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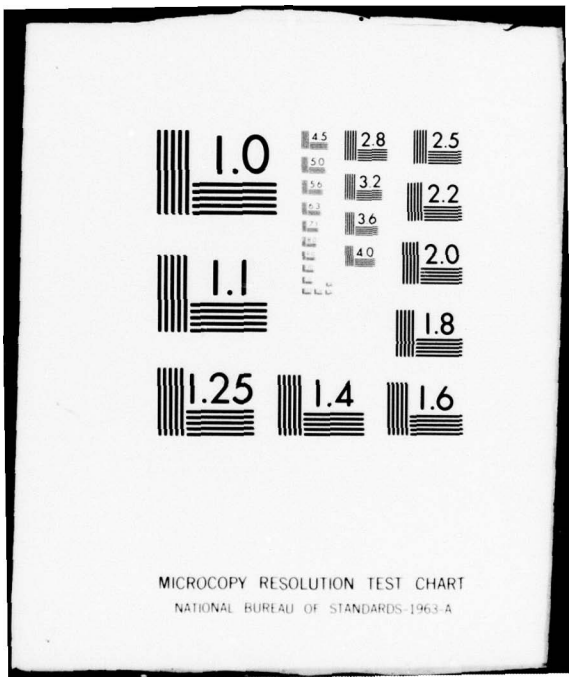
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AFAPL-TR-78-85
Volume II

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LEVEL II

THE GENERATION, RADIATION AND PREDICTION OF SUPERSONIC JET NOISE VOLUME II - APPENDIX-COMPUTER PROGRAM LISTING

LOCKHEED-GEORGIA COMPANY
MARIETTA, GEORGIA 30063

OCTOBER 1978

TECHNICAL REPORT AFAPL-TR-78-85
FINAL REPORT FOR PERIOD 1 DECEMBER 1975 – 1 SEPTEMBER 1978

AIR FORCE AERO-PROPULSION LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This appendix volume presents a complete listing of the unified jet noise predicton computer program (UNIJET), developed to predict the total noise from a subsonic or supersonic jet under static conditions. In addition, a listing of the computer program (called INTEG) to predict absolute turbulent mixing noise levels at 90° to the jet axis, using laser velocimeter turbulence measurements, is also given. A detailed description of these two programs in the form of a user's guide is given in the main volume of this report.

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PREFACE

This report was prepared by the Lockheed-Georgia Company, Marietta, Georgia, for the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base under Contract F33615-76-C-2021 (Project 3066, Task 14). The report covers work done in the period 1 December 1975 through 1 September 1978. The work described herein is part of the Air Force Aero Propulsion Laboratory's program to define and control the noise emission of aircraft propulsion systems, and forms a continuation of the studies conducted at Lockheed under two previous contracts (F33615-71-C-1663 and F33615-73-C-2032), which were reported in technical reports AFAPL-TR-72-53 (six volumes) and AFAPL-TR-76-65 (four volumes), respectively.

Mr. Paul Shahady was the Air Force Aero Propulsion Laboratory's Project Engineer for the first two contracts, and he also initiated the third (i.e. the present) contract. Lt. Robert McGregor was the AFAPL's Program Manager for the present contract. Lockheed's Program Manager for all three contracts was Dr. Harry E. Plumblee, Jr.

This Volume II – appendix volume – presents a complete listing of two computer programs. The first program, called UNIJET, is developed to predict the total noise from a subsonic or supersonic jet under static conditions using the results of the present contract together with the knowledge gained in the two previous contracts. The second computer program, called INTEG, is designed to predict absolute values of turbulent mixing noise at 90° to the jet axis, based on laser velocimeter turbulence measurements. A detailed description of these two programs in the form of a User's Guide is given in the main volume of this report.

The authors gratefully acknowledge the efforts of Mr. Robert H. Burrin in preparing this report and Mrs. Barbara C. Reagan in typing the manuscript.

This report was submitted by the authors on 15 September 1978.

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C                                                                           A 390
      DATA IC,OC/2HIC,2H  /                                                 A 400
C                                                                           A 410
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C                                                                           A 430
      DATA THDOCT /                                                         A 440
     1    50. ,    63. ,    80. ,   100. ,   125. ,   160. ,   200. ,      A 450
     2   250. ,   315. ,   400. ,   500. ,   630. ,   800. ,  1000. ,      A 460
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     4  6300. ,  8000. , 10000. , 12500. , 16000. , 20000. , 25000. ,      A 480
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C                                                                           A 510
      CALL DATE (DATED)                                                     A 520$
      CALL TIME (TIMED)                                                     A 530$
      WRITE (6,640) DATED,TIMED                                             A 540*
C                                                                           A 550
      WRITE (6,650)                                                         A 560*
C                                                                           A 570
      WRITE (6,660)                                                         A 580*
```

```
C                                                                       A 590
C       NOVEMBER 15 77.  PREDICTION FOR VJ/A0 GT 1 INSIDE CONE OF       A 600
C       SILENCE(IC) ALLOWED                                             A 610
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C                                                                       A 640
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C                                                                       A 670
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C                                                                       A 690
C     READ STATEMENTS                                                   A 700
C                                                                       A 710
      READ (5,690) DIA,R                                                A 720*
      DFT=DIA/12.0                                                      A 730
      ROD=R/DFT                                                         A 740
C                                                                       A 750
C     NFREQ = 0  INPUT STARTING 1/3 O.B. NUMBER IN ISTART AND           A 760
C                ENDING 1/3 O.B. NUMBER IN ISTOP                        A 770
C                NO FREQUENCIES ARE READ IN .                           A 780
C     NFREQ NE 0 NFREQ IS THE NUMBER OF FREQUENCIES TO BE READ IN       A 790
C                ISTART AND ISTOP ARE NOT USED.                         A 800
C                                                                       A 810
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C                                                                       A 830
      IF (NFREQ.EQ.0) GO TO 10                                          A 840
      READ (5,690) (FREQ(I),I=1,NFREQ)                                  A 850*
      GO TO 30                                                          A 860
C                                                                       A 870
   10 NFREQ=(ISTOP-ISTART)+1                                            A 880
      J=ISTART-1                                                        A 890
      DO 20 I=1,NFREQ                                                   A 900
      J=J+1                                                             A 910
   20 FREQ(I)=THDOCT(J)                                                 A 920
   30 CONTINUE                                                          A 930
C                                                                       A 940
      READ (5,690) (TM(J),J=1,NANG)                                     A 950*
C                                                                       A 960
C                                                                       A 970
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      READ (5,690) C,K0,K1,BC                                           A 990*
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C     *   OPPER 1 = FLOW PARAMETERS INPUT ARE P0,T0F,PRG,TRF        *   A1040
C     *                                                             *   A1050
C                                                                       A1060
      READ (5,700) OPNO,OPPER,ICODE,IFLG,BOPNO,ISS,IOPT,ILWR            A1070*
      IF (OPNO.EQ.2.OR.OPNO.EQ.4.OR.OPNO.EQ.5.OR.OPNO.EQ.7) CALL SELECT A1080$
     1(NU,ISS)                                                          A1090
   40 READ (5,700) TP                                                   A1100*
C                                                                       A1110
C                                                                       A1120
      IF (TP.EQ.0) GO TO 630                                            A1130
C                                                                       A1140
      IF (OPPER.EQ.1) GO TO 50                                          A1150
      READ (5,690) P0,T0F,VJA0,TJT0                                     A1160*
      GO TO 60                                                          A1170
```

```
   50 READ (5,690) P0,T0F,PRG,TRF                                          A1180*
   60 CONTINUE                                                             A1190
      IF (IOPT.EQ.2) READ (5,690) RSW                                      A1200*
      IF (IOPT.EQ.3) READ (5,690) RSW,ALTB,BLTB                            A1210*
C                                                                          A1220
C                                                                          A1230
      ICOMP=1                                                              A1240
      IF (ICODE.EQ.0) GO TO 100                                            A1250
      IF (ICODE.EQ.2) GO TO 90                                             A1260
      READ (5,700) IVEL,IANG,INCANG                                        A1270*
      ICOMP=0                                                              A1280
      IF (IVEL.EQ.0.OR.ISTART.EQ.0.OR.OPPER.EQ.0) ICOMP=1                  A1290
      IF (ICOMP.EQ.1) GO TO 100                                            A1300
      REWIND 2                                                             A1310*
      DO 80 IV=1,IVEL                                                      A1320
      DO 70 J=1,12                                                         A1330
      READ (2,710) (SPLM(I,J),I=7,30)                                      A1340*
   70 CONTINUE                                                             A1350
   80 CONTINUE                                                             A1360
      IOFF=ISTART-1                                                        A1370
      GO TO 100                                                            A1380
C                                                                          A1390
   90 IOFF=ISTART-1                                                        A1400
      ICOMP=0                                                              A1410
      IANG=1                                                               A1420
      INCANG=1                                                             A1430
      READ (5,710) ((SPLM(I,J),I=7,30),J=1,NANG)                           A1440*
C                                                                          A1450
  100 CONTINUE                                                             A1460
C                                                                          A1470
C     CLEAR MAIN ARRAY OF SPLS FROM LARGE SCALE NOISE PREDICTION           A1480
C                                                                          A1490
      DO 110 J=1,20                                                        A1500
      DO 110 I=1,30                                                        A1510
  110 SPLLS(I,J)=1.0                                                       A1520
C                                                                          A1530
      CALL CALPER (VJA0,TJT0,P0,T0F,TRF,PRG,TRK,TRT0,PRP0,PRGA,DJD0,MJ,A   A1540$
     10,VJ,GAMA,OPPER)                                                     A1550
C                                                                          A1560
      IF (MJ.LE.1.0) GO TO 120                                             A1570
C                                                                          A1580
      BETA=SQRT(MJ*MJ-1.0)                                                 A1590
      L0=K0*DIA*BETA                                                       A1600
      L1=K1*DIA*BETA                                                       A1610
      MC=C*VJA0                                                            A1620
      VC=C*VJ                                                              A1630
C                                                                          A1640
C     WRITE JET OPERATING CONDITIONS AND ALL BASIC PARAMETERS              A1650
C                                                                          A1660
  120 WRITE (6,720) TP,OPNO,PRG,P0,TRF,T0F,GAMA                            A1670*
C                                                                          A1680
      WRITE (6,730) PRP0,TRT0,TJT0,DJD0,VJA0,MJ,VJ                         A1690*
C                                                                          A1700
      WRITE (6,740) DIA,R,ROD                                              A1710*
C                                                                          A1720
      IF (IOPT.GT.1) WRITE (6,750) RSW                                     A1730*
      IF (IOPT.EQ.3) WRITE (6,760) ALTB,BLTB                               A1740*
      IF (OPNO.EQ.3) GO TO 130                                             A1750
      IF (OPNO.EQ.5) GO TO 130                                             A1760
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      IF (OPNO.EQ.6) GO TO 130                                          A1770
      IF (OPNO.EQ.7) GO TO 130                                          A1780
      GO TO 140                                                         A1790
C                                                                       A1800
  130 WRITE (6,770) C,K0,K1,NS                                          A1810*
C                                                                       A1820
      IF (MJ.LE.1.0) GO TO 140                                          A1830
C                                                                       A1840
      WRITE (6,780) BETA,VC,MC,L0,L1                                    A1850*
C                                                                       A1860
  140 CONTINUE                                                          A1870
C                                                                       A1880
C     BEGIN ANGLE LOOP                                                  A1890
C                                                                       A1900
      JJ=IANG-INCANG                                                    A1910
      DO 620 J=1,NANG                                                   A1920
      ZM=TM(J)/57.2957795                                               A1930
      JJ=JJ+INCANG                                                      A1940
C                                                                       A1950
C     COMPUTE PACKAGE A IF OPTION NUMBER IS 1, 4, 6, OR 7               A1960
C                                                                       A1970
      IF (OPNO.EQ.1) GO TO 150                                          A1980
      IF (OPNO.EQ.4) GO TO 150                                          A1990
      IF (OPNO.EQ.6) GO TO 150                                          A2000
      IF (OPNO.EQ.7) GO TO 150                                          A2010
      GO TO 220                                                         A2020
C                                                                       A2030
  150 CONTINUE                                                          A2040
C                                                                       A2050
C     PACKAGE A -- NOISE FROM LARGE-SCALE TURBULENCE STRUCTURE*****     A2060
C                                                                       A2070
      IF (ICOMP.EQ.1) GO TO 160                                         A2080
      WRITE (6,790) TM(J)                                               A2090*
      GO TO 170                                                         A2100
  160 WRITE (6,800) TM(J)                                               A2110*
C                                                                       A2120
C     BEGIN FREQUENCY LOOP (PACKAGE A)                                  A2130
C                                                                       A2140
  170 SUMDIF=0.0                                                        A2150
      IH=IOFF                                                           A2160
      NF=0                                                              A2170
C                                                                       A2180
      DO 210 I=1,NFREQ                                                  A2190
C                                                                       A2200
      IF (J.NE.1) GO TO 180                                             A2210
      F=FREQ(I)                                                         A2220
C                                                                       A2230
C                                                                       A2240
      STRNO=F*DFT/VJ                                                    A2250
      CALL LSMAIN (VJA0,TJT0,GAMA,DFT,VJ,F,I,NANG,TM,IFLG,SPLLS)        A2260S
  180 SPLA(I)=SPLLS(I,J)                                                A2270
C                                                                       A2280
      IF (ICOMP.EQ.1) GO TO 200                                         A2290
      IH=IH+1                                                           A2300
      SPLDIF=SPLA(I)-SPLM(IH,JJ)                                        A2310
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLA(I).LE.10.0) SPLDIF=9999999.9      A2320
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLA(I).LE.10.0) GO TO 190             A2330
      SUMDIF=SUMDIF+SPLDIF**2                                           A2340
      NF=NF+1                                                           A2350
```

```
C                                                                       A2360
C     WRITE PREDICTED VALUES (PACKAGE A)                                A2370
C                                                                       A2380
  190 WRITE (6,810) FREQ(I),SPLA(I),SPLM(IH,JJ),SPLDIF,SUMDIF           A2390*
      GO TO 210                                                         A2400
  200 WRITE (6,820) FREQ(I),SPLA(I)                                     A2410*
C                                                                       A2420
  210 CONTINUE                                                          A2430
      IF (ICOMP.EQ.1) GO TO 220                                         A2440
      STDEV=0.0                                                         A2450
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                A2460
      WRITE (6,830) STDEV                                               A2470*
C                                                                       A2480
C     COMPUTE PACKAGE B IF OPTION NUMBER IS 2, 4, 5, OR 7               A2490
C                                                                       A2500
  220 IF (OPNO.EQ.2) GO TO 230                                          A2510
      IF (OPNO.EQ.4) GO TO 230                                          A2520
      IF (OPNO.EQ.5) GO TO 230                                          A2530
      IF (OPNO.EQ.7) GO TO 230                                          A2540
      GO TO 290                                                         A2550
C                                                                       A2560
  230 CONTINUE                                                          A2570
C                                                                       A2580
C     PACKAGE B -- TURBULENT MIXING NOISE******                         A2590
C                                                                       A2600
      WRITE (6,840) BOPNO                                               A2610*
      IF (ISS.EQ.1) WRITE (6,850)                                       A2620*
      IF (NU.EQ.3) WRITE (6,860)                                        A2630*
      IF (ICOMP.EQ.1) GO TO 240                                         A2640
      WRITE (6,870) TM(J)                                               A2650*
      GO TO 250                                                         A2660
  240 WRITE (6,880) TM(J)                                               A2670*
C                                                                       A2680
C     BEGIN FREQUENCY LOOP (PACKAGE B)                                  A2690
C                                                                       A2700
  250 SUMDIF=0.0                                                        A2710
      IH=IOFF                                                           A2720
      NF=0                                                              A2730
C                                                                       A2740
      DO 280 I=1,NFREQ                                                  A2750
C                                                                       A2760
      CALL MXNOISE (NU,ILWR,OPNO,BOPNO,IOPT,ROD,DFT,TOF,A0,VJ,VJA0,TJT0,  A2770$
     1I,FREQ,S,ZM,SM,RSW,ALTB,BLTB,SPLB,SPLPD,SPLPQ,IND)                A2780
C                                                                       A2790
      IF (ICOMP.EQ.1) GO TO 270                                         A2800
      IH=IH+1                                                           A2810
      SPLDIF=SPLB(I)-SPLM(IH,JJ)                                        A2820
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLB(I).LE.15.0) SPLDIF=9999999.9      A2830
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLB(I).LE.15.0) GO TO 260             A2840
      SUMDIF=SUMDIF+SPLDIF**2                                           A2850
      NF=NF+1                                                           A2860
  260 WRITE (6,890) FREQ(I),S,SM,SPLPQ,SPLPD,SPLB(I),IND,SPLM(IH,JJ),SPL  A2870*
     1DIF,SUMDIF                                                        A2880
      GO TO 280                                                         A2890
  270 WRITE (6,900) FREQ(I),S,SM,SPLPQ,SPLPD,SPLB(I),IND                A2900*
C                                                                       A2910
  280 CONTINUE                                                          A2920
C                                                                       A2930
      IF (ICOMP.EQ.1) GO TO 290                                         A2940
```

```
      STDEV=0.0                                                          A2950
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                 A2960
      WRITE (6,910) STDEV                                                A2970*
C     COMPUTE PACKAGE C IF OPTION NUMBER IS 3, 5, 6, OR 7                A2980
C                                                                        A2990
  290 IF (OPNO.EQ.3) GO TO 300                                           A3000
      IF (OPNO.EQ.5) GO TO 300                                           A3010
      IF (OPNO.EQ.6) GO TO 300                                           A3020
      IF (OPNO.EQ.7) GO TO 300                                           A3030
      GO TO 370                                                          A3040
C                                                                        A3050
  300 CONTINUE                                                           A3060
C                                                                        A3070
C     PACKAGE C -- SHOCK ASSOCIATED NOISE*****                           A3080
C                                                                        A3090
      IF (MJ.LE.1.0) GO TO 310                                           A3100
C                                                                        A3110
      DF=(1.0-(MC*COS(ZM)))                                              A3120
      WORK2=((L1*DF)/(VC*12.0))                                          A3130
C                                                                        A3140
  310 WRITE (6,920) TM(J)                                                A3150*
      IF (ICOMP.EQ.1) GO TO 320                                          A3160
      WRITE (6,930)                                                      A3170*
      GO TO 330                                                          A3180
  320 WRITE (6,940)                                                      A3190*
C                                                                        A3200
C     BEGIN FREQUENCY LOOP (PACKAGE C)                                   A3210
C                                                                        A3220
  330 SUMDIF=0.0                                                         A3230
      IH=IOFF                                                            A3240
      NF=0                                                               A3250
      DO 360 I=1,NFREQ                                                   A3260
C                                                                        A3270
      CALL SANOISE (BETA,TJTO,ROD,BC,DFT,A0,NFREQ,FREQ,I,J,TM,LO,MJ,DF,W A3280$
     1ORK2,NS,SPLC,HXX,HYY,CYY,A3,A2)                                    A3290
C                                                                        A3300
C     WRITE PREDICTED VALUES (PACKAGE C)                                 A3310
C                                                                        A3320
      IF (ICOMP.EQ.1) GO TO 350                                          A3330
      IH=IH+1                                                            A3340
      SPLDIF=SPLC(I)-SPLM(IH,JJ)                                         A3350
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLC(I).LE.10.0) SPLDIF=9999999.9       A3360
      IF (SPLM(IH,JJ).LE.10.0.OR.SPLC(I).LE.10.0) GO TO 340              A3370
      SUMDIF=SUMDIF+SPLDIF**2                                            A3380
      NF=NF+1                                                            A3390
  340 WRITE (6,950) FREQ(I),HXX,HYY,CYY,A3,A2,SPLC(I),SPLM(IH,JJ),SPLDIF A3400*
     1,SUMDIF                                                            A3410
      GO TO 360                                                          A3420
  350 WRITE (6,960) FREQ(I),HXX,HYY,CYY,A3,A2,SPLC(I)                    A3430*
C                                                                        A3440
  360 CONTINUE                                                           A3450
C                                                                        A3460
      IF (ICOMP.EQ.1) GO TO 370                                          A3470
      STDEV=0.0                                                          A3480
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                 A3490
      WRITE (6,970) STDEV                                                A3500*
  370 CONTINUE                                                           A3510
C                                                                        A3520
C     THE FOLLOWING FOUR SECTIONS COMPUTE THE TOTAL NOISE*****           A3530
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C     **FOR OPTION NUMBERS 4, 5, 6, AND 7, RESPECTIVELY*****                    A3540
C                                                                               A3550
      IF (OPNO.EQ.1) GO TO 620                                                  A3560
      IF (OPNO.EQ.2) GO TO 620                                                  A3570
      IF (OPNO.EQ.3) GO TO 620                                                  A3580
      IF (OPNO.EQ.4) GO TO 380                                                  A3590
      IF (OPNO.EQ.5) GO TO 440                                                  A3600
      IF (OPNO.EQ.6) GO TO 520                                                  A3610
      IF (OPNO.EQ.7) GO TO 540                                                  A3620
C                                                                               A3630
C     COMPUTATION FOR OPTION 4 -- TOTAL NOISE = A+B                             A3640
C                                                                               A3650
  380 WRITE (6,980) TM(J)                                                       A3660*
      IF (ICOMP.EQ.0) WRITE (6,990)                                             A3670*
      IF (ICOMP.EQ.1) WRITE (6,1000)                                            A3680*
C                                                                               A3690
      SUMDIF=0.0                                                                A3700
      IH=IOFF                                                                   A3710
      NF=0                                                                      A3720
C                                                                               A3730
      DO 430 I=1,NFREQ                                                          A3740
      SPLT(I)=10.0*ALOG10(10.0**(SPLA(I)/10.0)+10.0**(SPLB(I)/10.0))            A3750
      IF (ICOMP.EQ.1) GO TO 420                                                 A3760
      IH=IH+1                                                                   A3770
      SPLDIF=SPLT(I)-SPLM(IH,JJ)                                                A3780
      IF (SPLM(IH,JJ).LE.10.0) GO TO 390                                        A3790
      IF (SPLT(I).LE.15.0) GO TO 390                                            A3800
      GO TO 400                                                                 A3810
  390 SPLDIF=9999999.9                                                          A3820
      GO TO 410                                                                 A3830
  400 CONTINUE                                                                  A3840
      SUMDIF=SUMDIF+SPLDIF**2                                                   A3850
      NF=NF+1                                                                   A3860
  410 WRITE (6,1010) FREQ(I),SPLA(I),SPLB(I),SPLT(I),SPLM(IH,JJ),SPLDIF,        A3870*
     1SUMDIF                                                                    A3880
      GO TO 430                                                                 A3890
  420 WRITE (6,1020) FREQ(I),SPLA(I),SPLB(I),SPLT(I)                            A3900*
  430 CONTINUE                                                                  A3910
C                                                                               A3920
      IF (ICOMP.EQ.1) GO TO 620                                                 A3930
      STDEV=0.0                                                                 A3940
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                        A3950
      WRITE (6,1030) STDEV                                                      A3960*
      GO TO 620                                                                 A3970
C                                                                               A3980
C     COMPUTATION FOR OPTION 5 -- TOTAL NOISE = B+C                             A3990
C                                                                               A4000
  440 WRITE (6,1040) TM(J)                                                      A4010*
      IF (ICOMP.EQ.1) GO TO 450                                                 A4020
      WRITE (6,1050)                                                            A4030*
      GO TO 460                                                                 A4040
  450 WRITE (6,1060)                                                            A4050*
C                                                                               A4060
  460 CONTINUE                                                                  A4070
      SUMDIF=0.0                                                                A4080
      IH=IOFF                                                                   A4090
      NF=0                                                                      A4100
      DO 510 I=1,NFREQ                                                          A4110
      SPLT(I)=10.0*ALOG10(10.0**(SPLB(I)/10.0)+10.0**(SPLC(I)/10.0))            A4120
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      IF (ICOMP.EQ.1) GO TO 500                                          A4130
      IH=IH+1                                                            A4140
      SPLDIF=SPLT(I)-SPLM(IH,JJ)                                         A4150
      IF (SPLM(IH,JJ).LE.10.0) GO TO 470                                 A4160
      IF (SPLB(I).LE.15.0) GO TO 470                                     A4170
      IF (SPLC(I).LT.10.0) GO TO 470                                     A4180
      GO TO 480                                                          A4190
  470 SPLDIF=9999999.9                                                   A4200
      GO TO 490                                                          A4210
  480 CONTINUE                                                           A4220
      SUMDIF=SUMDIF+SPLDIF**2                                            A4230
      NF=NF+1                                                            A4240
  490 WRITE (6,1070) FREQ(I),SPLB(I),SPLC(I),SPLT(I),SPLM(IH,JJ),SPLDIF, A4250*
     1SUMDIF                                                             A4260
      GO TO 510                                                          A4270
  500 CONTINUE                                                           A4280
      WRITE (6,1080) FREQ(I),SPLB(I),SPLC(I),SPLT(I)                     A4290*
  510 CONTINUE                                                           A4300
C                                                                        A4310
      IF (ICOMP.EQ.1) GO TO 620                                          A4320
      STDEV=0.0                                                          A4330
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                 A4340
      WRITE (6,1090) STDEV                                               A4350*
      GO TO 620                                                          A4360
C                                                                        A4370
C     COMPUTATION FOR OPTION 6 -- TOTAL NOISE = A+C                      A4380
C                                                                        A4390
  520 WRITE (6,1100) TM(J)                                               A4400*
C                                                                        A4410
      DO 530 I=1,NFREQ                                                   A4420
      SPLT(I)=10.0*ALOG10(10.0**(SPLA(I)/10.0)+10.0**(SPLC(I)/10.0))     A4430
      WRITE (6,1110) FREQ(I),SPLA(I),SPLC(I),SPLT(I)                     A4440*
  530 CONTINUE                                                           A4450
C                                                                        A4460
      GO TO 620                                                          A4470
C                                                                        A4480
C     COMPUTATION FOR OPTION 7 -- TOTAL NOISE = A+B+C                    A4490
C                                                                        A4500
  540 WRITE (6,1120) TM(J)                                               A4510*
      IF (ICOMP.EQ.1) GO TO 550                                          A4520
      WRITE (6,1130)                                                     A4530*
      GO TO 560                                                          A4540
  550 WRITE (6,1140)                                                     A4550*
  560 CONTINUE                                                           A4560
C                                                                        A4570
      SUMDIF=0.0                                                         A4580
      IH=IOFF                                                            A4590
      NF=0                                                               A4600
      DO 610 I=1,NFREQ                                                   A4610
      SPLT(I)=10.0*ALOG10(10.0**(SPLA(I)/10.0)+10.0**(SPLB(I)/10.0)+10.0 A4620
     1**(SPLC(I)/10.0))                                                  A4630
      IF (ICOMP.EQ.1) GO TO 600                                          A4640
      IH=IH+1                                                            A4650
      SPLDIF=SPLT(I)-SPLM(IH,JJ)                                         A4660
      IF (SPLM(IH,JJ).LE.10.0) GO TO 570                                 A4670
      IF ((SPLA(I).LE.10..AND.SPLB(I).LE.15.).OR.SPLC(I).LE.10.) GO TO 5 A4680
     1170                                                                A4690
      GO TO 580                                                          A4700
  570 SPLDIF=9999999.9                                                   A4710
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      GO TO 590                                                          A4720
  580 SUMDIF=SUMDIF+SPLDIF**2                                            A4730
      NF=NF+1                                                            A4740
  590 WRITE (6,1150) FREQ(I),SPLA(I),SPLB(I),SPLC(I),SPLT(I),SPLM(IH,JJ) A4750*
     1,SPLDIF,SUM                                                        A4760
      GO TO 610                                                          A4770
  600 CONTINUE                                                           A4780
      WRITE (6,1160) FREQ(I),SPLA(I),SPLB(I),SPLC(I),SPLT(I)             A4790*
  610 CONTINUE                                                           A4800
C                                                                        A4810
      IF (ICOMP.EQ.1) GO TO 620                                          A4820
      STDEV=0.0                                                          A4830
      IF (NF.GT.0) STDEV=SQRT(SUMDIF/NF)                                 A4840
      WRITE (6,1170) STDEV                                               A4850*
      GO TO 620                                                          A4860
C                                                                        A4870
C     END ANGLE LOOP                                                     A4880
C                                                                        A4890
  620 CONTINUE                                                           A4900
      GO TO 40                                                           A4910
  630 STOP                                                               A4920
C                                                                        A4930
  640 FORMAT (1H1,10X,"DATE ",1A10,10X,"TIME ",1A10,//)                  A4940
  650 FORMAT (2X,"***LARGE SCALE NOISE FAILURES ARE INDICATED BY THE ","  A4950
     1FOLLOWING***",//,5X,"SPLA=1.0  STABILITY CALCULATIONS FAILED TO CO A4960
     2NVERGE",/5X,"SPLA=2.0  LARGE SCALE NOISE AT THIS JET VELOCITY IS N A4970
     3EGLECTED ",/5X,"SPLA=3.0  LARGE SCALE NOISE AT THIS ANGLE IS NEGLE A4980
     4CTED",/5X,"SPLA=4.0  LARGE SCALE NOISE AT THIS FREQUENCY IS NEGLEC A4990
     5TED",/,5X,"SPLA=5.0  SEARCH FOR STARTING VALUES GIVES SINGULAR MAT A5000
     6RIX",////)                                                         A5010
  660 FORMAT (2X,"***TURBULENT MIXING NOISE (BOPNO 1) FAILURES ARE INDIC A5020
     1ATED BY THE FOLLOWING***",//5X,"SPLB=1.0  VELOCITY PROFILE GRADIEN A5030
     2T IS NOT AVAILABLE",/5X,"SPLB=2.0  SM IS OUTSIDE THE RANGE OF SOUR A5040
     3CE DATA",/5X,"SPLB=3.0  SOURCE DIRECTIVITY EXPRESSION IS LESS THAN A5050
     4 ZERO",/5X,"SPLB=4.0  NUMBER OF ITERATIONS EXCEEDS 50",/5X,"SPLB=5 A5060
     5.0  SM GOES NEGATIVE IN ITERATION ROUTINE",/5X,"SPLB=6.0  ARGUMENT A5070
     6 X IN DECAY FACTOR IS NEGATIVE",/5X,"SPLB=7.0  RADIATION ANGLE IS  A5080
     7LESS THAN 30.0 DEGREES",/5X,"SPLB=8.0  TURBULENT MIXING NOISE AT T A5090
     8HIS ANGLE AND JET ","VELOCITY IS NEGLECTED",////)                   A5100
  670 FORMAT (2X,"***TURBULENT MIXING NOISE (BOPNO 2) FAILURES ARE INDIC A5110
     1ATED BY THE FOLLOWING***",//5X,"SPLB=2.0  SM IS OUTSIDE THE RANGE  A5120
     2OF SOURCE DATA",/5X,"SPLB=3.0  SOURCE DIRECTIVITY EXPRESSION IS LE A5130
     3SS THAN ZERO",/5X,"SPLB=4.0  NUMBER OF ITERATIONS EXCEEDS 50",/5X, A5140
     4"SPLB=5.0  SM GOES NEGATIVE IN ITERATION ROUTINE",/5X,"SPLB=8.0  T A5150
     5URBULENT MIXING NOISE AT THIS ANGLE AND JET ","VELOCITY IS NEGLECT A5160
     6ED",/,5X,"SPLB=9.0  CRITICAL LAYER RADIUS TOO SMALL",/,5X,"SPLB=10 A5170
     7.0  BESSEL FUNCTION FAILURE",/,5X,"SPLB=11.0  SOURCE AND CRITICAL  A5180
     8LAYER RADIUS COINCIDE",////)                                       A5190
  680 FORMAT (2X,"***SHOCK ASSOCIATED NOISE FAILURES ARE INDICATED BY TH A5200
     1E FOLLOWING***",//5X,"SPLC=1.0  MJ IS LESS THAN 1.0",/5X,"SPLC=2.0 A5210
     2  SIGMA IS OUTSIDE THE RANGE OF MASTER SPECTRA",/5X,"SPLC=3.0  SHO A5220
     3CK NOISE CONTRIBUTION AT THIS ANGLE AND JET"," TEMPERATURE"/15X,"C A5230
     4AN BE (AND IS) NEGLECTED")                                         A5240
  690 FORMAT (8F10.0)                                                    A5250
  700 FORMAT (16I5)                                                      A5260
  710 FORMAT (12F6.1)                                                    A5270
  720 FORMAT (1H1,//////17X,40H***** UNIFIED JET NOISE PREDICTION *****, A5280
     1///32X,10HTEST POINT,I4,///31X,13HOPTION NUMBER,I3,///5X,20HRESERV A5290
     2OIR PRESSURE =,F6.2,2BH PSI, ATMOSPHERIC PRESSURE =,F6.2,4H PSI,/1 A5300
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   3X,23HRESERVOIR TEMPERATURE =,F7.1,29H DEG.F, CHAMBER TEMPERATURE =  A5310
   4,F7.1,3H DEG.F,/31X,7HGAMMA =,F5.2)                                A5320
730 FORMAT (//10X,22HPRESSURE RATIO PR/P0 =,F6.3,/10X,25HTEMPERATURE R  A5330
   1ATIO TR/T0 =,F6.3,/10X,36HJET STATIC TEMPERATURE RATIO TJ/T0 =,F6.  A5340
   23,/10X,25HJET DENSITY RATIO DJ/D0 =,F6.3,/10X,26HJET VELOCITY RATI  A5350
   30 VJ/A0 =,F6.3,/10X,20HJET MACH NUMBER MJ =,F6.3,/10X,17HJET VELOC  A5360
   4ITY VJ =,F7.1,4H FPS)                                               A5370
740 FORMAT (//10X,17HNOZZLE DIAMETER =,F6.2,7H INCHES,/10X,21HMICROPHO  A5380
   1NE DISTANCE =,F6.2,5H FEET,/10X,5HR/D =,F6.2)                       A5390
750 FORMAT (//,10X,"TURBULENCE INTENSITY RADIAL HALF WIDTH = ",E13.6)    A5400
760 FORMAT (10X,"RADIAL COHERENCE LENGTH SCALE COEFFICIENTS (A,B) = ",   A5410
   1E13.6," , ",E13.6)                                                  A5420
770 FORMAT (///10X,37H**SHOCK ASSOCIATED NOISE PARAMETERS**,///10X,3HC  A5430
   1 =,F5.2,5X,4HK0 =,F5.2,5X,4HK1 =,F5.2,/10X,21HNUMBER OF SHOCKS NS   A5440
   2=,I3)                                                               A5450
780 FORMAT (//10X,6HBETA =,F6.3,/10X,29HEDDY CONVECTION VELOCITY VC =,  A5460
   1F7.1,4H FPS,/10X,32HEDDY CONVECTION MACH NUMBER MC =,F6.3,/10X,30H  A5470
   2AVERAGE SHOCK CELL LENGTH L0 =,F7.3,7H INCHES,/10X,28HFIRST SHOCK   A5480
   3CELL LENGTH L1 =,F7.3,7H INCHES)                                    A5490
790 FORMAT (1H1,//////,5X,"NOISE FROM LARGE-SCALE TURBULENCE ","STRUCT  A5500
   1URE",///,5X,"OBSERVER ANGLE =",F7.2," DEGREES",///,1X,3X,"FREQ(HZ)  A5510
   2",4X,"SPLA(DB)",16X,"SPLM(DB)",4X,"DIFF",9X,"SUM",/)                A5520
800 FORMAT (1H1,//////5X,"NOISE FROM LARGE-SCALE TURBULENCE STRUCTURE"   A5530
   1,///5X,16HOBSERVER ANGLE =,F7.2,8H DEGREES,///1X,3X,"FREQ(HZ)",4X,  A5540
   2"SPLA(DB)"/)                                                        A5550
810 FORMAT (2X,2F10.1,14X,2(4X,F6.1),2X,F12.1)                          A5560
820 FORMAT (2X,F10.1,F10.1)                                             A5570
830 FORMAT (//,40X,"STANDARD DEVIATION = ",F7.2)                        A5580
840 FORMAT (1H1,////,5X,"TURBULENT MIXING NOISE (BOPNO =",I2,")")       A5590
850 FORMAT (/,T2,"*** ALTERNATIVE AXIAL SOURCE LOCATION MODEL ","UTILI  A5600
   1ZED ***")                                                           A5610
860 FORMAT (/,T2,"*** DISPLACEMENT SOURCE MODEL ***")                   A5620
870 FORMAT (///,5X,"OBSERVER ANGLE =",F7.2," DEGREES",///,1X,3X,"FREQ(  A5630
   1HZ)",4X,"FD/VJ",6X,"SM",5X,"SPLPQ(DB)",1X,"SPLPD(DB)",2X,"SPLB(DB)  A5640
   2",16X,"SPLM(DB)",4X,"DIFF",9X,"SUM",/)                              A5650
880 FORMAT (///,5X,16HOBSERVER ANGLE =,F7.2,8H DEGREES,///1X,3X,"FREQ(  A5660
   1HZ)",4X,"FD/VJ",6X,"SM",5X,"SPLPQ(DB)",1X,"SPLPD(DB)",2X,"SPLB(DB)  A5670
   2"/)                                                                 A5680
890 FORMAT (1X,F10.1,2F10.3,3F10.1,2X,A2,10X,2(4X,F6.1),2X,F12.1)       A5690
900 FORMAT (1X,F10.1,2F10.3,3F10.1,2X,A2)                               A5700
910 FORMAT (//,74X,"STANDARD DEVIATION = ",F7.2)                        A5710
920 FORMAT (1H1,//////5X,"SHOCK ASSOCIATED NOISE",///5X,16HOBSERVER AN  A5720
   1GLE =,F7.2,8H DEGREES,///)                                          A5730
930 FORMAT (1X,3X,"FREQ(HZ)",3X,"SIGMA",3X,"H0(DB)",3X,"C1",3X,"ANS3(D  A5740
   1B)",3X,"ANS2(DB)",5X,"SPLC(DB)",16X,"SPLM(DB)",4X,"DIFF",9X,"SUM",  A5750
   2/)                                                                  A5760
940 FORMAT (1X,3X,"FREQ(HZ)",3X,"SIGMA",3X,"H0(DB)",3X,"C1",3X,"ANS3(D  A5770
   1B)",3X,"ANS2(DB)",5X,"SPLC(DB)"/)                                   A5780
950 FORMAT (2X,F10.1,3X,F5.2,3X,F6.1,2X,F4.2,2X,F7.1,4X,F7.1,5X,F7.1,1  A5790
   15X,2(4X,F6.1),2X,F12.1)                                             A5800
960 FORMAT (2X,F10.1,3X,F5.2,3X,F6.1,2X,F4.2,2X,F7.1,4X,F7.1,5X,F7.1)   A5810
970 FORMAT (//,85X,"STANDARD DEVIATION = ",F7.2)                        A5820
980 FORMAT (1H1,//////5X,"TOTAL NOISE",///5X,16HOBSERVER ANGLE =,F7.2,  A5830
   18H DEGREES,///)                                                     A5840
990 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLA(DB)",2X,"SPLB(DB)",2X,"SPLT(DB)"  A5850
   1,19X,"SPLM(DB)",19X,"DIFF",13X,"SUMDIFF",/)                         A5860
1000 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLA(DB)",2X,"SPLB(DB)",2X,"SPLT(DB)" A5870
   1,/)                                                                 A5880
1010 FORMAT (2X,4F10.1,19X,F10.1,14X,F6.1,8X,F12.1)                     A5890
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1020 FORMAT (2X,4F10.1)                                                    A5900
1030 FORMAT (//,T79,"STANDARD DEVIATION = ",F6.1)                          A5910
1040 FORMAT (1H1,//////5X,"TOTAL NOISE",///5X,16HOBSERVER ANGLE =,F7.2,    A5920
     18H DEGREES,///)                                                      A5930
1050 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLB(DB)",2X,"SPLC(DB)",2X,"SPLT(DB)"   A5940
     1,16X,"SPLM(DB)",4X,"DIFF",9X,"SUM",/)                                A5950
1060 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLB(DB)",2X,"SPLC(DB)",2X,"SPLT(DB)"   A5960
     1/)                                                                   A5970
1070 FORMAT (2X,4F10.1,16X,2(4X,F6.1),2X,F12.1)                            A5980
1080 FORMAT (2X,4F10.1)                                                    A5990
1090 FORMAT (///,T64,"STANDARD DEVIATION = ",F6.1)                         A6000
1100 FORMAT (1H1,//////5X,"TOTAL NOISE",///5X,16HOBSERVER ANGLE =,F7.2,    A6010
     18H DEGREES,///1X,4X,"FREQ(HZ)",3X,"SPLA(DB)",2X,"SPLC(DB)",2X,"SPL   A6020
     2T(DB)"/)                                                             A6030
1110 FORMAT (2X,4F10.1)                                                    A6040
1120 FORMAT (1H1,//////5X,"TOTAL NOISE",///5X,16HOBSERVER ANGLE =,F7.2,    A6050
     18H DEGREES,///)                                                      A6060
1130 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLA(DB)",2X,"SPLB(DB)",2X,"SPLC(DB)"   A6070
     1,2X,"SPLT(DB)",16X,"SPLM(DB)",4X,"DIFF",9X,"SUM",/)                  A6080
1140 FORMAT (1X,4X,"FREQ(HZ)",3X,"SPLA(DB)",2X,"SPLB(DB)",2X,"SPLC(DB)"   A6090
     1,2X,"SPLT(DB)"/)                                                     A6100
1150 FORMAT (2X,5F10.1,15X,2(4X,F6.1),2X,F12.1)                            A6110
1160 FORMAT (2X,5F10.1)                                                    A6120
1170 FORMAT (//,T71,"STANDARD DEVIATION = ",F6.1)                          A6130
     END                                                                   A6140-
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*DECK CALPER
      SUBROUTINE CALPER (VJA0,TJT0,P0,T0F,TRF,PRG,TRK,TRT0,PRP0,PRGA,DJD  B  10
     10,MJ,A0,VJ,GAMA,OPPER)                                              B  20
      REAL MJ                                                             B  30
      INTEGER OPPER                                                       B  40
      DIMENSION GAM(11)                                                   B  50
      IF (OPPER.EQ.1) GO TO 30                                            B  60
C                                                                         B  70
C     CALCULATIONS FROM INPUT OF TJT0,VJA0,T0F,AND P0                     B  80
C                                                                         B  90
      TRK=5./9.*(T0F+460.0)*TJT0                                          B 100
      T0K=(5.0*(T0F+460.0))/9.0                                           B 110
      GAMA0=1.421-(T0K/11800.0)+(EXP(-ABS(T0K-450.0)/200.0)/80.0)         B 120
      IF (T0K.LE.290.0) GAMA0=1.402                                       B 130
      A0=SQRT(GAMA0*1716.8*(T0F+460.0))                                   B 140
      TJK=TJT0*T0K                                                        B 150
      GAMAJ=1.421-(TJK/11800.0)+(EXP(-ABS(TJK-450.0)/200.0)/80.0)         B 160
      IF (TJK.LE.290.0) GAMAJ=1.402                                       B 170
      GJG0=GAMAJ/GAMA0                                                    B 180
      MJ=VJA0/SQRT(GJG0*TJT0)                                             B 190
      VJ=VJA0*A0                                                          B 200
      DJD0=1.0/TJT0                                                       B 210
      GAM(1)=0.0                                                          B 220
      DO 10 I=2,11                                                        B 230
      GAM(I)=1.421-(TRK/11800.0)+(EXP(-ABS(TRK-450.0)/200.0)/80.0)        B 240
      IF (TRK.LE.290.0) GAM(I)=1.402                                      B 250
      PRGA=1.0+((GAM(I)-1.0)/2.0*MJ**2)                                   B 260
      PRP0=PRGA**(GAM(I)/(GAM(I)-1.0))                                    B 270
      TRT0=TJT0*PRGA                                                      B 280
      TRK=5./9.*(T0F+460.0)*TRT0                                          B 290
      PRG=(PRP0-1.0)*P0                                                   B 300
      TRF=TRT0*(T0F+460.0)-460.0                                          B 310
      DIFF=ABS(GAM(I)-GAM(I-1))                                           B 320
      JJ=I                                                                B 330
      IF (DIFF.LE.0.0001) GO TO 20                                        B 340
   10 CONTINUE                                                            B 350
      WRITE (6,40)                                                        B 360*
      STOP 100                                                            B 370
   20 GAMA=GAM(JJ)                                                        B 380
      RETURN                                                              B 390
C                                                                         B 400
C     CALCULATIONS FROM INPUT OF P0,T0F,PRG, AND TRF                      B 410
C                                                                         B 420
   30 PRP0=(PRG/P0)+1.0                                                   B 430
      TRT0=(TRF+460.0)/(T0F+460.0)                                        B 440
      TRK=(5.0*(TRF+460.0))/9.0                                           B 450
      GAMA=1.421-(TRK/11800.0)+(EXP(-ABS(TRK-450.0)/200.0)/80.0)          B 460
      IF (TRK.LE.290.0) GAMA=1.402                                        B 470
      PRGA=PRP0**((GAMA-1.0)/GAMA)                                        B 480
      MJ=SQRT((2.0/(GAMA-1.0))*(PRGA-1.0))                                B 490
      TJT0=TRT0/PRGA                                                      B 500
      DJD0=1.0/TJT0                                                       B 510
      T0K=(5.0*(T0F+460.0))/9.0                                           B 520
      GAMA0=1.421-(T0K/11800.0)+(EXP(-ABS(T0K-450.0)/200.0)/80.0)         B 530
      IF (T0K.LE.290.0) GAMA0=1.402                                       B 540
      A0=SQRT(GAMA0*1716.8*(T0F+460.0))                                   B 550
      TJK=TJT0*T0K                                                        B 560
      GAMAJ=1.421-(TJK/11800.0)+(EXP(-ABS(TJK-450.0)/200.0)/80.0)         B 570
      IF (TJK.LE.290.0) GAMAJ=1.402                                       B 580
```

