
14600      X4=PI/2*C5H*CEPS
14700      IF (Z(I,K).GT.4) GO TO 120
14800      C
14900      C  SUBSONIC LEADING EDGE
15000      C
15100      X5=2.*SAH**4+2.*CAH*CAH-4.*SAH*SAH-3.*SAH*SAH*CAH*CAH
15200      CLM(I,K)=((CPMXS+1.)/2.)*SAH*CAH*CAH*FISH*X3*X4*SHUSW
```

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```
15300      CDH(I,K)=ABS(CLH(I,K)*TAHDR)
15400      CLAFMR=SHUSW*CAH*X3*X4*X5/2.
15500      CLAFHT=CLAFMR/RAD
15600      GO TO 140
15700      C
15800      C      SUPERSONIC LEADING EDGE
15900      C
16000      120 X1=(ARW+2.)/(ARH+2.)
16100      X2=ARH*X1*CSH/(ARH*COS(SHPW))
16200      F=SHOSW*X2
16300      IF (ALR.EQ.0.0) ALR=0.001
16400      CLH(I,K)=CLW(I,K)*F*CEPS*ALPHAH/ALR
16500      IF (SOW.LE.50.) GO TO 130
16600      IF (ALPHA.LE.24.) GO TO 130
16700      FHAZ6=1.-CBARW*(SOW=50.)*(1.-0.4*COTAN(ALR))/(20.*MACH*LT)
16800      IF (FHAZ6.LT.0.4) FHAZ6=0.4
16900      CLH(I,K)=CLW(I,K)*FHAZ6
17000      130 CDH(I,K)=ABS(CLH(I,K)*TAHDR)
17100      CLAFHT=CLALFA*F*CEPS
17200      IF ((SOW.GT.50.) .AND. (ALPHA.GT.24.)) CLAFHT=CLAFHT*FHAZ6
17300      CLAFMR=CLAFHT*RAD
17400      C
17500      C      PITCHING MOMENT ABOUT THE CENTER OF GRAVITY, CM
17600      C      AND STATIC LONGITUDINAL STABILITY, STM
17700      C
17800      140 Y1=CRARW*CA
17900      IF (Z(I,K).LE.3) Y2=CLW(I,K)-CLO
18000      IF (Z(I,K).EQ.4) Y2=CLW(I,K)-CLO*FCFXN
18100      IF (Z(I,K).GE.5) Y2=CLW(I,K)
18200      Y3=CLH(I,K)*LE/Y1
18300      FMEX=FLFX*(XCG=XEXT)
18400      Y4=FMEX-EHAR
18500      DNMTN=CLALFA+CLAFHT*(1.-DFPDA)
18600      IF (DNMTN.EQ.0.0) DNMTN=0.001
18700      IF (IXCN.EQ.0) GO TO 150
18800      IF (Z(I,K).NE.4) GO TO 150
18900      IF (TRW.GE.1.0) TRW=.999
19000      XCT=XC/TRW=ARW*(1.+TRW)*TDIF/(4.*TRW)
```



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19100      Y1IM=SPANW*(2.*XCT*TRW+XC)/(6.*(XCT*TRW+XC))