```
      GJG0=GAMAJ/GAMA0                                                    B 590
      VJA0=MJ*SQRT(GJG0*TJT0)                                             B 600
      VJ=VJA0*A0                                                          B 610
      RETURN                                                              B 620
C                                                                         B 630
   40 FORMAT (///,1X,"***** THE GAMA ITERATION FAILED TO CONVERGE ","AFT  B 640
     1ER 10 TRIES. COMPUTATION STOPPED - CHECK INPUT. *****")              B 650
      END                                                                 B 660-
```

```
*DECK LSMAIN
      SUBROUTINE LSMAIN (VJA,TJT,GAMA,DFT,VJ,F,I,NANG,TM,IFN,SPLLS)          C  10
C                                                                            C  20
C     THIS PROGRAM IS AN INTERMEDIATE STEP BETWEEN UNIMAIN AND               C  30
C      LSNOISE TO HANDLE INITIALIZATION AND ERROR PROCESSING                 C  40
C                                                                            C  50
      DIMENSION TM(20),PTHETA(20),PDB(20),SPLLS(30,20)                       C  60
      COMPLEX ALPHA,DKDB                                                     C  70
       REAL MACH2,MLS                                                        C  80
      INTEGER GAMMA                                                          C  90
      COMMON/INFO/ALPHA,OMEGA,MACH2,TJT0,NORD,GM1,DKDB,IFLG,VJA0             C 100
      TJT0=TJT                                                               C 110
      VJA0=VJA                                                               C 120
      IFLG=IFN                                                               C 130
      B0=0.05                                                                C 140
      GAMMA=8                                                                C 150
      INF=0                                                                  C 160
      RADNF=0.                                                               C 170
      RSTART=0.                                                              C 180
      XLAST=0.                                                               C 190
      FREQ=F                                                                 C 200
      IEROR=0                                                                C 210
      SN=F*DFT/VJ                                                            C 220
      MLS=17.2*ALOG10(10.0*SN)                                               C 230
      CLS=74.13*SN**(-0.136)                                                 C 240
      CAL=MLS*10.0*ALOG10(VJA0)+CLS                                          C 250
      IF (VJA0.LT.1.15) GO TO 20                                             C 260
      IF (SN.LT.0.1.OR.SN.GT.0.5) GO TO 40                                   C 270
      CALL LSNOIS (FREQ,TM,NANG,GAMA,DFT,VJ,B0,GAMMA,INF,RADNF,XLAST,RST     C 280s
     1ART,PTHETA,PDB,IEROR)                                                  C 290
      IF (IEROR.EQ.1) RETURN                                                 C 300
      IF (IEROR.EQ.2) GO TO 60                                               C 310
      DO 10 J=1,NANG                                                         C 320
      SPLLS(I,J)=PDB(J)+CAL                                                  C 330
      IF (TM(J).LT.15.0.OR.TM(J).GT.45.0) SPLLS(I,J)=3.0                     C 340
   10 CONTINUE                                                               C 350
      RETURN                                                                 C 360
   20 DO 30 J=1,NANG                                                         C 370
   30 SPLLS(I,J)=2.0                                                         C 380
      RETURN                                                                 C 390
   40 DO 50 J=1,NANG                                                         C 400
   50 SPLLS(I,J)=4.0                                                         C 410
      RETURN                                                                 C 420
   60 DO 70 J=1,NANG                                                         C 430
   70 SPLLS(I,J)=5.0                                                         C 440
      RETURN                                                                 C 450
      END                                                                    C 460-
```

```
*DECK LSNOISE
      SUBROUTINE LSNOIS (FREQ,TM,NANG,GAMA,DFT,VJ,B0,GAMMA,INF,RADNF,XLA   D  10
     1ST,RSTART,PTHETA,PDB,IEROR)                                          D  20
       DIMENSION TM(NANG),PTHETA(NANG),PDB(NANG)                           D  30
C      ***************************************************************    D  40
C      *                                                             *    D  50
C      *      THIS PROGRAM DETERMINES THE GROWTH OF PRESSURE         *    D  60
C      *      FLUCTUATIONS IN A DIVERGING, COMPRESSIBLE              *    D  70
C      *      AXISYMMETRIC JET.                                      *    D  80
C      *                                                             *    D  90
C      ***************************************************************    D 100
       COMPLEX PY(3),Y(3),DY(3),P(3),Q(3),ACON(130),BB(130),ALPHA           D 110
       COMPLEX BB4,CSTEP,LIM(6),RADC,RAD,DIR(6)                            D 120
       COMPLEX UVAL,DUVAL,CVAL,LAMDAM,LAMDAP,ETAC                          D 130
       COMPLEX RHO,DRHO,AC,PP,DPP,ADAT(100),CDAT(100)                      D 140
       COMPLEX DUDS,D2UDRS,DRDS,D2RDRS                                     D 150
       COMPLEX HSUM(2,3,2),ISUM(2,2),DUMH(3),DUM,DUM1,L1,L2                D 160
       COMPLEX DKDB                                                        D 170
       COMPLEX ARG,H01,H02,H11,H12,I0,I1                                   D 180
       COMPLEX E0,E1,E2,E3,A2,A4                                           D 190
       REAL MACH2                                                          D 200
       INTEGER GAMMA                                                       D 210
       DIMENSION SDAT(100)                                                 D 220
       COMMON/INFO/ALPHA,OMEGA,MACH2,TJT0,NORD,GM1,DKDB,IFLG,VJA0          D 230
       COMMON/SPR/HTHETA,S,KEY1,UCENT,DUCDS,BETA1,BETA2,IFUNC              D 240
       COMMON/DECAY/ ID,SD                                                 D 250
      SMIN1=2.5E-4                                                         D 260
      SMAX1=.05                                                            D 270
      ERMIN=.1                                                             D 280
      ERMAX=.14                                                            D 290
      ERMIN=.1                                                             D 300
      ERMAX=.14                                                            D 310
      PI=3.14159265                                                        D 320
      A=.693147                                                            D 330
      STRNO=FREQ*DFT/VJ                                                    D 340
      NTT=0                                                                D 350
      ID=0                                                                 D 360
      SD=1000.                                                             D 370
C                                                                          D 380
C             SET UP CONDITIONS FOR STABILITY CALCULATION                  D 390
C                                                                          D 400
C             STARTING RADIUS                                              D 410
      RST1=0.05                                                            D 420
C             FINISHING RADIUS                                             D 430
      RFIN=4.                                                              D 440
C             DIMENSIONS OF COMPLEX CONTOUR DEFORMATION                    D 450
      ETA11=0.5                                                            D 460
      ETA21=0.5                                                            D 470
C             NUMBER OF THICKNESSES TO BE CALCULATED                       D 480
      NLIM=70                                                              D 490
C     3+          VARIATION IN PERCENTAGE FOR WAVENUMBER GUESSES           D 500
      PERCR=0.005                                                          D 510
      PERCI=0.005                                                          D 520
C      THICKNESS STEP SIZE                                                 D 530
      DS=0.005/STRNO                                                       D 540
C      STARTING THICKNESS FOR BOUNDARY LAYER                               D 550
      S=0.05-DS                                                            D 560
C             SET UP CALCULATED VALUE OF MODENUMBER                        D 570
      NORD=1                                                               D 580
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```
      AN=FLOAT(NORD)                                                    D 590
      GM1=GAMA-1                                                        D 600
      MACH2=VJA0*VJA0                                                   D 610
      NORD1=NORD+1                                                      D 620
   10 S=S+DS                                                            D 630
C                                                                       D 640
C              ADJUST MINIMUM AND MAXIMUM STEP SIZES TO THE LOCAL WIDTH D 650
C                                                                       D 660
      SMIN=SMIN1*S                                                      D 670
      SMAX=SMAX1*S                                                      D 680
      IF (SMIN.GT.SMIN1) SMIN=SMIN1                                     D 690
      IF (SMAX.LT.SMAX1) SMAX=SMAX1                                     D 700
      ETA1=ETA11*S                                                      D 710
      ETA2=ETA21*S                                                      D 720
C                                                                       D 730
C             CALCULATE THE LOCAL POTENTIAL CORE RADIUS                 D 740
C             OR THE CENTERLINE VELOCITY                                D 750
C                                                                       D 760
      KEY1=3                                                            D 770
      BETA1=0.                                                          D 780
      BETA2=0.                                                          D 790
      UCENT=1.                                                          D 800
      RAD=CMPLX(-.0125,0.)                                              D 810
      DO 20 I=1,161                                                     D 820
      RAD=RAD+.025                                                      D 830
      CALL UEVAL (RAD,UVAL,DUVAL,DUDS,D2UDRS,RHO,DRHO,DRDS,D2RDRS)      D 840$
      VAL=REAL(RHO*UVAL*UVAL)                                           D 850
      BETA1=BETA1+VAL*.025                                              D 860
      BETA2=BETA2+VAL*REAL(RAD)*.025                                    D 870
      IF (ABS(VAL).LT.1.E-5) GO TO 30                                   D 880
   20 CONTINUE                                                          D 890
C                                                                       D 900
C             CALCULATION OF THE POTENTIAL CORE RADIUS                  D 910
C                                                                       D 920
   30 VAL=S*S*((TJT0*BETA1)**2-2.*TJT0*BETA2)+1.                        D 930
      IF (VAL) 70,40,40                                                 D 940
   40 VAL=-S*BETA1*TJT0+SQRT(VAL)                                       D 950
      IF (VAL) 70,50,50                                                 D 960
   50 HTHETA=VAL                                                        D 970
      KEY1=1                                                            D 980
      IF (HTHETA.LT.RST1) GO TO 60                                      D 990
      RST=HTHETA+.1E-10                                                 D1000
      GO TO 150                                                         D1010
   60 RST=RST1                                                          D1020
      GO TO 150                                                         D1030
C                                                                       D1040
C             CALCULATION OF THE CENTERLINE VELOCITY                    D1050
C                                                                       D1060
   70 KEY1=4                                                            D1070
   80 BETA2=0.                                                          D1080
      RAD=CMPLX(-.0125,0.)                                              D1090
      USAVE=UCENT                                                       D1100
      DO 90 I=1,161                                                     D1110
      RAD=RAD+.025                                                      D1120
      CALL UEVAL (RAD,UVAL,DUVAL,DUDS,D2UDRS,RHO,DRHO,DRDS,D2RDRS)      D1130$
      VAL=REAL(RHO*UVAL*UVAL)                                           D1140
      BETA2=BETA2+VAL*REAL(RAD)*.025                                    D1150
      IF (ABS(VAL).LT.1.E-5) GO TO 100                                  D1160
   90 CONTINUE                                                          D1170
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  100 UCENT=1./SQRT(2.*TJT0*BETA2)/S                                        D1180
      IF (ABS(UCENT-USAVE).LT.1.E-4) GO TO 110                              D1190
      GO TO 80                                                              D1200
C                                                                           D1210
C             CALCULATION OF RATE OF CHANGE OF CENTERLINE VELOCITY          D1220
C             WITH LOCAL THICKNESS                                          D1230
C                                                                           D1240
  110 AA=GM1*MACH2/2.                                                       D1250
      BA=(1.-TJT0-AA)                                                       D1260
      AK=SQRT(BA*BA+4.*AA)                                                  D1270
      IF (VJA0.LT.1.E-10) GO TO 120                                         D1280
      DUCDS=-((AA*UCENT+BA)*UCENT-1.)*(ALOG(ABS((AA*UCENT+BA)*UCENT-1.))    D1290
     1-BA*ALOG(ABS((2.*AA*UCENT+BA-AK)*(BA+AK)/(2.*AA*UCENT+BA+AK)/(BA-A    D1300
     2K)))/AK)/UCENT/S/AA                                                   D1310
      GO TO 140                                                             D1320
  120 BA=1.-TJT0                                                            D1330
      IF (ABS(BA).LT.1.E-10) GO TO 130                                      D1340
      DUCDS=2.*(1.-BA*UCENT)*(BA*UCENT+ALOG(ABS(1.-BA*UCENT)))/S/UCENT/B    D1350
     1A/BA                                                                  D1360
      GO TO 140                                                             D1370
  130 DUCDS=-UCENT/S                                                        D1380
  140 KEY1=2                                                                D1390
      GO TO 160                                                             D1400
  150 YMAX=RFIN*S+HTHETA                                                    D1410
      GO TO 170                                                             D1420
  160 YMAX=RFIN*S                                                           D1430
  170 CONTINUE                                                              D1440
C                                                                           D1450
C           READ IN OR INTERPOLATE FOR THE GUESSED VALES OF ALPHA           D1460
C                                                                           D1470
      IF (NTT.EQ.NLIM) GO TO 710                                            D1480
      IF (NTT.EQ.0) GO TO 190                                               D1490
      ALPHA=ALPHA+DKDB*DS                                                   D1500
C                                                                           D1510
C             CONVERGENCE SEARCH FOR DAMPED SUPERSONIC WAVE                 D1520
C                                                                           D1530
      IF (AIMAG(ALPHA).LT.0.) GO TO 180                                     D1540
      IF ((OMEGA/REAL(ALPHA)).LT.(1./VJA0)) GO TO 180                       D1550

      ID=1                                                                  D1560
      SD=S-DS                                                               D1570
      GO TO 710                                                             D1580
  180 ACON(1)=ALPHA                                                         D1590
      ACON(2)=CMPLX((1.-PERCR)*REAL(ALPHA),(1.-PERCI)*AIMAG(ALPHA))         D1600
      ACON(3)=CMPLX((1.+PERCR)*REAL(ALPHA),(1.+PERCI)*AIMAG(ALPHA))         D1610
      NT=3                                                                  D1620
      GO TO 200                                                             D1630
C                                                                           D1640
C             DETERMINE THE STARTING VALUES FROM TABULATION                 D1650
C                                                                           D1660
  190 CALL ASTART (VJA0,STRNO,TJT0,ALPHA,NORD,IEROR)                        D1670$
      IF (IEROR.NE.2) GO TO 180                                             D1680
      RETURN                                                                D1690
C                                                                           D1700
C             CALCULATE STROUHAL NUMBER AND RADIAN FREQUENCY                D1710
C                                                                           D1720
  200 STRNO=FREQ*DFT/VJ                                                     D1730
      OMEGA=STRNO*PI                                                        D1740
      IF (IFLG.EQ.0) GO TO 210                                              D1750
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      WRITE (6,740) NORD,VJA0,TJT0,STRNO,OMEGA,S                        D1760*
  210 IF (KEY1.EQ.2) GO TO 220                                          D1770
      IF (IFLG.EQ.0) GO TO 230                                          D1780
      WRITE (6,750) HTHETA                                              D1790*
      GO TO 230                                                         D1800
  220 IF (IFLG.EQ.0) GO TO 230                                          D1810
      WRITE (6,760) UCENT                                               D1820*
C                                                                       D1830
C           BEGIN THE INTEGRATION AND CALCULATE THE                     D1840
C           STARTING VECTORS                                            D1850
C                                                                       D1860
  230 KK=0                                                              D1870
      IFUNC=1                                                           D1880
      IF (IFLG.EQ.0) GO TO 240                                          D1890
      WRITE (6,830) BETA1,BETA2                                         D1900*
  240 KK=KK+1                                                           D1910
      ALPHA=ACON(KK)                                                    D1920
C                                                                       D1930
C             IF KEY1 = 2 THE STARTING VECTORS ARE OBTAINED FROM A      D1940
C             SERIES SOLUTION                                           D1950
C                                                                       D1960
  250 IF (KEY1.EQ.2) GO TO 290                                          D1970
      LAMDAM=CSQRT(ALPHA*ALPHA-MACH2*(ALPHA-OMEGA)*(ALPHA-OMEGA)/TJT0)  D1980
      DO 260 I=1,3                                                      D1990
  260 Y(I)=(0.,0.)                                                      D2000
      Y(1)=CMPLX(RST,0.)                                                D2010
      ARG=LAMDAM*Y(1)                                                   D2020
      PHI=ATAN2(AIMAG(ARG),REAL(ARG))                                   D2030
      IF (PHI.GT.-PI.AND.PHI.LE.PI/2.) GO TO 270                        D2040
      ARG=ARG*(0.,-1.)                                                  D2050
      CALL NCBRTS (ARG,H01,H02,NORD,0)                                  D2060$
      CALL NCBRTS (ARG,H11,H12,NORD1,0)                                 D2070$
      I0=CEXP((0.,1.)*AN*PI/2.)*H01                                     D2080
      I1=CEXP((0.,1.)*(AN+1.)*PI/2.)*H11                                D2090
      GO TO 280                                                         D2100
  270 ARG=ARG*(0.,1.)                                                   D2110
      CALL NCBRTS (ARG,H01,H02,NORD,0)                                  D2120$
      CALL NCBRTS (ARG,H11,H12,NORD1,0)                                 D2130$
      I0=CEXP((0.,-1.)*AN*PI/2.)*H01                                    D2140
      I1=CEXP((0.,-1.)*(AN+1.)*PI/2.)*H11                               D2150
  280 Y(2)=I0                                                           D2160
      Y(3)=AN*I0/Y(1)+LAMDAM*I1                                         D2170
      GO TO 300                                                         D2180
C                                                                       D2190
C           SERIES SOLUTION FOR THE STARTING VECTORS                    D2200
C                                                                       D2210
  290 RHO=1./(1.-(1.-TJT0)*UCENT+0.5*GM1*MACH2*UCENT*(1.-UCENT))        D2220
      DRHO=-UCENT*RHO*RHO*(1.-TJT0-0.5*GM1*MACH2*(1.-2.*UCENT))         D2230
      D2RDR2=2.*DRHO*DRHO/RHO-DRHO*GM1*MACH2*RHO*RHO*UCENT*UCENT        D2240
      DUM=ALPHA*UCENT-OMEGA                                             D2250
      E0=(MACH2*DUM*DUM*RHO-ALPHA*ALPHA)                                D2260
      E1=(4.*ALPHA*UCENT/DUM-2.*DRHO/RHO)*A/S/S                         D2270
      E2=MACH2*DUM*(DUM*DRHO-2.*ALPHA*UCENT*RHO)*A/S/S                  D2280
      E3=(4.*ALPHA*UCENT*OMEGA/DUM/DUM-2.*(D2RDR2-DRHO*DRHO/RHO)/RHO)*A*D2290
     1A/S*4                                                             D2300
      A2=-(E0+AN*E1)/4./(AN+1.)                                         D2310
      A4=-(E2+AN*E3+A2*(E0+(AN+2.)*E1))/8./(AN+2.)                      D2320
      Y(1)=CMPLX(RST1,0.)                                               D2330
      Y(2)=Y(1)**NORD*(1.+Y(1)*Y(1)*(A2+A4*Y(1)*Y(1)))                  D2340
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      Y(3)=Y(1)**(NORD-1)*(AN*Y(1)*Y(1)*((AN+2.)*A2+(AN+4.)*A4*Y(1)*Y(1)   D2350
     1))                                                                   D2360
  300 M=3                                                                  D2370
C                                                                          D2380
C             IF IFUNC = 1,  EIGENVALUE IS BEING CALCULATED                D2390
C             IF IFUNC = 2,  DALPHA/DS IS BEING CALCULATED FROM THE        D2400
C                            SOLVABILITY CONDITION                         D2410
C                                                                          D2420
      IF (IFUNC.EQ.1) GO TO 320                                            D2430
      IF (KEY1.EQ.2) GO TO 310                                             D2440
      DUM=ALPHA-OMEGA                                                      D2450
      HSUM(1,1,1)=(0.,0.)                                                  D2460
      HSUM(2,1,1)=2.*(ALPHA-MACH2*DUM/TJT0)*Y(1)*Y(2)*Y(2)/DUM/DUM         D2470
      ISUM(1,1)=(0.,0.)                                                    D2480
      ISUM(2,1)=(ALPHA-MACH2*DUM/TJT0)*Y(1)*Y(1)*(I0*I0-I1*I1-2.*AN*I0*I  D2490
     11/LAMDAM/Y(1))/DUM/DUM*TJT0                                          D2500
      GO TO 320                                                            D2510
  310 CALL UEVAL (Y(1),UVAL,DUVAL,DUDS,D2UDRS,RHO,DRHO,DRDS,D2RDRS)        D2520$
      DUM=ALPHA*UVAL-OMEGA                                                 D2530
      HSUM(1,1,1)=(((D2RDRS-DRHO*DRDS/RHO)/RHO/RHO+2.*ALPHA*(D2UDRS-ALPH  D2540
     1A*DUVAL*DUDS/DUM)/RHO/DUM)*Y(3)/DUM/DUM-2.*MACH2*(DRDS/RHO+ALPHA*D  D2550
     2UDS/DUM)*Y(2))*Y(2)*Y(1)                                             D2560
      HSUM(2,1,1)=2.*(ALPHA-MACH2*DUM*RHO*UVAL)*Y(1)*Y(2)*Y(2)/DUM/DUM-2   D2570
     1.*OMEGA*DUVAL*Y(3)*Y(2)*Y(1)/DUM**4/RHO                              D2580
      ISUM(1,1)=(0.,0.)                                                    D2590
      ISUM(2,1)=(0.,0.)                                                    D2600
  320 INT=0                                                                D2610
C                                                                          D2620
C             DETERMINE THE CONTOUR OF INTEGRATION-                        D2630
C             LOCATE THE CRITICAL POINT                                    D2640
C                                                                          D2650
      IND=0                                                                D2660
      DO 330 I=1,3                                                         D2670
  330 DIR(I)=(1.,0.)                                                       D2680
      DO 340 I=4,6                                                         D2690
  340 DIR(I)=(-1.,0.)                                                      D2700
      CVAL=OMEGA/ALPHA                                                     D2710
      ETAC=CSQRT(-CLOG(CVAL/UCENT)/A)                                      D2720
      IF (KEY1.EQ.2) GO TO 350                                             D2730
      RADC=ETAC*S+HTHETA                                                   D2740
      GO TO 360                                                            D2750
  350 RADC=ETAC*S                                                          D2760
  360 IF (REAL(RADC).GT.(2.*RST1)) GO TO 370                               D2770
      RST1=RST1/2.                                                         D2780
      GO TO 250                                                            D2790
  370 TEMP1=AIMAG(RADC)+SIGN(ETA2,AIMAG(RADC))*SIGN(1.,-AIMAG(CVAL))       D2800
C                                                                          D2810
C             DECIDE WHETHER NECESSARY TO INTEGRATE AROUND                 D2820
C             THE CRITICAL POINT                                           D2830
C                                                                          D2840
      IF (ABS(AIMAG(RADC)).GT.ETA2.AND.AIMAG(CVAL).GT.0.) GO TO 380        D2850
      DIR(2)=CMPLX(0.,SIGN(1.,TEMP1))                                      D2860
      DIR(5)=DIR(2)                                                        D2870
C                                                                          D2880
C             DEFINE THE LIMITS OF THE CONTOUR INTEGRATION                 D2890
C                                                                          D2900
      LIM(1)=CMPLX(REAL(RADC)-ETA1,0.)                                     D2910
      LIM(2)=CMPLX(REAL(RADC)-ETA1,TEMP1)                                  D2920
      LIM(5)=CMPLX(REAL(RADC)+ETA1,TEMP1)                                  D2930
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      LIM(4)=CMPLX(REAL(RADC)*ETA1,0.)                                          D2940
      LIM(3)=CMPLX(REAL(RADC),TEMP1)                                            D2950
      LIM(6)=LIM(3)                                                             D2960
      IF (REAL(LIM(1)).GT.REAL(Y(1))) GO TO 400                                 D2970
      LIM(1)=Y(1)                                                               D2980
      LIM(2)=CMPLX(REAL(Y(1)),AIMAG(LIM(2)))                                    D2990
      IF (IFLG.EQ.0) GO TO 400                                                  D3000
      IF (IFUNC.EQ.2) WRITE (6,840) (LIM(I),I=1,6)                              D3010*
      GO TO 400                                                                 D3020
  380 DO 390 I=1,6                                                              D3030
  390 LIM(I)=CMPLX(REAL(RADC),0.)                                               D3040
  400 CONTINUE                                                                  D3050
C                                                                               D3060
C             PERFORM THE INTEGRATION                                           D3070
C                                                                               D3080
      IWR=0                                                                     D3090
      ISTEP=1                                                                   D3100
      CSTEP=(0.,0.)                                                             D3110
      INT=0                                                                     D3120
      K=1                                                                       D3130
      H=SMIN*10.                                                                D3140
      IFL=1                                                                     D3150
  410 PY(1)=Y(1)                                                                D3160
      PY(2)=Y(2)                                                                D3170
      PY(3)=Y(3)                                                                D3180
  420 IF (H.LT.SMIN) H=SMIN                                                     D3190
      IF (H.GT.SMAX) H=SMAX                                                     D3200
      IF (CABS(Y(1)-LIM(ISTEP)).GT.H) GO TO 430                                 D3210
      H=CABS(Y(1)-LIM(ISTEP))                                                   D3220
      IF (IFL.EQ.1) IFL=2                                                       D3230
      IF (IFL.EQ.3) IFL=4                                                       D3240
  430 CSTEP=ABS(H)*DIR(ISTEP)                                                   D3250
      CALL PJMRUN (M,CSTEP,Y,DY,P,Q,ERRES)                                      D3260$
      IND=IND+1                                                                 D3270
      IF (ERRES.LT.ERMIN) GO TO 450                                             D3280
      IF (ERRES.LT.ERMAX) GO TO 460                                             D3290
      IF (H.LE.SMIN) GO TO 440                                                  D3300
      H=0.8*H                                                                   D3310
      Y(1)=PY(1)                                                                D3320
      Y(2)=PY(2)                                                                D3330
      Y(3)=PY(3)                                                                D3340
      IF (IFL.EQ.2) IFL=1                                                       D3350
      IF (IFL.EQ.4) IFL=3                                                       D3360
      GO TO 420                                                                 D3370
  440 IWR=1                                                                     D3380
      GO TO 460                                                                 D3390
  450 H=1.25*H                                                                  D3400
  460 IF (IFUNC.EQ.1) GO TO 500                                                 D3410
C                                                                               D3420
C             CALCULATE INTEGRALS TO FIND DALPHA/DS                             D3430
C                                                                               D3440
      CALL UEVAL (Y(1),UVAL,DUVAL,DUDS,D2UDRS,RHO,DRHO,DRDS,D2RDRS)             D3450$
      DUM=ALPHA*UVAL-OMEGA                                                      D3460
      DUM1=Y(1)*Y(2)/DUM/DUM/RHO                                                D3470
      J=2                                                                       D3480
      IF (INT.EQ.1) J=3                                                         D3490
      HSUM(1,J,K)=DUM1*((D2RDRS/RHO-DRHO*DRDS/RHO/RHO+2.*ALPHA*(D2UDRS/D        D3500
     1UM-ALPHA*DUVAL*DUDS/DUM/DUM))*Y(3)-2.*MACH2*DUM*(DUM*DRDS+ALPHA*RH        D3510
     20*DUDS)*Y(2))                                                             D3520
```

```
      HSUM(2,J,K)=DUM1*2.*((ALPHA-MACH2*DUM*RHO*UVAL)*Y(2)-OMEGA*DUVAL*Y   D3530
     1(3)/DUM/DUM)                                                        D3540
      IF (J.EQ.3) GO TO 470                                               D3550
      L1=CSTEP                                                            D3560
      IF (K.EQ.2) L1=-L1                                                  D3570
      INT=1                                                               D3580
      GO TO 500                                                           D3590
  470 L2=CSTEP                                                            D3600
      IF (K.EQ.2) L2=-L2                                                  D3610
      DO 490 J=1,2                                                        D3620
      DO 480 I=1,3                                                        D3630
  480 DUMH(I)=HSUM(J,I,K)                                                 D3640
      DUM1=ISUM(J,K)                                                      D3650
      CALL INTEG (DUMH,DUM1,L1,L2)                                        D3660$
      ISUM(J,K)=DUM1                                                      D3670
  490 HSUM(J,1,K)=HSUM(J,3,K)                                             D3680
      INT=0                                                               D3690
  500 GO TO (410,510,410,550), IFL                                        D3700
  510 Y(1)=LIM(ISTEP)                                                     D3710
      IF (IFUNC.EQ.1) GO TO 530                                           D3720
      IF (INT.EQ.0) GO TO 530                                             D3730
      DO 520 I=1,2                                                        D3740
      ISUM(I,1)=ISUM(I,1)+0.5*L1*(HSUM(I,1,1)+HSUM(I,2,1))                D3750
  520 HSUM(I,1,1)=HSUM(I,2,1)                                             D3760
      INT=0                                                               D3770
      GO TO 530                                                           D3780
  530 ISTEP=ISTEP+1                                                       D3790
      IF (ISTEP.GT.3) GO TO 540                                           D3800
      IF (CABS(Y(1)-LIM(ISTEP)).LT.1.E-10) GO TO 510                      D3810
      IFL=1                                                               D3820
      GO TO 410                                                           D3830
C                                                                         D3840
C             STORE FUNCTION AND DERIVATIVE FOR MATCHING LATER            D3850
C                                                                         D3860
  540 PP=Y(2)                                                             D3870
      DPP=Y(3)                                                            D3880
      GO TO 580                                                           D3890
  550 Y(1)=LIM(ISTEP)                                                     D3900
      IF (IFUNC.EQ.1) GO TO 570                                           D3910
      IF (INT.EQ.0) GO TO 570                                             D3920
      DO 560 I=1,2                                                        D3930
      ISUM(I,2)=ISUM(I,2)+0.5*L1*(HSUM(I,1,2)+HSUM(I,2,2))                D3940
  560 HSUM(I,1,2)=HSUM(I,2,2)                                             D3950
      INT=0                                                               D3960
  570 ISTEP=ISTEP+1                                                       D3970
      IF (ISTEP.GT.6) GO TO 600                                           D3980
      IF (CABS(Y(1)-LIM(ISTEP)).LT.1.E-20) GO TO 550                      D3990
      IFL=3                                                               D4000
      GO TO 410                                                           D4010
C                                                                         D4020
C             STARTING CONDITIONS OUTSIDE THE JET                         D4030
C                                                                         D4040
  580 Y(1)=CMPLX(YMAX,0.)                                                 D4050
      LAMDAP=CSQRT(MACH2*OMEGA*OMEGA-ALPHA*ALPHA)                         D4060
      IF (AIMAG(LAMDAP).GT.0.) GO TO 590                                  D4070
      LAMDAP=-LAMDAP                                                      D4080
  590 ARG=LAMDAP*Y(1)                                                     D4090
      CALL NCBRTS (ARG,H01,H02,NORD,1)                                    D4100$
      CALL NCBRTS (ARG,H11,H12,NORD1,1)                                   D4110$
```

```
      Y(2)=H01                                                                D4120
      Y(3)=AN*H01/YMAX-LAMDAP*H11                                             D4130
      IFL=3                                                                   D4140
      IF (IFUNC.EQ.1) GO TO 410                                               D4150
      HSUM(1,1,2)=(0.,0.)                                                     D4160
      HSUM(2,1,2)=2.*ALPHA*Y(1)*Y(2)*Y(2)/OMEGA/OMEGA                         D4170
      ISUM(1,2)=(0.,0.)                                                       D4180
      ISUM(2,2)=-ALPHA*Y(1)*Y(1)*(H01*H01+H11*H11-2.*AN*H01*H11/LAMDAP/Y      D4190
     1(1))/OMEGA/OMEGA                                                        D4200
      INT=0                                                                   D4210
      K=2                                                                     D4220
      GO TO 410                                                               D4230
C                                                                             D4240
C             DETERMINE FUNCTION TO BE MINIMISED TO DETERMINE EIGENVALUE      D4250
C                                                                             D4260
  600 BB4=Y(3)*PP-Y(2)*DPP                                                    D4270
      AC=Y(2)/PP                                                              D4280
      IF (IFUNC.EQ.1) GO TO 620                                               D4290
      IF (IFLG.EQ.0) GO TO 610                                                D4300
      WRITE (6,810) AC                                                        D4310*
C                                                                             D4320
C             CALCULATE DALPHA/DS                                             D4330
C                                                                             D4340
  610 ISUM(1,1)=AC*AC*ISUM(1,1)+ISUM(1,2)                                     D4350
      ISUM(2,1)=AC*AC*ISUM(2,1)+ISUM(2,2)                                     D4360
      DKDB=-ISUM(1,1)/ISUM(2,1)                                               D4370
      IF (IFLG.EQ.0) GO TO 10                                                 D4380
      WRITE (6,820) DKDB                                                      D4390*
      GO TO 10                                                                D4400
  620 BB(KK)=BB4                                                              D4410
      IF (IFLG.EQ.0) GO TO 630                                                D4420
      WRITE (6,770) IND,ACON(KK),BB(KK)                                       D4430*
  630 IF (KK.LT.NT) GO TO 240                                                 D4440
C                                                                             D4450
C             FIND NEXT GUESS FOR ALPHA                                       D4460
C                                                                             D4470
      CALL LAGRAN (KK,ACON,ALPHA,BB)                                          D4480$
      IF (NTT.EQ.0) ALPHA=CMPLX(REAL(ALPHA),-ABS(AIMAG(ALPHA)))               D4490
      ACON(KK+1)=ALPHA                                                        D4500
      IF (ABS(REAL(ACON(KK+1))).LT.1.E-5) GO TO 640                           D4510
      IF (ABS(1.-REAL(ACON(KK))/REAL(ACON(KK+1))).GT.0.005) GO TO 680         D4520
      GO TO 650                                                               D4530
  640 WRITE (6,850)                                                           D4540*
  650 IF (ABS(AIMAG(ACON(KK+1))).LT.1.E-5) GO TO 660                          D4550
      IF (ABS(1.-AIMAG(ACON(KK))/AIMAG(ACON(KK+1))).GT.0.005) GO TO 680       D4560
      GO TO 670                                                               D4570
  660 WRITE (6,860)                                                           D4580*
      GO TO 690                                                               D4590
  670 CONTINUE                                                                D4600
      GO TO 690                                                               D4610
  680 IF (KK.LT.15) GO TO 240                                                 D4620
      IEROR=1                                                                 D4630
      RETURN                                                                  D4640
  690 IF (IFLG.EQ.0) GO TO 700                                                D4650
      WRITE (6,780) ALPHA                                                     D4660*
  700 NTT=NTT+1                                                               D4670
      ADAT(NTT)=ALPHA                                                         D4680
      SDAT(NTT)=S                                                             D4690
      CDAT(NTT)=AC                                                            D4700
```

```
      IFUNC=2                                                          D4710
      GO TO 240                                                        D4720
  710 CONTINUE                                                         D4730
      IF (IFLG.EQ.0) GO TO 730                                         D4740
      WRITE (6,790) VJA0                                               D4750*
      DO 720 I=1,NTT                                                   D4760
  720 WRITE (6,800) SDAT(I),ADAT(I),CDAT(I)                            D4770*
  730 CONTINUE                                                         D4780
      CALL DIRECT (ADAT,NTT,DS,TM,NANG,B0,GAMMA,INF,RADNF,XLAST,RSTART,P D4790$
     1THETA,PD8)                                                       D4800
      RETURN                                                           D4810
C                                                                      D4820
  740 FORMAT (1H1,10X,"INVISCID AXISYMMETRIC JET STABILITY CALCULATION"/ D4830
     111X,"**********************************************"//22X,"MODE N D4840
     2UMBER = ",I1//22X,"MACH NUMBER = ",F10.4//22X,"TEMPERATURE RATIO = D4850
     3 ",F10.4//22X,"STROUHAL NUMBER = ",F10.4//22X,"FREQUENCY = ",F10.4 D4860
     4//22X,"THICKNESS = ",F10.4//)                                    D4870
  750 FORMAT (22X,"POTENTIAL CORE RADIUS = ",F10.4//)                  D4880
  760 FORMAT (22X,"JET CENTERLINE VELOCITY = ",F10.4//)                D4890
  770 FORMAT (1X,I5,4X,"ALPHA = ",2E11.5,2X,"GIVES B4 = ",2E11.5/)     D4900
  780 FORMAT (21X,"WAVENUMBER = ",2F14.9//)                            D4910
  790 FORMAT (1H1,30X,"MACHNO = ",F10.4///3X,"THICKNESS",15X,"ALPHA",25X D4920
     1,"C"//)                                                          D4930
  800 FORMAT (1X,E11.5,4(2E11.5))                                      D4940
  810 FORMAT (30X,"C = ",2F14.9/)                                      D4950
  820 FORMAT (25X,"DK/DS = ",2E12.5//)                                 D4960
  830 FORMAT (1X,"BETA1 = ",F10.5,5X,"BETA2 = ",F10.5//)               D4970
  840 FORMAT (1X,4(1X,2E14.7))                                         D4980
  850 FORMAT (1X,"REAL PART OF ALPHA TOO SMALL FOR CONVERGENCE TEST"/) D4990
  860 FORMAT (1X,"IMAGINARY PART OF ALPHA TOO SMALL FOR CONVERGENCE ","T D5000
     1EST, ITERATIONS COMPLETED"//)                                    D5010
      END                                                              D5020-
```

```
*DECK PJMRUN
      SUBROUTINE PJMRUN (M,H,Y,DY,P,Q,ERRES)                          E  10
       COMPLEX Y(M),DY(M),P(M),Q(M),RR(8),H                           E  20
      DO 10 I=1,M                                                     E  30
   10 Q(I)=(0.,0.)                                                    E  40
      DY(1)=(1.,0.)                                                   E  50
      DO 20 I=2,M                                                     E  60
   20 DY(I)=(0.,0.)                                                   E  70
      CALL DERY (M,Y,DY)                                              E  80$
      DO 30 I=1,M                                                     E  90
      P(I)=H*DY(I)*0.5                                                E 100
      RR(I)=(P(I)-Q(I)+Y(I))-Y(I)                                     E 110
      Y(I)=Y(I)+RR(I)                                                 E 120
   30 Q(I)=(3.*Q(I))-P(I)+(3.*RR(I))                                  E 130
      CALL DERY (M,Y,DY)                                              E 140$
      DO 40 I=1,M                                                     E 150
      P(I)=H*DY(I)                                                    E 160
      RR(I)=((P(I)-Q(I))*0.5+Y(I))-Y(I)                               E 170
      Y(I)=Y(I)+RR(I)                                                 E 180
   40 Q(I)=(3.*P(I))-(2.*Q(I))-(6.*RR(I))                             E 190
      CALL DERY (M,Y,DY)                                              E 200$
      ERRES=0.                                                        E 210
      DO 60 I=1,M                                                     E 220
      IF (CABS(P(I)-Q(I)).LT.1.E-20) GO TO 50                         E 230
      E=CABS(((H*DY(I))-P(I))/(P(I)-Q(I)))                            E 240
      IF (E.GT.ERRES) ERRES=E                                         E 250
   50 P(I)=H*DY(I)-0.5*P(I)                                           E 260
      RR(I)=(P(I)+Y(I))-Y(I)                                          E 270
      Y(I)=Y(I)+RR(I)                                                 E 280
   60 Q(I)=Q(I)+6.*(P(I)-RR(I))                                       E 290
      CALL DERY (M,Y,DY)                                              E 300$
      DO 70 I=1,M                                                     E 310
      P(I)=(-4.*P(I)+H*DY(I)+Q(I))/6.                                 E 320
      RR(I)=(P(I)+Y(I))-Y(I)                                          E 330
      Y(I)=Y(I)+RR(I)                                                 E 340
   70 Q(I)=RR(I)-P(I)                                                 E 350
      RETURN                                                          E 360
      END                                                             E 370-
```

```
*DECK DERY
      SUBROUTINE DERY (M,Y,DY)                                                F  10
       COMPLEX Y(M),DY(M),ALPHA,UVAL,DUVAL,RHO,DRHO                           F  20
       COMPLEX DUDS,D2UDRS,DRDS,D2RDRS,DUM                                    F  30
       COMPLEX DKDB                                                           F  40
       REAL MACH2                                                             F  50
       COMMON/INFO/ALPHA,OMEGA,MACH2,TJTO,NORD,GM1,DKDB,IFLG,VJAO             F  60
       COMMON/SPR/HTHETA,S,KEY1,UCENT,DUCDS,BETA1,BETA2,IFUNC                 F  70
      AN=NORD                                                                 F  80
      CALL UEVAL (Y(1),UVAL,DUVAL,DUDS,D2UDRS,RHO,DRHO,DRDS,D2RDRS)           F  90$
      DUM=ALPHA*UVAL-OMEGA                                                    F 100
      DY(2)=Y(3)                                                              F 110
      DY(3)=(DRHO/RHO+2.*ALPHA*DUVAL/DUM-1./Y(1))*Y(3)+(ALPHA*ALPHA-MACH      F 120
     12*DUM*DUM*RHO+AN*AN/Y(1)/Y(1))*Y(2)                                     F 130
      RETURN                                                                  F 140
      END                                                                     F 150-
```

```
*DECK UEVAL
      SUBROUTINE UEVAL (X,U,DUDR,DUDS,D2UDRS,R,DRDR,DRDS,D2RDRS)          G  10
       COMPLEX X,U,DUDR,DUDS,D2UDRS,R,DRDR,DRDS,D2RDRS                   G  20
       COMPLEX ALPHA,ETA,DRDU,D2RDU2                                     G  30
       COMPLEX DKDB,D2UDR2                                               G  40
       REAL MACH2                                                        G  50
       COMMON/INFO/ALPHA,OMEGA,MACH2,TJT0,NORD,GM1,DKDB,IFLG,VJA0        G  60
       COMMON/SPR/HTHETA,S,KEY1,UCENT,DUCDS,BETA1,BETA2,IFUNC            G  70
      A=.693147                                                          G  80
      GO TO (10,40,60,60), KEY1                                          G  90
C                                                                        G 100
C            IF KEY1 = 1 WE CALCULATE UVAL IN THE ANNULAR MIXING         G 110
C            REGION FOR A GIVEN VALUE OF RADIUS, X.                      G 120
C                                                                        G 130
   10 IF (REAL(X).LT.HTHETA) GO TO 70                                    G 140
      ETA=(X-HTHETA)/S                                                   G 150
      U=CEXP(-A*ETA*ETA)                                                 G 160
      DUDR=-2.*A*ETA*U/S                                                 G 170
   20 R=1./(1.+(TJT0-1.)*U+0.5*GM1*MACH2*U*(1.-U))                       G 180
      IF (KEY1.EQ.3) GO TO 80                                            G 190
      DRDU=-R*R*(TJT0-1.+0.5*GM1*MACH2*(1.-2.*U))                        G 200
      DRDR=DRDU*DUDR                                                     G 210
      IF (IFUNC.EQ.1) GO TO 80                                           G 220
      D2UDR2=(4.*A*A*ETA*ETA-2.*A)*U/S/S                                 G 230
      IF (KEY1.EQ.2) GO TO 50                                            G 240
      DHDS=-TJT0*(HTHETA*BETA1+2.*BETA2*S)/(HTHETA+TJT0*BETA1*S)         G 250
      DUDS=-DUDR*(ETA+DHDS)                                              G 260
      D2UDRS=-D2UDR2*(ETA+DHDS)-DUDR/S                                   G 270
   30 DRDS=DRDU*DUDS                                                     G 280
      D2RDU2=2.*DRDU*DRDU/R+GM1*MACH2*R*R                                G 290
      D2RDRS=D2RDU2*DUDR*DUDS+DRDU*D2UDRS                                G 300
      RETURN                                                             G 310
C                                                                        G 320
C            IF KEY1 = 2 WE CALCULATE UVAL IN THE DEVELOPED JET          G 330
C            FLOW FOR A GIVEN VALUE OF RADIUS, X.                        G 340
C                                                                        G 350
   40 ETA=X/S                                                            G 360
      U=UCENT*CEXP(-A*ETA*ETA)                                           G 370
      DUDR=-2.*A*ETA*U/S                                                 G 380
      GO TO 20                                                           G 390
   50 DUDS=DUCDS*U/UCENT-ETA*DUDR                                        G 400
      D2UDRS=(DUCDS/UCENT-1./S)*DUDR-ETA*D2UDR2                          G 410
      GO TO 30                                                           G 420
C                                                                        G 430
C            IF KEY1 = 3 WE CALCULATE THE VALUE OF UVAL FOR A GIVEN      G 440
C            VALUE OF ETA=X.                                             G 450
C                                                                        G 460
   60 ETA=X                                                              G 470
      U=CEXP(-A*ETA*ETA)                                                 G 480
      DUDR=-2.*A*ETA*U                                                   G 490
      IF (KEY1.EQ.4) GO TO 90                                            G 500
      GO TO 20                                                           G 510
   70 U=(1.,0.)                                                          G 520
      DUDR=(0.,0.)                                                       G 530
      R=1./TJT0                                                          G 540
      DRDR=(0.,0.)                                                       G 550
   80 DUDS=(0.,0.)                                                       G 560
      D2UDRS=(0.,0.)                                                     G 570
      DRDS=(0.,0.)                                                       G 580
      D2RDRS=(0.,0.)                                                     G 590
      RETURN                                                             G 600
   90 R=1./(1.+(TJT0-1.)*U*UCENT+0.5*GM1*MACH2*U*UCENT*(1.-U*UCENT))     G 610
      RETURN                                                             G 620
      END                                                                G 630-
```

```
*DECK LAGRAN
      SUBROUTINE LAGRAN (NUM,C,CVAL,B4)                                  H  10
      COMPLEX C(10),B4(10),CVAL,CONT,CMIN                                H  20
      DO 20 JJ=1,2                                                       H  30
      N=NUM-JJ                                                           H  40
      CMIN=B4(N)                                                         H  50
      JN=N                                                               H  60
      DO 10 I=1,N                                                        H  70
      K=NUM-I-JJ+1                                                       H  80
      IF (CABS(CMIN).LE.CABS(B4(K))) GO TO 10                            H  90
      JN=K                                                               H 100
      CMIN=B4(K)                                                         H 110
   10 CONTINUE                                                           H 120
      IF (JN.EQ.N) GO TO 20                                              H 130
      B4(JN)=B4(N)                                                       H 140
      B4(N)=CMIN                                                         H 150
      CMIN=C(N)                                                          H 160
      C(N)=C(JN)                                                         H 170
      C(JN)=CMIN                                                         H 180
   20 CONTINUE                                                           H 190
      CVAL=(0.,0.)                                                       H 200
      DO 40 J=N,NUM                                                      H 210
      CONT=(1.,0.)                                                       H 220
      DO 30 I=N,NUM                                                      H 230
      IF (I.EQ.J) GO TO 30                                               H 240
      CONT=CONT*(B4(I)/(B4(J)-B4(I)))                                    H 250
   30 CONTINUE                                                           H 260
   40 CVAL=CVAL+C(J)*CONT                                                H 270
      RETURN                                                             H 280
      END                                                                H 290-
```

```
*DECK NCBRTS
      SUBROUTINE NCBRTS (Z,B1,B2,N,M)                                    I   10
      COMPLEX Z,H1(50),H2(50),B1,B2                                      I   20
      IF (M.EQ.0) GO TO 20                                               I   30
      IF (N.EQ.0.OR.N.EQ.1) GO TO 20                                     I   40
      CALL CBRTS (Z,H1(1),H2(1),0,1)                                     I   50$
      CALL CBRTS (Z,H1(2),H2(2),1,1)                                     I   60$
      NP1=N+1                                                            I   70
      DO 10 J=3,NP1                                                      I   80
      H1(J)=2.*(J-2)*H1(J-1)/Z-H1(J-2)                                   I   90
   10 H2(J)=2.*(J-2)*H2(J-1)/Z-H2(J-2)                                   I  100
      B1=H1(NP1)                                                         I  110
      B2=H2(NP1)                                                         I  120
      RETURN                                                             I  130
   20 CALL CBRTS (Z,B1,B2,N,M)                                           I  140$
      RETURN                                                             I  150
      END                                                                I  160-
```

```
*DECK CBRTS
      SUBROUTINE CBRTS (Z,H1,H2,N,M)                                    J  10
      DIMENSION AJ(1000)                                                J  20
      COMPLEX Z,CON,F2,SUM,AJN,AYN,FCT,FCD,H1,H2                        J  30
      AN=N                                                              J  40
      R=CABS(Z)                                                         J  50
      IF (R.GT.6.6) GO TO 60                                            J  60
      IF (R.GE..1E-30) GO TO 10                                         J  70
      THETA=0.                                                          J  80
      GO TO 20                                                          J  90
   10 THETA=ATAN2(AIMAG(Z),REAL(Z))                                     J 100
   20 CONTINUE                                                          J 110
      THN=AN*THETA                                                      J 120
      CON=CMPLX(COS(THN),SIN(THN))                                      J 130
      F1=-1.                                                            J 140
      F2=CMPLX((COS(2.*THETA)-1.),SIN(2.*THETA))                        J 150
      F3=R/2.                                                           J 160
      FAC=1.                                                            J 170
      LIM=29-N                                                          J 180
      CALL BSSLS (R,AJ,29,IERR)                                         J 190$
      SUM=CMPLX(AJ(N+1),0.)                                             J 200
      FCD=F1*F2*F3                                                      J 210
      FCT=(1.,0.)                                                       J 220
      DO 30 K=1,LIM                                                     J 230
      L=N+K+1                                                           J 240
      FAC=K*FAC                                                         J 250
      FCT=FCT*FCD                                                       J 260
      AJ(L)=AJ(L)/FAC                                                   J 270
   30 SUM=SUM+FCT*AJ(L)                                                 J 280
      IN=LIM+1                                                          J 290
      KN=LIM+11                                                         J 300
      DO 40 I=IN,KN                                                     J 310
      FAC=I*FAC                                                         J 320
      L=I+N                                                             J 330
      CALL BELS (R,Y,L)                                                 J 340$
      FCT=FCT*FCD                                                       J 350
      Y=Y/FAC                                                           J 360
   40 SUM=SUM+FCT*Y                                                     J 370
      AJN=CON*SUM                                                       J 380
      CALL BELZ (Z,AJN,AYN,N)                                           J 390$
      IF (M.NE.0) GO TO 50                                              J 400
      H1=AJN                                                            J 410
      H2=AYN                                                            J 420
      RETURN                                                            J 430
   50 H1=AJN+(0.,1.)*AYN                                                J 440
      H2=AJN-(0.,1.)*AYN                                                J 450
      RETURN                                                            J 460
   60 CONTINUE                                                          J 470
      CALL HAN (Z,H1,H2,N)                                              J 480$
      IF (M.NE.0) GO TO 70                                              J 490
      H1=(H1+H2)/2.                                                     J 500
      H2=(0.,-.5)*(H1-H2)                                               J 510
   70 RETURN                                                            J 520
      END                                                               J 530-
```

```
*DECK BSSLS
      SUBROUTINE BSSLS (X,F,N,IERR)                                    K  10
      DIMENSION F(1)                                                   K  20
      IERR=0                                                           K  30
      NMAX=30                                                          K  40
      IF (N.LE.NMAX) GO TO 10                                          K  50
      IERR=1                                                           K  60
      RETURN                                                           K  70
   10 MX=X                                                             K  80
      NPP=3*MX+12+10*(IABS(N-1)/10)                                    K  90
      IF (IFIX(X).GT.N) NPP=IFIX(3.*X+12.)                             K 100
      IF (MOD(NPP,2).EQ.0) NPP=NPP+1                                   K 110
      DO 20 I=1,NPP                                                    K 120
   20 F(I)=0.                                                          K 130
      IF (X.GE..1E-34) GO TO 30                                        K 140
      F(1)=1.                                                          K 150
      RETURN                                                           K 160
   30 IF (X.GE..14E0) GO TO 80                                         K 170
      Z=X/2.                                                           K 180
      F(1)=1.                                                          K 190
      LPP=NPP-1                                                        K 200
      DO 40 K=1,LPP                                                    K 210
   40 F(K+1)=F(K)*Z                                                    K 220
      FAC2=-Z*Z                                                        K 230
      FAC1=1.                                                          K 240
      DO 70 I=1,NPP                                                    K 250
      NORD=I-1                                                         K 260
      IF (I.EQ.1) GO TO 50                                             K 270
      FAC1=FAC1/FLOAT(NORD)                                            K 280
   50 VAL=FAC1                                                         K 290
      SUM=FAC1                                                         K 300
      DO 60 J=2,20                                                     K 310
      L=J+NORD-1                                                       K 320
      K=J-1                                                            K 330
      VAL=VAL*FAC2/FLOAT(L*K)                                          K 340
      IF (ABS(VAL).LT.1.E-20) GO TO 70                                 K 350
   60 SUM=SUM+VAL                                                      K 360
   70 F(I)=F(I)*SUM                                                    K 370
      RETURN                                                           K 380
   80 NP=NPP+1                                                         K 390
      NPR=NPP-1                                                        K 400
      F(NP-1)=.1E-34                                                   K 410
      F(NP)=0.                                                         K 420
      DO 90 I=1,NPR                                                    K 430
      NP=NPP-I                                                         K 440
      XN=NP                                                            K 450
   90 F(NP)=2.*XN/X*F(NP+1)-F(NP+2)                                    K 460
      XN=F(1)                                                          K 470
      DO 100 I=3,NPP,2                                                 K 480
  100 XN=2.*F(I)+XN                                                    K 490
      XN=1./XN                                                         K 500
      DO 110 I=1,NPP                                                   K 510
      F(I)=XN*F(I)                                                     K 520
  110 CONTINUE                                                         K 530
      RETURN                                                           K 540
      END                                                              K 550-
```

```
*DECK BELS
      SUBROUTINE BELS (X,Y,N)                                          L  10
      AN=N                                                             L  20
      FN=1.                                                            L  30
      DO 10 I=1,N                                                      L  40
      AI=I                                                             L  50
   10 FN=FN*AI                                                         L  60
      C=(.5*X)**2                                                      L  70
      CN=(.5*X)**N/FN                                                  L  80
      F=C/(AN+1.)                                                      L  90
      AJ=2.                                                            L 100
      D=1.                                                             L 110
      FN1=1.-F                                                         L 120
   20 F=F*C/((AN+AJ)*AJ)                                               L 130
      FN1=FN1+D*F                                                      L 140
      AJ=AJ+1.                                                         L 150
      D=-D                                                             L 160
      IF (ABS(F/FN1)-1.E-10) 30,30,20                                  L 170
   30 Y=FN1*CN                                                         L 180
      RETURN                                                           L 190
      END                                                              L 200-
```

```
*DECK BELZ
      SUBROUTINE BELZ (X,Y,XY,N)                                                M  10
      COMPLEX X,Y,XY,SM,CXF,CCN,CC,CF,CFN1,CFN3,CHA,XI                          M  20
      CHA=(.5,0.)                                                               M  30
      AN=N                                                                      M  40
      IF (CABS(X).GE..1E-30) GO TO 10                                           M  50
      PH=0.                                                                     M  60
      GO TO 20                                                                  M  70
   10 PH=ATAN2(AIMAG(X),REAL(X))                                                M  80
   20 CONTINUE                                                                  M  90
      XI=(0.,1.)                                                                M 100
      R=CABS(X)                                                                 M 110
      FN=1.                                                                     M 120
      FM=0.                                                                     M 130
      FQ=0.                                                                     M 140
      SM=(0.,0.)                                                                M 150
      IF (N) 30,60,30                                                           M 160
   30 DO 40 I=1,N                                                               M 170
      AI=I                                                                      M 180
      FM=FM+1./AI                                                               M 190
   40 FN=FN*AI                                                                  M 200
      CXF=CHA*CHA*X*X                                                           M 210
      CCN=(CHA*X)**(-N)/FN                                                      M 220
      FS=FN/AN                                                                  M 230
      GS=1.                                                                     M 240
      DO 50 I=1,N                                                               M 250
      AI=I                                                                      M 260
      SM=SM+CCN*FS/GS                                                           M 270
      CCN=CCN*CXF                                                               M 280
      GS=GS*AI                                                                  M 290
      IF (N.EQ.I) GO TO 50                                                      M 300
      FS=FS/(AN-AI)                                                             M 310
   50 CONTINUE                                                                  M 320
   60 CC=CHA*CHA*X*X                                                            M 330
      CCN=(CHA*X)**N                                                            M 340
      CCN=CCN/FN                                                                M 350
      CF=CC/(AN+1.)                                                             M 360
      AJ=2.                                                                     M 370
      D=1.                                                                      M 380
      CFN1=1.-CF                                                                M 390
      CFN3=CMPLX(FM,0.)                                                         M 400
      FQ=FQ+1./(AJ-1.)                                                          M 410
      FM=FM+1./(AN+AJ-1.)                                                       M 420
      FP=FM+FQ                                                                  M 430
      CFN3=CFN3-CF*FP                                                           M 440
   70 CF=CF*CC/((AN+AJ)*AJ)                                                     M 450
      CFN1=CFN1+D*CF                                                            M 460
      FQ=FQ+1./AJ                                                               M 470
      FM=FM+1./(AN+AJ)                                                          M 480
      FP=FM+FQ                                                                  M 490
      CFN3=CFN3+D*CF*FP                                                         M 500
      AJ=AJ+1.                                                                  M 510
      D=-D                                                                      M 520
      IF (CABS(CF/CFN1)-1.E-10) 80,80,70                                        M 530
   80 XY=(2.*(.5772156649+(ALOG(R/2.)+XI*PH))*Y-SM-CFN3*CCN)/3.141592653        M 540
     159                                                                        M 550
      RETURN                                                                    M 560
      END                                                                       M 570-
```

```
*DECK HAN
      SUBROUTINE HAN (Z,H1,H2,N)                                        N  10
      COMPLEX Z,H1,H2,SETI,SP,X,CP,CP1                                  N  20
      PI=3.14159265359                                                  N  30
      AN=N                                                              N  40
      IF (CABS(Z).GE..1E-30) GO TO 10                                   N  50
      PH=0.                                                             N  60
      GO TO 20                                                          N  70
   10 PH=ATAN2(AIMAG(Z),REAL(Z))                                        N  80
   20 CONTINUE                                                          N  90
      R=CABS(Z)                                                         N 100
      S1=EXP(-1.*AIMAG(Z))/SQRT(.5*PI*R)                                N 110
      SIGMA1=2.*REAL(Z)/PI-AN-.5-PH/PI                                  N 120
      SETI=CEXP(.5*(0.,1.)*PI*SIGMA1)                                   N 130
      SP=(1.,0.)                                                        N 140
      CP=SP                                                             N 150
      CP1=CP                                                            N 160
      X=-2.*Z*(0.,1.)                                                   N 170
      C1=1.                                                             N 180
   30 CP=CP*(4.*AN*AN-C1*C1)/(C1*4.*X)                                  N 190
      C1=C1+2.                                                          N 200
      SP=SP+CP                                                          N 210
      IF (CABS(CP)-CABS(CP1)) 40,50,50                                  N 220
   40 CP1=CP                                                            N 230
      GO TO 30                                                          N 240
   50 SP=SP-CP                                                          N 250
      H1=S1*SETI*SP                                                     N 260
      S1=EXP(AIMAG(Z))/SQRT(.5*PI*R)                                    N 270
      SIGMA1=-2.*REAL(Z)/PI+AN+.5-PH/PI                                 N 280
      SETI=CEXP(.5*(0.,1.)*PI*SIGMA1)                                   N 290
      SP=(1.,0.)                                                        N 300
      X=2.*Z*(0.,1.)                                                    N 310
      CP=SP                                                             N 320
      CP1=CP                                                            N 330
      C1=1.                                                             N 340
   60 CP=CP*(4.*AN*AN-C1*C1)/(C1*4.*X)                                  N 350
      C1=C1+2.                                                          N 360
      SP=SP+CP                                                          N 370
      IF (CABS(CP)-CABS(CP1)) 70,80,80                                  N 380
   70 CP1=CP                                                            N 390
      GO TO 60                                                          N 400
   80 SP=SP-CP                                                          N 410
      H2=S1*SETI*SP                                                     N 420
      RETURN                                                            N 430
      END                                                               N 440-
```

```
*DECK INTEG
      SUBROUTINE INTEG (H,SUM,L1,L2)                                          0  10
       COMPLEX H(3),SUM,L1,L2                                                 0  20
      SUM=SUM+(L1+L2)*(H(1)*L2*(2.*L1-L2)+H(2)*(L1+L2)**2+H(3)*L1*(2.*L2     0  30
     1-L1))/L1/L2/6.                                                         0  40
      RETURN                                                                 0  50
      END                                                                    0  60
```

```
*DECK DIRECT
      SUBROUTINE DIRECT (ADAT,NTT,DB,TM,NANG,B0,GAMMA,INF,RADNF,XLAST,RS  P  10
     1TART,PTHETA,PDB)                                                    P  20
       DIMENSION TM(NANG),PTHETA(NANG),PDB(NANG)                          P  30
       COMPLEX Y(4),DY(4),P(4),Q(4),XSAVE,PY(4)                           P  40
       COMPLEX ALPHA,DKDB,ADAT(1),AVAL,DUM                                P  50
       COMPLEX XVAL(1025),W(1025),WI(1025),BN(1025),CWAVE,CONT            P  60
       COMPLEX H01,H02                                                    P  70
       REAL NFDB(1025,10)                                                 P  80
       INTEGER GAMMA                                                      P  90
       REAL MJ,MACH2,KAPPA,M20                                            P 100
       COMMON/DATA/KAPPA,EPSI,POTB,IFLAG                                  P 110
       COMMON/INFO/ALPHA,OMEGA,MACH2,TJT0,NORD,GM1,DKDB,IFLG,VJA0         P 120
      ERMIN=0.1                                                           P 130
      ERMAX=0.14                                                          P 140
      PI=3.14159                                                          P 150
      FCT=57.2958                                                         P 160
      MJ=VJA0/SQRT(TJT0)                                                  P 170
      IF (MJ.GT.2.) GO TO 10                                              P 180
      SIGMA=10.7/(1.-.1163*MJ*MJ)                                         P 190
      GO TO 20                                                            P 200
   10 SIGMA=19.4*SQRT(MJ-0.9418)                                          P 210
   20 EPSI=1.2658/SIGMA                                                   P 220
      DELX=0.5/OMEGA                                                      P 230
      IF (IFLG.EQ.0) GO TO 30                                             P 240
      WRITE (6,680) NORD,VJA0,TJT0,EPSI,GAMMA                             P 250*
C                                                                         P 260
C       CALCULATION OF WIDTH AT END OF POTENTIAL CORE                     P 270
C                                                                         P 280
   30 M20=MACH2*OMEGA*OMEGA                                               P 290
      A=0.2*MACH2                                                         P 300
      B=(1.-TJT0-A)                                                       P 310
      IF (A.LT.1.E-10) GO TO 40                                           P 320
      AK=SQRT(B*B+4.*A)                                                   P 330
      POTB=-1.38629*A/(ALOG(ABS(A+B-1.))-B*ALOG(ABS((2.*A+B-AK)*(B+AK)/(  P 340
     12.*A+B+AK)/(B-AK)))/AK)/TJT0                                        P 350
      POTB=SQRT(POTB)                                                     P 360
      GO TO 60                                                            P 370
   40 IF (ABS(B).LT.1.E-10) GO TO 50                                      P 380
      POTB=-.693147*B*B/(B+ALOG(ABS(1.-B)))/TJT0                          P 390
      POTB=SQRT(POTB)                                                     P 400
      GO TO 70                                                            P 410
   50 POTB=1.17741                                                        P 420
      GO TO 80                                                            P 430
C                                                                         P 440
C       CALCULATION OF THE EDDY VISCOSITY CONSTANT                        P 450
C                                                                         P 460
   60 RHOB=1./(1.-0.5*B-0.25*A)                                           P 470
      KAPPA=(1./A-(B+A)*ALOG(ABS(A+B-1.))-(B*B+2.*A+A*B)*ALOG(ABS((2.*A   P 480
     1+B-AK)*(B+AK)/(2.*A+B+AK)/(B-AK)))/AK)/2./A/A)*2.88539/RHOB          P 490
      GO TO 90                                                            P 500
   70 RHOB=1./(1.-0.5*B)                                                  P 510
      KAPPA=(0.5+TJT0*ALOG(TJT0)/B/B)*2.88539/B/RHOB                      P 520
      GO TO 90                                                            P 530
   80 KAPPA=POTB/2.07944                                                  P 540
   90 IFLAG=1                                                             P 550
C                                                                         P 560
C       CALCULATION OF STARTING CONDITIONS                                P 570
C                                                                         P 580
```

```
      Y(1)=(0.,0.)                                                    P 590
      Y(2)=B0                                                         P 600
      Y(3)=(1.,0.)                                                    P 610
      Y(4)=(1.,0.)                                                    P 620
      B=REAL(Y(2))                                                    P 630
      UC=REAL(Y(3))                                                   P 640
      X=REAL(Y(1))                                                    P 650
      DBDX=EPSI                                                       P 660
C                                                                     P 670
C       CALCULATE INTEGRAND FOR FOURIER TRANSFORM                     P 680
C                                                                     P 690
      XVAL(1)=Y(4)                                                    P 700
      IF (NORD.EQ.0) GO TO 110                                        P 710
      CALL COEFF (ADAT,NTT,B,AVAL,DB)                                 P 720$
      DUM=CSQRT(MACH2*OMEGA*OMEGA-AVAL*AVAL)                          P 730
      IF (AIMAG(DUM).GT.0.) GO TO 100                                 P 740
      DUM=-DUM                                                        P 750
  100 DUM=DUM**NORD                                                   P 760
      XVAL(1)=XVAL(1)/DUM                                             P 770
  110 CONTINUE                                                        P 780
      AMP=CABS(XVAL(1))                                               P 790
      IF (ABS(AIMAG(XVAL(1))).LT.1.E-20) GO TO 120                    P 800
      IF (ABS(REAL(XVAL(1))).LT.1.E-20) GO TO 130                     P 810
      PHASE=ATAN2(AIMAG(XVAL(1)),REAL(XVAL(1)))*FCT                   P 820
      GO TO 140                                                       P 830
  120 PHASE=0.                                                        P 840
  130 PHASE=90.*SIGN(1.,AIMAG(XVAL(1)))                               P 850
  140 IF (IFLG.EQ.0) GO TO 150                                        P 860
      WRITE (6,690) X,B,DBDX,UC,XVAL(1),AMP,PHASE                     P 870*
C                                                                     P 880
C       BEGIN INTEGRATION                                             P 890
C                                                                     P 900
  150 N=2**GAMMA                                                      P 910
      ISTEP=1                                                         P 920
      H=DELX                                                          P 930
      SMAX=H                                                          P 940
      SMIN=H/1000.                                                    P 950
      XSAVE=Y(1)                                                      P 960
  160 IFL=1                                                           P 970
      XSTOP=REAL(XSAVE)+DELX                                          P 980
      ISTEP=ISTEP+1                                                   P 990
      IF (ISTEP.GE.(N+2)) GO TO 310                                   P1000
  170 DO 180 I=1,4                                                    P1010
  180 PY(I)=Y(I)                                                      P1020
  190 IF (H.LT.SMIN) H=SMIN                                           P1030
      IF (H.GT.SMAX) H=SMAX                                           P1040
      IF (CABS(Y(1)-XSTOP).GT.H) GO TO 200                            P1050
      H=CABS(Y(1)-XSTOP)                                              P1060
      IFL=2                                                           P1070
  200 CALL RUNREL (4,H,Y,DY,P,Q,ERRES,ADAT,NTT,DB)                    P1080$
      IND=IND+1                                                       P1090
      IF (ERRES.LT.ERMIN) GO TO 230                                   P1100
      IF (ERRES.LT.ERMAX) GO TO 240                                   P1110
      IF (H.LE.SMIN) GO TO 220                                        P1120
      H=0.8*H                                                         P1130
      DO 210 I=1,4                                                    P1140
  210 Y(I)=PY(I)                                                      P1150
      IFL=1                                                           P1160
      GO TO 190                                                       P1170
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  220 IWR=1                                                              P1180
      GO TO 240                                                          P1190
  230 H=1.25*H                                                           P1200
  240 IF (IFL.EQ.1) GO TO 170                                            P1210
      X=REAL(Y(1))                                                       P1220
      B=REAL(Y(2))                                                       P1230
      UC=REAL(Y(3))                                                      P1240
      DBDX=REAL(DY(2))                                                   P1250
C                                                                        P1260
C       CALCULATE INTEGRAND FOR FOURIER TRANSFORM                        P1270
C                                                                        P1280
      XVAL(ISTEP)=Y(4)                                                   P1290
      IF (NORD.EQ.0) GO TO 260                                           P1300
      CALL COEFF (ADAT,NTT,B,AVAL,DB)                                    P1310$
      DUM=CSQRT(MACH2*OMEGA*OMEGA-AVAL*AVAL)                             P1320
      IF (AIMAG(DUM).GT.0.) GO TO 250                                    P1330
      DUM=-DUM                                                           P1340
  250 DUM=CSQRT(DUM)                                                     P1350
      XVAL(ISTEP)=XVAL(ISTEP)/DUM                                        P1360
  260 CONTINUE                                                           P1370
      AMP=CABS(XVAL(ISTEP))                                              P1380
      IF (ABS(AIMAG(XVAL(ISTEP))).LT.1.E-20) GO TO 270                   P1390
      IF (ABS(REAL(XVAL(ISTEP))).LT.1.E-20) GO TO 280                    P1400
      PHASE=ATAN2(AIMAG(XVAL(ISTEP)),REAL(XVAL(ISTEP)))*FCT              P1410
      GO TO 290                                                          P1420
  270 PHASE=0.                                                           P1430
      GO TO 290                                                          P1440
  280 PHASE=90.*SIGN(1.,AIMAG(XVAL(ISTEP)))                              P1450
  290 IF (IFLG.EQ.0) GO TO 300                                           P1460
      WRITE (6,690) X,B,DBDX,UC,XVAL(ISTEP),AMP,PHASE                    P1470*
  300 XSAVE=Y(1)                                                         P1480
      GO TO 160                                                          P1490
  310 IF (IFLG.EQ.0) GO TO 320                                           P1500
      WRITE (6,700) IWR,IND                                              P1510*
C                                                                        P1520
C       PERFORM FOURIER TRANSFORM                                        P1530
C                                                                        P1540
  320 IGAM=GAMMA+1                                                       P1550
      INUM=2**IGAM                                                       P1560
      N1=N+1                                                             P1570
      N2=N+2                                                             P1580
      DO 360 I=N2,INUM                                                   P1590
      J=I-INUM-1                                                         P1600
      X=FLOAT(J)*DELX                                                    P1610
      DUM=(0.,1.)*ADAT(1)*X                                              P1620
      IF (CABS(DUM).GT.30.) GO TO 330                                    P1630
      XVAL(I)=XVAL(1)*CEXP(DUM)                                          P1640
      GO TO 340                                                          P1650
  330 XVAL(I)=(0.,0.)                                                    P1660
  340 IF (NORD.EQ.0) GO TO 360                                           P1670
      DUM=CSQRT(M2O-ADAT(1)*ADAT(1))                                     P1680
      IF (AIMAG(DUM).GT.0.) GO TO 350                                    P1690
      DUM=-DUM                                                           P1700
  350 DUM=DUM**NORD                                                      P1710
      XVAL(I)=XVAL(I)/DUM                                                P1720
  360 CONTINUE                                                           P1730
      CALL FFT (IGAM,INUM,XVAL,W)                                        P1740$
      DO 370 I=1,INUM                                                    P1750
  370 XVAL(I)=XVAL(I)*DELX/2./PI                                         P1760
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      DELW=2.*PI/DELX/INUM                                              P1770
      IF (IFLG.EQ.0) GO TO 380                                          P1780
      WRITE (6,710)                                                     P1790*
C                                                                       P1800
C      CALCULATION OF B(K)                                              P1810
C                                                                       P1820
  380 DO 440 I=1,INUM                                                   P1830
      IF (I.GE.N) GO TO 390                                             P1840
      KK=I+N1                                                           P1850
      W(KK)=DELW*(I-N)                                                  P1860
      GO TO 400                                                         P1870
  390 KK=I-N+1                                                          P1880
      W(KK)=DELW*(I-N)                                                  P1890
  400 BN(KK)=XVAL(KK)                                                   P1900
      AMP=CABS(BN(KK))                                                  P1910
      IF (ABS(AIMAG(BN(KK))).LT.1.E-20) GO TO 410                       P1920
      IF (ABS(REAL(BN(KK))).LT.1.E-20) GO TO 420                        P1930
      PHASE=ATAN2(AIMAG(BN(KK)),REAL(BN(KK)))*FCT                       P1940
      GO TO 430                                                         P1950
  410 PHASE=0.                                                          P1960
      GO TO 430                                                         P1970
  420 PHASE=90.*SIGN(1.,AIMAG(BN(KK)))                                  P1980
  430 WAVEN=REAL(W(KK))                                                 P1990
      IF (IFLG.EQ.0) GO TO 440                                          P2000
      WRITE (6,720) WAVEN,BN(KK),AMP,PHASE                              P2010*
  440 CONTINUE                                                          P2020
      INP1=INUM+1                                                       P2030
      XVAL(INP1)=XVAL(1)                                                P2040
      W(INP1)=W(1)                                                      P2050
      BN(INP1)=BN(1)                                                    P2060
C                                                                       P2070
C      CALCULATION OF FAR FIELD DIRECTIVITY PATTERN                     P2080
C                                                                       P2090
      IF (IFLG.EQ.0) GO TO 450                                          P2100
      WRITE (6,730)                                                     P2110*
  450 DO 550 M=1,NANG                                                   P2120
      ANGLE=TM(M)/FCT                                                   P2130
      COST=COS(ANGLE)                                                   P2140
      WAVEN=OMEGA*VJA0*COST                                             P2150
      IF (WAVEN.LT.0.) GO TO 460                                        P2160
      IVAL=IFIX(WAVEN/DELW-.001)+1                                      P2170
      IF (IVAL.LT.3) IVAL=3                                             P2180
      IF (IVAL.GT.(N-1)) IVAL=N-1                                       P2190
      GO TO 470                                                         P2200
  460 IVAL=IFIX(WAVEN/DELW-.001)+INP1                                   P2210
      IF (IVAL.LT.(N2+2)) IVAL=N2+2                                     P2220
      IF (IVAL.GT.(INP1-2)) IVAL=INP1-2                                 P2230
  470 IM2=IVAL-2                                                        P2240
      IP2=IVAL+2                                                        P2250
      CWAVE=(0.,0.)                                                     P2260
      DO 490 J=IM2,IP2                                                  P2270
      CONT=(1.,0.)                                                      P2280
      DO 480 KJ=IM2,IP2                                                 P2290
      IF (J.EQ.KJ) GO TO 480                                            P2300
      CONT=CONT*(WAVEN-W(KJ))/(W(J)-W(KJ))                              P2310
  480 CONTINUE                                                          P2320
  490 CWAVE=CWAVE+BN(J)*CONT                                            P2330
      IF (NORD.EQ.0) GO TO 520                                          P2340
      IF (ABS(ANGLE).LT.1.E-20) GO TO 500                               P2350
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      VAL=(SQRT(M2O-WAVEN*WAVEN))**NORD                                    P2360
      GO TO 510                                                            P2370
  500 VAL=0.                                                               P2380
  510 CWAVE=CWAVE*VAL                                                      P2390
  520 PTHETA(M)=2.*REAL(CWAVE*CONJG(CWAVE))                                P2400
      ANGLE=ANGLE*FCT                                                      P2410
      IF (PTHETA(M).LT.1.E-20) GO TO 530                                   P2420
      PDB(M)=10.*ALOG10(PTHETA(M))                                         P2430
      GO TO 540                                                            P2440
  530 PDB(M)=0.                                                            P2450
  540 IF (IFLG.EQ.0) GO TO 550                                             P2460
      WRITE (6,740) ANGLE,PTHETA(M),PDB(M)                                 P2470*
  550 CONTINUE                                                             P2480
      IF (INF.EQ.0) GO TO 670                                              P2490
C                                                                          P2500
C           CALCULATION OF NEAR FIELD SOUND PRESSURE LEVEL CONTOURS        P2510
C                                                                          P2520
      IF (NORD.EQ.0) GO TO 580                                             P2530
      DO 570 I=1,INUM                                                      P2540
      DUM=CSQRT(M2O-W(I)*W(I))                                             P2550
      IF (ABS(AIMAG(DUM)).LT.1.E-10) GO TO 560                             P2560
      IF (AIMAG(DUM).GT.0.) GO TO 570                                      P2570
      DUM=-DUM                                                             P2580
      GO TO 570                                                            P2590
  560 IF (REAL(DUM).LT.0.) DUM=-DUM                                        P2600
  570 BN(I)=BN(I)*DUM**NORD                                                P2610
  580 DO 650 I=1,INF                                                       P2620
      RAD=RSTART+FLOAT(I)*RADNF                                            P2630
      DO 610 J=1,INUM                                                      P2640
      DUM=CSQRT(M2O-W(J)*W(J))                                             P2650
      IF (ABS(AIMAG(DUM)).LT.1.E-10) GO TO 590                             P2660
      IF (AIMAG(DUM).GT.0.) GO TO 600                                      P2670
      DUM=-DUM                                                             P2680
      GO TO 600                                                            P2690
  590 IF (REAL(DUM).LT.0.) DUM=-DUM                                        P2700
  600 DUM=DUM*RAD                                                          P2710
      CALL NCBRTS (DUM,H01,H02,NORD,1)                                     P2720$
  610 XVAL(J)=BN(J)*H01                                                    P2730
      DO 620 J=1,INUM                                                      P2740
  620 XVAL(J)=XVAL(J)*SQRT(RAD)                                            P2750
      CALL FFT (IGAM,INUM,XVAL,W1)                                         P2760$
      DO 630 J=1,INUM                                                      P2770
  630 XVAL(J)=XVAL(J)*DELW                                                 P2780
      DO 640 J=2,N                                                         P2790
      K=J+N                                                                P2800
  640 NFDB(J,I)=10.*ALOG10(0.5*REAL(XVAL(K)*CONJG(XVAL(K)))/RAD)           P2810
  650 NFDB(1,I)=10.*ALOG10(0.5*REAL(XVAL(1)*CONJG(XVAL(1)))/RAD)           P2820
      WRITE (6,750) RADNF                                                  P2830*
      DO 660 J=1,N                                                         P2840
      K=N-J+2                                                              P2850
      IF (J.EQ.1) K=1                                                      P2860
      X=DELX*FLOAT(J-1)                                                    P2870
      IF (X.GT.XLAST) GO TO 660                                            P2880
      WRITE (6,760) X,(NFDB(K,I),I=1,INF)                                  P2890*
  660 CONTINUE                                                             P2900
  670 RETURN                                                               P2910
C                                                                          P2920
  680 FORMAT (1H1,28X,"VARIATION OF FOURIER TRANSFORM INTEGRAND"/29X,40H   P2930
     1*****************************/28X,"MODE NUMBER   ",I1/2              P2940
```

```
   28X,"MACH NUMBER = ",F10.4/23X,"TEMPERATURE RATIO = ",F10.4/32X,"EP   P2950
   3SILON = ",F10.4/34X,"GAMMA        ",I2///4X,"AXIAL",3X,"THICKNESS",  P2960
   44X,"DBDX",3X,"CENTERLINE",2X,"FOURIER TRANSFORM",7X,"AMPLITUDE",2X   P2970
   5,"PHASE"/3X,"DISTANCE",22X,"VELOCITY",2X,"INTEGRAND, G($)"//)        P2980
690 FORMAT (1X,4F10.4,2E12.4,2X,2F10.4)                                  P2990
700 FORMAT (//1X,"IWR = ",I1,2X,"IND = ",I5//)                           P3000
710 FORMAT (1H1,25X,"WAVENUMBER SPECTRUM, B(K)"/26X,25H*****************  P3010
   1**********//1X,"WAVENUMBER",4X,"WAVENUMBER SPECTRUM",6X,"AMPLITUDE   P3020
   2",2X,"PHASE"/21X,"B(K)"//)                                           P3030
720 FORMAT (1X,F10.4,2X,2E12.4,2X,2F10.4)                                P3040
730 FORMAT (1H1,20X,"FAR-FIELD DIRECTIVITY"/21X,21H********************  P3050
   1**//9X,"ANGLE",10X,"PTHETA",11X,"P DB"//)                            P3060
740 FORMAT (6X,F10.4,5X,E12.5,5X,F10.4)                                  P3070
750 FORMAT (1H1,20X,"NEAR FIELD SOUND PRESSURE LEVEL CONTOURS"/21X,40H   P3080
   1****************************************//35X,"RADIAL SPACING = ",   P3090
   2F5.2," RADII"//)                                                     P3100
760 FORMAT (1X,F10.4,5X,13F8.2)                                          P3110
    END                                                                  P3120-
```

```
*DECK RUNREL
      SUBROUTINE RUNREL (M,H,Y,DY,P,Q,ERRES,ADAT,NTT,DB)                Q  10
      COMPLEX Y(M),DY(M),P(M),Q(M),RR(4)                                Q  20
       COMPLEX ADAT(1)                                                  Q  30
   10 DO 20 I=1,M                                                       Q  40
   20 Q(I)=(0.,0.)                                                      Q  50
      DY(1)=(1.,0.)                                                     Q  60
      DO 30 I=2,M                                                       Q  70
   30 DY(I)=(0.,0.)                                                     Q  80
      CALL DERY1 (M,Y,DY,ADAT,NTT,DB)                                   Q  90$
      DO 40 I=1,M                                                       Q 100
      P(I)=H*DY(I)*.5                                                   Q 110
      RR(I)=(P(I)-Q(I)+Y(I))-Y(I)                                       Q 120
      Y(I)=Y(I)+RR(I)                                                   Q 130
   40 Q(I)=(3.*Q(I))-P(I)+(3.*RR(I))                                    Q 140
      CALL DERY1 (M,Y,DY,ADAT,NTT,DB)                                   Q 150$
      DO 50 I=1,M                                                       Q 160
      P(I)=H*DY(I)                                                      Q 170
      RR(I)=((P(I)-Q(I))*.5+Y(I))-Y(I)                                  Q 180
      Y(I)=Y(I)+RR(I)                                                   Q 190
   50 Q(I)=(3.*P(I))-(2.*Q(I))-(6.*RR(I))                               Q 200
      CALL DERY1 (M,Y,DY,ADAT,NTT,DB)                                   Q 210$
      ERRES=0.                                                          Q 220
      DO 70 I=1,M                                                       Q 230
      IF (CABS(P(I)-Q(I)).LT.1.E-20) GO TO 60                           Q 240
      E=CABS(((H*DY(I))-P(I))/(P(I)-Q(I)))                              Q 250
      IF (E.GT.ERRES) ERRES=E                                           Q 260
   60 P(I)=H*DY(I)-.5*P(I)                                              Q 270
      RR(I)=(P(I)+Y(I))-Y(I)                                            Q 280
      Y(I)=Y(I)+RR(I)                                                   Q 290
   70 Q(I)=Q(I)+6.*(P(I)-RR(I))                                         Q 300
      CALL DERY1 (M,Y,DY,ADAT,NTT,DB)                                   Q 310$
      DO 80 I=1,M                                                       Q 320
      P(I)=(-4.*P(I)+H*DY(I)+Q(I))/6.                                   Q 330
      RR(I)=(P(I)+Y(I))-Y(I)                                            Q 340
      Y(I)=Y(I)+RR(I)                                                   Q 350
   80 Q(I)=RR(I)-P(I)                                                   Q 360
      RETURN                                                            Q 370
      END                                                               Q 380-
```

```
*DECK DERY1
      SUBROUTINE DERY1 (M,Y,DY,ADAT,NTT,DB)                                    R  10
       COMPLEX Y(M),DY(M),ADAT(NTT),AVAL                                       R  20
       COMPLEX ALPHA,DKDB                                                      R  30
       COMPLEX YPEAK,APEAK,X0                                                  R  40
       REAL KAPPA,KAPB,MACH2,VJA0                                              R  50
       COMMON/DATA/KAPPA,EPSI,POTB,IFLAG                                       R  60
       COMMON/INFO/ALPHA,OMEGA,MACH2,TJT0,NORD,GM1,DKDB,IFLG,VJA0              R  70
       COMMON/DECAY/ ID,SD                                                     R  80
C                                                                              R  90
C      CALCULATION OF DBDX AND DUCDX                                           R 100
C                                                                              R 110
      B=REAL(Y(2))                                                             R 120
      IF (B.LT.POTB) GO TO 40                                                  R 130
      IF (IFLAG.EQ.2) GO TO 10                                                 R 140
      KAPPA=POTB*(1.-KAPPA*2.0*(EPSI-1./REAL(Y(1)))/0.04)                      R 150
      IFLAG=2                                                                  R 160
   10 AA=0.2*MACH2                                                             R 170
      AB=(1.-TJT0*AA)                                                          R 180
      UC=REAL(Y(3))                                                            R 190
      KAPB=0.04*(1.0-KAPPA/B)                                                  R 200
      IF (AA.LT.1.E-10) GO TO 20                                               R 210
      AK=SQRT(AB*AB+4.*AA)                                                     R 220
      RHOB=1./(1.-0.5*UC*(AB+0.5*UC*AA))                                       R 230
      DBDX=.693147*KAPB*UC**3*RHOB/(UC/AA-((AB+AA*UC)*ALOG(ABS((AA*UC+AB       R 240
     1)*UC-1.))-(AB*AB+2.*AA+AA*AB*UC)*ALOG(ABS((2.*AA*UC+AB-AK)*(AB+AK)       R 250
     2/(2.*AA*UC+AB+AK)/(AB-AK)))/AK)/2./AA/AA)/2.                             R 260
      DUCDX=1.38629*(AA*UC*UC+AB*UC-1.)*DBDX/UC/B**3/TJT0                      R 270
      GO TO 50                                                                 R 280
   20 IF (AB.LT.1.E-10) GO TO 30                                               R 290
      RHOB=1./(1.-UC*AB)                                                       R 300
      DBDX=.693147*KAPB*UC**3*RHOB*AB/(UC*UC/2.+UC*(1.-UC)/AB*(1.-UC*AB)       R 310
     1*ALOG(ABS(1.-AB*UC))/AB/AB)/2.                                           R 320
      DUCDX=-1.38629*(1.-AB*UC)*DBDX/B**3/UC/TJT0                              R 330
      GO TO 50                                                                 R 340
   30 DBDX=2.07944*KAPB/B                                                      R 350
      DUCDX=-UC*DBDX/B                                                         R 360
      GO TO 50                                                                 R 370
   40 DBDX=EPSI                                                                R 380
      DUCDX=0.                                                                 R 390
C                                                                              R 400
C      CALCULATION OF AXIAL DERIVATIVES                                        R 410
C                                                                              R 420
   50 DY(2)=CMPLX(DBDX,0.)                                                     R 430
      DY(3)=CMPLX(DUCDX,0.)                                                    R 440
      IF (B.GT.SD) GO TO 70                                                    R 450
      IF (B.GT.(NTT*DB)) GO TO 60                                              R 460
      CALL COEFF (ADAT,NTT,B,AVAL,DB)                                          R 470$
      DY(4)=(0.,1.)*AVAL*Y(4)                                                  R 480
      RETURN                                                                   R 490
   60 DY(4)=(0.,1.)*Y(4)*CMPLX(OMEGA/REAL(Y(3)),AIMAG(ADAT(NTT))*NTT*DB/       R 500
     1B)                                                                       R 510
      RETURN                                                                   R 520
   70 IF (ID.GT.1) GO TO 80                                                    R 530
      YPEAK=Y(4)                                                               R 540
      CALL COEFF (ADAT,NTT,B,APEAK,DB)                                         R 550$
      X0=Y(1)                                                                  R 560
      SIGMA=ALOG(CABS(YPEAK))/REAL(X0*X0)                                      R 570
      APR=REAL(APEAK)                                                          R 580
      ID=2                                                                     R 590
   80 DY(4)=Y(4)*(-2.0*SIGMA*(Y(1)-X0)+(0.,1.)*APEAK*(2.0*Y(1)/X0-1.0))        R 600
      RETURN                                                                   R 610
      END                                                                      R 620-
```