19200      Y2S=SPANW*(2.*TRW*(1.-XCT)+(1.-XC))/(6.*(TRW*(1.-XCT)+(1.-XC)))
19300      ALUS=2.*XC/(1.+TRW)=ARW*TDF/4.
19400      XCLIM=(XC-YLIM*TDF/CROOT)/(1.-YLIM*(1.-TRW)*2./SPANW)
19500      LYLIM=CROOT-2.*YLIM*CROOT*(1.-TRW)/SPANW
19600      DELXL=CBARW/4.+(YBAR-YLIM)*TAN(SWPWLE)=ED=XCLIM*CYLIM/2.
19700      CMUAI=(ALUS*DELXL+FMEX)*CPLIM/CBARW
19800      CY2=CROOT-2.*Y2S*CROOT*(1.-TRW)/SPANW
19900      XC2=(XC-Y2S*TDF/CROOT)/(1.-2.*Y2S*(1.-TRW)/SPANW)
20000      AZUS=1.-2.*XC/(1.+TRW)+ARW*TDF/4.
20100      Y5=FMEX=EL
20200      CML=(CLM/(1.+FLEX)=CLMU)*Y5/Y1
20300      DELX1=XC*CROOT+Y2S*TAN(SHK)+CY2*(1.-XC2)/3.
20400      DELX2=ED=CBARW/4.-YBAR*TAN(SWPWLE)+DELX1
20500      CMU2=CP2*A205*DELX2/CBARW
20600      CMUS=CMUAI+CMU2
20700      CM(I,K)=CMU(I)+CMUS+CML-Y3+CMNUSE(I,K)
20800      CMCL(I,K)=(CLALFA/(1.+FLEX)=DLMU)*Y5=LE*CLAFHT*(1.-DEPDA))/
20900      I(Y1*DNMTR)
21000      GO TO 160
21100      150 CM(I,K)=CMU(I)+Y2*Y4/(Y1*(1.+FLEX))=Y3+CMNUSE(I,K)
21200      IF (ALPHAS.GT.25.UR.CIALFA.LE.0.) GO TO 160
21300      CMCL(I,K)=(Y4*CLALFA/(1.+FLEX)=LE*CLAFHT*(1.-DEPDA))/(Y1*DNMTR)
21400      160 STM(I,K)=CMCL(I,K)
21500      RETURN
21600      170 IF (CLW(I,K).EQ.0..OR.ITRIM(I).FQ.0) RETURN
21700      IF (ALPHAS.GT.25.UR.CIALFA.LE.0.) GO TO 180
21800      C
21900      C   TRIM AT CONSTANT LIFT COEFFICIENT (ALPHA LE 25 DEG)
22000      C
22100      DCLTR(I,K)=CM(I,K)/(LE/Y1-STM(I,K))
22200      DALTR(I,K)=-DCLTR(I,K)/(CLALFA+CLAFHT*(1.-DEPDA))
22300      IF (ABS(DALTR(I,K)).GT.15.) GO TO 180
22400      IF (CLAFHR.EQ.0.0) CLAFHR=0.001
22500      DELHR=DCLTR(I,K)/CLAFHR
22600      GO TO 190
22700      C
22800      C   TRIM AT CONSTANT ANGLE OF ATTACK (ALPHA GT 25 DEG)

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22900 C  
23000 180 DALTR(I,K)=0.  
23100 DCLTR(I,K)=CM(I,K)\*YI/LE  
23200 DELHR=DCLTR(I,K)/(CFPS\*CLAFHR)  
23300 C  
23400 190 DELH(I,K)=DELHR\*RAD  
23500 ALPHA=ALPHA+DALTR(I,K)  
23600 ALFTR(I,K)=ALPHA  
23700 ALR=ALPHA/RAD  
23800 SA=SIN(ALR)  
23900 CA=COS(ALR)  
24000 TA=TAN(ALR)  
24100 TCUN=40./RAD  
24200 ABAG=ABS(ALPHA+DELHR)  
24300 IF (ABAG,LE,TCUN) GO TO 200  
24400 ABAG=TCUN  
24500 DELHR=TCUN\*DELH(I,K)/ABS(DELH(I,K))=ALPHAH  
24600 DELH(I,K)=DELHR\*RAD  
24700 200 ALRHTD=ALR+DELHR+IT/RAD  
24800 TAHTD=TAN(ALRHTD)  
24900 IF (ALPHAS,GT,25,OR,DALTR(I,K),EQ,0.) GO TO 220  
25000 C  
25100 C TRIM DRAG AT CONSTANT CL (ALPHA LE 25 DEG)  
25200 C  
25300 CDTB1=((CLH(I,K)+DCLTR(I,K))\*\*2-CLH(I,K)\*CLH(I,K))/SPAH  
25400 CDTB2=DCLTR(I,K)\*TAHTD  
25500 CDTB3=(CLW(I,K)\*CLW(I,K)-(CLW(I,K)+DCLTR(I,K))\*\*2)/(PI\*ARW)  