```
*DECK COEFF
      SUBROUTINE COEFF (A,NG,S,AVAL,DB)                                 S  10
       COMPLEX A(1),AVAL,A1,A2,A3                                       S  20
      I=IFIX((S-0.05)/DB)                                               S  30
      IF (I.EQ.1) I=2                                                   S  40
      IF (I.EQ.NG) I=NG-1                                               S  50
      IF (I.GT.NG) GO TO 10                                             S  60
      DS=S-0.05-(I-1)*DB                                                S  70
      A1=(A(I-1)-2.*A(I)+A(I+1))/2./DB/DB                               S  80
      A2=(4.*A(I)-3.*A(I-1)-A(I+1))/2./DB                               S  90
      A3=A(I-1)                                                         S 100
      AVAL=DS*(A1*DS+A2)+A3                                             S 110
   10 RETURN                                                            S 120
      END                                                               S 130-
```

```
*DECK FFT
      SUBROUTINE FFT (IGAM,INUM,XVAL,W)                                  T  10
C      TO COMPUTE THE FOURIER EXPONENTIAL TRANSFORM OF X(T)               T  20
C      USING THE FFT BY BRIGHAM AND MORROW                                T  30
C                                                                         T  40
C      IGAM -      POWER OF TWO NUMBER OF POINTS                          T  50
C      INUM -      NUMBER OF POINTS                                       T  60
C      W -         WORKING ARRAY OF DIMENSION INUM DIMENSIONED            T  70
C                  IN CALLING ROUTINE                                     T  80
C      XVAL -      DATA POINT ARRAY OF DIMENSION INUM DIMENSIONED         T  90
C                  IN CALLING ROUTINE. XVAL IS DEFINED SUCH THAT          T 100
C                  XVAL(1)=          VALUE AT T=0                         T 110
C                  XVAL(INUM/2+1)= VALUE AT T=PERIOD/2                    T 120
C                  XVAL(INUM/2+2)= VALUE AT T=-PERIOD/2                   T 130
C                  XVAL(INUM)=       VALUE AT T=-DELT                     T 140
C                  XVAL IS RETURNED AS THE FOURIER TRANSFORM S(F)         T 150
C                  IN STEPS OF DELF=1/PERIOD. S(F) IS FOLDED ABOUT        T 160
C                  F=INUM/2*PERIOD                                        T 170
C                  FOR A WAVENUMBER TRANSFORM THE CALLING PROGRAM         T 180
C                  MUST SUBSEQUENTLY DIVIDE BY 2*PI AND MULTIPLY          T 190
C                  BY DELX FOR A CONSISTENT TRANSFORM. FOR A FREQUENCY     T 200
C                  TRANSFORM THE CALLING ROUTINE MUST MULTIPLY BY DELT     T 210
C                  TO OBTAIN TRANSFORM AS DEFINED BY BRIGHAM AND MORROW.  T 220
C                                                                         T 230
C                                                                         T 240
      COMPLEX XVAL(INUM),W(INUM),VAL,XDUM                                T 250
       COMPLEX CEXP                                                      T 260
      PI=3.14159265359                                                   T 270
      NUM=2**(IGAM-1)                                                    T 280
      DO 10 I=1,NUM                                                      T 290
      AI=I-1                                                             T 300
      ANUM=NUM                                                           T 310
   10 W(I)=CEXP(-(0.,1.)*PI*AI/ANUM)                                     T 320
      DO 20 IOUT=1,IGAM                                                  T 330
      N2=2**(IOUT-1)                                                     T 340
      IGM=IGAM-IOUT                                                      T 350
      IGM2=2**IGM                                                        T 360
      DO 20 KKK=1,N2                                                     T 370
      DO 20 KK=1,IGM2                                                    T 380
      IVAL=KK-1+(KKK-1)*2*IGM2                                           T 390
      IF (IVAL.EQ.0) IVAL=0                                              T 400
      ISOL1=ISOL(IOUT,IGAM,IVAL)+1                                       T 410
      IDASH1=IDASH(IOUT,IGAM,IVAL)+1                                     T 420
      K1=IMOVE(IOUT,IGAM,IVAL)+1                                         T 430
      IVAL=IVAL+1                                                        T 440
      KVAL=IVAL+IGM2                                                     T 450
      XDUM=XVAL(IDASH1)                                                  T 460
      VAL=W(K1)*XVAL(ISOL1)                                              T 470
      XVAL(IVAL)=XDUM+VAL                                                T 480
   20 XVAL(KVAL)=XDUM-VAL                                                T 490
      NUM1=INUM-1                                                        T 500
      DO 30 I=1,NUM1                                                     T 510
      I1=IREV(IGAM,I)+1                                                  T 520
      IVAL=I+1                                                           T 530
      IF (IVAL.GT.I1) GO TO 30                                           T 540
      XDUM=XVAL(IVAL)                                                    T 550
      XVAL(IVAL)=XVAL(I1)                                                T 560
      XVAL(I1)=XDUM                                                      T 570
   30 CONTINUE                                                           T 580
      RETURN                                                             T 590
      END                                                                T 600-
```

```
*DECK ISOL
      FUNCTION ISOL(IOUT,IGAM,K)                                    U  10
      IB=2**(IGAM-IOUT)                                             U  20
      IW=IB.AND.K                                                   U  30
      IF (IW.EQ.0) GO TO 10                                         U  40
      ISOL=K                                                        U  50
      RETURN                                                        U  60
   10 ISOL=K+IB                                                     U  70
      RETURN                                                        U  80
      END                                                           U  90-
```

```
*DECK IMOVE
      FUNCTION IMOVE(IOUT,IGAM,K)                                    V  10
      I2=1                                                           V  20
      IG=IGAM-1                                                      V  30
      DO 10 I=1,IG                                                   V  40
   10 I2=I2+2**I                                                     V  50
      I1=K.AND.I2                                                    V  60
      I3=IGAM-IOUT                                                   V  70
      I4=SHIFT(I1,-I3)                                               V  80
      I1=COMPL(I2)                                                   V  90
      I3=I1.AND.K                                                    V 100
      I1=I3.OR.I4                                                    V 110
      IMOVE=IREV(IGAM,I1)                                            V 120
      RETURN                                                         V 130
      END                                                            V 140-
```

```
*DECK IDASH
      FUNCTION IDASH(IOUT,IGAM,K)                                    W  10
      IB=2**(IGAM-IOUT)                                              W  20
      IA=COMPL(IB)                                                   W  30
      IDASH=K.AND.IA                                                 W  40
      RETURN                                                         W  50
      END                                                            W  60-
```

```
*DECK IREV
      FUNCTION IREV(M,II)                                              X  10
      I2=1                                                             X  20
      NG=M-1                                                           X  30
      DO 10 I=1,NG                                                     X  40
   10 I2=I2+2**I                                                       X  50
      I1=II.AND.I2                                                     X  60
      I3=I1.AND.1525258                                                X  70
      I4=SHIFT(I3,1)                                                   X  80
      I3=I1.AND.1252528                                                X  90
      I5=SHIFT(I3,-1)                                                  X 100
      I3=I4.OR.I5                                                      X 110
      I4=I3.AND.314638                                                 X 120
      I5=SHIFT(I4,2)                                                   X 130
      I6=I3.AND.1463148                                                X 140
      I3=SHIFT(I6,-2)                                                  X 150
      I4=I3.OR.I5                                                      X 160
      I3=I4.AND.7417B                                                  X 170
      I5=SHIFT(I3,4)                                                   X 180
      I3=I4.AND.170360B                                                X 190
      I6=SHIFT(I3,-4)                                                  X 200
      I4=I5.OR.I6                                                      X 210
      I3=I4.AND.377B                                                   X 220
      I5=SHIFT(I3,8)                                                   X 230
      I3=I4.AND.177400B                                                X 240
      I6=SHIFT(I3,-8)                                                  X 250
      I4=I5.OR.I6                                                      X 260
      IM=16-M                                                          X 270
      IF (IM.EQ.0) GO TO 20                                            X 280
      I5=SHIFT(I4,-IM)                                                 X 290
      GO TO 30                                                         X 300
   20 I5=I4                                                            X 310
   30 I3=COMPL(I2)                                                     X 320
      I4=I3.AND.II                                                     X 330
      IREV=I5.OR.I4                                                    X 340
      RETURN                                                           X 350
      END                                                              X 360-
```

```
*DECK ASTART
      SUBROUTINE ASTART (VJA0,STRNO,TJT0,ALPHA,NORD,IEROR)                Y  10
       COMPLEX ALPHA,ASTAR0(4,3,8),ASTAR1(4,3,8),A(7,7),B(7)              Y  20
       COMPLEX ALSTAR(4,3,8)                                              Y  30
       COMMON/ADATA/ASTAR0,ASTAR1                                         Y  40
C                                                                         Y  50
C      LOCATE CLOSEST VALUE IN STARTING VALUE MATRIX                      Y  60
C                                                                         Y  70
      IF (STRNO.LE.0.065) I=1                                             Y  80
      IF (STRNO.LE.0.2.AND.STRNO.GT.0.065) I=2                            Y  90
      IF (STRNO.LE.0.4.AND.STRNO.GT.0.2) I=3                              Y 100
      IF (STRNO.GT.0.4) I=4                                               Y 110
      IF (TJT0.LE.1.63) J=1                                               Y 120
      IF (TJT0.LE.2.56.AND.TJT0.GT.1.63) J=2                              Y 130
      IF (TJT0.GT.2.56) J=3                                               Y 140
      K=IFIX((VJA0-0.5)/0.25)+1                                           Y 150
      IKEY=I                                                              Y 160
      JKEY=J                                                              Y 170
      IF (NORD.EQ.0) GO TO 20                                             Y 180
      DO 10 II=1,4                                                        Y 190
      DO 10 JJ=1,3                                                        Y 200
      DO 10 KK=1,8                                                        Y 210
   10 ALSTAR(II,JJ,KK)=ASTAR1(II,JJ,KK)                                  Y 220
      GO TO 40                                                            Y 230
   20 DO 30 II=1,4                                                        Y 240
      DO 30 JJ=1,3                                                        Y 250
      DO 30 KK=1,8                                                        Y 260
   30 ALSTAR(II,JJ,KK)=ASTAR0(II,JJ,KK)                                   Y 270
C                                                                         Y 280
C      CALCULATE STARTING VALUE MATRIX                                    Y 290
C                                                                         Y 300
   40 DO 90 IFL=1,7                                                       Y 310
      IF (IFL.EQ.1) GO TO 80                                              Y 320
      IF (IFL.LT.4) GO TO 60                                              Y 330
      IF (IFL.LT.6) GO TO 70                                              Y 340
      IF (IFL.EQ.6) GO TO 50                                              Y 350
      K=K+2                                                               Y 360
      GO TO 80                                                            Y 370
   50 K=K-1                                                               Y 380
      IF (K.EQ.0) K=2                                                     Y 390
      IF (K.EQ.7) K=K-1                                                   Y 400
      I=IKEY                                                              Y 410
      GO TO 80                                                            Y 420
   60 J=J+1                                                               Y 430
      IF (J.EQ.4) J=1                                                     Y 440
      GO TO 80                                                            Y 450
   70 J=JKEY                                                              Y 460
      I=I+1                                                               Y 470
      IF (I.EQ.5) I=2                                                     Y 480
   80 IF (I.EQ.1) S1=0.03                                                 Y 490
      IF (I.EQ.2) S1=0.1                                                  Y 500
      IF (I.EQ.3) S1=0.3                                                  Y 510
      IF (I.EQ.4) S1=0.5                                                  Y 520
      IF (J.EQ.1) T1=1.0                                                  Y 530
      IF (J.EQ.2) T1=2.273                                                Y 540
      IF (J.EQ.3) T1=2.857                                                Y 550
      AM1=0.5+(K-1)*0.25                                                  Y 560
      A(IFL,1)=(1.,0.)                                                    Y 570
      A(IFL,2)=S1                                                         Y 580
```

```
      A(IFL,3)=S1*S1                                                    Y 590
      A(IFL,4)=T1                                                       Y 600
      A(IFL,5)=T1*T1                                                    Y 610
      A(IFL,6)=AM1                                                      Y 620
      A(IFL,7)=AM1*AM1                                                  Y 630
   90 B(IFL)=ALSTAR(I,J,K)                                              Y 640
C                                                                       Y 650
C      CALL FOR SOLUTION OF SIMULTANEOUS EQUATIONS                      Y 660
C                                                                       Y 670
      CALL SIMQ (A,B,7,KS)                                              Y 680$
      IF (KS.EQ.0) GO TO 100                                            Y 690
      IEROR=2                                                           Y 700
      RETURN                                                            Y 710
C                                                                       Y 720
C      CALCULATE STARTING VALUE                                         Y 730
C                                                                       Y 740
  100 ALPHA=B(1)+B(2)*STRNO+B(3)*STRNO*STRNO+B(4)*TJT0+B(5)*TJT0*TJT0+B(  Y 750
     16)*VJA0+B(7)*VJA0*VJA0                                            Y 760
      RETURN                                                            Y 770
      END                                                               Y 780-
```

```
*DECK ISEQ
      SUBROUTINE ISEQ (I)                                          Z  10
      GO TO (10,10,20), I                                          Z  20
   10 I=I+1                                                        Z  30
      RETURN                                                       Z  40
   20 I=1                                                          Z  50
      RETURN                                                       Z  60
      END                                                          Z  70-
```

```
*DECK SIMQ
      SUBROUTINE SIMQ (A,B,N,KS)                                        AA  10
       COMPLEX A(1),B(1),BIGA,SAVE                                      AA  20
C                                                                       AA  30
C       FORWARD SOLUTION                                                AA  40
C                                                                       AA  50
      TOL=0.0                                                           AA  60
      KS=0                                                              AA  70
      JJ=-N                                                             AA  80
      DO 80 J=1,N                                                       AA  90
      JY=J+1                                                            AA 100
      JJ=JJ+N+1                                                         AA 110
      BIGA=(0.,0.)                                                      AA 120
      IT=JJ-J                                                           AA 130
      DO 20 I=J,N                                                       AA 140
C                                                                       AA 150
C       SEARCH FOR MAXIMUM COEFFICIENT IN COLUMN                        AA 160
C                                                                       AA 170
      IJ=IT+I                                                           AA 180
      IF (CABS(BIGA)-CABS(A(IJ))) 10,20,20                              AA 190
   10 BIGA=A(IJ)                                                        AA 200
      IMAX=I                                                            AA 210
   20 CONTINUE                                                          AA 220
C                                                                       AA 230
C       TEST FOR PIVOT LESS THAN TOLERANCE (SINGULAR MATRIX)            AA 240
C                                                                       AA 250
      IF (CABS(BIGA)-TOL) 30,30,40                                      AA 260
   30 KS=1                                                              AA 270
      RETURN                                                            AA 280
C                                                                       AA 290
C       INTERCHANGE ROWS IF NECESSARY                                   AA 300
C                                                                       AA 310
   40 I1=J+N*(J-2)                                                      AA 320
      IT=IMAX-J                                                         AA 330
      DO 50 K=J,N                                                       AA 340
      I1=I1+N                                                           AA 350
      I2=I1+IT                                                          AA 360
      SAVE=A(I1)                                                        AA 370
      A(I1)=A(I2)                                                       AA 380
      A(I2)=SAVE                                                        AA 390
C                                                                       AA 400
C       DIVIDE EQUATION BY LEADING COEFFICIENT                          AA 410
C                                                                       AA 420
   50 A(I1)=A(I1)/BIGA                                                  AA 430
      SAVE=B(IMAX)                                                      AA 440
      B(IMAX)=B(J)                                                      AA 450
      B(J)=SAVE/BIGA                                                    AA 460
C                                                                       AA 470
C       ELIMINATE NEXT VARIABLE                                         AA 480
C                                                                       AA 490
      IF (J-N) 60,90,60                                                 AA 500
   60 IOS=N*(J-1)                                                       AA 510
      DO 80 IX=JY,N                                                     AA 520
      IXJ=IOS+IX                                                        AA 530
      IT=J-IX                                                           AA 540
      DO 70 JX=JY,N                                                     AA 550
      IXJX=N*(JX-1)+IX                                                  AA 560
      JJX=IXJX+IT                                                       AA 570
   70 A(IXJX)=A(IXJX)-(A(IXJ)*A(JJX))                                   AA 580
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   80 B(IX)=B(IX)-(B(J)*A(IXJ))                                    AA 590
C                                                                  AA 600
C       BACK SOLUTION                                              AA 610
C                                                                  AA 620
   90 NY=N-1                                                       AA 630
      IT=N*N                                                       AA 640
      DO 100 J=1,NY                                                AA 650
      IA=IT-J                                                      AA 660
      IB=N-J                                                       AA 670
      IC=N                                                         AA 680
      DO 100 K=1,J                                                 AA 690
      B(IB)=B(IB)-A(IA)*B(IC)                                      AA 700
      IA=IA-N                                                      AA 710
  100 IC=IC-1                                                      AA 720
      RETURN                                                       AA 730
      END                                                          AA 740-
```

```
*DECK BLKLSN
      BLOCK DATA LSN                                                                AB  10
       COMPLEX ASTAR0(4,3,8),ASTAR1(4,3,8)                                          AB  20
       COMMON /ADATA/ ASTAR0,ASTAR1                                                 AB  30
       DATA (((ASTAR0(I,J,K),I=1,4),J=1,3),K=1,4) /                                 AB  40
     1 (.09358,-.00988),(.3018,-1.0835),(.8303,-.5622),(1.4941,-1.3801),            AB  50
     2 (.09268,-.0147),(.2843,-.1235),(.5727,-.83452),(1.5899,-2.4995),             AB  60
     3 (.09227,-.0165),(.2762,-.1375),(.4225,-.8857),(1.6951,-2.8943),              AB  70
     4 (.09370,-.0104),(.3045,-.0895),(.8813,-.6111),(1.6631,-1.3868),              AB  80
     5 (.09282,-.0155),(.2885,-.1312),(.6531,-.9349),(1.7001,-2.3972),              AB  90
     6 (.09258,-.0173),(.2806,-.1450),(.4920,-1.0286),(1.7864,-2.8183),             AB 100
     7 (.09432,-.0110),(.3118,-.0943),(.9654,-.6463),(1.8513,-1.3641),              AB 110
     8 (.09385,-.0163),(.2965,-.1402),(.7901,-1.0089),(1.8762,-2.2768),             AB 120
     9 (.09340,-.0183),(.2895,-.1538),(.6586,-1.1550),(1.9302,-2.7002),             AB 130
     $ (.09584,-.0109),(.3230,-.0957),(1.0682,-.6527),(2.0507,-1.3039),             AB 140
     $ (.09555,-.0164),(.3085,-.1443),(.9465,-1.0326),(2.0944,-2.1508),             AB 150
     $ (.09528,-.0183),(.3018,-.1593),(.8603,-1.1941),(2.1292,-2.5534) /            AB 160
       DATA (((ASTAR0(I,J,K),I=1,4),J=1,3),K=5,8) /                                 AB 170
     1 (.09622,-.0102),(.3345,-.0945),(1.1765,-.6259),(2.2561,-1.1935),             AB 180
     2 (.09638,-.0156),(.3225,-.1450),(1.0996,-1.0170),(2.3324,-2.0077),            AB 190
     3 (.09628,-.0175),(.3162,-.1618),(1.0434,-1.1779),(2.3664,-2.3866),            AB 200
     4 (.09656,-.00982),(.3425,-1.0907),(1.2791,-.5613),(2.455,-1.0065),            AB 210
     5 (.09696,-.0150),(.3355,-.1430),(1.2449,-.9702),(2.5775,-1.8286),             AB 220
     6 (.09700,-.0170),(.3300,-.1610),(1.2092,-1.1304),(2.6217,-2.1918),            AB 230
     7 (.09678,-.00947),(.3488,-.0855),(1.3532,-.4552),(2.5695,-0.6875),            AB 240
     8 (.09733,-.0145),(.3472,-.1371),(1.3808,-.8920),(2.8178,-1.5880),             AB 250
     9 (.09744,-.0165),(.3432,-.1585),(1.3623,-1.0552),(2.8803,-1.9492),            AB 260
     $ (.09790,-.00917),(.3540,-.0790),(1.3646,-.3370),(2.7500,0.0000),             AB 270
     $ (.09765,-.0141),(.3578,-.1318),(1.4992,-.7761),(3.0192,-1.2388),             AB 280
     $ (.09782,-.0160),(.3568,-.1525),(1.5013,-.9476),(3.1223,-1.6252) /            AB 290
       DATA (((ASTAR1(I,J,K),I=1,4),J=1,3),K=1,4) /                                 AB 300
     1 (.1013,-.0930),(.353,-.291),(1.0606,-.7823),(1.7405,-1.3550),                AB 310
     2 (.1071,-.1403),(.388,-.427),(1.0934,-1.1439),(1.6609,-2.1340),               AB 320
     3 (.1095,-.1573),(.402,-.475),(1.0913,-1.2721),(1.5279,-2.5331),               AB 330
     4 (.1015,-.0930),(.357,-.293),(1.0949,-.7973),(1.8407,-1.3815),                AB 340
     5 (.1074,-.1405),(.393,-.431),(1.1354,-1.1581),(1.8220,-2.1505),               AB 350
     6 (.1098,-.1576),(.407,-.477),(1.1359,-1.2871),(1.7537,-2.5379 ),              AB 360
     7 (.1018,-.0933),(.363,-.297),(1.1461,-.8100),(1.9793,-1.3880),                AB 370
     8 (.1078,-.1408),(.401,-.435),(1.1952,-1.1708),(2.0182,-2.1410),               AB 380
     9 (.1103,-.1581),(.414,-.479),(1.1990,-1.3006),(1.9946,-2.5056),               AB 390
     $ (.1022,-.0938),(.372,-.301),(1.2134,-.8131),(2.1455,-1.3590),                AB 400
     $ (.1083,-.1414),(.410,-.437),(1.2715,-1.1754),(2.2342,-2.0963),               AB 410
     $ (.1110,-.1585),(.424,-.482),(1.2790,-1.3067),(2.2422,-2.4416) /              AB 420
       DATA (((ASTAR1(I,J,K),I=1,4),J=1,3),K=5,8) /                                 AB 430
     1 (.1027,-.0943),(.381,-.304),(1.2928,-.7999),(2.3276,-1.2818),                AB 440
     2 (.1090,-.1420),(.421,-.439),(1.3611,-1.1669),(2.4613,-2.0123),               AB 450
     3 (.1117,-.1590),(.436,-.484),(1.3730,-1.3005),(2.4945,-2.3437),               AB 460
     4 (.1032,-.0948),(.393,-.307),(1.3790,-.7646),(2.5121,-1.1393),                AB 470
     5 (.1099,-.1426),(.434,-.441),(1.4604,-1.1414),(2.6935,-1.8810),               AB 480
     6 (.1126,-.1596),(.451,-.486),(1.4774,-1.2776),(2.7490,-2.2042),               AB 490
     7 (.1040,-.0953),(.407,-.306),(1.4639,-.7010),(2.6612,-0.8973),                AB 500
     8 (.1109,-.1431),(.450,-.441),(1.5657,-1.0942),(2.9228,-1.6878),               AB 510
     9 (.1138,-.1603),(.467,-.485),(1.5886,-1.2345),(3.0011,-2.0110),               AB 520
     $ (.1049,-.0956),(.422,-.303),(1.5320,-.6039),(2.6335,-0.5950),                AB 530
     $ (.1122,-.1438),(.468,-.437),(1.6713,-1.0205),(3.1281,-1.4037),               AB 540
     $ (.1151,-.1611),(.484,-.482),(1.7025,-1.1668),(3.2391,-1.7421) /              AB 550
       END                                                                          AB 560-
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*DECK MXNOISE
      SUBROUTINE MXNOISE (NU,ILWR,OPNO,BOPNO,IOPT,ROD,DFT,T0F,A0,VJ,VJA0 AC  10
     1,TJT0,I,FREQ,S,ZM,SM,RSW,ALTB,BLTB,SPLB,SPLPD,SPLPQ,IND)           AC  20
      DIMENSION SPLB(1),FREQ(1),SMD(28)                                  AC  30
         DIMENSION T1(6)                                                 AC  40
       REAL KS,KZRZ,LH,LHH                                               AC  50
       INTEGER OC,BOPNO,OPNO                                             AC  60
C                                                                        AC  70
       COMMON/ONE/ SPLNQ(28),CQ(28),SPLND(28),CD(28),UCLUJ(28),SD(28,6)   AC  80
      COMMON/ELEVEN/X(7)                                                 AC  90
      COMMON/TWELVE/DEC(7)                                               AC 100
C                                                                        AC 110
C                                                                        AC 120
       DATA IC,OC,IT/2HIC,2H  ,2HIT/                                     AC 130
         DATA T1/0.98,1.77,2.209,3.330,0.0,0.0/                          AC 140
C                                                                        AC 150
      IND=OC                                                             AC 160
      TM=ZM*57.2957795                                                   AC 170
      IF (OPNO.EQ.2.OR.OPNO.EQ.5) GO TO 10                               AC 180
      S=FREQ(I)*DFT/VJ                                                   AC 190
      SM=0.0                                                             AC 200
      IF ((TM.LE.45.0.AND.VJA0.GE.1.15).AND.(S.GE.0.1.AND.S.LE.0.5)) GO  AC 210
     1TO 410                                                             AC 220
C                                                                        AC 230
C     THIS LOOP CALCULATES SMD FOR A GIVEN TJT0                          AC 240
C     FOR ALL 16 VALUES OF SM (PACKAGE B)                                AC 250
C                                                                        AC 260
   10 DO 60 N=1,28                                                       AC 270
      IF (TJT0.GE.0.98.AND.TJT0.LE.3.33) GO TO 20                        AC 280
      IF (TJT0.LT.T1(1)) SMD(N)=SD(N,1)-(T1(1)-TJT0)*(SD(N,2)-SD(N,1))/( AC 290
     1T1(2)-T1(1))                                                       AC 300
      IF (TJT0.GT.T1(4)) SMD(N)=SD(N,4)                                  AC 310

      IF (SMD(N).LT.0.0) SMD(N)=0.0                                      AC 330
      GO TO 60                                                           AC 340
   20 J=2                                                                AC 350
   30 IF (TJT0-T1(J)) 50,50,40                                           AC 360
   40 J=J+1                                                              AC 370
      GO TO 30                                                           AC 380
   50 SMD(N)=SD(N,J)+(T1(J)-TJT0)*(SD(N,J-1)-SD(N,J))/(T1(J)-T1(J-1))    AC 390
   60 CONTINUE                                                           AC 400
C                                                                        AC 410
C     THIS SECTION ITERATES TO FIND SM ASSOCIATED WITH THE REQUIRED S    AC 420
C                                                                        AC 430
      ICOUNT=0                                                           AC 440
      SO=FREQ(I)*DFT/VJ                                                  AC 450
      SM1=0.01                                                           AC 460
      SM=SM1                                                             AC 470
      CALL DOPPLE (NU,SM,Z,TS,GS,DS,DM,S,TZ,EI,ETAI,RODA,ROD,ZM,T0F,VJA0 AC 480S
     1,TJT0,GAMA)                                                        AC 490
      S1=S                                                               AC 500
      SM2=0.63                                                           AC 510
      SM=SM2                                                             AC 520
      CALL DOPPLE (NU,SM,Z,TS,GS,DS,DM,S,TZ,EI,ETAI,RODA,ROD,ZM,T0F,VJA0 AC 530S
     1,TJT0,GAMA)                                                        AC 540
      S2=S                                                               AC 550
      SME=SM1+(SO-S1)*(SM2-SM1)/(S2-S1)                                  AC 560
      SM=SME                                                             AC 570
      IF (SM.LT.0.0) GO TO 380                                           AC 580
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      CALL DOPPLE (NU,SM,Z,TS,GS,DS,DM,S,TZ,EI,ETAI,RODA,ROD,ZM,TOF,VJA0 AC 590$
     1,TJT0,GAMA)                                                       AC 600
      SOE=S                                                             AC 610
      IF (ABS(SOE-SO).LE.0.001) GO TO 80                                AC 620
   70 SM1=SM2                                                           AC 630
      SM2=SME                                                           AC 640
      S1=S2                                                             AC 650
      S2=SOE                                                            AC 660
      SME=SM1+(SO-S1)*(SM2-SM1)/(S2-S1)                                 AC 670
      SM=SME                                                            AC 680
      IF (SM.LT.0.0) GO TO 380                                          AC 690
      CALL DOPPLE (NU,SM,Z,TS,GS,DS,DM,S,TZ,EI,ETAI,RODA,ROD,ZM,TOF,VJA0 AC 700$
     1,TJT0,GAMA)                                                       AC 710
      SOE=S                                                             AC 720
      ICOUNT=ICOUNT+1                                                   AC 730
      IF (ABS(SOE-SO).LE.0.001) GO TO 80                                AC 740
      IF (ICOUNT.EQ.50) GO TO 370                                       AC 750
      GO TO 70                                                          AC 760
C                                                                       AC 770
C     THIS SECTION INTERPOLATES VALUES OF SMD,SPLNQ,SPLND,CQ,CD         AC 780
C                                                                       AC 790
   80 SM=SME                                                            AC 800
      S=SOE                                                             AC 810
      SM1000=SM*1000.0                                                  AC 820
      Y=ALOG10(SM1000)                                                  AC 830
      XX=10.0*Y-14                                                      AC 840
      IF (XX.GT.28) GO TO 350                                           AC 850
      IF (XX.LT.1.0) GO TO 350                                          AC 860
      JX=XX                                                             AC 870
      J1=JX+1                                                           AC 880
      EX=XX-JX                                                          AC 890
      SMDI=SMD(JX)+EX*(SMD(J1)-SMD(JX))                                 AC 900
      SPLNQI=SPLNQ(JX)+EX*(SPLNQ(J1)-SPLNQ(JX))                         AC 910
      SPLNQI=SPLNQI-20.0*ALOG10(RODA/72.0)                              AC 920
      SPLNDI=SPLND(JX)+EX*(SPLND(J1)-SPLND(JX))                         AC 930
      SPLNDI=SPLNDI-20.0*ALOG10(RODA/72.0)                              AC 940
      CQI=CQ(JX)+EX*(CQ(J1)-CQ(JX))                                     AC 950
      CDI=CD(JX)+EX*(CD(J1)-CD(JX))                                     AC 960
C                                                                       AC 970
      IF (BOPNO.EQ.1) GO TO 100                                         AC 980
      IF (BOPNO.EQ.2) GO TO 90                                          AC 990
C                                                                       AC1000
   90 PI=3.141593                                                       AC1010
      KZRZ=PI*FREQ(I)*DFT/A0                                            AC1020
      DELRAD=(SMDI*VJA0)/(DM*KZRZ)                                      AC1030
      UCLUJI=UCLUJ(JX)+EX*(UCLUJ(J1)-UCLUJ(JX))                         AC1040
      UICZ=VJA0                                                         AC1050
      IF (DELRAD.GT.1.818535) UICZ=VJA0*UCLUJI                          AC1060
      ETAIN=ETAI                                                        AC1070
      IF (DELRAD.GT.1.818535) ETAIN=ETAI/UCLUJI                         AC1080
      GM=(GAMA-1.0)/2.0                                                 AC1090
      TITZ=1.0-GM*UICZ*UICZ+(TS-1.0+GM*ETAIN*ETAIN*UICZ*UICZ)/ETAIN     AC1100
      GO TO 100                                                         AC1110
C                                                                       AC1120
  100 KS=(DS*DS)/(TS*GS)-(COS(Z)*COS(Z))                                AC1130
      DSP2=DS*DS+0.06*0.06*VJA0*VJA0*COS(Z)*COS(Z)                      AC1140
      IND=OC                                                            AC1150
      IF (KS.LT.0.0) GO TO 170                                          AC1160
C                                                                       AC1170
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C     **PREDICTION OUTSIDE CONE OF SILENCE**                                AC1180
C                                                                           AC1190
C     QUADRUPOLE CONTRIBUTION                                               AC1200
C                                                                           AC1210
      LH=80.0*ALOG10(VJA0)                                                  AC1220
      CA=-10.0*(2*NU+3)*ALOG10(DM)                                          AC1230
      IF (BOPNO.EQ.1) GO TO 110                                             AC1240
      IF (BOPNO.EQ.2) GO TO 120                                             AC1250
  110 FF=10.0*ALOG10(DS**4*DSP2**(NU-2))-30.0*ALOG10(TS)-20.0*ALOG10(GS)    AC1260
      ZZ=1.0+(CQI*(TS*TS)*(GS*GS)*((1.0/DS)**4)*((COS(Z))**4))              AC1270
      GO TO 130                                                             AC1280
  120 CALL LILLEY (NU,IOPT,6,DELRAD,UICZ,TITZ,GAMA,KZRZ,TZ,ETAIN,RSW,ALT   AC1290S
     1B,BLTB,ILWR,FPM,FPD,FPQ,IERL)                                         AC1300
      IF (IERL.NE.0) GO TO 420                                              AC1310
      FF=FPQ                                                                AC1320
      ZZ=1.0+CQI*10.0**((FPM-FPQ)/10.0)*COS(Z)**4                           AC1330
      GO TO 130                                                             AC1340
  130 IF (ZZ.LE.0.0) GO TO 360                                              AC1350
      DIRECT=10.0*ALOG10(ZZ)                                                AC1360
      SPLPQ=SPLNQI+LH+CA+FF+DIRECT                                          AC1370
C                                                                           AC1380
C     DIPOLE CONTRIBUTION                                                   AC1390
C                                                                           AC1400
      LH=60.0*ALOG10(VJA0)                                                  AC1410
      RTS=1.0/TS                                                            AC1420
      TEMPS=10.0*ALOG10((1.0-RTS)*(1.0-RTS))                                AC1430
      CA=-10.0*(2*NU+1)*ALOG10(DM)                                          AC1440
      IF (BOPNO.EQ.1) GO TO 140                                             AC1450
      IF (BOPNO.EQ.2) GO TO 150                                             AC1460
  140 FF=10.0*ALOG10(DS*DS*DSP2**(NU-2))-20.0*ALOG10(TS)-10.0*ALOG10(GS)    AC1470
      ZZ=1.0+(CDI*TS*GS*((1.0/DS)**2)*((COS(Z))**2))                        AC1480
      GO TO 160                                                             AC1490
  150 FF=FPD                                                                AC1500
      ZZ=1.0+CDI*10.0**((FPM-FPD)/10.0)*COS(Z)**2                           AC1510
      GO TO 160                                                             AC1520
  160 IF (ZZ.LE.0.0) GO TO 360                                              AC1530
      DIRECT=10.0*ALOG10(ZZ)                                                AC1540
      SPLPD=SPLNDI+LH+TEMPS+CA+FF+DIRECT                                    AC1550
C                                                                           AC1560
      GO TO 330                                                             AC1570
C                                                                           AC1580
C     **PREDICTION INSIDE CONE OF SILENCE**                                 AC1590
C                                                                           AC1600
  170 CONTINUE                                                              AC1610
      IND=IC                                                                AC1620
      TZ=Z*57.2957795                                                       AC1630
      IF (TZ.LT.30.0.AND.BOPNO.EQ.1) GO TO 400                              AC1640
C                                                                           AC1650
      IF (BOPNO.EQ.1) GO TO 180                                             AC1660
      IF (BOPNO.EQ.2) GO TO 260                                             AC1670
C                                                                           AC1680
C     CALCULATION OF UT/US AND TRANSITION POINT TEMPERATURE RATIO TT        AC1690
C                                                                           AC1700
  180 ONE=2.0*ETAI*VJA0/COS(Z)+TS-1.0+ETAI*ETAI*VJA0*VJA0*VJA0*0.2          AC1710
      TWO=1.2*ETAI*ETAI*VJA0*VJA0                                           AC1720
      THREE=(SIN(Z)/COS(Z))**2                                              AC1730
      FOUR=ONE*ONE-4.0*TWO*THREE                                            AC1740
      IF (FOUR.LT.0.0) GO TO 190                                            AC1750
      UTUS=(ONE-SQRT(FOUR))/(2.0*TWO)                                       AC1760
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      GO TO 200                                                          AC1770
  190 UTUS=100.0                                                         AC1780
  200 CONTINUE                                                           AC1790
C                                                                        AC1800
      TT=((1.0/COS(Z))-(VJA0*UTUS*ETAI))**2                              AC1810
C                                                                        AC1820
C     CALCULATION OF EXPONENTIAL DECAY                                   AC1830
C                                                                        AC1840
      PHI=UTUS*ETAI                                                      AC1850
      DE=((TJT0-1.0)/TT)+(2.0*VJA0/(SQRT(TT)))+(0.2*VJA0*VJA0*(1.0-2.0*P AC1860
     1HI)/TT)                                                            AC1870
      GPHI=GPT(PHI)                                                      AC1880
      IF (GPHI.EQ.0.0) GO TO 340                                         AC1890
      DEN=-1.0*GPHI*COS(Z)*COS(Z)*DE                                     AC1900
C                                                                        AC1910
      Q=(SQRT(ABS(KS)))**3                                               AC1920
      Y=(4.0*Q)/(3.0*DEN)                                                AC1930
      AA3=Y*SMDI*VJA0/DM                                                 AC1940
      IF (AA3.GE.0.6) GO TO 240                                          AC1950
      IND=IT                                                             AC1960
      IF (AA3.LT.0.0) GO TO 390                                          AC1970
      II=2                                                               AC1980
  210 IF (AA3-X(II)) 230,230,220                                         AC1990
  220 II=II+1                                                            AC2000
      IF (II.GT.7) GO TO 240                                             AC2010
      GO TO 210                                                          AC2020
  230 QQ=DEC(II)+((X(II)-AA3)/(X(II)-X(II-1)))*(DEC(II-1)-DEC(II))       AC2030
      GO TO 250                                                          AC2040
  240 QQ=0.39152*EXP(-AA3)/(SQRT(3.0*AA3+1.0))                           AC2050
  250 DECAY=10.0*ALOG10(QQ)                                              AC2060
      GO TO 260                                                          AC2070
C                                                                        AC2080
C     QUADRUPOLE CONTRIBUTION                                            AC2090
C                                                                        AC2100
  260 LH=80.0*ALOG10(VJA0)                                               AC2110
      CA=-10.0*(2*NU+3)*ALOG10(DM)                                       AC2120
      IF (BOPNO.EQ.1) GO TO 270                                          AC2130
      IF (BOPNO.EQ.2) GO TO 280                                          AC2140
  270 CONTINUE                                                           AC2150
      P1=ABS(KS)*COS(Z)*COS(Z)                                           AC2160
      FFF=10.0*ALOG10(DSP2**(NU-2)*P1*P1/TS)                             AC2170
      FFI=FFF+DECAY                                                      AC2180
      ZZ=P1/(COS(Z)*COS(Z))                                              AC2190
      YY=1.0+CQI/(ZZ*ZZ)                                                 AC2200
      GO TO 290                                                          AC2210
  280 CALL LILLEY (NU,IOPT,6,DELRAD,UICZ,TITZ,GAMA,KZRZ,TZ,ETAIN,RSW,ALT AC2220$
     1B,BLTB,ILWR,FPM,FPD,FPQ,IERL)                                      AC2230
      IF (IERL.NE.0) GO TO 420                                           AC2240
      FFI=FPQ                                                            AC2250
      YY=1.0+CQI*10.0**((FPM-FPQ)/10.0)*COS(Z)**4                        AC2260
      GO TO 290                                                          AC2270
  290 IF (YY.LE.0.0) GO TO 360                                           AC2280
      DIRECI=10.0*ALOG10(YY)                                             AC2290
      SPLPQ=SPLNQI+LH+CA+FFI+DIRECI                                      AC2300
C                                                                        AC2310
C     DIPOLE CONTRIBUTION                                                AC2320
C                                                                        AC2330
      LHH=60.0*ALOG10(VJA0)                                              AC2340
      RTS=1.0/TS                                                         AC2350
```

```
      TEMP2=10.0*ALOG10((1.0-RTS)*(1.0-RTS))                              AC2360
      CAH=-10.0*(2*NU+1)*ALOG10(DM)                                       AC2370
      IF (BOPNO.EQ.1) GO TO 300                                           AC2380
      IF (BOPNO.EQ.2) GO TO 310                                           AC2390
  300 FF=10.0*ALOG10(DSP2**(NU-2)*P1/TS)                                  AC2400
      FFH=FF+DECAY                                                        AC2410
      YYH=1.0+CDI/ZZ                                                      AC2420
      GO TO 320                                                           AC2430
  310 FFH=FPD                                                             AC2440
      YYH=1.0+CDI*10.0**((FPM-FPD)/10.0)*COS(Z)**2                        AC2450
      GO TO 320                                                           AC2460
  320 IF (YYH.LE.0.0) GO TO 360                                           AC2470
      DIRH=10.0*ALOG10(YYH)                                               AC2480
      SPLPD=SPLNDI+LHH+TEMP2+CAH+FFH+DIRH                                 AC2490
C                                                                         AC2500
C     **ADDITION OF QUADRUPOLE AND DIPOLE CONTRIBUTIONS**                 AC2510
C                                                                         AC2520
  330 SPLB(I)=10.0*ALOG10(10.0**(SPLPQ/10.0)+10.0**(SPLPD/10.0))          AC2530
      GO TO 430                                                           AC2540
C                                                                         AC2550
C     FAILURE CODE STATEMENTS (PACKAGE B)                                 AC2560
C                                                                         AC2570
  340 SPLB(I)=1.0                                                         AC2580
      SPLPQ=0.0                                                           AC2590
      SPLPD=0.0                                                           AC2600
      GO TO 430                                                           AC2610
C                                                                         AC2620
  350 SPLB(I)=2.0                                                         AC2630
      SPLPQ=0.0                                                           AC2640
      SPLPD=0.0                                                           AC2650
      GO TO 430                                                           AC2660
C                                                                         AC2670
  360 SPLB(I)=3.0                                                         AC2680
      SPLPQ=0.0                                                           AC2690
      SPLPD=0.0                                                           AC2700
      GO TO 430                                                           AC2710
C                                                                         AC2720
  370 SPLB(I)=4.0                                                         AC2730
      SPLPQ=0.0                                                           AC2740
      SPLPD=0.0                                                           AC2750
      GO TO 430                                                           AC2760
C                                                                         AC2770
  380 SPLB(I)=5.0                                                         AC2780
      SPLPQ=0.0                                                           AC2790
      SPLPD=0.0                                                           AC2800
      GO TO 430                                                           AC2810
C                                                                         AC2820
  390 SPLB(I)=6.0                                                         AC2830
      SPLPQ=0.0                                                           AC2840
      SPLPD=0.0                                                           AC2850
      GO TO 430                                                           AC2860
C                                                                         AC2870
  400 SPLB(I)=7.0                                                         AC2880
      SPLPQ=0.0                                                           AC2890
      SPLPD=0.0                                                           AC2900
      GO TO 430                                                           AC2910
C                                                                         AC2920
  410 SPLB(I)=8.0                                                         AC2930
      SPLPQ=0.0                                                           AC2940
```