25600 CDTB4=-DCLTR(I,K)\*TA\*\*DEXP  
25700 IF (ALEI,LE,1,OR,Z(I,K),GT,2) GO TO 210  
25800 DCDTR(I,K)=(CDTB1+CDTB3)\*FTRIM  
25900 GO TO 240  
26000 210 DCDTR(I,K)=CDTB4+CDTB2  
26100 GO TO 240  
26200 C  
26300 C TRIM DRAG AT CONSTANT ANGLE OF ATTACK (ALPHA GT 25 DEG)  
26400 C  
26500 220 ZNUM1=CLH(I,K)+DCLTR(I,K)/CEPS  
26600 CDTA1=(ZNUM1\*ZNUM1-CLH(I,K)\*CLH(I,K))/SPAH

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26700      IF (ALEI J.EQ.1.OR.2(I,K).GT.2) GO TO 230
26800      DCDTR(I,K)=CDTA1*FTRIM
26900      GO TO 240
27000      230 DCDTR(I,K)=DCI TR(I,K)*TAHTD
27100      240 IF (ITRIM(I).EQ.1) CM(I,K)=0.0
27200      IF (ITRIM(I).EQ.0) DELH(I,K)=0.0
27300      RETURN
27400      END
```

ORIGINAL PAGE IS  
OF POOR QUALITY

PLOTS 02/25/77 12:07:08

```
100      SUBROUTINE PLOT (NPLOT)
200      C
300      C      PLOT PROGRAM TO PRINT CL VS ALPHA AND CL VS CD ON AN OUTPUT FILE
400      C
500      C      NEW VERSION CREATED ON 5/19/76
600      C
700      COMMON /DISPLY/ LDISP(6),DDISP(4),TITLE(14),PPL0T
800      COMMON /FWING/ CLW(20,20),CDW(20,20),CLWU(20,20),CLWL(20,20),
900      ;CDSEF(20,20),CLO,DL(20,20),CLALF(20,20),CMU(20),CDU(20),CLM,CLMU,
1000     2DLMU,CPLIM,CP2,CPMXS
1100     COMMON /FTOTAL/ CL(20,20),CDL(20,20)
1200     COMMON /NOSE/ BDMAX,ASECT,APLAN,XLN,CLN(20,20),CDN(20,20),
1300     1CMNUSE(20,20),XLB,CLDB(20),CMOB(20),CDOB(20)
1400     COMMON /TAIL/ SHOR,SHOSW,XQHUR,YHOR,CLH(20,20),CDH(20,20),SQH,ARH,
1500     1ALFTR(20,20)
1600     COMMON /FLOW/ SMN(20),NSMN,RNLUC(20),I6A,I6B,I6C,Z(20,20),AMC
1700     COMMON /TRIM/ CLI,CLT,I,KAY,LL,ALPHA,DCDIR(20,20),DALTR(20,20),
1800     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CHARW,YBAR,XCG,CLALFA,
1900     2IT,DEXP,LE,LT,ED,ITRIM(20),RETA,SA,CA,CEXN,IXCD,IFLEX,ICDU
2000     DIMENSION WLIST(61),DLIST(61),PLIST(101),DISLST(7),DVAL(6),
2100     1PVAL(11)
2200     INTEGER DDISP,PPL0T
2300     DATA WLIST,DLIST,PLIST,DISLST/223*1H ,1HH,1HN,1HL,1HU,1HW,1HT,1HS/
2400     DATA PLUS,BLANK,AST,EYE/1H+,1H ,1H*,1H!/
2500     C.....SKIP TO TOP OF PAGE; PRINT PLOT NUMBER IN UPPER RIGHT HAND
2600     C      CORNER OF PAGE
2700     WRITE (6,450) NPLOT
2800     C.....FIND MAX. LIFT COEFF. (CLMAX), MAX. DRAG COEFF. (CDMAX), MIN. CM
2900     C      COEFF. (CMMIN) AND MAX. CM COEFF. (CMMAX)
3000     CLMAX=0.0
3100     CDMAX=0.0
3200     CMMIN=10.0
3300     CMMAX=-10.0
3400     DO 20 I6=16A,16B,16C
3500     K=(I6-16A)/(16C+1)
3600     CLMAX=AMAX1(CL(I,K),CLMAX)
3700     CDMAX=AMAX1(CDL(I,K),CDMAX)
3800     CMMIN=AMIN1(CM(I,K),CMMIN)
```

PLU18 02/25/77 12107108