```
      SPLPD=0.0                                                    AC2950
      GO TO 430                                                    AC2960
  420 CONTINUE                                                     AC2970
      SPLB(I)=FLOAT(IERL)                                          AC2980
      SPLPQ=0.0                                                    AC2990
      SPLPD=0.0                                                    AC3000
  430 CONTINUE                                                     AC3010
      RETURN                                                       AC3020
      END                                                          AC3030-
```

```
*DECK SELECT
      SUBROUTINE SELECT (NU,ISS)                                          AD  10
C                                                                         AD  20
       DIMENSION IRD(8),SM(28),DELRAD(28,6)                               AD  30
       DIMENSION IWRT(8)                                                  AD  40
       COMMON/FOUR/ A(16)                                                 AD  50
       COMMON/FIVE/ B(16)                                                 AD  60
       COMMON/SIX/ C(16)                                                  AD  70
       COMMON/SEVEN/ D(16)                                                AD  80
       COMMON/EIGHT/ E(16)                                                AD  90
       COMMON/ANINE/ F(16)                                                AD 100
       COMMON/THIRTN/ R(16)                                               AD 110
       COMMON/EIGHTY/ T1(16),SD(16,6)                                     AD 120
C                                                                         AD 130
       COMMON/FOUR1/ A1(28)                                               AD 140
       COMMON/FIVE1/ B1(28)                                               AD 150
       COMMON/SIX1/ C1(28)                                                AD 160
       COMMON/SEVEN1/ D1(28)                                              AD 170
       COMMON/EIGHT1/ E1(28)                                              AD 180
       COMMON/ANINE1/ F1(28)                                              AD 190
       COMMON/THIRTN1/ R1(28)                                             AD 200
       COMMON/EIGHTY1/ SD1(28,6),SDT1(28,6)                               AD 210
C                                                                         AD 220
       COMMON/ONE/ SPLNQ(28),CQ(28),SPLND(28),CD(28),UCLUJ(28),XSD(28,6)  AD 230
C                                                                         AD 240
       COMMON/TWO/ ETA(28),XE(28)                                         AD 250
       DATA PI / 3.141593 /                                               AD 260
       DATA SM / 0.0316,0.04,0.05,0.063,0.08,0.1,0.125,0.16,0.2,0.25,     AD 270
     1         0.316,0.4,0.5,0.63,0.8,1.0,1.25,1.6,2.0,2.5,3.16,4.0,5.0,  AD 280
     2         6.3,8.0,10.0,12.5,16.0 /                                   AD 290
C                                                                         AD 300
       ICOUNT=0                                                           AD 310
C                                                                         AD 320
       IF (NU.EQ.3) GO TO 40                                              AD 330
C                                                                         AD 340
       DO 10 N=1,28                                                       AD 350
       ETA(N)=A1(N)                                                       AD 360
       SPLNQ(N)=B1(N)                                                     AD 370
       CQ(N)=C1(N)                                                        AD 380
       SPLND(N)=D1(N)                                                     AD 390
       XE(N)=E1(N)                                                        AD 400
       CD(N)=F1(N)                                                        AD 410
       UCLUJ(N)=R1(N)                                                     AD 420
   10  CONTINUE                                                           AD 430
       DO 30 I=1,4                                                        AD 440
       DO 30 N=1,28                                                       AD 450
       IF (ISS.EQ.1) GO TO 20                                             AD 460
       XSD(N,I)=SD1(N,I)                                                  AD 470
       GO TO 30                                                           AD 480
   20  XSD(N,I)=SDT1(N,I)                                                 AD 490
   30  CONTINUE                                                           AD 500
       GO TO 90                                                           AD 510
C                                                                         AD 520
   40  CONTINUE                                                           AD 530
       DO 60 N=1,28                                                       AD 540
       IF (N.LT.6.OR.N.GT.21) GO TO 50                                    AD 550
       ETA(N)=A(N-5)                                                      AD 560
       SPLNQ(N)=B(N-5)                                                    AD 570
       CQ(N)=C(N-5)                                                       AD 580
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      SPLND(N)=D(N-5)                                                    AD 590
      XE(N)=E(N-5)                                                       AD 600
      CD(N)=F(N-5)                                                       AD 610
      UCLUJ(N)=R(N-5)                                                    AD 620
      GO TO 60                                                           AD 630
   50 CONTINUE                                                           AD 640
      ETA(N)=0.0                                                         AD 650
      SPLNQ(N)=0.0                                                       AD 660
      CQ(N)=0.0                                                          AD 670
      SPLND(N)=0.0                                                       AD 680
      XE(N)=0.0                                                          AD 690
      CD(N)=0.0                                                          AD 700
      UCLUJ(N)=1.0                                                       AD 710
   60 CONTINUE                                                           AD 720
      DO 80 I=1,4                                                        AD 730
      DO 80 N=1,28                                                       AD 740
      IF (N.LT.6.OR.N.GT.21) GO TO 70                                    AD 750
      XSD(N,I)=SD(N-5,I)                                                 AD 760
      GO TO 80                                                           AD 770
   70 XSD(N,I)=0.0                                                       AD 780
   80 CONTINUE                                                           AD 790
C                                                                        AD 800
   90 CONTINUE                                                           AD 810
      IF (ISS.EQ.0.OR.ISS.EQ.1) GO TO 150                                AD 820
      READ (5,200) (IRD(I),I=1,8)                                        AD 830*
      DO 100 I=1,8                                                       AD 840
      IF (IRD(I).EQ.0) GO TO 100                                         AD 850
      ICOUNT=ICOUNT+1                                                    AD 860
      IWRT(ICOUNT)=I                                                     AD 870
  100 CONTINUE                                                           AD 880
      IF (IRD(1).EQ.1) READ (5,210) (SPLNQ(N),N=1,28)                    AD 890*
      IF (IRD(2).EQ.1) READ (5,210) (CQ(N),N=1,28)                       AD 900*
      IF (IRD(3).EQ.1) READ (5,210) (SPLND(N),N=1,28)                    AD 910*
      IF (IRD(4).EQ.1) READ (5,210) (CD(N),N=1,28)                       AD 920*
      IF (IRD(5).EQ.1) READ (5,210) (ETA(N),N=1,28)                      AD 930*
      IF (IRD(6).EQ.1) READ (5,210) (XE(N),N=1,28)                       AD 940*
      IF (IRD(7).EQ.1) READ (5,210) (UCLUJ(N),N=1,28)                    AD 950*
      IF(IRD(8).EQ.0) GO TO 150                                          AD 955
      DO 120 JJ=1,4                                                      AD 960
      IF (IRD(8).EQ.1) READ (5,210) (DELRAD(N,JJ),N=1,28)                AD 970*
      DO 110 N=1,28                                                      AD 980
      XSD(N,JJ)=PI*SM(N)*DELRAD(N,JJ)                                    AD 990
  110 CONTINUE                                                           AD1000
  120 CONTINUE                                                           AD1010
      IF (IRD(8).NE.2) GO TO 150                                         AD1020
      DO 130 N=1,28                                                      AD1030
      XSRJ=2.0/SQRT(0.021*SM(N)*SM(N)+0.057*SM(N))                       AD1040
      DELRAD(N,1)=XSRJ/7.616559                                          AD1050
      IF (XSRJ.GT.13.85) DELRAD(N,1)=(1.0+0.55*(XSRJ-13.85)/(26.0-13.85) AD1060
     1)*1.818535                                                         AD1070
  130 CONTINUE                                                           AD1080
      FAC1=0.98**0.25                                                    AD1090
      FAC2=1.77**0.25                                                    AD1100
      FAC3=2.209**0.25                                                   AD1110
      FAC4=3.330**0.25                                                   AD1120
      DO 140 N=1,28                                                      AD1130
      DELRAD(N,2)=DELRAD(N,1)*FAC2                                       AD1140
      XSD(N,2)=PI*SM(N)*DELRAD(N,2)                                      AD1150
      DELRAD(N,3)=DELRAD(N,1)*FAC3                                       AD1160
```

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      XSD(N,3)=PI*SM(N)*DELRAD(N,3)                                      AD1170
      DELRAD(N,4)=DELRAD(N,1)*FAC4                                       AD1180
      XSD(N,4)=PI*SM(N)*DELRAD(N,4)                                      AD1190
      DELRAD(N,1)=DELRAD(N,1)*FAC1                                       AD1200
      XSD(N,1)=PI*SM(N)*DELRAD(N,1)                                      AD1210
  140 CONTINUE                                                           AD1220
  150 CONTINUE                                                           AD1230
      IF (IRD(8).NE.0) GO TO 170                                         AD1240
      DO 160 JJ=1,4                                                      AD1250
      DO 160 N=1,28                                                      AD1260
      DELRAD(N,JJ)=XSD(N,JJ)/(PI*SM(N))                                  AD1270
  160 CONTINUE                                                           AD1280
  170 CONTINUE                                                           AD1290
      WRITE (6,220)                                                      AD1300*
      IF (ICOUNT.EQ.0) WRITE (6,230)                                     AD1310*
      IF (ICOUNT.GT.0) WRITE (6,240) (IWRT(I),I=1,ICOUNT)                AD1320*
      IF (IRD(8).EQ.2) WRITE (6,250)                                     AD1330*
      WRITE (6,260) (SM(N),N=1,14)                                       AD1340*
      WRITE (6,270) (SPLNQ(N),N=1,14)                                    AD1350*
      WRITE (6,280) (CQ(N),N=1,14)                                       AD1360*
      WRITE (6,290) (SPLND(N),N=1,14)                                    AD1370*
      WRITE (6,300) (CD(N),N=1,14)                                       AD1380*
      WRITE (6,310) (ETA(N),N=1,14)                                      AD1390*
      WRITE (6,320) (XE(N),N=1,14)                                       AD1400*
      WRITE (6,330) (UCLUJ(N),N=1,14)                                    AD1410*
      DO 180 JJ=1,4                                                      AD1420
      WRITE (6,340) (DELRAD(N,JJ),N=1,14)                                AD1430*
  180 CONTINUE                                                           AD1440
      WRITE (6,350) (SM(N),N=15,28)                                      AD1450*
      WRITE (6,270) (SPLNQ(N),N=15,28)                                   AD1460*
      WRITE (6,280) (CQ(N),N=15,28)                                      AD1470*
      WRITE (6,290) (SPLND(N),N=15,28)                                   AD1480*
      WRITE (6,300) (CD(N),N=15,28)                                      AD1490*
      WRITE (6,310) (ETA(N),N=15,28)                                     AD1500*
      WRITE (6,320) (XE(N),N=15,28)                                      AD1510*
      WRITE (6,330) (UCLUJ(N),N=15,28)                                   AD1520*
      DO 190 JJ=1,4                                                      AD1530
      WRITE (6,340) (DELRAD(N,JJ),N=15,28)                               AD1540*
  190 CONTINUE                                                           AD1550
      RETURN                                                             AD1560
C                                                                        AD1570
  200 FORMAT (16I5)                                                      AD1580
  210 FORMAT (8F10.1)                                                    AD1590
  220 FORMAT (1H1,44X,"MIXING NOISE SOURCE AND MEAN FLOW CONSTANTS")     AD1600
  230 FORMAT (/,52X,"* STANDARD DATA VALUES USED *")                     AD1610
  240 FORMAT (/,44X,"USER INPUT VALUES FOR PARAMETERS",8(1X,I1))         AD1620
  250 FORMAT (1X,"SOURCE LOCATION MODEL USED , WITH SIGMA = 13.5 , ","TO AD1630
     1 CALCULATE DELTA/RJ",/,1X,"(TJ/T0)**0.25 DEPENDENCE ","ASSUMED , A AD1640
     2T STANDARD TEMPERATURES 0.98,1.77,2.209,3.33")                     AD1650
  260 FORMAT (///,1X,"SM",7X,14F7.3)                                     AD1660
  270 FORMAT (/,1X,"SPLQ",5X,14F7.2)                                     AD1670
  280 FORMAT (/,1X,"AXWTQ",4X,14F7.2)                                    AD1680
  290 FORMAT (/,1X,"SPLD",5X,14F7.2)                                     AD1690
  300 FORMAT (/,1X,"AXWTD",4X,14F7.2)                                    AD1700
  310 FORMAT (/,1X,"VS/VJ",4X,14F7.2)                                    AD1710
  320 FORMAT (/,1X,"VC/VJ",4X,14F7.2)                                    AD1720
  330 FORMAT (/,1X,"VMAX/VJ",2X,14F7.2,/)                                AD1730
  340 FORMAT (1X,"DELTA/RJ",1X,14F7.2)                                   AD1740
  350 FORMAT (///,1X,"SM",7X,14F7.2)                                     AD1750
      END                                                                AD1760-
```

```
*DECK DOPPLER
      SUBROUTINE DOPPLE (NU,SM,Z,TS,GS,DS,DM,S,TZ,EI,ETAI,RODA,ROD,ZM,T0 AE  10
     1F,VJA0,TJT0,G)                                                    AE  20
      COMMON/TWO/ETA(28),E(28)                                          AE  30
C                                                                       AE  40
C     CALCULATION OF DM AND S*****                                      AE  50
C                                                                       AE  60
C     EI=INTERPOLATED E                                                 AE  70
C     ETAI=INTERPOLATED ETA                                             AE  80
C     A=ALPHA                                                           AE  90
C     B=BETA                                                            AE 100
C     GS=GAMMA RATIO GS/G0                                              AE 110
C     TS=SOURCE TEMPERATURE RATIO TS/T0                                 AE 120
C                                                                       AE 130
C                                                                       AE 140
      IF (NU.NE.3) GO TO 30                                             AE 150
      IF (SM.LT.3.16) GO TO 10                                          AE 160
      EI=0.6                                                            AE 170
      ETAI=0.6                                                          AE 180
      GO TO 70                                                          AE 190
   10 IF (SM.GT.0.1) GO TO 20                                           AE 200
      EI=0.8                                                            AE 210
      ETAI=0.5                                                          AE 220
      GO TO 70                                                          AE 230
   20 SM1000=SM*1000                                                    AE 240
      Y=ALOG10(SM1000)                                                  AE 250
      X=10.0*Y-14.0                                                     AE 260
      GO TO 60                                                          AE 270
   30 IF (SM.LT.16.0) GO TO 40                                          AE 280
      EI=0.6                                                            AE 290
      ETAI=0.6                                                          AE 300
      GO TO 70                                                          AE 310
   40 IF (SM.GT.0.0316) GO TO 50                                        AE 320
      EI=1.0                                                            AE 330
      ETAI=0.3                                                          AE 340
      GO TO 70                                                          AE 350
   50 SM1000=SM*1000                                                    AE 360
      Y=ALOG10(SM1000)                                                  AE 370
      X=10.0*Y-14.0                                                     AE 380
   60 CONTINUE                                                          AE 390
      JX=X                                                              AE 400
      J1=JX+1                                                           AE 410
      EX=X-JX                                                           AE 420
      EI=E(JX)+EX*(E(J1)-E(JX))                                         AE 430
      ETAI=ETA(JX)+EX*(ETA(J1)-ETA(JX))                                 AE 440
C     CALCULATION OF RADIATION ANGLE TZ(DEGREES)                        AE 450
C                                                                       AE 460
   70 POS=1.0/SQRT(0.057*SM+0.021*SM*SM)                                AE 470
      RODA=SQRT(ROD*ROD+POS*POS-2.0*ROD*POS*COS(ZM))                    AE 480
      XX=(ROD*ROD+RODA*RODA-POS*POS)/(2.0*ROD*RODA)                     AE 490
      AA=SQRT(1.0-XX*XX)                                                AE 500
      W=ATAN2(AA,XX)                                                    AE 510
      Z=W+ZM                                                            AE 520
      TZ=Z*57.2957795                                                   AE 530
C                                                                       AE 540
C     CALCULATION OF GAMMAS                                             AE 550
C                                                                       AE 560
      D=0.073                                                           AE 570
      TSM=1.0+(0.6*(TJT0-1.0))+(VJA0*VJA0*(0.6-0.6*0.6)*0.2)            AE 580
```

```
      IF (TSM.LT.0.999) D=0.034                                          AE 590
      TS=1.0+(TSM-1.0)/((0.98+D/(SM*SM))**0.25)                          AE 600
      T0C=((T0F-32.0)*5.0)/9.0                                           AE 610
      T0K=T0C+273.0                                                      AE 620
      T=TS*T0K                                                           AE 630
      G0=1.421-(T0K/11800.0)+(EXP(-ABS(T0K-450.0)/200.0)/80.0)           AE 640
      IF (T0K.LE.290.0) G0=1.402                                         AE 650
      G=1.421-(T/11800.0)+(EXP(-ABS(T-450.0)/200.0)/80.0)                AE 660
      IF (T.LE.290.0) G=1.402                                            AE 670
      GS=G/G0                                                            AE 680
C                                                                        AE 690
      A=0.2*TS**1.2                                                      AE 700
      IF (NU.EQ.3) A=0.2*TS**0.6                                         AE 710
      B=0.55*TS**0.2                                                     AE 720
      IF (NU.EQ.3) B=0.4*TS**0.2                                         AE 730
      DS=1.0-ETAI*VJA0*COS(Z)                                            AE 740
      DC=1.0-EI*VJA0*COS(Z)                                              AE 750
C                                                                        AE 760
C     CALCULATION OF MODIFIED DOPPLER FACTOR DM AND STROUHAL NUMBER S    AE 770
C                                                                        AE 780
C     *** A NEGATIVE SQUARE ROOT ARGUMENT ERROR CAN OCCUR IN THE NEXT
C     STATEMENT, FOR EXAMPLE, AT HIGH TEMPERATURES. THIS PROBLEM DOES
C     NOT ARISE IF DM IS GIVEN BY
C
C     DM=SQRT(DC*DC+B*B*VJA0*VJA0*COS(Z)*COS(Z)
C    1   +A*A*VJA0*VJA0*ABS(DS*DS/(TS*GS)-COS(Z)*COS(Z)))
C
C     THIS REVISED DEFINITION OF DM WAS SUGGESTED BY THE INVESTIGATION
C     INTO TRANSVERSE NONCOMPACTNESS EFFECTS WITH NUMERICAL LILLEY
C     EQUATION SOLUTIONS, DESCRIBED IN SECTION 2.1.5.2. HOWEVER THE
C     SHEAR LAYER THICKNESS PARAMETER SHOULD BE FIRST RE-OPTIMISED, WITH
C     THE REVISED DM, BEFORE THIS CHANGE IS CONSIDERED FOR GENERAL
C     PREDICTION PURPOSES.
C
      DM=SQRT(DC*DC+B*B*VJA0*VJA0*COS(Z)*COS(Z)+A*A*VJA0*VJA0*(DS*DS/(TS AE 790
     1*GS)-COS(Z)*COS(Z)))                                               AE 800
      S=SM/DM                                                            AE 810
      RETURN                                                             AE 820
      END                                                                AE 830-
```

```
*DECK GPT
      FUNCTION GPT(PHI)                                                  AF  10
C                                                                        AF  20
C     THIS FUNCTION CALCULATES THE GRADIENT OF VELOCITY PROFILE*****     AF  30
C                                                                        AF  40
      DATA RPI,PI/1.7724539,3.141593/                                    AF  50
      IF (PHI.LT.0.0.OR.PHI.GT.1.0) GO TO 10                             AF  60
      GPT=0.0                                                            AF  70
      IF (PHI.LT.0.0001.OR.PHI.GT.0.9999) RETURN                         AF  80
      X=0.0                                                              AF  90
      DO 10 I=1,20                                                       AF 100
      DEL=0.5*(1.0-ERF(RPI*X))-PHI                                       AF 110
      DELP=-EXP(-X*X*PI)                                                 AF 120
      DIF=DEL/DELP                                                       AF 130
      X=X-DIF                                                            AF 140
      IF (ABS(DIF).LT.0.0001) GO TO 20                                   AF 150
   10 CONTINUE                                                           AF 160
      STOP 7                                                             AF 170
   20 CONTINUE                                                           AF 180
      GPT=DELP                                                           AF 190
      RETURN                                                             AF 200
      END                                                                AF 210-
```

```
*DECK LILLEY
C       ************************************************************** AG  10
C       SUBROUTINE LILLEY                                              AG  20
C                                                                      AG  30
C       PURPOSE                                                        AG  40
C          TO SOLVE THE LILLEY EQUATION WITH SPECIFIED MONOPOLE,DIPOLE AG  50
C          AND QUADRUPOLE SOURCE DISTRIBUTIONS IN AN AXISYMMETRIC,     AG  60
C          PARALLEL FLOW FIELD AT A GIVEN FREQUENCY AND OBSERVER ANGLE AG  70
C                                                                      AG  80
C       USAGE                                                          AG  90
C          CALL LILLEY(NU,IOPT,IW,DELRAD,UICZ,TITZ,GAMMA,KZRZ,THETZ,   AG 100
C          ETAIN,RSW,ALTB,BLTB,ILWR,FPM,FPD,FPQ,IERL)                  AG 110
C                                                                      AG 120
C       DESCRIPTION OF PARAMETERS                                      AG 130
C       ** INPUT                                                       AG 140
C          IOPT   - =1 RING SOURCE, RADIUS SPECIFIED BY ETAIN          AG 150
C                   =2 RADIALLY DISTRIBUTED SOURCE,WIDTH RSW           AG 160
C                   =3 AS FOR IOPT=2 BUT WITH RADIAL-AZIMUTHAL         AG 170
C                      NONCOMPACTNESS SPECIFIED BY ALTB,BLTB           AG 180
C          IW     - OUTPUT FILE INDICATOR                             AG 190
C          DELRAD - VORTICITY THICKNESS OF VELOCITY PROFILE NORMALISED AG 200
C                   BY JET NOZZLE RADIUS.  0.LT.DELRAD.LE.9            AG 210
C          UICZ   - CENTER-LINE VELOCITY NORMALISED BY AMBIENT SOUND   AG 220
C                   SPEED.  0.LE.UICZ.LE.3                            AG 230
C          TITZ   - CENTER-LINE STATIC TEMPERATURE NORMALISED BY       AG 240
C                   AMBIENT TEMPERATURE.  0.LT.TITZ.LE.9              AG 250
C          GAMMA  - RATIO OF SPECIFIC HEATS.  1.LE.GAMMA.LE.1.5       AG 260
C          KZRZ   - 2*PI*FREQUENCY*NOZZLE RADIUS/AMBIENT SOUND SPEED  AG 270
C                   0.LT.KZRZ.LE.20                                   AG 280
C          THETZ  - FAR-FIELD OBSERVER ANGLE TO DOWNSTREAM JET AXIS    AG 290
C                   0.LT.THETZ.LT.180                                 AG 300
C          ETAIN  - FLOW VELOCITY AT SOURCE RADIUS VS/VMAX             AG 310
C                   STANDARD VALUES ARE TABULATED BELOW               AG 320
C                   ISRL   VS/VMAX=ETAIN  (ETA=VS/VJ)                 AG 330
C                     1    0.990                                      AG 340
C                     2    0.982                                      AG 350
C                     3    0.969                                      AG 360
C                     4    0.948                                      AG 370
C                     5    0.919                                      AG 380
C                     6    0.877                                      AG 390
C                     7    0.824                                      AG 400
C                     8    0.757                                      AG 410
C                     9    0.679                                      AG 420
C                    10    0.670                                      AG 430
C                    11    0.663                                      AG 440
C                    12    0.600                                      AG 450
C                    13    0.592                                      AG 460
C                    14    0.500                                      AG 470
C                    15    0.408                                      AG 480
C                    16    0.321                                      AG 490
C                    17    0.243                                      AG 500
C                    18    0.176                                      AG 510
C                    19    0.123                                      AG 520
C                    20    0.081                                      AG 530
C                    21    0.052                                      AG 540
C                    22    0.031                                      AG 550
C                    23    0.018                                      AG 560
C                    24    0.010                                      AG 570
C          RSW    - TURBULENCE INTENSITY RADIAL HALF WIDTH            AG 580
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C                                                                       AG 590
C        ALTB   - THESE COEFFICIENTS SPECIFY THE RADIAL-AZIMUTHAL       AG 600
C        BLTB   - COHERENCE LENGTH SCALE LTB=ALTB*X+BLTB                AG 610
C                                                                       AG 620
C                                                                       AG 630
C        ILWR   - SET ILWR=1 IF OUTPUT REQUIRED, OTHERWISE ILWR=0       AG 640
C                                                                       AG 650
C        IERL   - ERROR FLAG  =0  NO ERRORS                             AG 660
C                             9  CRITICAL RADIUS TOO SMALL              AG 670
C     **OUTPUT                                                          AG 680
C        FPM    - FLOW FACTOR FOR     MONOPOLE   SOURCE DISTRIBUTION    AG 690
C        FPD    - FLOW FACTOR FOR S.I. DIPOLE    SOURCE DISTRIBUTION    AG 700
C        FPQ    - FLOW FACTOR FOR S.I. QUADRUPOLE SOURCE DISTRIBUTION   AG 710
C                 (S.I. - STATISTICALLY ISOTROPIC)                      AG 720
C                                                                       AG 730
C     REMARKS                                                           AG 740
C        AXIAL SOURCE CONVECTION AND COHERENCE EFFECTS ARE NOT          AG 750
C        INCLUDED HERE BUT MAY BE SIMULATED THROUGH A MODIFIED          AG 760
C        DOPPLER FREQUENCY SHIFT WITH ANGLE.                            AG 770
C                                                                       AG 780
C                                                                       AG 790
C     SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED                     AG 800
C        DSETUP                                                         AG 810
C        SUB2                                                           AG 820
C        AXIAL                                                          AG 830
C        SLOC                                                           AG 840
C        VELT                                                           AG 850
C        ERF                                                            AG 860
C        CRIT                                                           AG 870
C        RABC                                                           AG 880
C        CBESL1                                                         AG 890
C        CBESL2                                                         AG 900
C        IDERY                                                          AG 910
C        HPCL                                                           AG 920
C        AFCT                                                           AG 930
C        FCT                                                            AG 940
C        OUTP                                                           AG 950
C        COEF                                                           AG 960
C        TRANS                                                          AG 970
C        WRCAL                                                          AG 980
C        TCON                                                           AG 990
C        TSIGN                                                          AG1000
C        RADCSD                                                         AG1010
C        INTRAP                                                         AG1020
C        SRPSD                                                          AG1030
C        BESI                                                           AG1040
C        QTFG                                                           AG1050
C                                                                       AG1060
C     ERROR STOPS                                                       AG1070
C        0      - FLOW PARAMETER OUTSIDE ALLOWED RANGE                  AG1080
C        1      - FREQUENCY OR ANGLE OUTSIDE ALLOWED RANGE              AG1090
C        2      - INTEGRATION FAILURE IHLF=11                           AG1100
C        3      - NUMBER OF INTEGRATION STEPS EXCEEDS DIMENSION         AG1110
C                 OF ARRAYS YMI,YPU(EQUIVALENCED) FIRST HPCL CALL       AG1120
C        4      - DITTO THIRD AND FOURTH CALLS                          AG1130
C        5      - DITTO FIFTH CALL                                      AG1140
C     ********************************************************          AG1150
      SUBROUTINE LILLEY (NU,IOPT,IW,DELRAD,UICZ,TITZ,GAMMA,KZRZ,THETZ,ET AG1160
     1AIN,RSW,ALTB,BLTB,ILWR,FPM,FPD,FPQ,IERL)                          AG1170
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      DIMENSION D(50),ID(50)                                                AG1180
        COMMON/FOURTN/US(24)                                                AG1190
        REAL KZRZ                                                           AG1200
      IERL=0                                                                AG1210
      GO TO (10,60,70), IOPT                                                AG1220
   10 CONTINUE                                                              AG1230
C                                                                           AG1240
C        FIND NEAREST STANDARD SOURCE RADIAL POSITION                       AG1250
      DO 20 I=1,24                                                          AG1260
      ISRL=I                                                                AG1270
      IF (ETAIN.GT.US(I)) GO TO 30                                          AG1280
   20 CONTINUE                                                              AG1290
   30 CONTINUE                                                              AG1300
      CALL DSETUP (NU,IOPT,IW,DELRAD,UICZ,TITZ,GAMMA,KZRZ,THETZ,ISRL,ETA    AG1310$
     1IN,RSW,ALTB,BLTB,D,ID,ILWR)                                           AG1320
      CALL SUB2 (D,ID)                                                      AG1330$
      FPM=D(31)                                                             AG1340
      FPD=D(32)                                                             AG1350
      FPQ=D(33)                                                             AG1360
      IF (ISRL.LE.1) GO TO 40                                               AG1370
      FACL=(ETAIN-US(ISRL-1))/(US(ISRL)-US(ISRL-1))                         AG1380
      FPM=D(41)+(FPM-D(41))*FACL                                            AG1390
      FPD=D(42)+(FPD-D(42))*FACL                                            AG1400
      FPQ=D(43)+(FPQ-D(43))*FACL                                            AG1410
   40 CONTINUE                                                              AG1420
      IERL=ID(41)                                                           AG1430
      IF (ILWR.EQ.0) GO TO 50                                               AG1440
      WRITE (IW,90) IERL,FPM,FPD,FPQ                                        AG1450*
   50 CONTINUE                                                              AG1460
      RETURN                                                                AG1470
   60 CONTINUE                                                              AG1480
   70 CONTINUE                                                              AG1490
      ISRL=0                                                                AG1500
      CALL DSETUP (NU,IOPT,IW,DELRAD,UICZ,TITZ,GAMMA,KZRZ,THETZ,ISRL,ETA    AG1510$
     1IN,RSW,ALTB,BLTB,D,ID,ILWR)                                           AG1520
      CALL SUB2 (D,ID)                                                      AG1530$
      FPM=D(36)                                                             AG1540
      FPD=D(37)                                                             AG1550
      FPQ=D(38)                                                             AG1560
      IERL=ID(41)                                                           AG1570
      IF (ILWR.EQ.0) GO TO 80                                               AG1580
      WRITE (IW,90) IERL,FPM,FPD,FPQ                                        AG1590*
   80 CONTINUE                                                              AG1600
      RETURN                                                                AG1610
C                                                                           AG1620
   90 FORMAT (1X,I5,3E13,6)                                                 AG1630
      END                                                                   AG1640-
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*DECK DSETUP
      SUBROUTINE DSETUP (NU,IOPT,IW,DELRAD,UICZ,TITZ,GAMMA,KZRZ,THETZ,IS AH  10
     1RL,ETAIN,RSW,ALTB,BLTB,D,ID,ILWR)                                 AH  20
       REAL KZRZ                                                        AH  30
         DIMENSION D(1),ID(1)                                           AH  40
       DATA RTPI / 2.506628 /                                           AH  50
      ITEST=0                                                           AH  60
      PI=3.141593                                                       AH  70
      X1=7.616559*DELRAD                                                AH  80
      IF (X1.GT.13.85) X1=13.85+(DELRAD/1.818535-1.0)*(26.0-13.85)/0.55 AH  90
      ANG=THETZ*PI/180.0                                                AH 100
      IF (DELRAD.LE.0.0.OR.DELRAD.GT.9.0) GO TO 70                      AH 110
      IF (UICZ.LT.0.0.OR.UICZ.GT.3.0) GO TO 70                          AH 120
      IF (TITZ.LE.0.0.OR.TITZ.GT.9.0) GO TO 70                          AH 130
      IF (GAMMA.LT.1.0.OR.GAMMA.GT.1.5) GO TO 70                        AH 140
      IF (KZRZ.LE.0.0.OR.KZRZ.GT.20.0) STOP 1                           AH 150
      IF (THETZ.LE.0.0.OR.THETZ.GE.180.) STOP 1                         AH 160
      D(1)=0.02*X1/8.0                                                  AH 170
      D(2)=.001                                                         AH 180
      D(3)=0.0                                                          AH 190
      D(4)=0.02                                                         AH 200
      D(5)=0.0                                                          AH 210
      D(6)=0.12*X1/8.0                                                  AH 220
      D(7)=.005                                                         AH 230
      D(8)=GAMMA                                                        AH 240
      D(9)=0.0                                                          AH 250
      D(10)=0.0                                                         AH 260
      IF (IOPT.EQ.1) GO TO 20                                           AH 270
      RTEST=0.5*X1*RSW/0.832554                                         AH 280
      IF (RTEST.LT.D(1)) ITEST=1                                        AH 290
      IF (RTEST.LT.D(1)) GO TO 20                                       AH 300
      D(9)=RSW                                                          AH 310
      RS=0.0                                                            AH 320
      IF (ETAIN.LT.0.0001.OR.ETAIN.GT.0.9999) GO TO 10                  AH 330
      IF (DELRAD.LE.1.818535) RS=1.0+DELRAD*(SQRT(ABS(ALOG(-GPT(ETAIN)))AH 340
     1)+0.022*13.5/SQRT(PI))                                            AH 350
      IF (DELRAD.GT.1.818535) RS=DELRAD*SQRT(2.0*EXP(-1.0)*ABS(ALOG(ETAI AH 360
     1N)))                                                              AH 370
   10 CONTINUE                                                          AH 380
      RSC=(RS-1.0)/X1                                                   AH 390
      D(10)=RSC                                                         AH 400
   20 CONTINUE                                                          AH 410
      D(11)=KZRZ                                                        AH 420
      D(12)=UICZ                                                        AH 430
      D(13)=TITZ                                                        AH 440
      D(14)=COS(ANG)                                                    AH 450
      D(15)=SIN(ANG)                                                    AH 460
      D(16)=X1                                                          AH 470
      D(17)=0.0                                                         AH 480
      D(18)=0.0                                                         AH 490
      D(19)=0.0                                                         AH 500
      D(20)=0.0                                                         AH 510
      D(21)=1.0                                                         AH 520
      D(22)=1.0                                                         AH 530
      D(23)=0.0                                                         AH 540
      D(24)=0.0                                                         AH 550
      D(25)=0.0                                                         AH 560
      D(26)=0.0                                                         AH 570
      GO TO (30,40,50), IOPT                                            AH 580
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   30 CONTINUE                                                          AH 590
      D(26)=0.0                                                         AH 600
      GO TO 60                                                          AH 610
   40 CONTINUE                                                          AH 620
      D(26)=0.0                                                         AH 630
      IF (D(1).GE.10.0*0.5*X1*D(9)/0.832554) ITEST=1                    AH 640
      IF (D(1).GE.10.0*0.5*X1*D(9)/0.832554) GO TO 60                   AH 650
      D(26)=D(1)                                                        AH 660
      GO TO 60                                                          AH 670
   50 CONTINUE                                                          AH 680
      SLTB=(ALTB*X1+BLTB)/RTPI                                          AH 690
      IF (SLTB.LT.D(1)) ITEST=1                                         AH 700
      IF (SLTB.LT.D(1)) GO TO 60                                        AH 710
      D(26)=SLTB                                                        AH 720
   60 CONTINUE                                                          AH 730
      ID(1)=5                                                           AH 740
      ID(2)=IW                                                          AH 750
      ID(3)=1                                                           AH 760
      ID(4)=NU                                                          AH 770
      ID(5)=0                                                           AH 780
      ID(6)=0                                                           AH 790
      ID(7)=1                                                           AH 800
      ID(8)=0                                                           AH 810
      ID(9)=0                                                           AH 820
      ID(10)=12                                                         AH 830
      ID(11)=0                                                          AH 840
      ID(12)=0                                                          AH 850
      ID(13)=0                                                          AH 860
      ID(14)=0                                                          AH 870
      ID(15)=0                                                          AH 880
      ID(16)=82                                                         AH 890
      ID(17)=ISRL                                                       AH 900
      ID(18)=0                                                          AH 910
      ID(25)=0                                                          AH 920
      ID(26)=ILWR                                                       AH 930
      IF (IOPT.EQ.2.OR.IOPT.EQ.3.AND.ITEST.EQ.0) ID(25)=1               AH 940
      IF (ITEST.NE.0) WRITE (IW,80) RSW,ALTB,BLTB                       AH 950*
      RETURN                                                            AH 960
   70 CONTINUE                                                          AH 970
      WRITE (IW,90) DELRAD,UICZ,TITZ,GAMMA                              AH 980*
      STOP                                                              AH 990
C                                                                       AH1000
   80 FORMAT (1X,"RSW,ALTB,BLTB",3E13.6,"TOO SMALL,OPTION 1 ASSUMED")   AH1010
   90 FORMAT (1X,"FLOW PARAMETERS OUTSIDE ALLOWED RANGE",4E13.6)        AH1020
      END                                                               AH1030-
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*DECK SUB2
      SUBROUTINE SUB2 (D,ID)                                                    AI  10
        EXTERNAL FCT,AFCT,OUTP                                                  AI  20
        DIMENSION D(1),ID(1)                                                    AI  30
        DIMENSION PRMT(8),Y(4),DERY(4),AUX(16,4),A(4,4),XOS(40),AMP(3)          AI  40
        DIMENSION APLUG(3),IER(2),TIJ(7,40),YMI(450,5),TX(7)                    AI  50
        DIMENSION PRS(40),PQ(40),PD(40)                                         AI  60
       DIMENSION PA(40)                                                         AI  70
        COMPLEX CMPLX,CSQRT                                                     AI  80
        COMPLEX JSR,CAMP(2),BET1,BET2,STP1,STP2,RADM,BCNS,RPRES                 AI  90
        COMPLEX KRO,KRD,BCWS,CPLUG(2),TRN,TRRN                                  AI 100
       COMPLEX ST1(40),BE1(40),BET1D                                            AI 110
        COMPLEX ST2(40),BE2(40),BET2D                                           AI 120
        COMPLEX TRFN,TFFN                                                       AI 130
       COMPLEX SAV                                                              AI 140
        REAL KW,M,M1,KWS                                                        AI 150
        COMMON YPU(450,5)                                                       AI 160
C       YPU IN OUTP,RADCSD                                                      AI 170
C       NMP BELOW IS MAX FIRST DIMENSION                                        AI 180
C       NMP IN YMI ABOVE                                                        AI 190
        COMMON/CI/ IR,IW,NOUT,ICHECK                                            AI 200
        COMMON/BJ/ M,KW,CANG,PI,BV,CV,TJR,G                                     AI 210
        COMMON/CRIT/ICC,RC,XMC(16),XTC(16),YCR                                  AI 220
        COMMON/BN/ NGEO,NCJ,NUT                                                 AI 230
        COMMON/ER/ IERX                                                         AI 240
C       *** FIX STEP SIZE MOD                                                   AI 250
        COMMON/FIX/ JFIXSS                                                      AI 260
        COMMON/ FJET/IFJ,FJUT,FJTT,FJRT,FJBV,FJCV                               AI 270
        COMMON/BUG/ IDBUG                                                       AI 280
        COMMON/STYPE/ MTYPS                                                     AI 290
       COMMON /SRDCSD/ SAV(450)                                                 AI 300
        EQUIVALENCE(YPU(1,1),YMI(1,1))                                          AI 310
      NDIM=4                                                                    AI 320
      ICC=3                                                                     AI 330
      NMP=450                                                                   AI 340
      PI=3.141593                                                               AI 350
      TEMP=.25                                                                  AI 360
      JSR=(0.,1.)                                                               AI 370
      DO 10 JJ=1,8                                                              AI 380
   10 PRMT(JJ)=0.                                                               AI 390
      DO 20 I=1,16                                                              AI 400
   20 AUX(I,1)=0.0                                                              AI 410
C                                                                               AI 420
      PRMT(3)=-D(1)                                                             AI 430
      PRMT(4)=D(2)                                                              AI 440
      PRMT(7)=D(3)                                                              AI 450
      DFC=D(4)                                                                  AI 460
      ROX=D(5)                                                                  AI 470
      RC=D(6)                                                                   AI 480
      ECON=D(7)                                                                 AI 490
      G=D(8)                                                                    AI 500
      RSW=D(9)                                                                  AI 510
      RSC=D(10)                                                                 AI 520
      KW=D(11)                                                                  AI 530
      M=D(12)                                                                   AI 540
      TJR=D(13)                                                                 AI 550
      CANG=D(14)                                                                AI 560
      SANG=D(15)                                                                AI 570
      X1=D(16)                                                                  AI 580
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      BV=D(17)                                                          AI 590
      TCOR=D(18)                                                        AI 600
      DCOR=D(19)                                                        AI 610
      FJUT=D(20)                                                        AI 620
      FJTT=D(21)                                                        AI 630
      FJRT=D(22)                                                        AI 640
      FJBV=D(23)                                                        AI 650
      FJCV=D(24)                                                        AI 660
      FJFF=D(25)                                                        AI 670
      IW=ID(2)                                                          AI 680
      NGEO=ID(3)                                                        AI 690
      MTYPS=ID(4)                                                       AI 700
      NUT=ID(5)                                                         AI 710
      IERX=ID(6)                                                        AI 720
      IHX=ID(7)                                                         AI 730
      IWB=ID(8)                                                         AI 740
      JFIXSS=ID(9)                                                      AI 750
      JCC=ID(10)                                                        AI 760
      ISG=ID(11)                                                        AI 770
      IDBUG=ID(12)                                                      AI 780
      NSLOX=ID(13)                                                      AI 790
      NSLO=ID(14)                                                       AI 800
      NCJN=ID(15)                                                       AI 810
      NCJM=ID(16)                                                       AI 820
      ISRL=ID(17)                                                       AI 830
      IFJ=ID(18)                                                        AI 840
      IO=ID(26)                                                         AI 850
      IF (PRMT(3).EQ.0.0) RETURN                                        AI 860
      NCJMX=NCJM+1                                                      AI 870
      NCJNX=NCJN+1                                                      AI 880
C                                                                       AI 890
C                                                                       AI 900
      CALL AXIAL (X1,BV,CV)                                             AI 910$
C                                                                       AI 920
C                                                                       AI 930
C        SET UP RADIAL SOURCE LOCATIONS IF REQUIRED                     AI 940
      IF (NSLOX.GT.0) GO TO 40                                          AI 950
      CALL SLOC (DFC,X1,BV,CV,G,XOS,NSLO)                               AI 960$
      IF (ISRL.LE.0) GO TO 30                                           AI 970
      IF (CV.EQ.0.0) NSLO=ISRL                                          AI 980
      IF (CV.NE.0.0) NSLO=ISRL+NSLO-24                                  AI 990
   30 CONTINUE                                                          AI1000
   40 CONTINUE                                                          AI1010
C                                                                       AI1020
C                                                                       AI1030
      FJPC=(1.-FJUT)*(1.-FJUT)/FJTT                                     AI1040
      ROI=0.                                                            AI1050
      XVS=DFC                                                           AI1060
      FJSW=0                                                            AI1070
      DO 80 IVS=1,1000                                                  AI1080
      RO=XVS                                                            AI1090
      CALL VELT (XVS,M,TJR,BV,CV,G,XMC,XTC,3)                           AI1100$
      IF (IVS.EQ.1) M1=XMC(1)                                           AI1110
      IF (IVS.EQ.1) T1=XTC(1)                                           AI1120
      IF (IO.EQ.0) GO TO 50                                             AI1130
      IF (NUT.GT.0) WRITE (IW,460) XVS,(XMC(I),I=1,3),(XTC(I),I=1,3)    AI1140*
   50 CONTINUE                                                          AI1150
      IF (XMC(1).GE..99) GO TO 70                                       AI1160
      TPRO=(1.-XMC(1))*(1.-XMC(1))/XTC(1)                               AI1170
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      IF (FJSW.NE.0.OR.IFJ.EQ.0) GO TO 60                                   AI1180
      IF (ABS(TPRO-FJPC).LT.1.E-04) ROI=XVS                                 AI1190
      IF (ABS(TPRO-FJPC).LT.1.E-04) FJSW=1                                  AI1200
   60 CONTINUE                                                              AI1210
      IF (ABS(TPRO-1.).LT..1E-03) GO TO 90                                  AI1220
   70 CONTINUE                                                              AI1230
      XVS=XVS+FJRT*DFC                                                      AI1240
   80 CONTINUE                                                              AI1250
   90 CONTINUE                                                              AI1260
      IF (M.EQ.0.0.AND.TJR.EQ.1.) RO=ROX                                    AI1270
      IF (XOS(1).LT.DFC) DFC=XOS(1)+PRMT(3)/2048.                           AI1280
      IF (XOS(NSLO).GT.RO) RO=XOS(NSLO)-PRMT(3)/2048.                       AI1290
      RO=DFC+IFIX(RO/PRMT(3))*PRMT(3)                                       AI1300
      IF (ROX.NE.0..AND.ROX.GT.XOS(NSLO)) ROI=ROX                           AI1310
      IF (IFJ.EQ.0.AND.ROI.NE.0.) RO=ROI                                    AI1320
      IF (IFJ.EQ.0.AND.ROI.EQ.0.) ROI=RO                                    AI1330
      IF (IO.EQ.0) GO TO 100                                                AI1340
      IF (NUT.GT.0) WRITE (IW,440) X1,DFC,ROI,RO,RC                         AI1350*
  100 CONTINUE                                                              AI1360
C                                                                           AI1370
C                                                                           AI1380
      XKW2=KW*KW                                                            AI1390
      ICC=2                                                                 AI1400
      DO 120 MS=1,NSLO                                                      AI1410
      CALL VELT (XOS(MS),M,TJR,BV,CV,G,AMP,APLUG,ICC)                       AI1420$
      PRS(MS)=1.-AMP(1)*CANG                                                AI1430
      ID(41)=0                                                              AI1440
      IF (ABS(PRS(MS)).LT.1.E-30) ID(41)=11                                 AI1450
      IF (ABS(PRS(MS)).LT.1.E-30) GO TO 420                                 AI1460
      PRS(MS)=PRS(MS)*PRS(MS)/APLUG(1)                                      AI1470
      PQ(MS)=(CANG*CANG-PRS(MS))*KW*KW                                      AI1480
      PD(MS)=-APLUG(2)/APLUG(1)-2.*AMP(2)*CANG/(1.-AMP(1)*CANG)             AI1490
      PA(MS)=-APLUG(2)/APLUG(1)                                             AI1500
      IF (ISG.EQ.1) PA(MS)=0.0                                              AI1510
      IF (ISG.EQ.1) PD(MS)=0.                                               AI1520
      IF (IO.EQ.0) GO TO 110                                                AI1530
      IF (NUT.GT.0) WRITE (IW,440) XOS(MS),AMP(1),APLUG(1),PRS(MS),PQ(MS    AI1540*
     1),PD(MS)                                                              AI1550
  110 CONTINUE                                                              AI1560
  120 CONTINUE                                                              AI1570
C                                                                           AI1580
C                                                                           AI1590
      ICC=3                                                                 AI1600
      YCR=0.                                                                AI1610
      ICRIT=0                                                               AI1620
      CTEST=1.-M1*CANG                                                      AI1630
      IF (CTEST.GT.0.0) GO TO 140                                           AI1640
      ICRIT=1                                                               AI1650
      YCR=1.                                                                AI1660
      CALL CRIT (YCR,M,TJR,BV,CV,G,CANG)                                    AI1670$
      ICC=JCC                                                               AI1680
      CALL VELT (YCR,M,TJR,BV,CV,G,XMC,XTC,ICC)                             AI1690$
      ICC=3                                                                 AI1700
      IF (IO.EQ.0) GO TO 130                                                AI1710
      IF (NUT.GT.0) WRITE (IW,440) YCR,(XMC(KI),KI=1,JCC)                   AI1720*
      IF (NUT.GT.0) WRITE (IW,440) YCR,(XTC(KI),KI=1,JCC)                   AI1730*
  130 CONTINUE                                                              AI1740
      ID(41)=0                                                              AI1750
      IF (YCR.LT.(DFC-PRMT(3)*RC)) ID(41)=9                                 AI1760
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      IF (YCR.LT.(DFC-PRMT(3)*RC)) GO TO 420                            AI1770
  140 CONTINUE                                                          AI1780
C                                                                       AI1790
C                                                                       AI1800
      KRO=CMPLX(KW*SANG,0.0)                                            AI1810
      DUM=CTEST*CTEST/T1-CANG*CANG                                      AI1820
      KRD=CMPLX(KW*KW*DUM,0.0)                                          AI1830
      KRD=CSQRT(KRD)                                                    AI1840
      IF (DUM.LT.0.0) KRD=-KRD                                          AI1850
      IF (NCJNX.GT.1) GO TO 160                                         AI1860
      DO 150 NTS=1,7                                                    AI1870
      DO 150 MS=1,NSLO                                                  AI1880
  150 TIJ(NTS,MS)=0.                                                    AI1890
  160 CONTINUE                                                          AI1900
      MXOS=1                                                            AI1910
C                                                                       AI1920
C                                                                       AI1930
      DO 370 NCJX=NCJNX,NCJMX                                           AI1940
      ICHECK=0                                                          AI1950
      NCJ=NCJX-1                                                        AI1960
      SCALE=10.**(-NCJ)                                                 AI1970
C                                                                       AI1980
C                                                                       AI1990
      BCWS=(0.0,0.0)                                                    AI2000
      IF (NGEO.EQ.1) GO TO 170                                          AI2010
      RADM=-JSR*KRO                                                     AI2020
      BCNS=JSR*KRD                                                      AI2030
      BCWS=(0.,0.)                                                      AI2040
C        ORIGIN AT EDGE OF SINGLE SHEAR LAYER                           AI2050
      RPRES=-1./(2.*JSR*KRO)                                            AI2060
      IERDS=0                                                           AI2070
      GO TO 180                                                         AI2080
  170 CONTINUE                                                          AI2090
      CALL RABC (NCJ,RO,DFC,KRO,KRD,RADM,BCNS,BCWS,RPRES,IERDS)         AI2100$
  180 CONTINUE                                                          AI2110
      DUM=T1/(CTEST*CTEST)                                              AI2120
      BCNS=DUM*BCNS                                                     AI2130
      BCWS=DUM*BCWS                                                     AI2140
      IF (IO.EQ.0) GO TO 190                                            AI2150
      IF (NUT.GT.0) WRITE (IW,440) KRO,KRD,BCWS,RADM,BCNS,RPRES         AI2160*
  190 CONTINUE                                                          AI2170
      ID(41)=0                                                          AI2180
      IF (IERDS.NE.0) ID(41)=10                                         AI2190
      IF (IERDS.NE.0) GO TO 420                                         AI2200
C                                                                       AI2210
C                                                                       AI2220
      NOUT=0                                                            AI2230
C        WRONSK - REMOVED                                               AI2240
      PRMT(3)=-PRMT(3)                                                  AI2250
      PRMT(1)=DFC                                                       AI2260
      PRMT(2)=ROI                                                       AI2270
      IF (ICRIT.EQ.0) GO TO 200                                         AI2280
      IF (PRMT(2).GT.(YCR-RC)) PRMT(2)=YCR-RC                           AI2290
  200 CONTINUE                                                          AI2300
      PRMT(6)=XOS(MXOS)-2.*PRMT(3)                                      AI2310
      IF (MXOS.EQ.1) PRMT(6)=DFC                                        AI2320
      PRMT(8)=XOS(NSLO)+2.*PRMT(3)                                      AI2330
      CALL IDERY (DERY,TEMP,NDIM,PRMT,ICC)                              AI2340$
      Y(1)=SCALE                                                        AI2350
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      Y(2)=0.                                                          AI2360
      Y(3)=REAL(BCNS)*Y(1)                                             AI2370
      Y(4)=0.                                                          AI2380
C        EXTRA MOD NEEDED HERE IF 2-D JET CASE TO BE INCLUDED          AI2390
      IF (NGEO.EQ.0) Y(4)=AIMAG(BCNS)*Y(1)                             AI2400
C        USE NEXT CARD FOR COMPLEX ANGLES                              AI2410
C        Y(4)=AIMAG(BCNS)                                              AI2420
      CALL HPCL (PRMT,Y,DERY,NDIM,IHLF,AFCT,FCT,OUTP,AUX,A,XCU)        AI2430$
      IF (IHLF.GE.11) STOP 2                                           AI2440
      IF (NOUT.GT.NMP) STOP 3                                          AI2450
      IF (ICRIT.EQ.0) GO TO 240                                        AI2460
C                                                                      AI2470
C                                                                      AI2480
      DO 210 IZ=1,NDIM                                                 AI2490
  210 Y(IZ)=Y(IZ)+DERY(IZ)*(PRMT(2)-XCU)                               AI2500
      CALL TRANS (Y,ST2,NDIM)                                          AI2510$
      IF (NOUT.GT.0) NOUT=NOUT-1                                       AI2520
      PRMT(1)=-PI                                                      AI2530
      PRMT(2)=0.                                                       AI2540
      PRMT(3)=PRMT(3)/(RC*2.**IHX)                                     AI2550
      PRMT(3)=PRMT(3)*PI                                               AI2560
      DO 220 IZ=1,NDIM                                                 AI2570
  220 DERY(IZ)=TEMP                                                    AI2580
      ICC=JCC                                                          AI2590
      CALL HPCL (PRMT,Y,DERY,NDIM,IHLF,AFCT,FCT,OUTP,AUX,A,XCU)        AI2600$
      IF (IHLF.GE.11) STOP 2                                           AI2610
      IF (NOUT.GT.NMP) STOP 3                                          AI2620
      DO 230 IZ=1,NDIM                                                 AI2630
  230 Y(IZ)=Y(IZ)-DERY(IZ)*XCU                                         AI2640
      CALL TRANS (Y,BE2,NDIM)                                          AI2650$
C                                                                      AI2660
C                                                                      AI2670
      ICC=3                                                            AI2680
      PRMT(3)=RC*PRMT(3)*2.**IHX                                       AI2690
      PRMT(3)=PRMT(3)/PI                                               AI2700
      IF (NOUT.GT.0) NOUT=NOUT-1                                       AI2710
C                                                                      AI2720
C                                                                      AI2730
      PRMT(1)=YCR+RC                                                   AI2740
C        WRONSK                                                        AI2750
      PRMT(2)=ROI                                                      AI2760
      PRMT(6)=XOS(MXOS)-2.*PRMT(3)                                     AI2770
      IF (PRMT(1).GT.PRMT(2)) PRMT(2)=PRMT(1)+PRMT(3)                  AI2780
      CALL IDERY (DERY,TEMP,NDIM,PRMT,ICC)                             AI2790$
      CALL HPCL (PRMT,Y,DERY,NDIM,IHLF,AFCT,FCT,OUTP,AUX,A,XCU)        AI2800$
      IF (IHLF.GE.11) STOP 2                                           AI2810
  240 CONTINUE                                                         AI2820
      NOUTM=NOUT                                                       AI2830
      IF (NOUTM.GT.NMP) STOP 5                                         AI2840
      IF (IO.EQ.0) GO TO 250                                           AI2850
      IF (NUT.GT.0) WRITE (IW,450) NCJ,MXOS,NOUTP,NOUTM,ICHECK         AI2860*
  250 CONTINUE                                                         AI2870
C                                                                      AI2880
C                                                                      AI2890
      IF (IFJ.EQ.0) GO TO 260                                          AI2900
      PRMT(1)=XCU                                                      AI2910
      PRMT(2)=RO                                                       AI2920
      PRMT(3)=PRMT(3)*IFIX(FJRT*FJFF)                                  AI2930
      PRMT(8)=0.                                                       AI2940
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      CALL IDERY (DERY,TEMP,NDIM,PRMT,ICC)                                  AI2950$
      CALL HPCL (PRMT,Y,DERY,NDIM,IHLF,AFCT,FCT,OUTP,AUX,A,XCU)             AI2960$
      IF (IHLF.GE.11) STOP 2                                                AI2970
      PRMT(3)=PRMT(3)/IFIX(FJRT*FJFF)                                       AI2980
  260 CONTINUE                                                              AI2990
C                                                                           AI3000
C                                                                           AI3010
      NOUT=0                                                                AI3020
      PRMT(3)=-PRMT(3)                                                      AI3030
      DO 290 MS=MXOS,NSLO                                                   AI3040
      STEST=10.                                                             AI3050
      DO 270 ISE=1,NOUTM                                                    AI3060
      XTEST=ABS(YMI(ISE,1)-XOS(MS))                                         AI3070
      IF (XTEST.GT.STEST) GO TO 280                                         AI3080
      STEST=XTEST                                                           AI3090
      MMI=ISE                                                               AI3100
  270 CONTINUE                                                              AI3110
  280 CONTINUE                                                              AI3120
      IF (XOS(MS).LT.YMI(MMI,1)) MMI=MMI-1                                  AI3130
      STP2=CMPLX(YMI(MMI,2),YMI(MMI,3))                                     AI3140
      XINTP=(XOS(MS)-YMI(MMI,1))/(YMI(MMI+1,1)-YMI(MMI,1))                  AI3150
      STP2=(1.-XINTP)*STP2+XINTP*CMPLX(YMI(MMI+1,2),YMI(MMI+1,3))           AI3160
      ST2(MS)=STP2                                                          AI3170
      BE1(MS)=(1.-XINTP)*SAV(MMI)+XINTP*SAV(MMI+1)                          AI3180
      BET2=CMPLX(YMI(MMI,4),YMI(MMI,5))                                     AI3190
      BET2D=CMPLX(YMI(MMI+1,4),YMI(MMI+1,5))                                AI3200
      BET2=(1.-XINTP)*BET2+XINTP*BET2D                                      AI3210
      BE2(MS)=BET2/ST2(MS)                                                  AI3220
  290 CONTINUE                                                              AI3230
C                                                                           AI3240
C                                                                           AI3250
      XN4=FLOAT(NCJ)                                                        AI3260
      XN4=XN4*XN4*XN4*XN4                                                   AI3270
      NCON=7*(MXOS-1)                                                       AI3280
C        WRONSK                                                             AI3290
      DO 300 IZ=1,4                                                         AI3300
      Y(IZ)=Y(IZ)+DERY(IZ)*(RO-XCU)                                         AI3310
  300 CONTINUE                                                              AI3320
      CALL WRCAL (NGEO,Y,RADM,RPRES,CAMP(1))                                AI3330$
C        CALCULATE RADIAL/AZIMUTHAL COHERENCE AND RADIAL                    AI3340
C        SOURCE DISTRIBUTION EFFECTS FOR THIS AZIMUTHAL MODE                AI3350
      IFLAG=0                                                               AI3360
      IF (ID(25).GT.0) CALL RADCSD (IFLAG,NCJ,CAMP(1),D,ID,NOUTM,BV,CV)     AI3370$
C                                                                           AI3380
C                                                                           AI3390
      DO 340 MS=MXOS,NSLO                                                   AI3400
      XAV=XOS(MS)                                                           AI3410
C        EXTRA MOD NEEDED HERE IF 2-D JET CASE TO BE INCLUDED               AI3420
      IF (NGEO.EQ.0) XAV=1.                                                 AI3430
      CAMP(2)=ST2(MS)*CAMP(1)                                               AI3440
C        THIS RESTRICTS FREQ. TO GT. 10. E-14                               AI3450
C        IF(ALOG10(CABS(CAMP(2)))-NCJ.LT.-30.) CAMP(2)=(0.,0.)              AI3460
      RCAMP=ABS(REAL(CAMP(2)))                                              AI3470
      AICAMP=ABS(AIMAG(CAMP(2)))                                            AI3480
      IF (IO.EQ.0) GO TO 310                                                AI3490
      IF (RCAMP.LT.1.E-30.AND.AICAMP.LT.1.E-30) WRITE (IW,440) CAMP(2)      AI3500*
  310 CONTINUE                                                              AI3510
      IF (RCAMP.LT.1.E-30.AND.AICAMP.LT.1.E-30) CAMP(2)=(0.,0.)             AI3520
      XAV2=XAV*XAV                                                          AI3530
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      XAV3=XAV*XAV2                                                        AI3540
      XAV4=XAV2*XAV2                                                       AI3550
      TRN=BE2(MS)*PRS(MS)/XAV                                              AI3560
C        EXTRA MOD NEEDED HERE IF 2-D JET CASE TO BE INCLUDED              AI3570
      TRRN=PQ(MS)+NCJ*NCJ/XAV2+TRN*(PD(MS)-NGEO/XAV)                       AI3580
      IF (MTYPS.EQ.1) TRRN=PQ(MS)+NCJ*NCJ/XAV2+TRN*(PA(MS)-NGEO/XAV)       AI3590
      IF (MTYPS.EQ.3) GO TO 320                                            AI3600
C                                                                          AI3610
C                                                                          AI3620
C        EXTRA INFO. FOR MTYPS.NE.3                                        AI3630
      ICC=3                                                                AI3640
      CALL VELT (XOS(MS),M,TJR,BV,CV,G,AMP,APLUG,ICC)                      AI3650$
      AMP(1)=1.-AMP(1)*CANG                                                AI3660
      ST1(MS)=-CANG*AMP(2)/BE1(MS)                                         AI3670
      IF (ISG.EQ.1) ST1(MS)=(0.0,0.0)                                      AI3680
      IF (ISG.EQ.1) AMP(2)=0.                                              AI3690
      AMP(3)=-CANG*AMP(3)/AMP(1)                                           AI3700
      IF (ISG.EQ.1) AMP(3)=0.                                              AI3710
  320 CONTINUE                                                             AI3720
C                                                                          AI3730
C                                                                          AI3740
      TRC=CABS(TRN)                                                        AI3750
      IF (MTYPS.EQ.1) TRC=CABS(TRN+ST1(MS))                                AI3760
      TRC=TRC*TRC                                                          AI3770
      TRRC=CABS(TRRN)                                                      AI3780
      TRRC=TRRC*TRRC                                                       AI3790
      TRR=2.*REAL(TRN)                                                     AI3800
      TRFN=(TRN-1./XAV)/XAV                                                AI3810
      IF (MTYPS.EQ.1) TRFN=(TRN+ST1(MS)-1.0/XAV)/XAV                       AI3820
      TRFC=CABS(TRFN)                                                      AI3830
      TRFC=TRFC*TRFC                                                       AI3840
      TFFN=(TRN-NCJ*NCJ/XAV)/XAV                                           AI3850
      TFFC=CABS(TFFN)                                                      AI3860
      TFFC=TFFC*TFFC                                                       AI3870
      CN=CABS(CAMP(2))                                                     AI3880
      CN=CN*CN                                                             AI3940
      IF (NCJ.GT.0) CN=2.*CN                                               AI3950
      TX(1)=CN                                                             AI3960
      TX(2)=TRC*CN                                                         AI3970
      TX(3)=TRRC*CN                                                        AI3980
C        EXTRA MOD NEEDED HERE IF 2-D JET CASE TO BE INCLUDED              AI3990
      IF (NGEO.EQ.0) GO TO 330                                             AI4000
      TX(4)=NCJ*NCJ*CN/XAV2                                                AI4010
      TX(5)=NCJ*NCJ*TRFC*CN                                                AI4020
      TX(6)=TFFC*CN                                                        AI4030
      TX(7)=CABS(TRN)*CABS(TRN)*CN
  330 CONTINUE                                                             AI4040
      CALL TCON (MS,NCJX,NCJNX,TIJ,TX,ECON,NCON,MXOS)                      AI4050$
      IF (NCON.EQ.7*NSLO) GO TO 380                                        AI4060
  340 CONTINUE                                                             AI4070
C                                                                          AI4080
C                                                                          AI4090
      IF (IFIX(PRMT(7)).EQ.0) GO TO 370                                    AI4100
      IF (IO.EQ.0) GO TO 360                                               AI4110
      DO 350 MS=1,NSLO                                                     AI4120
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      WRITE (IW,440) (TIJ(NTS,MS),NTS=1,7)                                  AI4130*
  350 CONTINUE                                                              AI4140
  360 CONTINUE                                                              AI4150
  370 CONTINUE                                                              AI4160
C                                                                           AI4170
C                                                                           AI4180
  380 CONTINUE                                                              AI4190
      TX(1)=0.0                                                             AI4200
      SIPD=0.0                                                              AI4210
      TISO=0.0                                                              AI4220
      DO 410 MS=1,NSLO                                                      AI4230
C      SAVE TX(1),SIPD,TISO FOR INTERPOLATION IN S.R. LILLEY                AI4240
      D(41)=TX(1)                                                           AI4250
      D(42)=SIPD                                                            AI4260
      D(43)=TISO                                                            AI4270
      CALL TSIGN (MS,TIJ)                                                   AI4280$
      TX(1)=10.*ALOG10(TIJ(1,MS))                                           AI4290
      TX(2)=10.*ALOG10(TIJ(2,MS)/(.5*XKW2))                                 AI4300
      TX(3)=10.*ALOG10(TIJ(3,MS)/(.375*XKW2*XKW2))                          AI4310
C        EXTRA MOD NEEDED HERE IF 2-D JET CASE TO BE INCLUDED               AI4320
      IF (NGEO.EQ.0) GO TO 390                                              AI4330
      TX(4)=10.*ALOG10(TIJ(4,MS)/(.5*XKW2))                                 AI4340
      TX(5)=10.*ALOG10(TIJ(5,MS)/(.125*XKW2*XKW2))                          AI4350
      TX(6)=10.*ALOG10(TIJ(6,MS)/(.375*XKW2*XKW2))                          AI4360
      TX(7)=10.0*ALOG10(TIJ(7,MS)/(0.5*XKW2))
  390 CONTINUE                                                              AI4370
      TISO=TIJ(3,MS)+TIJ(6,MS)+2.*TIJ(5,MS)                                 AI4380
      TISO=TISO+XKW2*XKW2*(CANG**4)*TIJ(1,MS)+2.*XKW2*CANG*CANG*(TIJ(2,M    AI4390
     1S)+TIJ(4,MS))                                                         AI4400
      TISO=10.*ALOG10(TISO/(XKW2*XKW2))                                     AI4410
      TISO=TISO+TCOR                                                        AI4420
      SIPD=TIJ(7,MS)+TIJ(4,MS)+XKW2*CANG*CANG*TIJ(1,MS)                     AI4430
      SIPD=10.*ALOG10(SIPD/XKW2)                                            AI4440
      SIPD=SIPD+DCOR                                                        AI4450
      ICC=1                                                                 AI4460
      SMACH=1.                                                              AI4470
      IF (M.NE.0.) SMACH=M                                                  AI4480
      CALL VELT (XOS(MS),SMACH,TJR,BV,CV,G,AMP,APLUG,ICC)                   AI4490$
C        VEL. AND TEMP. MUST BE LESS THAN 10. SOURCE POS. LESS THAN 99.     AI4500
      IF (IO.EQ.0) GO TO 400                                                AI4510
      WRITE (IW,430) XOS(MS),AMP(1),APLUG(1),(TX(NTS),NTS=1,7),TISO,SIPD    AI4520*
  400 CONTINUE                                                              AI4530
C     JAN76                                                                 AI4540
  410 CONTINUE                                                              AI4550
      D(31)=TX(1)                                                           AI4560
      D(32)=SIPD                                                            AI4570
      D(33)=TISO                                                            AI4580
C                                                                           AI4590
C                                                                           AI4600
C      OBTAIN NON-COMPACT FLOW FACTORS                                      AI4610
      IFLAG=1                                                               AI4620
      IF (ID(25).GT.0) CALL RADCSD (IFLAG,NCJ,CAMP(1),D,ID,NOUTM,BV,CV)     AI4630$
C                                                                           AI4640
C                                                                           AI4650
  420 CONTINUE                                                              AI4660
      RETURN                                                                AI4670
C                                                                           AI4680
  430 FORMAT (1X,F8.4,2F7.4,9F7.2)                                          AI4690
  440 FORMAT (1X,6E13.6)                                                    AI4700
  450 FORMAT (1X,3HNCJ,5I5)                                                 AI4710
  460 FORMAT (1X,7E11.4)                                                    AI4720
      END                                                                   AI4730-
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*DECK AXIAL
      SUBROUTINE AXIAL (X1,BV,CV)                                    AJ  10
      IF (X1.GT.13.85) GO TO 10                                      AJ  20
      BV=X1/13.5                                                     AJ  30
      CV=-.022*X1                                                    AJ  40
      GO TO 20                                                       AJ  50
   10 CONTINUE                                                       AJ  60
      BV=1.0+(X1-13.85)*0.55/(26.0-13.85)                            AJ  70
      BV=BV*1.559874                                                 AJ  80
      CV=0.                                                          AJ  90
   20 CONTINUE                                                       AJ 100
      RETURN                                                         AJ 110
      END                                                            AJ 120-
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*DECK SLOC
      SUBROUTINE SLOC (XS,X1,BV,CV,G,XOS,NSLO)                          AK  10
         DIMENSION XOS(1)                                               AK  20
         DIMENSION U(40)                                                AK  30
         DATA U(1),U(2),U(3),U(4),U(5),U(6),U(7),U(8),U(9),U(10),U(11),  AK  40
     1U(12),U(13),U(14),U(15),U(16),U(17),U(18),U(19),U(20),U(21),U(22),  AK  50
     2   U(23),U(24)/.99,.98199,.968865,.9481,.91859,.87741,.82377,       AK  60
     3   .757455,.67936,.67,.66295,.6,.591905,.5,.408098,.3206435,        AK  70
     4   .2425485,.1762325,.1225905,.081409,.051541,.0311374,.0180080,    AK  80
     5   .01/                                                           AK  90
       IF (CV.EQ.0.) GO TO 70                                           AK 100
       IF (X1.GT.8.01) GO TO 40                                         AK 110
       RMDEL=1.+.022*X1-.12185*X1                                       AK 120
       XOS(1)=2.*XS                                                     AK 130
       RDEL=(RMDEL-XOS(1))/9.                                           AK 140
       DO 10 IDEL=1,9                                                   AK 150
       XOS(IDEL+1)=XOS(IDEL)+RDEL                                       AK 160
   10 CONTINUE                                                          AK 170
       RDEL=.2437*X1/20.                                                AK 180
       DO 20 IDEL=10,17                                                 AK 190
       XOS(IDEL+1)=XOS(IDEL)+RDEL                                       AK 200
   20 CONTINUE                                                          AK 210
       XOS(19)=1.-.001007875*X1                                         AK 220
       XOS(20)=1.                                                       AK 230
       XOS(21)=1.+.00872375*X1                                          AK 240
       XOS(22)=XOS(18)+RDEL                                             AK 250
       DO 30 IDEL=22,32                                                 AK 260
       XOS(IDEL+1)=XOS(IDEL)+RDEL                                       AK 270
   30 CONTINUE                                                          AK 280
       NSLO=33                                                          AK 290
       RETURN                                                           AK 300
   40 CONTINUE                                                          AK 310
       XOS(1)=2.0*XS                                                    AK 320
       RDEL=0.2437*X1/20.0                                              AK 330
       NMAX=(1.0+0.022*X1-XOS(1))/RDEL                                  AK 340
       XOS(NMAX+5)=1.0+0.022*X1                                         AK 350
       XOS(2)=XOS(NMAX+5)-NMAX*RDEL                                     AK 360
       NDUM=NMAX-1                                                      AK 370
       DO 50 IDUM=2,NDUM                                                AK 380
       XOS(IDUM+1)=XOS(IDUM)+RDEL                                       AK 390
   50 CONTINUE                                                          AK 400
       XOS(NMAX+1)=1.0-0.001007875*X1                                   AK 410
       XOS(NMAX+2)=1.0                                                  AK 420
       XOS(NMAX+3)=1.0+0.00872375*X1                                    AK 430
       XOS(NMAX+4)=XOS(NMAX)+RDEL                                       AK 440
       NDMIN=NMAX+5                                                     AK 450
       NDMAX=NMAX+14                                                    AK 460
       DO 60 IDUM=NDMIN,NDMAX                                           AK 470
       XOS(IDUM+1)=XOS(IDUM)+RDEL                                       AK 480
   60 CONTINUE                                                          AK 490
       NSLO=NMAX+15                                                     AK 500
       RETURN                                                           AK 510
   70 CONTINUE                                                          AK 520
       NSLO=24                                                          AK 530
       DO 80 I=1,NSLO                                                   AK 540
       XOS(I)=BV*SQRT(ALOG(1./U(I)))                                    AK 550
       IF (XOS(I).LE.XS) XOS(I)=1.1*XS                                  AK 560
   80 CONTINUE                                                          AK 570
       RETURN                                                           AK 580
       END                                                              AK 590
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*DECK VELT
      SUBROUTINE VELT (X,M,TJR,BV,CV,G,XMC,XTC,ICC)                          AL  10
         DIMENSION XMC(1)                                                    AL  20
         DIMENSION XTC(1)                                                    AL  30
         COMMON/ FJET/IFJ,FJUT,FJTT,FJRT,FJBV,FJCV                           AL  40
         REAL M                                                              AL  50
         DATA SPI/1.7724538/                                                 AL  60
      VRT=0.0                                                                AL  70
      GMM=(G-1.)/2.                                                          AL  80
      TJX=TJR-FJTT+GMM*(M-FJUT)*(M-FJUT)                                     AL  90
      FJTJX=FJTT-(1.-GMM*FJUT*FJUT)                                          AL 100
      IF (CV.EQ.0.) GO TO 180                                                AL 110
C                                                                            AL 120
C                                                                            AL 130
      XN=(ABS(X)-1.*CV)/BV                                                   AL 140
      IF (XN.GT.10.) GO TO 10                                                AL 150
      IF (XN.LT.-10.) GO TO 70                                               AL 160
      VR=0.5*(1.-ERF(XN))                                                    AL 170
      XMC(1)=(M-FJUT)*VR                                                     AL 180
      XTC(1)=FJTT-GMM*XMC(1)*XMC(1)+VR*TJX                                   AL 190
      IF (ICC.EQ.1.AND.IFJ.EQ.0) RETURN                                      AL 200
      IF (IFJ.EQ.0) GO TO 90                                                 AL 210
      GO TO 30                                                               AL 220
C                                                                            AL 230
C                                                                            AL 240
   10 DO 20 I=1,ICC                                                          AL 250
      XTC(I)=0.                                                              AL 260
   20 XMC(I)=0.0                                                             AL 270
      XTC(1)=1.                                                              AL 280
      IF (IFJ.EQ.0) GO TO 60                                                 AL 290
C                                                                            AL 300
C                                                                            AL 310
   30 CONTINUE                                                               AL 320
      XX=(ABS(X)/FJRT-1.*FJCV)/FJBV                                          AL 330
      IF (XX.GT.10.) GO TO 60                                                AL 340
      IF (XX.LT.-10.) GO TO 50                                               AL 350
      VRT=0.5*(1.-ERF(XX))                                                   AL 360
      XMC(1)=FJUT*VRT+XMC(1)                                                 AL 370
      IF (XTC(1).EQ.1.0) XTC(1)=1.0-GMM*XMC(1)*XMC(1)+VRT*FJTJX              AL 380
   40 CONTINUE                                                               AL 390
      IF (ICC.EQ.1) GO TO 60                                                 AL 400
      IF (XN.GT.10..AND.CV.NE.0.) GO TO 60                                   AL 410
      IF (XN.GT.4..AND.CV.EQ.0.) GO TO 60                                    AL 420
      IF (CV.EQ.0.) GO TO 210                                                AL 430
      GO TO 90                                                               AL 440
C                                                                            AL 450
C                                                                            AL 460
   50 CONTINUE                                                               AL 470
      XMC(1)=FJUT+XMC(1)                                                     AL 480
      IF (XTC(1).EQ.1.0) XTC(1)=FJTT                                         AL 490
      VRT=1.                                                                 AL 500
      GO TO 40                                                               AL 510
   60 CONTINUE                                                               AL 520
      RETURN                                                                 AL 530
C                                                                            AL 540
C                                                                            AL 550
   70 XMC(1)=M                                                               AL 560
      XTC(1)=TJR                                                             AL 570
      IF (ICC.EQ.1) RETURN                                                   AL 580
```

```
      DO 80 I=2,ICC                                                    AL 590
      XTC(I)=0.                                                        AL 600
   80 XMC(I)=0.0                                                       AL 610
      RETURN                                                           AL 620
C                                                                      AL 630
C                                                                      AL 640
   90 CONTINUE                                                         AL 650
      XMC(1)=VR                                                        AL 660
      XMC(2)=1.                                                        AL 670
      IF (ICC.GT.2) XMC(3)=2.*XN                                       AL 680
      N=ICC-1                                                          AL 690
      IF (N-2) 120,120,100                                             AL 700
  100 DO 110 I=3,N                                                     AL 710
  110 XMC(I+1)=2.*XN*XMC(I)-2.*(I-2)*XMC(I-1)                          AL 720
  120 EP=EXP(-XN*XN)                                                   AL 730
      FACT=EP/SPI                                                      AL 740
      DO 130 I=2,ICC                                                   AL 750
      FACT=-FACT/BV                                                    AL 760
  130 XMC(I)=FACT*XMC(I)                                               AL 770
C        FORM DER. OF VEL. RATIO                                       AL 780
      DO 150 ND=2,ICC                                                  AL 790
      XTC(ND)=0.                                                       AL 800
      AFAC=1.                                                          AL 810
      DO 140 NDR=1,ND                                                  AL 820
      INDR=ND-NDR+1                                                    AL 830
      XTC(ND)=XTC(ND)+AFAC*XMC(INDR)*XMC(NDR)                          AL 840
      AFAC=AFAC*(ND-NDR)/NDR                                           AL 850
  140 CONTINUE                                                         AL 860
  150 CONTINUE                                                         AL 870
      DO 160 ND=2,ICC                                                  AL 880
      XTC(ND)=-GMM*(M-FJUT)*(M-FJUT)*XTC(ND)+XMC(ND)*TJX               AL 890
  160 CONTINUE                                                         AL 900
      DO 170 I=1,ICC                                                   AL 910
      XMC(I)=(M-FJUT)*XMC(I)                                           AL 920
  170 CONTINUE                                                         AL 930
      XMC(1)=FJUT*VRT+XMC(1)                                           AL 940
C        FJ GRADIENTS NOT INCLUDED                                     AL 950
      RETURN                                                           AL 960
C                                                                      AL 970
C                                                                      AL 980
  180 CONTINUE                                                         AL 990
      XN=X/BV                                                          AL1000
      IF (XN.GT.4.) GO TO 190                                          AL1010
      VR=EXP(-XN*XN)                                                   AL1020
      XMC(1)=(M-FJUT)*VR                                               AL1030
      XTC(1)=FJTT-GMM*XMC(1)*XMC(1)+VR*TJX                             AL1040
      IF (ICC.EQ.1.AND.IFJ.EQ.0) RETURN                                AL1050
      IF (IFJ.EQ.0) GO TO 210                                          AL1060
      GO TO 30                                                         AL1070
C                                                                      AL1080
C                                                                      AL1090
  190 DO 200 I=1,ICC                                                   AL1100
      XTC(I)=0.                                                        AL1110
  200 XMC(I)=0.                                                        AL1120
      XTC(1)=1.                                                        AL1130
      IF (IFJ.EQ.0) RETURN                                             AL1140
      GO TO 30                                                         AL1150
C                                                                      AL1160
C                                                                      AL1170
```

```
  210 CONTINUE                                                          AL1180
      XMC(1)=1.                                                         AL1190
      XMC(2)=2.*XN                                                      AL1200
      IF (ICC-2) 240,240,220                                            AL1210
  220 DO 230 I=3,ICC                                                    AL1220
  230 XMC(I)=2.*XN*XMC(I-1)-2.*(I-2)*XMC(I-2)                           AL1230
  240 FACT=VR                                                           AL1240
      DO 250 I=1,ICC                                                    AL1250
      XMC(I)=FACT*XMC(I)                                                AL1260
  250 FACT=-FACT/BV                                                     AL1270
      DO 270 ND=2,ICC                                                   AL1280
      XTC(ND)=0.                                                        AL1290
      AFAC=1.                                                           AL1300
      DO 260 NDR=1,ND                                                   AL1310
      INDR=ND-NDR+1                                                     AL1320
      XTC(ND)=XTC(ND)+AFAC*XMC(INDR)*XMC(NDR)                           AL1330
      AFAC=AFAC*(ND-NDR)/NDR                                            AL1340
  260 CONTINUE                                                          AL1350
  270 CONTINUE                                                          AL1360
      DO 280 ND=2,ICC                                                   AL1370
      XTC(ND)=-GMM*(M-FJUT)*(M-FJUT)*XTC(ND)*XMC(ND)*TJX                AL1380
  280 CONTINUE                                                          AL1390
      DO 290 I=1,ICC                                                    AL1400
      XMC(I)=(M-FJUT)*XMC(I)                                            AL1410
  290 CONTINUE                                                          AL1420
      XMC(1)=FJUT*VRT+XMC(1)                                            AL1430
C        FJ GRADIENTS NOT INCLUDED                                      AL1440
      RETURN                                                            AL1450
      END                                                               AL1460-
```

```
*DECK ERF
       FUNCTION ERF(XN)                                                    AM  10
C        ERROR FUNCTION RATIONAL APPROXIMATION 7.1.27 OF NBS(ABRAMOWITZ)   AM  20
         DATA SPI,A1,A2,A3,A4/1.7724538,.278393,.230389,.000972,.078108/   AM  30
      XA=ABS(XN)                                                           AM  40
      X1=XA                                                                AM  50
      X2=XA*X1                                                             AM  60
      X3=XA*X2                                                             AM  70
      X4=XA*X3                                                             AM  80
      XRF=1.+A1*X1+A2*X2+A3*X3+A4*X4                                       AM  90
      ERF=1.-1./(XRF*XRF*XRF*XRF)                                          AM 100
      IF (XN.LT.0.) ERF=-ERF                                               AM 110
      RETURN                                                               AM 120
      END                                                                  AM 130-
```

```
*DECK CRIT
      SUBROUTINE CRIT (Y,M,TJR,BV,CV,G,CANG)                          AN  10
         DIMENSION YMC(3)                                             AN  20
         DIMENSION YTC(3)                                             AN  30
      ICC=3                                                           AN  40
      DO 10 N=1,10                                                    AN  50
      CALL VELT (Y,M,TJR,BV,CV,G,YMC,YTC,ICC)                         AN  60$
      YX=Y+(1.-YMC(1)*CANG)/(YMC(2)*CANG)                             AN  70
      IF (ABS((YX-Y)/YX).LT..001) GO TO 20                            AN  80
      Y=YX                                                            AN  90
   10 CONTINUE                                                        AN 100
      Y=0.                                                            AN 110
   20 RETURN                                                          AN 120
      END                                                             AN 130-
```

```
*DECK RABC
      SUBROUTINE RABC (N,RO,DFC,KRO,KRD,RADM,BCNS,BCWS,RPRES,IERDS)      AO  10
         COMPLEX CMPLX                                                  AO  20
         COMPLEX J,HND,JND                                              AO  30
         COMPLEX KRO,KRD,RADM,BCNS,BCWS,RPRES                           AO  40
         COMPLEX Z,BJ,Y                                                 AO  50
         COMMON/ER/ IERX                                                AO  60
         COMMON/BUG/ IDBUG                                              AO  70
      IERDS=0                                                           AO  80
      J=(0.,1.)                                                         AO  90
      Z=RO*KRO                                                          AO 100
      D=.001                                                            AO 110
      CALL CBESL1 (Z,N,BJ,D,IERDS)                                      AO 120$
      IF (IERDS.NE.0) RETURN                                            AO 130
      CALL CBESL2 (Z,N,Y,IERDS)                                         AO 140$
      IF (IERDS.NE.0) RETURN                                            AO 150
      RPRES=BJ-J*Y                                                      AO 160
      CALL CBESL1 (Z,N+1,BJ,D,IERDS)                                    AO 170$
      IF (IERDS.NE.0) RETURN                                            AO 180
      CALL CBESL2 (Z,N+1,Y,IERDS)                                       AO 190$
      IF (IERDS.NE.0) RETURN                                            AO 200
      HND=-(BJ-J*Y)+N*RPRES/Z                                           AO 210
      RADM=Z*HND/RPRES                                                  AO 220
      Z=DFC*KRD                                                         AO 230
      IF (FLOAT(N+1).GT.250.*CABS(Z*Z)) GO TO 10                        AO 240
      CALL CBESL1 (Z,N,BJ,D,IERDS)                                      AO 250$
      IF (IERDS.NE.0) RETURN                                            AO 260
      BCNS=BJ                                                           AO 270
      CALL CBESL1 (Z,N+1,BJ,D,IERDS)                                    AO 280$
      IF (IERDS.NE.0) RETURN                                            AO 290
      JND=-BJ+N*BCNS/Z                                                  AO 300
      BCNS=Z*JND/BCNS                                                   AO 310
      RETURN                                                            AO 320
   10 BCNS=N-Z*Z/(2.*(N+1))                                             AO 330
      RETURN                                                            AO 340
      END                                                               AO 350-
```

```
*DECK CBESL1
C     ************************************************************** AP  10
C        BESSEL FUNCTION OF COMPLEX VARIABLES                        * AP  20
C     ************************************************************** AP  30
C                                                                     AP  40
      SUBROUTINE CBESL1 (CX,N,CBJ,D,IER)                            AP  50
         COMPLEX CX,CALPHA,CBJ,CFM1,CBPREV,CFM,CBMK,CS              AP  60
         COMMON/BUG/ IDBUG                                          AP  70
      IF (IDBUG.EQ.1) WRITE (6,80)                                  AP  80*
      CBJ=(0.,0.)                                                   AP  90
      IF (N.LT.0) IER=1                                             AP 100
      IF (N.LT.0) RETURN                                            AP 110
      X=CABS(CX)                                                    AP 120
      Y=AIMAG(CX)                                                   AP 130
      IF (X.EQ.0.0.AND.Y.EQ.0.0) IER=2                              AP 140
      IF (X.EQ.0.0.AND.Y.EQ.0.0) RETURN                             AP 150
      IF (X.LE.15.) NTEST=20.+10.*X-X**2/3.                         AP 160
      IF (X.LE.15.) GO TO 10                                        AP 170
      NTEST=90.+X/2.                                                AP 180
   10 IF (N.GE.NTEST) IER=4                                         AP 190
      IF (N.GE.NTEST) RETURN                                        AP 200
      IER=0                                                         AP 210
      N1=N+1                                                        AP 220
      CBPREV=(0.,0.)                                                AP 230
      IF (X.LT.5.) MA=X+6.                                          AP 240
      IF (X.LT.5.) GO TO 20                                         AP 250
      MA=1.4*X+60./X                                                AP 260
   20 MB=N+X/4+2                                                    AP 270
      MZERO=MAX0(MA,MB)                                             AP 280
      MMAX=NTEST                                                    AP 290
      IF (MZERO.GE.MMAX-2) MMAX=MZERO+3                             AP 300
      DO 70 M=MZERO,MMAX,3                                          AP 310
      CFM1=(1.E-28,1.E-28)                                          AP 320
      CFM=(0.,0.)                                                   AP 330
      CALPHA=(0.,0.)                                                AP 340
      IF (M.EQ.(M/2)*2) JT=-1                                       AP 350
      IF (M.EQ.(M/2)*2) GO TO 30                                    AP 360
      JT=1                                                          AP 370
   30 M2=M-2                                                        AP 380
      DO 60 K=1,M2                                                  AP 390
      MK=M-K                                                        AP 400
      CBMK=2.*MK*CFM1/CX-CFM                                        AP 410
      CFM=CFM1                                                      AP 420
      CFM1=CBMK                                                     AP 430
      IF (MK-N-1) 50,40,50                                          AP 440
   40 CBJ=CBMK                                                      AP 450
   50 JT=-JT                                                        AP 460
      CS=1+JT                                                       AP 470
   60 CALPHA=CALPHA+CBMK*CS                                         AP 480
      CBMK=2.*CFM1/CX-CFM                                           AP 490
      IF (N.EQ.0) CBJ=CBMK                                          AP 500
      CALPHA=CALPHA+CBMK                                            AP 510
      CBJ=CBJ/CALPHA                                                AP 520
      ACBJ=CABS(CBJ)                                                AP 530
      ER1=(REAL(CBJ)-REAL(CBPREV))/ACBJ                             AP 540
      ER2=(AIMAG(CBJ)-AIMAG(CBPREV))/ACBJ                           AP 550
C     ER1 = (REAL(CBJ) - REAL(CBPREV)) / REAL(CBJ)                  AP 560
C     ER2 = (AIMAG(CBJ) - AIMAG(CBPREV)) / AIMAG(CBJ)               AP 570
      IF (ABS(ER1).GT.D) GO TO 70                                   AP 580
      IF (ABS(ER2).GT.D) GO TO 70                                   AP 590
      RETURN                                                        AP 600
   70 CBPREV=CBJ                                                    AP 610
      IER=3                                                         AP 620
      RETURN                                                        AP 630
C                                                                   AP 640
   80 FORMAT (1X,4HCBE1)                                            AP 650
      END                                                           AP 660-
```

```
*DECK CBESL2                                                                    AQ  10
C     ***************************************************************           AQ  20
C        C B E S L 2                                                  *          AQ  30
C     ***************************************************************           AQ  40
C                                                                               AQ  50
      SUBROUTINE CBESL2 (X,N,BY,IER)                                            AQ  60
C        COMPLEX CSQRT,CSIN,CCOS,CLOG                                           AQ  70
           COMPLEX T, P0, Q0, P1, Q1, A, B, Y0, Y1, XX, X2, TERM,               AQ  80
     1  TS, YA, YB, YC                                                         AQ  90
      COMPLEX X, BY                                                             AQ 100
         COMMON/BUG/ IDBUG                                                      AQ 110*
      IF (IDBUG.EQ.1) WRITE (6,200)                                             AQ 120
      IF (N) 180,10,10                                                          AQ 130
   10 IER=0                                                                     AQ 140
      IF (CABS(X)) 190,190,20                                                   AQ 150
   20 PI=3.141592653                                                            AQ 160
      IF (CABS(X)-4.) 40,40,30                                                  AQ 170
   30 T=4./X                                                                    AQ 180*
      IF (IDBUG.EQ.1) WRITE (6,200)                                             AQ 190
      P0=.3989422793                                                            AQ 200
      Q0=-.0124669441                                                           AQ 210
      P1=.3989422819                                                            AQ 220
      Q1=.0374008364                                                            AQ 230
      A=T*T                                                                     AQ 240
      B=A                                                                       AQ 250
      P0=P0-.0017530620*A                                                       AQ 260
      Q0=Q0+.0004564324*A                                                       AQ 270
      P1=P1+.0029218256*A                                                       AQ 280
      Q1=Q1-.00063904*A                                                         AQ 290
      A=A*A                                                                     AQ 300
      P0=P0+.00017343*A                                                         AQ 310
      Q0=Q0-.0000869791*A                                                       AQ 320
      P1=P1-.000223203*A                                                        AQ 330
      Q1=Q1+.0001064741*A                                                       AQ 340
      A=A*B                                                                     AQ 350
      P0=P0-.0000487613*A                                                       AQ 360
      Q0=Q0+.0000342468*A                                                       AQ 370
      P1=P1+.0000580759*A                                                       AQ 380
      Q1=Q1-.0000398708*A                                                       AQ 390
      A=A*B                                                                     AQ 400
      P0=P0+.0000173565*A                                                       AQ 410
      Q0=Q0-.0000142078*A                                                       AQ 420
      P1=P1-.000020092*A                                                        AQ 430
      Q1=Q1+.00001622*A                                                         AQ 440
      A=A*B                                                                     AQ 450
      P0=P0-.0000037043*A                                                       AQ 460
      Q0=Q0+.0000032312*A                                                       AQ 470
      P1=P1+.0000042414*A                                                       AQ 480
      Q1=Q1-.0000036594*A                                                       AQ 490
      A=SQRT(2.*PI)                                                             AQ 500
      B=4.*A                                                                    AQ 510
      P0=A*P0                                                                   AQ 520
      Q0=B*Q0/X                                                                 AQ 530
      P1=A*P1                                                                   AQ 540
      Q1=B*Q1/X                                                                 AQ 550
      A=X-PI/4.                                                                 AQ 560
      B=CSQRT(2./(PI*X))                                                        AQ 570
      Y0=B*(P0*CSIN(A)+Q0*CCOS(A))                                              AQ 580
      Y1=B*(-P1*CCOS(A)+Q1*CSIN(A))
```

```
      IF (IDBUG.EQ.1) WRITE (6,200)                                    AQ 590*
      GO TO 90                                                         AQ 600
   40 XX=X/2.                                                          AQ 610
      X2=XX*XX                                                         AQ 620
      T=CLOG(XX)+.5772156649                                           AQ 630
      SUM=0.                                                           AQ 640
      TERM=T                                                           AQ 650
      Y0=T                                                             AQ 660
      DO 70 L=1,15                                                     AQ 670
      IF (L-1) 50,60,50                                                AQ 680
   50 SUM=SUM+1./FLOAT(L-1)                                            AQ 690
   60 FL=L                                                             AQ 700
      TS=T-SUM                                                         AQ 710
      TERM=(TERM*(-X2)/FL**2)*(1.-1./(FL*TS))                          AQ 720
   70 Y0=Y0+TERM                                                       AQ 730
      TERM=XX*(T-.5)                                                   AQ 740
      SUM=0.                                                           AQ 750
      Y1=TERM                                                          AQ 760
      DO 80 L=2,16                                                     AQ 770
      SUM=SUM+1./FLOAT(L-1)                                            AQ 780
      FL=L                                                             AQ 790
      FL1=FL-1.                                                        AQ 800
      TS=T-SUM                                                         AQ 810
      TERM=(TERM*(-X2)/(FL1*FL))*((TS-.5/FL)/(TS+.5/FL1))              AQ 820
   80 Y1=Y1+TERM                                                       AQ 830
      PI2=2./PI                                                        AQ 840
      Y0=PI2*Y0                                                        AQ 850
      Y1=-PI2/X+PI2*Y1                                                 AQ 860
   90 IF (N-1) 100,100,130                                             AQ 870
  100 IF (N) 110,120,110                                               AQ 880
  110 BY=Y1                                                            AQ 890
      GO TO 170                                                        AQ 900
  120 BY=Y0                                                            AQ 910
      GO TO 170                                                        AQ 920
  130 YA=Y0                                                            AQ 930
      YB=Y1                                                            AQ 940
      K=1                                                              AQ 950
  140 T=FLOAT(2*K)/X                                                   AQ 960
      YC=T*YB-YA                                                       AQ 970
      K=K+1                                                            AQ 980
      IF (K-N) 150,160,150                                             AQ 990
  150 YA=YB                                                            AQ1000
      YB=YC                                                            AQ1010
      GO TO 140                                                        AQ1020
  160 BY=YC                                                            AQ1030
  170 RETURN                                                           AQ1040
  180 IER=1                                                            AQ1050
      RETURN                                                           AQ1060
  190 IER=2                                                            AQ1070
      RETURN                                                           AQ1080
C                                                                      AQ1090
  200 FORMAT (1X,4HCBE2)                                               AQ1100
      END                                                              AQ1110-
```