```
3900      CMMAX=AMAX1(CM(1,K),CMMAX)
4000      20 CONTINUE
4100      C.....DETERMINE SCALE (SCALE) FOR CLMAX (LIFT COEFF. VS ANGLE OF ATTACK
4200      C      PLOT)
4300      SCALE=60.
4400      IF (LMAX.GT..7) SCALE=30.
4500      IF (CLMAX.GT.1.4) SCALE=20.
4600      IF (CLMAX.GT.2.1) SCALE=15.
4700      IF (CLMAX.GT.2.8) SCALE=12.
4800      C.....DETERMINE SCALE (DSCALE) FOR CDMAX
4900      C      (TOT. LIFT COEFF. VS DRAG COEFFS. PLOT)
5000      DSCALE=500.
5100      IF (CDMAX.GT..12) DSCALE=200.
5200      IF (CDMAX.GT..30) DSCALE=100.
5300      IF (CDMAX.GT..6) DSCALE=50.
5400      IF (CDMAX.GT.1.2) USCALE=60./1.8
5500      IF (CDMAX.GT.1.8) DSCALE=25.
5600      IF (CDMAX.GT.2.4) USCALE=20.
5700      IF (CDMAX.GT.3.) DSCALE=10.
5800      C.....DETERMINE RANGE OF CM. CALCULATE FACTOR
5900      RANGE=CMMAX-CMMIN
6000      FACTOR=10.0
6100      IF (RANGE.GT.0.1) FACTOR=5.0
6200      IF (RANGE.GT.0.2) FACTOR=2.0
6300      IF (RANGE.GT.0.5) FACTOR=1.0
6400      IF (RANGE.GT.1.0) FACTOR=2./3.
6500      IF (RANGE.GT.1.5) FACTOR=0.5
6600      IF (RANGE.GT.2.0) FACTOR=0.2
6700      C.....TEST FOR NEGATIVE CMMAX! IF = CL AXIS IS AT FAR RIGHT
6800      IF (CMMAX.GT.0.0) GO TO 30
6900      ISCLE2=-500
7000      IF (CMMIN.LT.-0.5) ISCLE2=-1000
7100      IF (CMMIN.LT.-1.0) ISCLE2=-1500
7200      IF (CMMIN.LT.-1.5) ISCLE2=-2000
7300      IF (CMMIN.LT.-2.0) ISCLE2=-5000
7400      FACTOR=1000./FLOAT(ABS(ISCLE2))
7500      KU=101
7600      GO TO 70
```

PLOTS 02/25/77 12:07:08

```
7700 C.....TEST FOR POSITIVE CMMIN; IF + , CL AXIS IS AT FAR LEFT
7800   30 IF (CMMIN.LT.0.0) GO TO 40
7900   ISCLE2=0
8000   FACTOR=10.0
8100   IF (CMMAX.GT.0.1) FACTOR=5.0
8200   IF (CMMAX.GT.0.2) FACTOR=2.0
8300   IF (CMMAX.GT.0.5) FACTOR=1.0
8400   IF (CMMAX.GT.1.0) FACTOR=2./3.
8500   IF (CMMAX.GT.1.5) FACTOR=0.5
8600   IF (CMMAX.GT.2.0) FACTOR=0.2
8700   KO=1
8800   GO TO 70
8900 C.....DETERMINE MINIMUM SCALE VALUE (SCALE2), INCREMENT (AINCR)
9000 C      AND CL AXIS LOCATION (KU)
9100   40 IMIN=IFIX(CMMIN*1000.)
9200   IDECR=IFIX(100./FACTOR)
9300   ICMMAX=1500
9400   ICMMIN=-1500
9500   DO 50 ISCLE2=ICMMIN,ICMMAX,IDECR
9600   IF (ISCLE2.GT.IMIN) GO TO 60
9700   50 CONTINUE
9800   60 ISCLE2=ISCLE2-IDECR
9900   70 SCALE2=FLOAT(ISCLE2)/1000.
10000  AINCR=0.1/FACTOR
10100  IF (CMMAX.GT.0.0.AND.CMMIN.LT.0.0) KO=INT(ABS(SCALE2)*FACTOR*100./+
10200  10.5)+1
10300  IF (PLOT.EQ.0) GO TO 80
10400  KO=102-KO
10500  GO TO 100
10600 C.....CALCULATE SCALE VALUES FOR CM
10700  80 PVAL(1)=SCALE2
10800  DO 90 J2=2,11
10900  PVAL(J2)=PVAL(J2-1)+AINCR
11000  90 CONTINUE
11100  GO TO 120
11200  100 PVAL(11)=SCALE2
11300  DO 110 J2=2,11
11400  J3=12-J2
```

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11500      PVAL(J3)=PVAL(J3+1)+AINCR
11600      110 CONTINUE
11700 C.....START PLOTS OF CL VS. ANGLE OF ATTACK AND CL VS. CD
11800 C.....LOOP THROUGH NUMBER OF LINES ON PAGE
11900      120 DO 360 J=1,42
12000      VER=FLOAT(43-J)
12100 C.....INSERT (+) INTO WLIST AND DLIST EVERY SIXTH LINE, STARTING WITH
12200 C      FIRST
12300      JTEST=((J-1)/6)*6
12400      IF (JTEST.NE.J-1) GO TO 150
12500      DO 130 K2=1,61,12
12600      130 WLIST(K2)=PLUS
12700      DO 140 K2=1,61,10
12800      140 DLIST(K2)=PLUS
12900 C.....LOOP THROUGH NUMBER OF ANGLES OF ATTACK