AD-A064 685 LOCKHEED-GEORGIA CO MARIETTA F/G 20/1
THE GENERATION, RADIATION AND PREDICTION OF SUPERSONIC JET NOIS--ETC(U)
OCT 78 B J TESTER, P J MORRIS, H K TANNA F33615-76-C-2021
UNCLASSIFIED LG78ER0262-VOL-2 AFAPL-TR-78-85-VOL-2 NL

2 OF 2
AD A064 685

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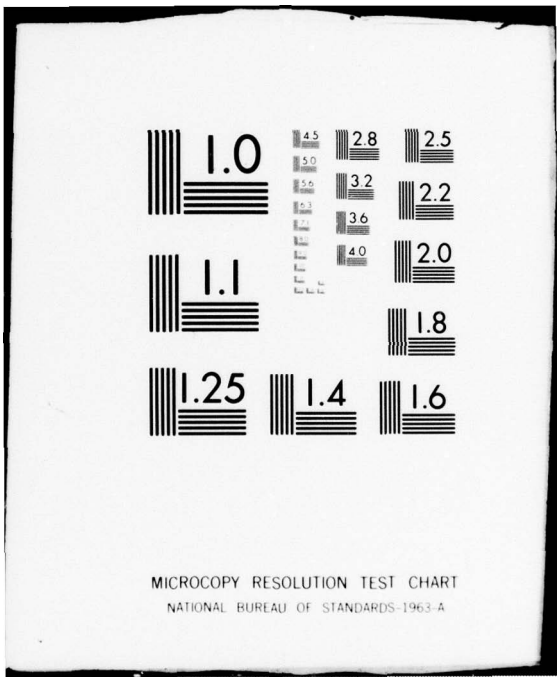
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1.1
1.25
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1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
*DECK IDERY
      SUBROUTINE IDERY (DERY,TEMP,NDIM,PRMT,ICC)                        AR  10
         DIMENSION DERY(1),PRMT(1)                                      AR  20
      DO 10 I=1,NDIM                                                    AR  30
      DERY(I)=TEMP                                                      AR  40
   10 CONTINUE                                                          AR  50
      ICC=3                                                             AR  60
      IF (IFIX(PRMT(7)).EQ.0) ICC=1                                     AR  70
      RETURN                                                            AR  80
      END                                                               AR  90-
```

```
*DECK HPCL
      SUBROUTINE HPCL (PRMT,Y,DERY,NDIM,IHLF,AFCT,FCT,OUTP,AUX,A,X)          A  10
      DIMENSION PRMT(1),Y(1),DERY(1),AUX(16,1),A(1),BT(6)                   A  20
      GO TO 40                                                              A  30
C                                                                           A  40
C     THIS PART OF SUBROUTINE HPCL COMPUTES THE RIGHT HAND SIDE DERY OF     A  50
C     THE GIVEN SYSTEM OF LINEAR DIFFERENTIAL EQUATIONS.                    A  60
   10 CALL AFCT (X,A,Y)                                                     A  70$
      CALL FCT (X,DERY)                                                     A  80$
      DO 30 M=1,NDIM                                                        A  90
      LL=M-NDIM                                                             A 100
      HS=0.                                                                 A 110
      DO 20 L=1,NDIM                                                        A 120
      LL=LL+NDIM                                                            A 130
   20 HS=HS+A(LL)*Y(L)                                                      A 140
   30 DERY(M)=HS+DERY(M)                                                    A 150
      GO TO (90,420,440,460,190,260,290,560,600,750,770,320), ISW2          A 160
C                                                                           A 170
C     POSSIBLE BREAK-POINT FOR LINKAGE                                      A 180
C                                                                           A 190
   40 N=1                                                                   A 200
      IJ=1                                                                  A 210
      IHLF=0                                                                A 220
      X=PRMT(1)                                                             A 230
      H=PRMT(3)                                                             A 240
      PRMT(5)=0.                                                            A 250
      DO 50 I=1,NDIM                                                        A 260
      AUX(16,I)=0.                                                          A 270
      AUX(15,I)=DERY(I)                                                     A 280
   50 AUX(1,I)=Y(I)                                                         A 290
      IF (H*(PRMT(2)-X)) 70,60,80                                           A 300
C                                                                           A 310
C     ERROR RETURNS                                                         A 320
   60 IHLF=12                                                               A 330
      GO TO 80                                                              A 340
   70 IHLF=13                                                               A 350
C                                                                           A 360
C     COMPUTATION OF DERY FOR STARTING VALUES                               A 370
   80 ISW2=1                                                                A 380
      GO TO 10                                                              A 390
C                                                                           A 400
C     RECORDING OF STARTING VALUES                                          A 410
   90 CALL OUTP (X,Y,DERY,IHLF,NDIM,PRMT)                                   A 420$
      IF (PRMT(5)) 110,100,110                                              A 430
  100 IF (IHLF) 120,120,110                                                 A 440
  110 RETURN                                                                A 450
  120 DO 130 I=1,NDIM                                                       A 460
  130 AUX(8,I)=DERY(I)                                                      A 470
C                                                                           A 480
C     COMPUTATION OF AUX(2,I)                                               A 490
      ISW1=1                                                                A 500
      GO TO 400                                                             A 510
C                                                                           A 520
  140 X=X+H                                                                 A 530
      DO 150 I=1,NDIM                                                       A 540
  150 AUX(2,I)=Y(I)                                                         A 550
C                                                                           A 560
C     INCREMENT H IS TESTED BY MEANS OF BISECTION                           A 570
  160 IHLF=IHLF+1                                                           A 580
```

```
      X=X-H                                                          A 590
      DO 170 I=1,NDIM                                                A 600
  170 AUX(4,I)=AUX(2,I)                                              A 610
      H=.5*H                                                         A 620
      N=1                                                            A 630
      ISW1=2                                                         A 640
      GO TO 400                                                      A 650
C                                                                    A 660
  180 X=X+H                                                          A 670
      ISW2=5                                                         A 680
      GO TO 10                                                       A 690
  190 N=2                                                            A 700
      DO 200 I=1,NDIM                                                A 710
      AUX(2,I)=Y(I)                                                  A 720
  200 AUX(9,I)=DERY(I)                                               A 730
      ISW1=3                                                         A 740
      GO TO 400                                                      A 750
C                                                                    A 760
C     COMPUTATION OF TEST VALUE DELT                                 A 770
  210 DELT=0.                                                        A 780
      DO 220 I=1,NDIM                                                A 790
C     118 DELT=DELT+AUX(15,I)*ABS(Y(I)-AUX(4,I))                     A 800
      IF (Y(I).EQ.0.0) GO TO 220                                     A 810
      DELT=DELT+AUX(15,I)*ABS((Y(I)-AUX(4,I))/Y(I))                  A 820
  220 CONTINUE                                                       A 830
      DELT=.06666667*DELT                                            A 840
      IF (ABS(DELT)-PRMT(4)) 250,250,230                             A 850
  230 IF (IHLF-10) 160,240,240                                       A 860
C                                                                    A 870
C     NO SATISFACTORY ACCURACY AFTER 10 BISECTIONS. ERROR MESSAGE.   A 880
  240 IHLF=11                                                        A 890
      X=X+H                                                          A 900
      GO TO 80                                                       A 910
C                                                                    A 920
C     SATISFACTORY ACCURACY AFTER LESS THAN 11 BISECTIONS            A 930
  250 X=X+H                                                          A 940
      ISW2=6                                                         A 950
      GO TO 10                                                       A 960
  260 DO 270 I=1,NDIM                                                A 970
      AUX(3,I)=Y(I)                                                  A 980
  270 AUX(10,I)=DERY(I)                                              A 990
      N=3                                                            A1000
      ISW1=4                                                         A1010
      GO TO 400                                                      A1020
C                                                                    A1030
  280 N=1                                                            A1040
      X=X+H                                                          A1050
      ISW2=7                                                         A1060
      GO TO 10                                                       A1070
  290 X=PRMT(1)                                                      A1080
      DO 300 I=1,NDIM                                                A1090
      AUX(11,I)=DERY(I)                                              A1100
  300 Y(I)=AUX(1,I)+H*(.375*AUX(8,I)+.7916667*AUX(9,I)-.2083333*AUX(10,I  A1110
     1)+.04166667*DERY(I))                                           A1120
  310 X=X+H                                                          A1130
      N=N+1                                                          A1140
      ISW2=12                                                        A1150
      GO TO 10                                                       A1160
  320 CALL OUTP (X,Y,DERY,IHLF,NDIM,PRMT)                            A1170$
```

```
      IF (PRMT(5)) 110,330,110                                          A1180
  330 IF (N-4) 340,480,480                                              A1190
  340 DO 350 I=1,NDIM                                                   A1200
      AUX(N,I)=Y(I)                                                     A1210
  350 AUX(N+7,I)=DERY(I)                                                A1220
      IF (N-3) 360,380,480                                              A1230
C                                                                       A1240
  360 DO 370 I=1,NDIM                                                   A1250
      DELT=AUX(9,I)+AUX(9,I)                                            A1260
      DELT=DELT+DELT                                                    A1270
  370 Y(I)=AUX(1,I)+.3333333*H*(AUX(8,I)+DELT+AUX(10,I))                A1280
      GO TO 310                                                         A1290
C                                                                       A1300
  380 DO 390 I=1,NDIM                                                   A1310
      DELT=AUX(9,I)+AUX(10,I)                                           A1320
      DELT=DELT+DELT+DELT                                               A1330
  390 Y(I)=AUX(1,I)+.375*H*(AUX(8,I)+DELT+AUX(11,I))                    A1340
      GO TO 310                                                         A1350
C                                                                       A1360
C     THE FOLLOWING PART OF SUBROUTINE HPCL COMPUTES BY MEANS OF        A1370
C     RUNGE-KUTTA METHOD STARTING VALUES FOR THE NOT SELF-STARTING      A1380
C     PREDICTOR-CORRECTOR METHOD.                                       A1390
  400 Z=X                                                               A1400
      DO 410 I=1,NDIM                                                   A1410
      XX=H*AUX(N+7,I)                                                   A1420
      AUX(5,I)=XX                                                       A1430
  410 Y(I)=AUX(N,I)+.4*XX                                               A1440
C     XX IS AN AUXILIARY STORAGE LOCATION                               A1450
C                                                                       A1460
      X=Z+.4*H                                                          A1470
      ISW2=2                                                            A1480
      GO TO 10                                                          A1490
  420 DO 430 I=1,NDIM                                                   A1500
      XX=H*DERY(I)                                                      A1510
      AUX(6,I)=XX                                                       A1520
  430 Y(I)=AUX(N,I)+.2969776*AUX(5,I)+.1587596*XX                       A1530
C                                                                       A1540
      X=Z+.4557372*H                                                    A1550
      ISW2=3                                                            A1560
      GO TO 10                                                          A1570
  440 DO 450 I=1,NDIM                                                   A1580
      XX=H*DERY(I)                                                      A1590
      AUX(7,I)=XX                                                       A1600
  450 Y(I)=AUX(N,I)+.2181004*AUX(5,I)-3.050965*AUX(6,I)+3.832865*XX     A1610
C                                                                       A1620
      X=Z+H                                                             A1630
      ISW2=4                                                            A1640
      GO TO 10                                                          A1650
  460 DO 470 I=1,NDIM                                                   A1660
  470 Y(I)=AUX(N,I)+.1747603*AUX(5,I)-.5514807*AUX(6,I)+1.205536*AUX(7,I A1670
     1)+.1711848*H*DERY(I)                                              A1680
      X=Z                                                               A1690
      GO TO (140,180,210,280), ISW1                                     A1700
C                                                                       A1710
C     POSSIBLE BREAK-POINT FOR LINKAGE                                  A1720
C                                                                       A1730
C     STARTING VALUES ARE COMPUTED.                                     A1740
C     NOW START HAMMINGS MODIFIED PREDICTOR-CORRECTOR METHOD.           A1750
  480 ISTEP=3                                                           A1760
```

```
  490 IF (N-8) 520,500,520                                                  A1770
C                                                                           A1780
C     N=8 CAUSES THE ROWS OF AUX TO CHANGE THEIR STORAGE LOCATIONS          A1790
  500 DO 510 N=2,7                                                          A1800
      DO 510 I=1,NDIM                                                       A1810
      AUX(N-1,I)=AUX(N,I)                                                   A1820
  510 AUX(N+6,I)=AUX(N+7,I)                                                 A1830
      N=7                                                                   A1840
C                                                                           A1850
C     N LESS THAN 8 CAUSES N+1 TO GET N                                     A1860
  520 N=N+1                                                                 A1870
C                                                                           A1880
C     COMPUTATION OF NEXT VECTOR Y                                          A1890
      DO 530 I=1,NDIM                                                       A1900
      AUX(N-1,I)=Y(I)                                                       A1910
  530 AUX(N+6,I)=DERY(I)                                                    A1920
      X=X+H                                                                 A1930
  540 ISTEP=ISTEP+1                                                         A1940
      DO 550 I=1,NDIM                                                       A1950
      DELT=AUX(N-4,I)+1.333333*H*(AUX(N+6,I)+AUX(N+6,I)-AUX(N+5,I)+AUX(N    A1960
     1+4,I)+AUX(N+4,I))                                                     A1970
      Y(I)=DELT-.9256198*AUX(16,I)                                          A1980
  550 AUX(16,I)=DELT                                                        A1990
C     PREDICTOR IS NOW GENERATED IN ROW 16 OF AUX, MODIFIED PREDICTOR       A2000
C     IS GENERATED IN Y. DELT MEANS AN AUXILIARY STORAGE.                   A2010
      ISW2=8                                                                A2020
      GO TO 10                                                              A2030
C     DERIVATIVE OF MODIFIED PREDICTOR IS GENERATED IN DERY                 A2040
C                                                                           A2050
  560 DO 570 I=1,NDIM                                                       A2060
      DELT=.125*(9.*AUX(N-1,I)-AUX(N-3,I)+3.*H*(DERY(I)+AUX(N+6,I)+AUX(N    A2070
     1+6,I)-AUX(N+5,I)))                                                    A2080
      AUX(16,I)=AUX(16,I)-DELT                                              A2090
  570 Y(I)=DELT+.07438017*AUX(16,I)                                         A2100
C                                                                           A2110
C     TEST WHETHER H MUST BE HALVED OR DOUBLED                              A2120
      DELT=0.                                                               A2130
      DO 580 I=1,NDIM                                                       A2140
      IF (Y(I).EQ.0.0) GO TO 580                                            A2150
C     310 DELT=DELT+AUX(15,I)*ABS(AUX(16,I))                                A2160
      DELT=DELT+AUX(15,I)*ABS(AUX(16,I)/Y(I))                               A2170
  580 CONTINUE                                                              A2180
      IF (ABS(DELT)-PRMT(4)) 590,720,720                                    A2190
C                                                                           A2200
C     H MUST NOT BE HALVED. THAT MEANS Y(I) ARE GOOD.                       A2210
  590 ISW2=9                                                                A2220
      GO TO 10                                                              A2230
  600 CALL OUTP (X,Y,DERY,IHLF,NDIM,PRMT)                                   A2240$
      IF (PRMT(5)) 620,610,620                                              A2250
  610 IF (IHLF-11) 630,620,620                                              A2260
  620 RETURN                                                                A2270
  630 IF (H*(X-PRMT(2))) 640,620,620                                        A2280
  640 IF (ABS(X-PRMT(2))-.1*ABS(H)) 620,650,650                             A2290
  650 IF (ABS(DELT)-.02*PRMT(4)) 660,660,490                                A2300
C                                                                           A2310
C                                                                           A2320
C     H COULD BE DOUBLED IF ALL NECESSARY PRECEEDING VALUES ARE             A2330
C     AVAILABLE                                                             A2340
  660 IF (IHLF) 490,490,670                                                 A2350
```

```
  670 IF (N-7) 490,680,680                                                    A2360
  680 IF (ISTEP-4) 490,690,690                                                A2370
  690 IMOD=ISTEP/2                                                            A2380
      IF (ISTEP-IMOD-IMOD) 490,700,490                                        A2390
  700 H=H+H                                                                   A2400
      IHLF=IHLF-1                                                             A2410
      ISTEP=0                                                                 A2420
      DO 710 I=1,NDIM                                                         A2430
      AUX(N-1,I)=AUX(N-2,I)                                                   A2440
      AUX(N-2,I)=AUX(N-4,I)                                                   A2450
      AUX(N-3,I)=AUX(N-6,I)                                                   A2460
      AUX(N+6,I)=AUX(N+5,I)                                                   A2470
      AUX(N+5,I)=AUX(N+3,I)                                                   A2480
      AUX(N+4,I)=AUX(N+1,I)                                                   A2490
      DELT=AUX(N+6,I)+AUX(N+5,I)                                              A2500
      DELT=DELT+DELT+DELT                                                     A2510
  710 AUX(16,I)=8.962963*(Y(I)-AUX(N-3,I))-3.361111*H*(DERY(I)+DELT+AUX(      A2520
     1N+4,I))                                                                 A2530
      GO TO 490                                                               A2540
C                                                                             A2550
C                                                                             A2560
C     H MUST BE HALVED                                                        A2570
  720 IHLF=IHLF+1                                                             A2580
      IF (IHLF-10) 730,730,590                                                A2590
  730 H=.5*H                                                                  A2600
      ISTEP=0                                                                 A2610
      DO 740 I=1,NDIM                                                         A2620
      Y(I)=.00390625*(80.*AUX(N-1,I)+135.*AUX(N-2,I)+40.*AUX(N-3,I)+AUX(      A2630
     1N-4,I))-.1171875*(AUX(N+6,I)-6.*AUX(N+5,I)-AUX(N+4,I))*H                A2640
      AUX(N-4,I)=.00390625*(12.*AUX(N-1,I)+135.*AUX(N-2,I)+108.*AUX(N-3,      A2650
     1I)+AUX(N-4,I))-.0234375*(AUX(N+6,I)+18.*AUX(N+5,I)-9.*AUX(N+4,I))*      A2660
     2H                                                                       A2670
      AUX(N-3,I)=AUX(N-2,I)                                                   A2680
  740 AUX(N+4,I)=AUX(N+5,I)                                                   A2690
      DEL=X-H                                                                 A2700
      X=DEL-(H+H)                                                             A2710
      ISW2=10                                                                 A2720
      GO TO 10                                                                A2730
  750 DO 760 I=1,NDIM                                                         A2740
      AUX(N-2,I)=Y(I)                                                         A2750
      AUX(N+5,I)=DERY(I)                                                      A2760
  760 Y(I)=AUX(N-4,I)                                                         A2770
      X=X-(H+H)                                                               A2780
      ISW2=11                                                                 A2790
      GO TO 10                                                                A2800
  770 X=DEL                                                                   A2810
      DO 780 I=1,NDIM                                                         A2820
      DELT=AUX(N+5,I)+AUX(N+4,I)                                              A2830
      DELT=DELT+DELT+DELT                                                     A2840
      AUX(16,I)=8.962963*(AUX(N-1,I)-Y(I))-3.361111*H*(AUX(N+6,I)+DELT+D      A2850
     1ERY(I))                                                                 A2860
  780 AUX(N+3,I)=DERY(I)                                                      A2870
      GO TO 540                                                               A2880
      END                                                                     A2890-
```

```
*DECK AFCT
      SUBROUTINE AFCT (X,A,Y)                                          B  10
      DIMENSION A(1),Y(1)                                              B  20
         COMPLEX ACF,BCF,CCF,DCF                                       B  30
      DO 10 I=1,16                                                     B  40
   10 A(I)=0.0                                                         B  50
      CALL COEF (X,ACF,BCF,CCF,DCF)                                    B  60$
      A(3)=REAL(ACF)                                                   B  70
      A(3)=-A(3)                                                       B  80
      A(8)=A(3)                                                        B  90
      A(9)=REAL(BCF)                                                   B 100
      A(14)=A(9)                                                       B 110
      A(10)=AIMAG(BCF)                                                 B 120
      A(13)=-A(10)                                                     B 130
      A(7)=AIMAG(ACF)                                                  B 140
      A(4)=-A(7)                                                       B 150
      RETURN                                                           B 160
      END                                                              B 170-
```

```
*DECK FCT
      SUBROUTINE FCT (X,F)                                          C  10
      DIMENSION F(1)                                                C  20
      F(1)=0.                                                       C  30
      F(2)=0.                                                       C  40
      F(3)=0.                                                       C  50
      F(4)=0.                                                       C  60
      RETURN                                                        C  70
      END                                                           C  80-
```

```
*DECK OUTP
      SUBROUTINE OUTP (X,Y,DERY,IHLF,NDIM,PRMT)                          D  10
        DIMENSION Y(1),DERY(1),PRMT(1)                                   D  20
        COMMON YPU(450,5)                                                D  30
        COMPLEX ZDUM,SAVF,SAVFM                                          D  40
       COMPLEX SAV                                                       D  50
        COMMON/CRIT/ ICC,RC,XMC(16),XTC(16),YCR                          D  60
        COMMON/SF/ SAVF                                                  D  70
        COMMON/STYPE/ MTYPS                                              D  80
        COMMON/CI/ IR,IW,NOUT,ICHECK                                     D  90
        COMMON/BJ/ M,KW,CANG,PI,BV,CV,TJR,G                              D 100
        COMMON/JB/ M1,M1D,M1DD,TR,TRD,TRDD                               D 110
        COMMON/BN/ NGEO,NCJ,NUT                                          D 120
       COMMON /SRDCSD/ SAV(450)                                          D 130
        REAL M,KW,M1,M1D,M1DD                                            D 140
      XDUM=X                                                             D 150
      IF (ICC.GT.3) XDUM=YCR+RC*COS(X)                                   D 160
      IF (XDUM.LT.PRMT(6).OR.XDUM.GT.PRMT(8)) GO TO 20                   D 170
      NOUT=NOUT+1                                                        D 180
      IF (NOUT.GT.450) WRITE (IW,50) X                                   D 190*
      IF (NOUT.GT.450) RETURN                                            D 200
      IF (ICC.GT.3) GO TO 30                                             D 210
      YPU(NOUT,1)=X                                                      D 220
      DO 10 I=1,NDIM                                                     D 230
   10 YPU(NOUT,I+1)=Y(I)*(1.0-M1*CANG)**(MTYPS-3)                        D 240
      SAV(NOUT)=SAVF                                                     D 250
   20 CONTINUE                                                           D 260
      IF (IFIX(PRMT(7)).EQ.0) RETURN                                     D 270
      IF (NOUT.GT.450) WRITE (6,40) X                                    D 280*
      WRITE (IW,50) X,Y(1),Y(3),M1,M1D,TR,TRD,IHLF                       D 290*
      RETURN                                                             D 300
   30 CONTINUE                                                           D 310
      SAVFM=SAVF**(3-MTYPS)                                              D 320
      YPU(NOUT,1)=XDUM                                                   D 330
      ZDUM=CMPLX(Y(1),Y(2))/SAVFM                                        D 340
      YPU(NOUT,2)=REAL(ZDUM)                                             D 350
      YPU(NOUT,3)=AIMAG(ZDUM)                                            D 360
      ZDUM=CMPLX(Y(3),Y(4))/SAVFM                                        D 370
      YPU(NOUT,4)=REAL(ZDUM)                                             D 380
      YPU(NOUT,5)=AIMAG(ZDUM)                                            D 390
      SAV(NOUT)=SAVF                                                     D 400
      GO TO 20                                                           D 410
C                                                                        D 420
   40 FORMAT (1X,"STORAGE OVERFLOW - TRY LARGER STEP SIZE, X = ",E13.6)   D 430
   50 FORMAT (1X,7E11.4,I1)                                              D 440
      END                                                                D 450-
```

```
*DECK COEF
      SUBROUTINE COEF (X,ACF,BCF,CCF,DCF)                                E  10
C        CHECK FOR 2-D CASE                                              E  20
         REAL M,KW,M1,M1D,M1DD                                           E  30
         COMMON/CI/ IR,IW,NOUT,ICHECK                                    E  40
         COMMON/BJ/ M,KW,CANG,PI,BV,CV,TJR,G                             E  50
         COMMON/JB/ M1,M1D,M1DD,TR,TRD,TRDD                              E  60
         COMMON/CRIT/ICC,RC,XMC(16),XTC(16),YCR                          E  70
         COMMON/BN/ NGEO,NCJ,NUT                                         E  80
         COMMON/SF/ SAVF                                                 E  90
         COMPLEX SAVF                                                    E 100
         COMPLEX CMPLX,CEXP                                              E 110
         COMPLEX ACF,BCF,CCF,DCF,ZERO,FAC,J,WUN,MPHI,CXJJ                E 120
         COMPLEX MPHIX                                                   E 130
         COMPLEX TPHI,TPHIX,CSIG                                         E 140
         DIMENSION YMC(3)                                                E 150
         DIMENSION YTC(3)                                                E 160
      ZERO=(0.0,0.0)                                                     E 170
      J=(0.0,1.0)                                                        E 180
      WUN=(1.0,0.0)                                                      E 190
      IF (ICC.GT.3) GO TO 20                                             E 200
      CALL VELT (X,M,TJR,BV,CV,G,YMC,YTC,ICC)                            E 210$
      M1=YMC(1)                                                          E 220
      TR=YTC(1)                                                          E 230
      IF (ICC.EQ.1) GO TO 10                                             E 240
      IF (X.LT.0.) YMC(2)=-YMC(2)                                        E 250
      IF (X.LT.0.) YTC(2)=-YTC(2)                                        E 260
      M1D=YMC(2)                                                         E 270
      TRD=YTC(2)                                                         E 280
      M1DD=YMC(3)                                                        E 290
      TRDD=YTC(3)                                                        E 300
   10 CONTINUE                                                           E 310
      V=1.0-M1*CANG                                                      E 320
      SAVF=CMPLX(V,0.0)                                                  E 330
      P=V*V/TR                                                           E 340
      ACF=CMPLX(KW*KW*(P-CANG*CANG)/P,0.0)                               E 350
      IF (NGEO.GT.0) ACF=X*ACF-NCJ*NCJ/(X*P)                             E 360
      BCF=CMPLX(P,0.0)                                                   E 370
      IF (NGEO.GT.0) BCF=BCF/X                                           E 380
      CCF=ZERO                                                           E 390
      DCF=ZERO                                                           E 400
      RETURN                                                             E 410
   20 CONTINUE                                                           E 420
      MPHI=ZERO                                                          E 430
      TPHI=ZERO                                                          E 440
      MPHIX=ZERO                                                         E 450
      TPHIX=ZERO                                                         E 460
      CSIG=RC*CEXP(J*X)                                                  E 470
      CXJJ=WUN                                                           E 480
      FAC=WUN                                                            E 490
      DO 40 JJ=1,ICC                                                     E 500
      MPHI=MPHI+XMC(JJ)*FAC/CXJJ                                         E 510
      TPHI=TPHI+XTC(JJ)*FAC/CXJJ                                         E 520
      IF (CABS((MPHI-MPHIX)/MPHI).GT..0001) GO TO 30                     E 530
      IF (CABS((TPHI-TPHIX)/TPHI).LT..0001) GO TO 50                     E 540
   30 CONTINUE                                                           E 550
      MPHIX=MPHI                                                         E 560
      TPHIX=TPHI                                                         E 570
      FAC=FAC*CSIG                                                       E 580
```

```
      XJJ=JJ                                                                    E 590
      CXJJ=CMPLX(XJJ,0.0)*CXJJ                                                  E 600
   40 CONTINUE                                                                  E 610
      STOP 7                                                                    E 620
   50 CONTINUE                                                                  E 630
      FAC=WUN-MPHI*CANG                                                         E 640
      SAVF=FAC                                                                  E 650
      FAC=FAC*FAC/TPHI                                                          E 660
      ACF=J*CSIG*KW*KW*(WUN-CANG*CANG/FAC)                                      E 670
      IF (NGEO.EQ.1) ACF=(YCR*CSIG)*ACF-NCJ*NCJ/(FAC*(YCR*CSIG))*J*CSIG         E 680
      BCF=J*CSIG*FAC                                                            E 690
      IF (NGEO.EQ.1) BCF=BCF/(YCR*CSIG)                                         E 700
      CCF=ZERO                                                                  E 710
      DCF=ZERO                                                                  E 720
      IF (JJ.EQ.ICC) ICHECK=1                                                   E 730
C       WRITE(IW,400) MPHI,TPHI,ACF,JJ,ICC                                     E 740
C     400    FORMAT(1X,6E13.6/1X,2I5)                                           E 750
      M1=REAL(MPHI)                                                             E 760
      TR=REAL(TPHI)                                                             E 770
      M1D=XMC(2)                                                                E 780
      TRD=XTC(2)                                                                E 790
      M1DD=XMC(3)                                                               E 800
      TRDD=XTC(3)                                                               E 810
      RETURN                                                                    E 820
      END                                                                       E 830-
```

```
*DECK TRANS
      SUBROUTINE TRANS (ST2,Y,NDIM)                                    F  10
         DIMENSION ST2(1),Y(1)                                         F  20
      DO 10 I=1,NDIM                                                   F  30
      Y(I)=ST2(I)                                                      F  40
   10 CONTINUE                                                         F  50
      RETURN                                                           F  60
      END                                                              F  70-
```

```
*DECK WRCAL
      SUBROUTINE WRCAL (NGEO,Y,RADM,RPRES,FWRONS)                          G  10
         COMPLEX CMPLX                                                     G  20
         COMPLEX RADM,RPRES,FWRONS ,WRONSK                                 G  30
         DIMENSION Y(1)                                                    G  40
      PI=3.141593                                                          G  50
      WRONSK=(1.,0.)                                                       G  60
      IF (NGEO.EQ.1) WRONSK=CMPLX(0.,-2./PI)                               G  70
      FWRONS=(CMPLX(Y(1),Y(2))*RADM-CMPLX(Y(3),Y(4)))*RPRES                G  80
      FWRONS=WRONSK/FWRONS                                                 G  90
      RETURN                                                               G 100
      END                                                                  G 110-
```

```
*DECK TCON
      SUBROUTINE TCON (MS,NCJX,NCJNX,TIJ,TX,ECON,NCON,MXOS)                  H  10
         DIMENSION TIJ(7,1),TX(1)                                            H  20
      IF (NCJX.EQ.NCJNX) GO TO 20                                            H  30
      IF (NCJX.LT.3) GO TO 20                                                H  40
      ICT=0                                                                  H  50
      DO 10 I=1,7                                                            H  60
      IF (TIJ(I,MS).EQ.0.) GO TO 10                                          H  70
      IF (TX(I)/TIJ(I,MS).LT.ECON) NCON=NCON+1                               H  80
      IF (TX(I)/TIJ(I,MS).LT.ECON/100.) ICT=ICT+1                            H  90
   10 CONTINUE                                                               H 100
      IF (ICT.EQ.7) MXOS=MXOS+1                                              H 110
   20 DO 30 I=1,7                                                            H 120
      TIJ(I,MS)=TIJ(I,MS)+TX(I)                                              H 130
   30 CONTINUE                                                               H 140
      RETURN                                                                 H 150
      END                                                                    H 160-
```

```
*DECK TSIGN
      SUBROUTINE TSIGN (MS,TIJ)                                          I  10
         DIMENSION TIJ(6,1)                                              I  20
         COMMON/CI/ IR,IW,NOUT,ICHECK                                    I  30
      DO 20 I=1,6                                                        I  40
      IF (TIJ(I,MS).GT.0.) GO TO 10                                      I  50
      WRITE (IW,30) I,TIJ(I,MS)                                          I  60*
      TIJ(I,MS)=-TIJ(I,MS)                                               I  70
      IF (TIJ(I,MS).EQ.0.) TIJ(I,MS)=1.                                  I  80
   10 CONTINUE                                                           I  90
   20 CONTINUE                                                           I 100
      RETURN                                                             I 110
C                                                                        I 120
   30 FORMAT (1X,13H**SOURCE TYPE,I5,2HIS,E13.6)                         I 130
      END                                                                I 140-
```

```
*DECK RADCSD
      SUBROUTINE RADCSD (IFLAG,NCJ,WINV,D,ID,NOUTM,BV,CV)                    J  10
       DIMENSION D(1),ID(1),XM(2),XT(2),SLTB(5),A(5,7),TIJ(7,5)              J  20
       DIMENSION SSIM(5),SSID(5),SSIQ(5)                                     J  30
       COMPLEX C(450,7)                                                      J  40
       COMPLEX WINV,TRRN,RES                                                 J  50
       COMPLEX SAV                                                           J  60
         REAL M,KW                                                           J  70
         COMMON YPU(450,5)                                                   J  80
       COMMON /SRDCSD/ SAV(450)                                              J  90
         COMMON/PSD/ RC,BLTB,CVD                                             J 100
C                                                                            J 110
      RPI=1.772424                                                           J 120
      CVD=CV                                                                 J 130
      G=D(8)                                                                 J 140
      RSW=D(9)                                                               J 150
      RSC=D(10)                                                              J 160
      KW=D(11)                                                               J 170
      XKW2=KW*KW                                                             J 180
      M=D(12)                                                                J 190
      TJR=D(13)                                                              J 200
      CANG=D(14)                                                             J 210
      X1=D(16)                                                               J 220
      TCOR=D(18)                                                             J 230
      DCOR=D(19)                                                             J 240
C                                                                            J 250
      IW=ID(2)                                                               J 260
      NGEO=ID(3)                                                             J 270
      MTYPS=ID(4)                                                            J 280
      IWB=ID(8)                                                              J 290
      NCL=ID(25)                                                             J 300
      IO=ID(26)                                                              J 310
C        GO AND FORM SIQ,SID IF THIS IS FINAL CALL                           J 320
      IF (IFLAG.GT.0) GO TO 70                                               J 330
      DO 10 IT=1,NCL                                                         J 340
C        SLTB(IT)=D(IT+24)*X1                                                J 350
      SLTB(IT)=D(IT+25)                                                      J 360
   10 CONTINUE                                                               J 370
      AWINV=CABS(WINV)                                                       J 380
      RC=RSC*X1+1.0                                                          J 390
      R99=BV*SQRT(ALOG(1.0/0.99))                                            J 400
      IF (CV.EQ.0.0.AND.RC.LT.R99) RC=R99                                    J 410
      IF (RC.LE.2.0*D(4)) RC=2.0*D(4)                                        J 420
      BLTB=0.5*X1*RSW/0.832554611                                            J 430
      IF (BLTB.LE.0.0) RETURN                                                J 440
      RCB=RC/BLTB                                                            J 450
      REF=BLTB*BLTB/2.0*(EXP(-RCB*RCB)+RCB*RPI*(1.0+ERF(RCB)))               J 460
      ICC=1                                                                  J 470
      CALL VELT (RC,M,TJR,BV,CV,G,XM,XT,ICC)                                 J 480$
      XKAPS2=(1.0-XM(1)*CANG)*(1.0-XM(1)*CANG)/XT(1)-CANG*CANG               J 490
      XKAPS2=ABS(XKAPS2)                                                     J 500
      IF (NCJ.NE.0) GO TO 30                                                 J 510
      DO 20 IT=1,5                                                           J 520
      DO 20 JS=1,7                                                           J 530
   20 TIJ(JS,IT)=0.0                                                         J 540
   30 CONTINUE                                                               J 550
C        SET UP CNAB FOR ALL SOURCE TYPES                                    J 560
      ICC=2                                                                  J 570
      DO 40 I=1,NOUTM                                                        J 580
```