13000      150 DO 240 I6=16A,16B,16C
13100      K=(I6-16A)/16C+1
13200 C.....COMPUTE COLUMN INDEX FOR ANGLE OF ATTACK
13300      K1=(I6*60)/4000+1
13400      IF (I6B.GT.4000) K1=(I6*60)/8000+1
13500 C.....TEST FOR PLOT OF CL DUE TO HORIZONTAL TAIL (H)
13600      IF (LDISP(1).EQ.0) GO TO 160
13700      IF (ABS(CLM(I,K)*SCALE-VER).LE..5) WLIST(K1)=DISLST(1)
13800 C.....TEST FOR PLOT OF CL DUE TO NOSE (N)
13900      160 IF (LDISP(2).EQ.0) GO TO 170
14000      IF (ABS(CLN(I,K)*SCALE-VER).LE..5) WLIST(K1)=DISLST(2)
14100 C.....TEST FOR PLOT OF CL DUE TO WING LOWER SURFACE (L)
14200      170 IF (LDISP(3).EQ.0) GO TO 180
14300      IF (ABS(CLWL(I,K)*SCALE-VER).LE..5) WLIST(K1)=DISLST(3)
14400 C.....TEST FOR PLOT OF CL DUE TO WING UPPER SURFACE (U)
14500      180 IF (LDISP(4).EQ.0) GO TO 190
14600      IF (ABS(CLWU(I,K)*SCALE-VER).LE..5) WLIST(K1)=DISLST(4)
14700 C.....TEST FOR PLOT OF CL DUE TO NET WING (W)
14800      190 IF (LDISP(5).EQ.0) GO TO 200
14900      IF (ABS(CLW(I,K)*SCALE-VER).LE..5) WLIST(K1)=DISLST(5)
15000 C.....TEST FOR PLOT OF CL DUE TO TOTAL COMPONENTS (T)
15100      200 IF (ABS(CL(I,K)*SCALE-VER).GT..5) GO TO 240
15200      IF (LDISP(6).NE.0) WLIST(K1)=DISLST(6)
```

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15300 C.....TEST FOR PLOT OF CD DUE TO SEPARATION (S)
15400     IF (DDISP(2),EQ.0) GO TO 210
15500     IX=INT(CDSEP(I,K)*DSCALE+.50001)+1
15600     IF (IX,GE.1,AND,IX,LE.61) DLIST(IX)=DISLST(7)
15700 C.....TEST FOR PLOT OF CD DUE TO NUSE (N)
15800     210 IF (DDISP(1),EQ.0) GO TO 220
15900     IX=INT(CDN(I,K)*DSCALE+.50001)+1
16000     IF (IX,GE.1,AND,IX,LE.61) DLIST(IX)=DISLST(2)
16100 C.....TEST FOR PLOT OF CD DUE TO WING (W)
16200     220 IF (DDISP(3),EQ.0) GO TO 230
16300     IX=INT(CDW(I,K)*DSCALE+.90001)+1
16400     IF (IX,GE.1,AND,IX,LE.61) DLIST(IX)=DISLST(5)
16500 C.....TEST FOR PLOT OF CD DUE TO TITAL AIRCRAFT (T)
16600     230 IF (DDISP(4),EQ.0) GO TO 240
16700     IX=INT(CDL(I,K)*DSCALE+.50001)+1
16800     IF (IX,GE.1,AND,IX,LE.61) DLIST(IX)=DISLST(6)
16900     240 CONTINUE
17000 C.....WRITE LINE WITH SCALE VALUE EVERY SIXTH LINE, STARTING WITH FIRST
17100     IF (JTEST,EQ,J=1) GO TO 320
17200     IF (J,GT,6) GO TO 280
17300 C.....WRITE LABELS FOR LIFT VS. ANGLE OF ATTACK PLOT
17400     GO TO (320,330,250,260,270,230), J
17500     250 WRITE (6,460) (WLST(J2),J2=24,61),(DLIST(J3),J3=1,61)
17600     GO TO 340
17700     260 WRITE (6,470) (WLST(J2),J2=24,61),(DLIST(J3),J3=1,61)
17800     GO TO 340
17900     270 WRITE (6,480) (WLST(J2),J2=24,61),(DLIST(J3),J3=1,61)
18000     GO TO 340
18100     280 IF (J,LT,39) GO TO 330
18200     J3=J-38
18300 C.....WRITE LABELS FOR LIFT VS. DRAG PLOT
18400     GO TO (290,300,310,330), J3
18500     290 WRITE (6,490) (WLST(J2),J2=1,61),(DLIST(J4),J4=1,37)
18600     GO TO 340
18700     300 WRITE (6,500) (WLST(J2),J2=1,61),(DLIST(J4),J4=1,46)
18800     GO TO 340
18900     310 WRITE (6,510) (WLST(J2),J2=1,61),(DLIST(J4),J4=1,40)
19000     GO TO 340
```



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19100 C.....WRITE @VALUE LINE@
19200     320 CLL=FLOAT(43-J)/SCALE
19300     WRITE (6,520) CLL,(WLIST(J2),J2=1,61),(DLIST(J3),J3=1,61)
19400     GO TO 340
19500 C.....WRITE @NORMAL LINE@
19600     330 WRITE (6,530) (WLIST(J2),J2=1,61),(DLIST(J3),J3=1,61)
19700 C.....RE=SET LINE TO BLANKS AND @*@
19800     340 WLIST(1)=AST
19900         DLIST(1)=AST
20000         DO 350 J2=2,61
20100         WLIST(J2)=BLANK
20200         DLIST(J2)=BLANK
20300     350 CONTINUE
20400     360 CONTINUE
20500 C.....CALCULATE SCALE VALUES FOR INDUCED DRAG COEFFICIENTS
20600         DO 370 J2=1,6
20700         370 DVAL(J2)=10.*FLOAT(J2)/DSCALE+.00001
20800 C.....WRITE LAST TWO LINES
20900         IF (16B.GT.4000) WRITE (6,590) (DVAL(J2),J2=1,6)
21000         IF (16B.LE.4000) WRITE (6,540) (DVAL(J2),J2=1,6)
21100 C.....START PLOT OF TOTAL LIFT COEFF. VS. PITCHING MOMENT COEFF.
21200 C.....SKIP TO TOP OF PAGE, PRINT PLOT NUMBER IN UPPER RIGHT HAND
21300 C         CORNER OF PAGE
21400         WRITE (6,550) NPLUT
21500 C.....LOUP THROUGH NUMBER OF LINES ON PAGE
21600         DO 440 J=1,42
21700         VER=FLOAT(43-J)
21800 C.....INSERT (+) INTO PLIST EVERY SIXTH LINE, STARTING WITH FIRST
21900         JTEST=((J-1)/6)*6
22000         IF (JTEST.NE.J-1) GO TO 390
22100         DO 380 K2=1,10,10
22200         PLIST(K2)=PLUS
22300     380 CONTINUE
22400     390 DO 400 I6=16A,16B,16C
22500         K=(I6-16A)/16C+1
22600         IF (ABS(CL(I,K)*SCALE-VER).GT.0.5) GO TO 400
22700         K1=INT(((CM(I,K)+ABS(SCALF2))*FACTOR)*100.+0.5)+1
22800         IF (PLOT.EQ.1) K1=102-K1
```

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22900      IF (K1.GE.1.AND.K1.LE.101) PLIST(K1)=AST
23000      400 CONTINUE
23100      C.....WRITE LINE WITH CL SCALE VALUE EVERY SIXTH LINE, STARTING
23200      C          WITH FIRST
23300      IF (JTEST.NE.J=1) GO TO 410
23400      C.....WRITE @VALUE LINE@
23500      CLL=FLOAT(43-J)/SCALE
23600      WRITE (6,560) CLL,(PLIST(J2),J2=1,101),CLL
23700      GO TO 420
23800      C.....WRITE @NORMAL LINE@
23900      410 WRITE (6,570) (PLIST(J2),J2=1,101)
24000      C.....RE-SET LINE TO BLANKS AND @I@
24100      420 DO 430 J2=1,101
24200      PLIST(J2)=BLANK
24300      430 CONTINUE
24400      PLIST(K0)=EYE
24500      440 CONTINUE
24600      C.....WRITE CM AXIS, CM SCALE AND TITLE
24700      WRITE (6,580) (PVAL(J2),J2=1,11)
24800      RETURN
24900      C
25000      450 FORMAT (1H1,T124,4HPLLOT,13,1HA)
25100      460 FORMAT (T6,1H*,T12,17HLIFT COEFFICIENTS,38A1,T70,61A1)
25200      470 FORMAT (T6,1H*,T19,3HVS.,T29,38A1,T70,61A1)
25300      480 FORMAT (T6,1H*,T13,15HANGLE OF ATTACK,T29,38A1,T70,61A1)
25400      490 FORMAT (T6,61A1,T70,37A1,22HTOTAL LIFT COEFFICIENT)
25500      500 FORMAT (T6,61A1,T70,46A1,3HVS.)
25600      510 FORMAT (T6,61A1,T70,40A1,16HDURAG COEFFICIENT)
25700      520 FORMAT (T2,F3.1,1H=,61A1,T70,61A1)
25800      530 FORMAT (T6,61A1,T70,61A1)
25900      540 FORMAT (T2,5H0.0+,.20(3H--+),T70,1H+,12(5H-----+)/T6,1HU,T18,1H8, -
26000      1T29,2H16,T41,2H24,T53,2H32,T65,2H40,T69,3HU.0,6(5X,F5.2))
26100      550 FORMAT (1H1,T40,44HTOTAL LIFT COEFFICIENT VS. PITCHING MOMENT, -
26200      111HCOEFFICIENT ,T124,4HPLLOT,13,1HB)
26300      560 FORMAT (T12,F3.1,2X,101A1,2X,F3.1)
26400      570 FORMAT (T17,101A1)
26500      580 FORMAT (T12,3H0.0,T17,1H+,10(10H-----+),5H 0.0/T10, -
26600      111(5X,F5.2))
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26700 590 FORMAT (T2,5H0,0+,20(3H--+),T70,1H+,12(5H---+))/T6,1H0,T17,2H16, -  
26800 1T29,2H32,T41,2H48,T53,2H64,T65,2H80,T69,3H0,0,6(5X,F5.2)  
26900 END

ORIGINAL PAGE IS  
OF POOR QUALITY

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```
100      SUBROUTINE MLOT (NPLOT)
200      C
300      C      PLOT PROGRAM TO PRINT CL VS ALPHA AND CL VS CD FOR A GIVEN
400      C      RANGE OF MACH NUMBERS ON AN OUTPUT FILE
500      C
600      C      NEW VERSION CREATED ON 4/26/76
700      C
800      COMMON /WING/ ARW,SPANW,SWING,TRW,CROOT,CTIP,CRUSH,TCRW,TCTW,TCWP,=
900      ITCW,SOM,SMPW,SHPWLE,XOMAC,CSHQC,SEXT,XEXT,FLEX,TDIF,FINI,DELX
1000     COMMON /FTOTAL/ CL(20,20),CDL(20,20)
1100     COMMON /TAIL/ SHOR,SHOSW,XQHUR,YHUR,CLH(20,20),CDH(20,20),SUH,ARH,=
1200     1ALFTR(20,20)
1300     COMMON /FLOW/ SMN(20),NSMN,RNLUC(20),I6A,I6B,I6C,Z(20,20),AMC
1400     COMMON /AFDIL/ ALFLJ,XCD,SHK,RUC
1500     COMMON /TRIM/ CL1,CLT,I,K,LL,ALPHA,DCDTR(20,20),DALTR(20,20),=
1600     1CM(20,20),DCLTR(20,20),CMCL(20,20),FTRIM,XC,CBARW,YBAR,XCG,CLALFA,=
1700     2IT,DEXP,LE,LT,EO,ITRIM(20),RETAM,SA,CA,CENX,IXCD,IFLEX,ICNO
1800     DIMENSION WLIST(6),DLIST(6),DISLST(10),VAL(6)
1900     INTEGER HNSMN
2000     DATA WLIST,DLIST/122*1H /
2100     DATA DISLST/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/
2200     DATA PLANK,AST,PLUS/1H 1H*,1H*/
2300     C.....SKIP TO TOP OF PAGE. WRITE ARW, XCD AND MACH SPEEDS
2400     HNSMN=NSMN
2500     WRITE (6,210) ARW,XCD,(J1,SMN(J1),J1=1,HNSMN)
2600     WRITE (6,220) NPLOT
2700     C.....DETERMINE MAX. LIFT COEFF. (CLMAX) AND MAX. DRAG COEFF. (CDMAX)
2800     CLMAX=CL(1,1)
2900     CDMAX=CDL(1,1)
3000     DO 20 I=1,NSMN
3100     DO 20 I6=I6A,I6B,I6C
3200     IF (ITRIM(I),EO,0) GO TO 20
3300     K=(I6-I6A)/I6C+1
3400     IF (CL(I,K).GT.CLMAX) CLMAX=CL(I,K)
3500     IF (CDL(I,K).GT.CDMAX) CDMAX=CDL(I,K)
3600     20 CONTINUE
3700     C.....DETERMINE SCALING
3800     RANGE=CLMAX
```

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3900      SCALE=60.
4000      IF (RANGE.GT..7) SCALE=30.
4100      IF (RANGE.GT.1.4) SCALE=20.
4200      IF (RANGE.GT.2.1) SCALE=15.
4300      IF (RANGE.GT.2.8) SCALE=12.
4400      DRANGF=CDMAX
4500      DSCALE=500.
4600      IF (DRANGE.GT..12) DSCALE=200.
4700      IF (DRANGE.GT..3) DSCALE=100.
4800      IF (DRANGE.GT..6) DSCALE=50.
4900      IF (DRANGE.GT.1.2) DSCALE=60./1.8
5000      IF (DRANGE.GT.1.8) DSCALE=25.
5100      IF (DRANGE.GT.2.4) DSCALE=20.
5200      C.....LOOP THROUGH NUMBER OF LINES PER PLOT
5300      ON 190 J=1,42
5400      C.....INSERT (+) INTO WLIST AND DLIST EVERY SIXTH LINE, STARTING
5500      C          WITH FIRST
5600      JTEST=((J-1)/6)*6
5700      IF (.JTEST.NE.J-1) GO TO 50
5800      DO 30 K2=1,61,12
5900      30 WLIST(K2)=PLUS
6000      DO 40 K2=1,61,10
6100      40 DLIST(K2)=PLUS
6200      50 VFR=FLOAT(43-J)
6300      KOUNT=0
6400      C.....LOOP THROUGH NUMBER OF MACH NUMBERS
6500      DO 70 I=1,NSMN
6600      IF (ITRIM(I).EQ.0) GO TO 70
6700      KOUNT=KOUNT+1
6800      C.....LOOP THROUGH NUMBER OF ANGLES OF ATTACK
6900      DO 60 I6=I6A,I6B,I6C
7000      K=(I6-I6A)/I6C+1
7100      IF (ABS(CL(I,K)*SCALE-VFR).GT..5.OR.DALTR(I,K).EQ.0.0) GO TO 60
7200      K1=(ALFTR(I,K)*1.5+.50001)+1
7300      IF (I6B.GT.4000) K1=(ALFTR(I,K)*.75+.50001)+1
7400      IF (K1.GT.61) GO TO 60
7500      WLIST(K1)=DISLST(KOUNT)
7600      IX=INT(COL(I,K)*DSCALE+.50001)
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7700      IF (IX.EQ.0) IX=1
7800      IF (IX.LE.61) DLIST(IX)=DISLST(KOUNT)
7900      60 CONTINUE
8000      70 CONTINUE
8100      C.....PRINT LINE WITH SCALE VALUE EVERY SIXTH LINE, STARTING WITH FIRST
8200          JTEST=((J-1)/6)*6
8300          IF (JTEST.EQ.J-1) GO TO 150
8400          IF (J.GT.6) GO TO 110
8500      C.....WRITE LABELS FOR LIFT VS ANGLE OF ATTACK PLOT
8600          GO TO (110,110,80,90,100,110), J
8700          80 WRITE (6,230) (WLIST(J2),J2=24,61),(DLIST(J3),J3=1,61)
8800          GO TO 170
8900          90 WRITE (6,240) (WLIST(J2),J2=24,61),(DLIST(J3),J3=1,61)
9000          GO TO 170
9100          100 WRITE (6,250) (WLIST(J2),J2=24,61),(DLIST(J3),J3=1,61)
9200          GO TO 170
9300          110 IF (J.LT.39) GO TO 160
9400          J3=J-38
9500      C.....WRITE LABELS FOR LIFT VS DRAG PLOT
9600          GO TO (120,130,140,160), J3
9700          120 WRITE (6,260) (WLIST(J2),J2=1,61),(DLIST(J4),J4=1,37)
9800          GO TO 170
9900          130 WRITE (6,270) (WLIST(J2),J2=1,61),(DLIST(J4),J4=1,45)
10000         GO TO 170
10100         140 WRITE (6,280) (WLIST(J2),J2=1,61),(DLIST(J4),J4=1,35)
10200         GO TO 170
10300      C.....WRITE ZVALUE LINE?
10400          150 CLL=FLOAT(43-J)/SCALE
10500          WRITE (6,290) CLL,(WLIST(J2),J2=1,61),(DLIST(J3),J3=1,61)
10600          GO TO 170
10700      C.....WRITE TNORMAL LINE?
10800          160 WRITE (6,300) (WLIST(J2),J2=1,61),(DLIST(J3),J3=1,61)
10900      C.....RE=SET LINE TO BLANKS AND *#
11000          170 WLIST(1)=AST
11100             DLIST(1)=AST
11200             DO 180 J2=2,61
11300             WLIST(J2)=BLANK
11400             DLIST(J2)=BLANK
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11500 180 CONTINUE
11600 190 CONTINUE
11700 C.....CALCULATE SCALE VALUES FOR INDUCED DRAG COEFFICIENTS
11800      DO 200 J2=1,6
11900      200 VAL(J2)=10.*FLOAT(J2)/NSCALE+.00001
12000 C.....PRINT LAST TWO LINES (DASH AND PLUSES AND VALUE LINE
12100 C      FOR BOTH PL(ITS)
12200      IF (I6B.GT.4000) WRITE (6,J2) (VAL(J2),J2=1,6)
12300      IF (I6B.LE.4000) WRITE (6,J1) (VAL(J2),J2=1,6)
12400      RETURN
12500 C
12600 210 FORMAT (1H1,T2,4HARW=F5.2,2X,4HXCDF=F5.3,9H OF CHORD,2X,3HSMN=
12700      110(2X,11,1H=F4.2))
12800 220 FORMAT (1H+,T12,4HPLDT,13)
12900 230 FORMAT (T6,1H+,T12,17HLIFT COEFFICIENTS,38A1,T70,61A1)
13000 240 FORMAT (T6,1H+,T18,4HV.S.,T29,38A1,T70,61A1)
13100 250 FORMAT (T6,1H+,T13,15HANGLE OF ATTACK,T29,38A1,T70,61A1)
13200 260 FORMAT (T6,61A1,T70,37A1,22HTOTAL LIFT COEFFICIENT)
13300 270 FORMAT (T6,61A1,T70,45A1,4HV.S.)
13400 280 FORMAT (T6,61A1,T70,35A1,22H      DRAG COEFFICIENTS)
13500 290 FORMAT (T2,F3.1,1H=61A1,T70,61A1)
13600 300 FORMAT (T6,61A1,T70,61A1)
13700 310 FORMAT (T2,5H0.0-+,20(3H--+),T70,1H+,12(5H--+)/T6,1HU,T18,1H8,
13800      1129,2H16,T41,2H24,T53,2H32,T65,2H40,T69,3HU.0,6(5X,F5.2))
13900 320 FORMAT (T2,5H0.0-+,20(3H--+),T70,1H+,12(5H--+)/T6,1HU,T17,2H16,
14000      1T29,2H32,T41,2H48,T53,2H64,T65,2H80,T69,3HU.0,6(5X,F5.2))
14100      END
```