```
      R=YPU(I,1)                                                        J 590
      CALL VELT (R,M,TJR,BV,CV,G,XM,XT,ICC)                             J 600$
      PRS=1.0-XM(1)*CANG                                                J 610
      PRS=PRS*PRS/XT(1)                                                 J 620
      PQ=(CANG*CANG-PRS)*KW*KW                                          J 630
      PD=-XT(2)/XT(1)-2.0*XM(2)*CANG/(1.0-XM(1)*CANG)                   J 640
      C(I,1)=CMPLX(YPU(I,2),YPU(I,3))                                   J 650
      C(I,2)=CMPLX(YPU(I,4),YPU(I,5))                                   J 660
      C(I,2)=C(I,2)*PRS/R                                               J 670
      TRRN=(PQ+NCJ*NCJ/(R*R))*C(I,1)+(PD-NGEO/R)*C(I,2)                 J 680
      C(I,3)=TRRN-(MTYPS-3)*XM(2)*CANG/(1.0-XM(1)*CANG)*C(I,2)          J 690
      C(I,4)=NCJ*C(I,1)/R                                               J 700
      C(I,6)=(C(I,2)-NCJ*NCJ*C(I,1)/R)/R                                J 710
      C(I,7)=C(I,2)
      C(I,2)=C(I,2)-XM(2)*CANG*C(I,1)/SAV(I)                            J 720
      C(I,5)=NCJ*(C(I,2)-C(I,1)/R)/R                                    J 730
   40 CONTINUE                                                          J 740
      DO 60 IT=1,NCL                                                    J 750
      IF (SLTB(IT).LT.D(1).OR.BLTB.LT.D(1)) GO TO 60                    J 760
      DO 50 JS=1,7                                                      J 770
      CALL INTRAP (NCJ,YPU(1,1),C(1,JS),NOUTM,SLTB(IT),RES,IERS)        J 780$
      IF (CABS(RES).LE.0.0) RES=(1.E-99,0.0)                            J 790
      C(IT,JS)=RES                                                      J 800
      C(IT,JS)=C(IT,JS)*AWINV*AWINV                                     J 810
      ARG=KW*SLTB(IT)/2.0                                               J 820
      IF (SLTB(IT).LT.BLTB/10.0) ARG=0.0                                J 830
      C(IT,JS)=EXP(ARG*ARG*XKAPS2)*C(IT,JS)                             J 840
      C(IT,JS)=C(IT,JS)/(REF*SLTB(IT)*SLTB(IT)/2.0)                     J 850
      TIJ(JS,IT)=TIJ(JS,IT)+CABS(C(IT,JS))                             J 860
      IF (NCJ.NE.0) TIJ(JS,IT)=TIJ(JS,IT)+CABS(C(IT,JS))                J 870
   50 CONTINUE                                                          J 880
      SIM=10.0*ALOG10(CABS(C(IT,1)))                                    J 890
      IF (NCJ.EQ.0) SSIM(IT)=SIM                                        J 900
      SIM=SIM-SSIM(IT)                                                  J 910
      SID=CABS(C(IT,7))+CABS(C(IT,4))+XKW2*CANG*CANG*CABS(C(IT,1))      J 920
      SID=10.0*ALOG10(SID/XKW2)                                         J 930
      IF (NCJ.EQ.0) SSID(IT)=SID                                        J 940
      SID=SID-SSID(IT)                                                  J 950
      SIQ=CABS(C(IT,3))+CABS(C(IT,6))+2.0*CABS(C(IT,5))                 J 960
      SIQ=SIQ+XKW2*XKW2*CANG**4*CABS(C(IT,1))+2.0*CANG**2*XKW2*(CABS(C(I J 970
     1T,2))+CABS(C(IT,4)))                                              J 980
      SIQ=10.0*ALOG10(SIQ/(XKW2*XKW2))                                  J 990
      IF (NCJ.EQ.0) SSIQ(IT)=SIQ                                        J1000
      SIQ=SIQ-SSIQ(IT)                                                  J1010
      IF (IO.EQ.0) GO TO 60                                             J1020
      IF (IWB.NE.0) WRITE (IW,100) IERS,SLTB(IT),(TIJ(JS,IT),JS=1,7),SIM J1030*
     1,SID,SIQ,NCJ                                                      J1040
   60 CONTINUE                                                          J1050
      GO TO 90                                                          J1060
   70 CONTINUE                                                          J1070
      DO 80 IT=1,NCL                                                    J1080
      IF (SLTB(IT).LT.D(1).OR.BLTB.LT.D(1)) GO TO 80                    J1090
      A(IT,1)=10.0*ALOG10(TIJ(1,IT))                                    J1100
      A(IT,2)=10.0*ALOG10(TIJ(2,IT)/(0.5*XKW2))                         J1110
      A(IT,3)=10.0*ALOG10(TIJ(3,IT)/(0.375*XKW2*XKW2))                  J1120
      A(IT,4)=10.0*ALOG10(TIJ(4,IT)/(0.5*XKW2))                         J1130
      A(IT,5)=10.0*ALOG10(TIJ(5,IT)/(0.125*XKW2*XKW2))                  J1140
      A(IT,6)=10.0*ALOG10(TIJ(6,IT)/(0.375*XKW2*XKW2))                  J1150
      A(IT,7)=10.0*ALOG10(TIJ(7,IT)/(0.5*XKW2))
      SIQ=TIJ(3,IT)+TIJ(6,IT)+2.0*TIJ(5,IT)                             J1160
      SIQ=SIQ+XKW2*XKW2*(CANG**4)*TIJ(1,IT)+2.0*CANG*CANG*XKW2*(TIJ(2,IT J1170
```

```
     1)+TIJ(4,IT))                                                          J1180
      SIQ=10.0*ALOG10(SIQ/(XKW2*XKW2))                                      J1190
      SIQ=SIQ+TCOR                                                          J1200
      SID=TIJ(7,IT)+TIJ(4,IT)+XKW2*CANG*CANG*TIJ(1,IT)                      J1210
      SID=10.0*ALOG10(SID/XKW2)                                             J1220
      SID=SID+DCOR                                                          J1230
      IF (IO.EQ.0) GO TO 80                                                 J1240
      IF (IWB.NE.0) WRITE (IW,110) SLTB(IT),(A(IT,JS),JS=1,7),SIQ,SID       J1250*
   80 CONTINUE                                                              J1260
      D(36)=A(IT,1)                                                         J1270
      D(37)=SID                                                             J1280
      D(38)=SIQ                                                             J1290
   90 CONTINUE                                                              J1300
      RETURN                                                                J1310
C                                                                           J1320
  100 FORMAT (1X,I1,11E11.4,I5)                                             J1330
  110 FORMAT (1X,F3.4,14X,9F7.2)                                            J1340
      END                                                                   J1350-
```

```
*DECK INTRAP
      SUBROUTINE INTRAP (NCJ,R,CNAB,NOUTM,SLTB,RES,IERS)                    K  10
         COMMON/PSD/ RC,BLTB,CVD                                            K  20
       DIMENSION R(1)                                                       K  30
       COMPLEX CNAB(1),YIN(450),YOUT(450),RES                               K  40
      IERS=0                                                                K  50
      RMIN=RC-1.96*BLTB*1.414                                               K  60
      RMAX=RC+1.96*BLTB*1.414                                               K  70
      SLTB2=SLTB*SLTB/2.0                                                   K  80
      IZC=0                                                                 K  90
      IF (SLTB.LT.BLTB/10.0) IZC=1                                          K 100
      DO 40 JOUT=1,NOUTM                                                    K 110
      RFIX=R(JOUT)                                                          K 120
      YOUT(JOUT)=(0.0,0.0)                                                  K 130
      IF (RFIX.LT.RMIN.OR.RFIX.GT.RMAX) GO TO 40                            K 140
      RFB=RFIX/SLTB                                                         K 150
      IF (IZC.EQ.0) GO TO 10                                                K 160
      YIN(NOUTM)=CNAB(JOUT)*SRPSD(RFIX)*SLTB2                               K 170
      GO TO 30                                                              K 180
   10 CONTINUE                                                              K 190
      DO 20 JIN=1,NOUTM                                                     K 200
      YIN(JIN)=(0.0,0.0)                                                    K 210
      RVAR=R(JIN)                                                           K 220
      IF (RVAR.LT.RMIN.OR.RVAR.GT.RMAX) GO TO 20                            K 230
      RVB=RVAR/SLTB                                                         K 240
      ARG=2.0*RFB*RVB                                                       K 250
      DR2=(RVB-RFB)*(RVB-RFB)                                               K 260
C        -675.84,X.741.67 FOR EXP(X) ON CDC 7600                            K 270
      IF (DR2.GT.3.84) GO TO 20                                             K 280
      CALL BESI (ARG,NCJ,ANS,IER)                                           K 290$
      IF (IER.NE.0) IERS=1                                                  K 300
      YIN(JIN)=RVAR*CNAB(JIN)*SRPSD(RVAR)*ANS*EXP(-DR2)                     K 310
   20 CONTINUE                                                              K 320
      CALL QTFG (R,YIN,YIN,NOUTM)                                           K 330$
   30 CONTINUE                                                              K 340
      YOUT(JOUT)=RFIX*CONJG(CNAB(JOUT))*SRPSD(RFIX)*YIN(NOUTM)              K 350
   40 CONTINUE                                                              K 360
      CALL QTFG (R,YOUT,YOUT,NOUTM)                                         K 370$
      RES=YOUT(NOUTM)                                                       K 380
      RETURN                                                                K 390
      END                                                                   K 400-
```

```
*DECK SRPSD
      FUNCTION SRPSD(R)                                              L  10
      COMMON/PSD/ RC,BLTB,CVD                                        L  20
      SRPSD=0.0                                                      L  30
      DR=(R-RC)/BLTB                                                 L  40
      DR2=DR*DR                                                      L  50
      IF (DR2.GT.78.0) GO TO 10                                      L  60
      SRPSD=EXP(-DR2/2.0)                                            L  70
   10 CONTINUE                                                       L  80
      RETURN                                                         L  90
      END                                                            L 100-
```

```
*DECK BESI
      SUBROUTINE BESI (X,N,BI,IER)                                      M  10
C        BESI MODIFIED TO COMPUTE EXP(-X)*ORIGINAL                      M  20
      IER=0                                                             M  30
      BI=1.0                                                            M  40
      IF (N) 210,20,10                                                  M  50
   10 IF (X) 220,40,40                                                  M  60
   20 IF (X) 220,30,40                                                  M  70
   30 RETURN                                                            M  80
   40 TOL=1.0E-2                                                        M  90
      IF (X-12.0) 60,60,50                                              M 100
   50 IF (X-FLOAT(N)) 60,60,170                                         M 110
   60 XX=X/2.0                                                          M 120
      TERM=1.0                                                          M 130
      IF (N) 100,100,70                                                 M 140
   70 DO 90 I=1,N                                                       M 150
      FI=I                                                              M 160
      IF (ABS(TERM)-1.0E-68) 80,90,90                                   M 170
   80 IER=3                                                             M 180
      BI=0.0                                                            M 190
      RETURN                                                            M 200
   90 TERM=TERM*XX/FI                                                   M 210
  100 BI=TERM                                                           M 220
      XX=XX*XX                                                          M 230
      DO 120 K=1,1000                                                   M 240
C     IF (ABS(TERM) - ABS(BI*TOL)) 100,100,80                           M 250
      IF (ABS(TERM)-ABS(BI*TOL)) 130,130,110                            M 260
C     80  FK=K*(N+K)                                                    M 270
  110 FK=FLOAT(K)*FLOAT(N+K)                                            M 280
      TERM=TERM*(XX/FK)                                                 M 290
  120 BI=BI+TERM                                                        M 300
      IER=5                                                             M 310
      GO TO 160                                                         M 320
  130 CONTINUE                                                          M 330
      IF (X-170.0) 150,150,140                                          M 340
  140 IER=4                                                             M 350
      GO TO 160                                                         M 360
  150 BI=EXP(-X)*BI                                                     M 370
  160 RETURN                                                            M 380
  170 FN=4*N*N                                                          M 390
C     IF (X-170.0) 115,111,111                                          M 400
C     111  IER=4                                                        M 410
C     RETURN                                                            M 420
      XX=1.0/(8.0*X)                                                    M 430
      TERM=1.0                                                          M 440
      BI=1.0                                                            M 450
      DO 190 K=1,30                                                     M 460
      IF (ABS(TERM)-ABS(TOL*BI)) 200,200,180                            M 470
  180 FK=(2*K-1)**2                                                     M 480
      TERM=TERM*XX*(FK-FN)/FLOAT(K)                                     M 490
  190 BI=BI+TERM                                                        M 500
      GO TO 60                                                          M 510
  200 PI=3.141592653                                                    M 520
C     BI=BI*EXP(X)/SQRT(2.0*PI*X)                                       M 530
      BI=BI/SQRT(2.0*PI*X)                                              M 540
      GO TO 160                                                         M 550
  210 IER=1                                                             M 560
      GO TO 160                                                         M 570
  220 IER=2                                                             M 580
      GO TO 160                                                         M 590
      END                                                               M 600-
```

```
*DECK QTFG
C      ********************************************************************      N  10
C      SUBROUTINE QTFG                                                           N  20
C                                                                                N  30
C      PURPOSE                                                                   N  40
C         TO COMPUTE THE VECTOR OF INTEGRAL VALUES FOR A GIVEN                   N  50
C         GENERAL TABLE OF ARGUMENT AND FUNCTION VALUES.                         N  60
C                                                                                N  70
C      DESCRIPTION IS ON PAGE 86 OF IBM-SSP MANUAL                               N  80
C                                                                                N  90
C      ********************************************************************      N 100
C                                                                                N 110
       SUBROUTINE QTFG (X,Y,Z,NDIM)                                              N 120
C                                                                                N 130
        DIMENSION X(1)                                                           N 140
        COMPLEX Y(1),Z(1),SUM1,SUM2                                              N 150
C                                                                                N 160
       SUM2=0.0                                                                  N 170
       IF (NDIM-1) 40,30,10                                                      N 180
C                                                                                N 190
C      INTEGRATION LOOP                                                          N 200
   10  DO 20 I=2,NDIM                                                           N 210
       SUM1=SUM2                                                                 N 220
       SUM2=SUM2+.5*(X(I)-X(I-1))*(Y(I)+Y(I-1))                                  N 230
   20  Z(I-1)=SUM1                                                              N 240
   30  Z(NDIM)=SUM2                                                             N 250
   40  RETURN                                                                   N 260
       END                                                                      N 270-
```

```
*DECK BLKTMN
      BLOCK DATA TMN                                                    0  10
C                                                                       0  20
C     INPUT DATA*****                                                  0  30
C                                                                       0  40
C     A=ETA(SM)                                                         0  50
C     B=SPLNQ(SM)                                                       0  60
C     C=CQ(SM)                                                          0  70
C     D=SPLND(SM)                                                       0  80
C     E=E(SM)                                                           0  90
C     F=CD(SM)                                                          0 100
C     H=ARGUMENT X IN EXPONENTIAL DECAY FACTOR                          0 110
C     P=EXPONENTIAL DECAY FACTOR DEC(X) FOR ARGUMENT X                  0 120
C                                                                       0 130
C     R=RATIO OF CENTER-LINE VELOCITY TO JET EXIT VELOCITY AT EACH      0 140
C       STROUHAL NUMBER                                                 0 150
C     U=RATIO OF MEAN VELOCITY TO CENTER-LINE VELOCITY AT EACH          0 160
C       STANDARD SOURCE POSITION                                        0 170
C                                                                       0 180
      COMMON/FOUR/A(16)                                                 0 190
      COMMON/FIVE/B(16)                                                 0 200
      COMMON/SIX/C(16)                                                  0 210
      COMMON/SEVEN/D(16)                                                0 220
      COMMON/EIGHT/E(16)                                                0 230
      COMMON/ANINE/F(16)                                                0 240
      COMMON/ELEVEN/H(7)                                                0 250
      COMMON/TWELVE/P(7)                                                0 260
C                                                                       0 270
       COMMON/FOUR1/ A1(28)                                             0 280
       COMMON /FIVE1/ B1(28)                                            0 290
       COMMON /SIX1/ C1(28)                                             0 300
       COMMON /SEVEN1/ D1(28)                                           0 310
       COMMON /EIGHT1/ E1(28)                                           0 320
       COMMON /ANINE1/ F1(28)                                           0 330
       COMMON /EIGHTY1/ SD1(28,6),SDT1(28,6)                            0 340
C                                                                       0 350
       COMMON/THIRTN1/ R1(28)                                           0 360
      COMMON/THIRTN/R(16)                                               0 370
      COMMON/FOURTN/U(24)                                               0 380
C                                                                       0 390
      COMMON/EIGHTY/T1(6),SD(16,6)                                      0 400
C                                                                       0 410
      DATA (T1(I),I=1,4) / 0.980, 1.770, 2.209, 3.330 /                 0 420
      DATA ((SD(N,K),N=1,16),K=1,4) / 0.67,0.80,0.95,1.18,1.43,1.70,    0 430
     1 2.00,2.30,2.62,2.92,3.23,3.50,3.75,4.00,4.25,4.45,0.67,0.80,    0 440
     2 0.95,1.18,1.43,1.70,2.00,2.30,2.70,3.10,3.40,3.80,4.18,4.[illegible]  0 450
     3 4.80,5.15,0.67,0.80,0.95,1.15,1.50,1.90,2.30,2.72,3.14,3.[illegible]  0 460
     4 3.95,4.38,4.75,5.12,5.40,5.60,0.67,0.80,0.95,1.20,1.55,2.00,    0 470
     5 2.50,2.90,3.45,3.90,4.35,4.75,5.10,5.35,5.60,5.80 /             0 480
C                                                                       0 490
       DATA ((SDT1(N,I),N=1,28),I=1,4) /                                0 500
     10.01,0.01,0.01,0.01,0.01,0.01,0.05,0.13,0.30,0.52,0.80,1.05,1.30, 0 510
     21.50,1.75,1.90,2.05,2.18,2.30,2.40,2.50,2.60,2.69,2.79,2.89,2.96, 0 520
     33.03,3.09,                                                        0 530
     40.08,0.09,0.11,0.12,0.15,0.23,0.32,0.45,0.65,0.90,1.20,1.50,1.80, 0 540
     52.10,2.35,2.55,2.70,2.90,3.03,3.17,3.30,3.43,3.55,3.67,3.79,3.89, 0 550
     63.98,4.06,                                                        0 560
     70.20,0.22,0.25,0.28,0.31,0.39,0.53,0.70,0.95,1.25,1.60,1.95,2.25, 0 570
     82.55,2.85,3.05,3.30,3.50,3.70,3.90,4.06,4.23,4.39,4.56,4.71,4.84, 0 580
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     94.94,5.04,                                                          0 590
     $0.25,0.28,0.32,0.36,0.45,0.57,0.75,0.95,1.25,1.60,2.00,2.35,2.70,   0 600
     $3.00,3.30,3.60,3.85,4.10,4.30,4.50,4.70,4.80,5.10,5.24,5.42,5.56,   0 610
     $5.68,5.80/                                                          0 620
C                                                                         0 630
      DATA ((SD1(N,I),N=1,28),I=1,4)/                                     0 640
     1 0.11,0.14,0.18,0.23,0.31,0.45,0.65,0.85,1.10,1.35,1.60,1.85,2.20,  0 650
     2 2.55,3.00,3.30,3.60,3.85,4.10,4.45,4.75,5.10,5.32,5.53,5.71,5.86,  0 660
     3 5.99,6.11,                                                         0 670
     4 0.11,0.14,0.18,0.23,0.31,0.45,0.65,0.85,1.10,1.35,1.60,1.85,2.25,  0 680
     5 2.70,3.15,3.50,3.95,4.30,4.70,5.00,5.30,5.58,5.82,6.04,6.24,6.41,  0 690
     6 6.55,6.68,                                                         0 700
     7 0.11,0.14,0.18,0.25,0.35,0.50,0.70,0.95,1.25,1.55,1.90,2.25,2.75,  0 710
     8 3.25,3.75,4.20,4.60,5.00,5.35,5.65,5.95,6.26,6.53,6.78,7.01,7.19,  0 720
     9 7.35,7.50,                                                         0 730
     $ 0.11,0.14,0.18,0.25,0.35,0.50,0.77,1.10,1.50,1.85,2.25,2.75,3.25,  0 740
     $ 3.80,4.30,4.75,5.20,5.55,5.85,6.13,6.40,6.74,7.03,7.29,7.54,7.74,  0 750
     $ 7.91,8.07 /                                                        0 760
C                                                                         0 770
      DATA A(1),A(2),A(3),A(4),A(5),A(6),A(7),A(8),A(9),A(10),A(11),      0 780
     1 A(12),A(13),A(14),A(15),A(16)/0.5,0.52,0.54,0.56,0.57,0.58,0.585,  0 790
     2 0.59,0.595,0.598,0.6,0.6,0.6,0.6,0.6,0.6,0.6/                      0 800
C                                                                         0 810
      DATA A1/ 0.32,0.36,0.40,0.44,0.47,0.5,0.52,0.54,0.56,0.57,0.58,     0 820
     1 0.585,0.59,0.595,0.598,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0 830
     2 0.6,0.6,0.6 /                                                      0 840
C                                                                         0 850
      DATA B(1),B(2),B(3),B(4),B(5),B(6),B(7),B(8),B(9),B(10),B(11),      0 860
     1 B(12),B(13),B(14),B(15),B(16)/81.5,83.5,85.2,86.9,88.2,89.4,90.4,  0 870
     2 91.2,91.8,92.1,92.2,92.2,92.1,92.0,91.9,91.6/                      0 880
C                                                                         0 890
      DATA B1/ 70.5,73.5,75.5,78.0,79.9,81.5,83.1,84.6,86.2,87.7,89.0,    0 900
     1 90.0,90.7,91.3,91.8,92.1,92.1,92.0,91.9,91.7,91.4,90.8,90.3,       0 910
     2 89.7,89.2,88.6,88.1,87.5 /                                         0 920
C                                                                         0 930
      DATA C(1),C(2),C(3),C(4),C(5),C(6),C(7),C(8),C(9),C(10),C(11),      0 940
     1 C(12),C(13),C(14),C(15),C(16)/0.75,0.75,0.75,0.75,1.1,1.0,1.0,1.0,1.1,0 950
     2 0.75,0.5,0.3,0.1,0.0,-0.2,-0.4,-0.5/                               0 960
C                                                                         0 970
      DATA C1/ 7.0,5.0,4.0,3.0,3.0,2.3,1.5,1.0,1.0,1.2,1.2,1.0,0.9,0.7,   0 980
     1 0.6,0.3,0.1,0.0,-0.15,-0.25,-0.4,-0.4,-0.5,-0.55,-0.6,-0.65,       0 990
     2 -0.7,-0.7 /                                                        01000
C                                                                         01010
      DATA D(1),D(2),D(3),D(4),D(5),D(6),D(7),D(8),D(9),D(10),D(11),      01020
     1 D(12),D(13),D(14),D(15),D(16)/93.2,95.3,97.0,98.4,99.4,100.1,      01030
     2 100.7,100.9,100.9,100.8,100.6,100.1,99.5,98.7,97.8,96.9/           01040
C                                                                         01050
      DATA D1/ 82.0,84.4,86.6,88.8,91.0,93.1,95.2,97.0,98.3,99.4,100.1,   01060
     1 100.6,101.0,101.1,101.0,100.6,100.0,99.3,98.5,97.6,96.6,95.8,      01070
     2 94.9,94.0,93.0,92.0,91.0,90.0 /                                    01080
C                                                                         01090
      DATA E(1),E(2),E(3),E(4),E(5),E(6),E(7),E(8),E(9),E(10),E(11),      01100
     1 E(12),E(13),E(14),E(15),E(16)/0.8,0.77,0.75,0.7,0.68,0.66,0.63,    01110
     2 0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6/                           01120
C                                                                         01130
      DATA E1/ 1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,0.9,0.8,0.73,0.68,0.65, 01140
     1 0.63,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6,0.6 / 01150
C                                                                         01160
      DATA F(1),F(2),F(3),F(4),F(5),F(6),F(7),F(8),F(9),F(10),F(11),      01170
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     1 F(12),F(13),F(14),F(15),F(16)/2.3,2.0,1.5,1.3,1.0,0.8,0.6,0.5,      01180
     2 0.3,0.1,-0.15,-0.2,-0.35,-0.4,-0.4,-0.4/                            01190
C                                                                          01200
      DATA F1/ 15.0,10.0,10.0,7.5,6.0,4.5,3.0,1.7,1.3,1.0,0.8,0.6,0.3,    01210
     1 0.2,0.0,-0.15,-0.2,-0.3,-0.3,-0.4,-0.4,-0.5,-0.55,-0.6,-0.62,      01220
     2 -0.62,-0.65,-0.7 /                                                  01230
C                                                                          01240
      DATA H(1),H(2),H(3),H(4),H(5),H(6),H(7)/0.0,0.1,0.2,0.3,0.4,0.5,     01250
     1 0.6/                                                                01260
C                                                                          01270
      DATA P(1),P(2),P(3),P(4),P(5),P(6),P(7)/1.0,0.59,0.4,0.28,0.2,       01280
     1 0.158,0.128/                                                        01290
C                                                                          01300
      DATA R/ 0.58,0.65,0.74,0.82,0.9,0.95,0.99,1.0,1.0,1.0,1.0,1.0,1.0,   01310
     1 1.0,1.0,1.0 /                                                       01320
C                                                                          01330
      DATA R1 / 0.32,0.36,0.4,0.46,0.52,0.58,0.65,0.74,0.82,0.90,0.96,     01340
     1 1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,       01350
     2 1.0,1.0 /                                                           01360
C                                                                          01370
      DATA U(1),U(2),U(3),U(4),U(5),U(6),U(7),U(8),U(9),U(10),U(11),       01380
     1 U(12),U(13),U(14),U(15),U(16),U(17),U(18),U(19),U(20),U(21),       01390
     2 U(22),U(23),U(24)/0.99,0.98199,0.968865,0.9481,0.91859,0.87741,    01400
     3 0.82377,0.757455,0.67936,0.67,0.66295,0.6,0.591905,0.5,0.408098,    01410
     4 0.3206435,0.2425485,0.1762325,0.1225905,0.081409,0.051541,          01420
     5 0.0311374,0.018008,0.01/                                            01430
C                                                                          01440
      END                                                                  01450-
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```
*DECK SANOISE
      SUBROUTINE SANOISE (BETA,TJT0,ROD,BC,DFT,A0,NFREQ,FREQ,I,J,TM,L0,M  P  10
     1J,DF,WORK2,NS,SPLC,HXX,HYY,CYY,A3,A2)                               P  20
        DIMENSION TM(20),FREQ(20),SPLC(30),HVX(30),HVY(30),CVX(30),       P  30
     1          CVY(30),ANS3DB(30)                                       P  40
        COMMON / THIRTY / HX(20)                                          P  50
        COMMON / FORTY / HY(20)                                           P  60
        COMMON / FIFTY / CX(20)                                           P  70
        COMMON / SIXTY / CY(20)                                           P  80
        REAL MJ,K0,K1,L0,L1,MC                                            P  90
        IF (J.NE.1.OR.I.NE.1) GO TO 50                                    P 100
C                                                                         P 110
C       CALCULATION OF OASPLC (PACKAGE C)                                 P 120
C                                                                         P 130
        IF (BETA.GT.1.0) GO TO 20                                         P 140
        IF (TJT0.LT.0.9) GO TO 10                                         P 150
        ANS1DB=(40.0*ALOG10(BETA))-(20.0*ALOG10(ROD))                     P 160
        OASPLC=157.5+ANS1DB                                               P 170
        GO TO 40                                                          P 180
   10   ANS1DB=(40.0*ALOG10(BETA))-(20.0*ALOG10(ROD))                     P 190
        OASPLC=155.5+ANS1DB                                               P 200
        GO TO 40                                                          P 210
   20   IF (TJT0.LT.0.9) GO TO 30                                         P 220
        ANS1DB=(20.0*ALOG10(BETA))-(20.0*ALOG10(ROD))                     P 230
        OASPLC=157.5+ANS1DB                                               P 240
        GO TO 40                                                          P 250
   30   ANS1DB=(10.0*ALOG10(BETA))-(20.0*ALOG10(ROD))                     P 260
        OASPLC=155.5+ANS1DB                                               P 270
        GO TO 40                                                          P 280
   40   CONTINUE                                                          P 290
   50   IF (J.NE.1) GO TO 70                                              P 300
C                                                                         P 310
C       CALCULATION OF ANS3DB AND INTERPOLATED VALUES OF H0 AND C1        P 320
C       FOR ALL SPECIFIED FREQUENCIES (PACKAGE C)                         P 330
C                                                                         P 340
        WORK1=((6.2832*BC*DFT*BETA)/A0)                                   P 350
        HVX(I)=((6.283*FREQ(I)*L0)/(12.0*A0))                             P 360
        CVX(I)=HVX(I)                                                     P 370
        IF (HVX(I).LT.0.2) GO TO 60                                       P 380
        IF (HVX(I).GT.70.0) GO TO 60                                      P 390
        CALL LAGRNG (HX,HY,20,HVX(I),HVY(I))                             P 400$
        IF (TJT0.LT.0.9) HVY(I)=HVY(I)-2.0                                P 410
        CALL LAGRNG (CX,CY,20,CVX(I),CVY(I))                             P 420$
        ANS3DB(I)=10.0*ALOG10(WORK1*FREQ(I))                              P 430
   60   CONTINUE                                                          P 440
   70   CONTINUE                                                          P 450
        IF (MJ.LE.1.0) GO TO 110                                          P 460
C                                                                         P 470
C        SHOCK NOISE CONTRIBUTION CAN BE AND IS NEGLECTED                 P 480
C        FOR THE FOLLOWING CONDITIONS :                                   P 490
C               (1) TJT0 LESS THAN 0.9 AND TM(J) LESS THAN 50 DEG.        P 500
C               (2) TJT0 GREATER THAN 0.9 AND TM(J) LESS THAN 30 DEG.     P 510
C                                                                         P 520
        IF (TJT0.LT.0.9.AND.TM(J).LT.50.0.OR.TJT0.GE.0.9.AND.TM(J).LT.30.0 P 530
     1) GO TO 120                                                         P 540
C                                                                         P 550
        IF (HVX(I).LT.0.2) GO TO 100                                      P 560
        IF (HVX(I).GT.70.0) GO TO 100                                     P 570
C                                                                         P 580
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      WC=6.283*FREQ(I)                                                  P 590
      IIEND=NS-1                                                        P 600
      SUMI=0.0                                                          P 610
      DO 90 II=1,IIEND                                                  P 620
      CI2=CVY(I)**(II*II)                                               P 630
      ISEND=NS-II                                                       P 640
      SUMS=0.0                                                          P 650
      DO 80 ISN=1,ISEND                                                 P 660
      IS=ISN-1                                                          P 670
      QIS=WORK2*II*(1.0-(0.06*(IS+((II+1.0)/2.0))))                     P 680
      QCOS=COS(QIS*WC)                                                  P 690
      QSIN=SIN((QIS*WC*BC)/2.0)                                         P 700
      WORK3=(QCOS*QSIN)/QIS                                             P 710
      SUMS=SUMS+WORK3                                                   P 720
   80 CONTINUE                                                          P 730
      WORK4=CI2*SUMS                                                    P 740
      SUMI=SUMI+WORK4                                                   P 750
   90 CONTINUE                                                          P 760
C                                                                       P 770
      WORK5=(4.0*SUMI)/(NS*BC*WC)                                       P 780
      ANS2=1.0+WORK5                                                    P 790
      ANS2DB=10.0*ALOG10(ABS(ANS2))                                     P 800
C                                                                       P 810
      SPL=HVY(I)+ANS1DB+ANS3DB(I)+ANS2DB                                P 820
      SPLC(I)=SPL                                                       P 830
      HXX=HVX(I)                                                        P 840
      HYY=HVY(I)                                                        P 850
      CYY=CVY(I)                                                        P 860
      A3=ANS3DB(I)                                                      P 870
      A2=ANS2DB                                                         P 880
      GO TO 130                                                         P 890
C                                                                       P 900
C     FAILURE CODE STATEMENTS (PACKAGE C)                               P 910
C                                                                       P 920
  100 HYY=0.0                                                           P 930
      HXX=HVX(I)                                                        P 940
      CYY=0.0                                                           P 950
      A3=0.0                                                            P 960
      A2=0.0                                                            P 970
      SPLC(I)=2.0                                                       P 980
      GO TO 130                                                         P 990
C                                                                       P1000
  110 HXX=0.0                                                           P1010
      HYY=0.0                                                           P1020
      CYY=0.0                                                           P1030
      A3=0.0                                                            P1040
      A2=0.0                                                            P1050
      SPLC(I)=1.0                                                       P1060
      GO TO 130                                                         P1070
C                                                                       P1080
  120 HXX=0.0                                                           P1090
      HYY=0.0                                                           P1100
      CYY=0.0                                                           P1110
      A3=0.0                                                            P1120
      A2=0.0                                                            P1130
      SPLC(I)=3.0                                                       P1140
      GO TO 130                                                         P1150
  130 RETURN                                                            P1160
      END                                                               P1170-
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*DECK LAGRNG
      SUBROUTINE LAGRNG (X,Y,N,VALX,VALY)                                  Q  10
C                                                                          Q  20
C     THIS SUBROUTINE CONDUCTS LAGRANGIAN INTERPOLATION*****               Q  30
C                                                                          Q  40
C     X=X-COORDINATES OF H0 OR C1 MASTER INPUT SPECTRUM                    Q  50
C     Y=Y-COORDINATES OF H0 OR C1 MASTER INPUT SPECTRUM                    Q  60
C     N=NUMBER OF POINTS DESCRIBING H0 OR C1 MASTER INPUT SPECTRUM         Q  70
C     VALX=ARGUMENT SIGMA                                                  Q  80
C     VALY=INTERPOLATED VALUE OF H0 OR C1 AT ARGUMENT SIGMA                Q  90
C                                                                          Q 100
      DIMENSION X(20),Y(20)                                                Q 110
C                                                                          Q 120
      N1=N-1                                                               Q 130
      DO 10 I=2,N1                                                         Q 140
      IF (VALX.LE.X(I)) GO TO 20                                           Q 150
   10 CONTINUE                                                             Q 160
      I=N1                                                                 Q 170
   20 IS1=I-1                                                              Q 180
      IS2=I+1                                                              Q 190
      VALY=0.0                                                             Q 200
      DO 40 I=IS1,IS2                                                      Q 210
      P=1.0                                                                Q 220
      DO 30 J=IS1,IS2                                                      Q 230
      IF (I.EQ.J) GO TO 30                                                 Q 240
      A=(VALX-X(J))/(X(I)-X(J))                                            Q 250
      P=P*A                                                                Q 260
   30 CONTINUE                                                             Q 270
      B=P*Y(I)                                                             Q 280
      VALY=VALY+B                                                          Q 290
   40 CONTINUE                                                             Q 300
      RETURN                                                               Q 310
      END                                                                  Q 320-
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*DECK BLKSAN
      BLOCK DATA SAN                                                    R  10
C                                                                       R  20
C     INPUT DATA*****                                                   R  30
C                                                                       R  40
C     HX=ARGUMENT SIGMA IN SOURCE STRENGTH SPECTRUM                     R  50
C     HY=SOURCE STRENGTH H0(SIGMA) FOR ARGUMENT SIGMA                   R  60
C     CX=ARGUMENT SIGMA IN CORRELATION COEFFICIENT SPECTRUM             R  70
C     CY=CORRELATION COEFFICIENT C1(SIGMA) FOR ARGUMENT SIGMA           R  80
C                                                                       R  90
      COMMON/THIRTY/HX(20)                                              R 100
      COMMON/FORTY/HY(20)                                               R 110
      COMMON/FIFTY/CX(20)                                               R 120
      COMMON/SIXTY/CY(20)                                               R 130
C                                                                       R 140
      DATA HX/ 0.2,0.3,0.4,0.7,1.0,1.5,2.0,3.0,3.5,4.0,4.5,5.0,6.0,7.0, R 150
     1 8.0,10.0,20.0,40.0,68.0,70.0 /                                   R 160
C                                                                       R 170
      DATA HY/ 116.0,121.6,125.5,132.5,137.7,142.7,145.7,148.5,149.1,   R 180
     1 149.2,149.1,148.8,147.9,146.7,145.7,143.7,137.4,130.5,125.4,     R 190
     2 125.2 /                                                          R 200
C                                                                       R 210
      DATA CX/ 0.2,0.3,0.4,0.7,1.0,1.5,2.0,3.0,3.5,4.0,4.5,5.0,6.0,7.0, R 220
     1 8.0,10.0,20.0,40.0,68.0,70.0 /                                   R 230
C                                                                       R 240
      DATA CY/ 0.70,0.71,0.71,0.72,0.73,0.74,0.74,0.71,0.69,0.67,0.64,  R 250
     1 0.62,0.58,0.54,0.50,0.45,0.28,0.12,0.02,0.02 /                   R 260
C                                                                       R 270
      END                                                               R 280-
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```
*DECK INTEG
      PROGRAM INTEG(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)                    S  10
      EXTERNAL FCT,FCD,FQA6                                                   S  20
      REAL I1,I2,K                                                            S  30
      REAL MJ                                                                 S  40
      DIMENSION W(24),FREQ(24),WI1(24),WI2(24),XU(24),XX(21),ENT1(21),        S  50
     1         ENT2(21),DBU(24),DBD(24),DB(24)                              S  60
     2         ,SN(24),SPLM(24),IL(3)                                       S  70
      COMMON/CON/ A0,VJ,XC,K,A1,B1,C1,A2,B2,C2,D2,A3,B3,RJ,WP,                S  80
     1 A4,A5,XLIMIT,INTFLG                                                   S  90
      PI=3.141593                                                            S 100
C                                                                            S 110
C              READ INPUT CONSTANTS                                          S 120
C                                                                            S 130
      READ (5,140) RUNNO                                                     S 140*
      READ (5,170) (FREQ(I),I=1,24)                                          S 150*
   10 READ (5,140) TP                                                        S 160*
      IF (TP.LT.1.0) GO TO 130                                               S 170
      READ (5,180) (SPLM(I),I=1,24)                                          S 180*
      READ (5,160) IOUT                                                      S 190*
      READ (5,160) INTFLG                                                    S 200*
      READ (5,140) MJ                                                        S 210*
      READ (5,140) VJF                                                       S 220*
      READ (5,140) XC                                                        S 230*
      READ (5,140) T0F                                                       S 240*
      READ (5,150) K                                                         S 250*
      READ (5,140) A1                                                        S 260*
      READ (5,140) B1                                                        S 270*
      READ (5,140) C1                                                        S 280*
      READ (5,150) A2                                                        S 290*
      READ (5,150) B2                                                        S 300*
      READ (5,140) C2                                                        S 310*
      READ (5,150) D2                                                        S 320*
      READ (5,150) A3                                                        S 330*
      READ (5,150) B3                                                        S 340*
      READ (5,150) A4                                                        S 350*
      READ (5,150) A5                                                        S 360*
      READ (5,150) XLIMIT                                                    S 370*
      READ (5,140) RJ                                                        S 380*
      READ (5,140) R                                                         S 390*
      READ (5,150) PAMB                                                      S 400*
C                                                                            S 410
      A0F=49.02*SQRT(T0F+459.67)                                             S 420
      PAMB=PAMB*6894.7572                                                    S 430
      VJ=VJF*12.0                                                            S 440
      AJ=VJ/MJ                                                               S 450
      A0=A0F*12.0                                                            S 460
      XC=XC*2.0*RJ*(4.3+1.1*MJ*MJ)                                           S 470
      VJA0=VJ/A0                                                             S 480
      TJT0=(AJ/A0)**2                                                        S 490
      THETA=90.0                                                             S 500
C                                                                            S 510
      K=K/(0.63*AJ*2.0*MJ*(1.1+0.9*MJ))                                      S 520
C              BEGIN FREQUENCY LOOP                                          S 530
C                                                                            S 540
      XLOWER=0.0                                                             S 550
      XUPER2=1.0/XC                                                          S 560
      TURB=0.6667*0.179*MJ**(-.1028)                                         S 570
      CONST=20.0*ALOG10(1.4*PAMB/2.0E-5)-20.0*ALOG10(R)+10.0*ALOG10(0.23     S 580
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     116)+40.0*ALOG10(VJ/A0*TURB/A0)-10.0*ALOG10(64.0*PI*SQRT(PI))+10.0*   S 590
     2ALOG10(2.0)                                                          S 600
      DO 80 I=1,24                                                         S 610
      W(I)=2.0*PI*FREQ(I)                                                  S 620
      SN(I)=FREQ(I)*2.0*RJ/VJ                                              S 630
      WP=W(I)                                                              S 640
      XMAX=5.99402199/(FREQ(I)*K)                                          S 650
      IF (INTFLG.EQ.1) GO TO 20                                            S 660
      IF (XC.LT.XMAX) GO TO 20                                             S 670
      XUPPER=XMAX                                                          S 680
      CALL QA6 (FQA6,I1)                                                   S 690$
      GO TO 30                                                             S 700
   20 XUPPER=XC                                                            S 710
      CALL DQG32 (XLOWER,XUPPER,FCT,I1)                                    S 720$
   30 XU(I)=XUPPER                                                         S 730
      WI1(I)=I1*W(I)**5*(1.0/SQRT(C1))                                     S 740
      WI1(I)=WI1(I)*SQRT(PI)/2.0                                           S 750
      IF (WI1(I).GT.0.0) GO TO 40                                          S 760
      DBU(I)=0.0                                                           S 770
      GO TO 50                                                             S 780
   40 DBU(I)=10.0*ALOG10(WI1(I))                                           S 790
   50 CALL DQG32 (XLOWER,XUPER2,FCD,I2)                                    S 800$
      WI2(I)=I2*W(I)**5/(2.0*C2)                                           S 810
      WI2(I)=WI2(I)/4.0                                                    S 820
      IF (WI2(I).GT.0.0) GO TO 60                                          S 830
      DBD(I)=0.0                                                           S 840
      GO TO 70                                                             S 850
   60 DBD(I)=10.0*ALOG10(WI2(I))                                           S 860
   70 DB(I)=10.0*ALOG10(10.0**(DBU(I)/10.0)+10.0**(DBD(I)/10.0))           S 870
      DBU(I)=DBU(I)+CONST                                                  S 880
      DBD(I)=DBD(I)+CONST                                                  S 890
      DB(I)=DB(I)+CONST                                                    S 900
   80 CONTINUE                                                             S 910
      WRITE (6,190) INTFLG,MJ,TOF,A0,VJF,XC,RJ,A1,A2,B1,B2,C1,C2,K,D2,A3  S 920*
     1,B3,A4,A5,R,PAMB,XLIMIT                                              S 930
      DO 90 I=1,24                                                         S 940
      WRITE (6,200) FREQ(I),SN(I),DBU(I),DBD(I),DB(I)                      S 950*
   90 CONTINUE                                                             S 960
      IF (IOUT.EQ.0) GO TO 120                                             S 970
      WRITE (6,210)                                                        S 980*
      ENT2(1)=0.0                                                          S 990
      DO 110 I=1,24                                                        S1000
      WP=W(I)                                                              S1010
      WRITE (6,220) FREQ(I),W(I)                                           S1020*
      DO 100 J=1,21                                                        S1030
      XX(J)=FLOAT(J-1)                                                     S1040
      ENT1(J)=FCT(XX(J))*W(I)**5*(1.0/SQRT(C1))                            S1050
      IF (J.EQ.1) GO TO 100                                                S1060
      ENT2(J)=FCD(1.0/XX(J))*W(I)**5/(2.0*C2)/XX(J)**2                     S1070
  100 CONTINUE                                                             S1080
      WRITE (6,230) XX(1),ENT1(1)                                          S1090*
      WRITE (6,230) (XX(J),ENT1(J),ENT2(J),J=2,21)                         S1100*
  110 CONTINUE                                                             S1110
  120 CONTINUE                                                             S1120
C                                                                          S1130
C      RETURN FOR NEXT COMPUTATION                                         S1140
C                                                                          S1150
      GO TO 10                                                             S1160
C                                                                          S1170
```

```
  130 STOP                                                                  S1180
C                                                                           S1190
C       FORMAT STATEMENTS                                                   S1200
C                                                                           S1210
C                                                                           S1220
  140 FORMAT (F15.1)                                                        S1230
  150 FORMAT (E10.4)                                                        S1240
  160 FORMAT (I1)                                                           S1250
  170 FORMAT (8F10.1)                                                       S1260
  180 FORMAT (12F6.1)                                                       S1270
  190 FORMAT (1H1,T8,"INPUT PARAMETERS FOR INTEGRATION ARE -",//,T2,"INT    S1280
     1FLG = ",I2,//T5,"MJ = ",E15.8,T40,"T0 = ",E15.8,//,T5,"A0 = ",E15.   S1290
     28,T40,"VJ = ",E15.8,//,T5,"XC = ",E15.8,T40,"RJ = ",E15.8,//,T5,"A   S1300
     31 = ",E15.8,T40,"A2 = ",E15.8,//,T5,"B1 = ",E15.8,T40,"B2 = ",E15.   S1310
     48,//,T5,"C1 = ",E15.8,T40,"C2 = ",E15.8,//,T5," K = ",E15.8,T40,"D   S1320
     52 = ",E15.8,//,T5,"A3 = ",E15.8,T40,"B3 = ",E15.8,//,T5,"A4 = ",E1   S1330
     65.8,T40,"A5 = ",E15.8,//,T5," R = ",E15.8,T40,"P0 = ",E15.8,//,T5,   S1340
     7"XLIMIT = ",F6.2,////,T2,"FREQUENCY",T18,"SN",T29,"DBU",T40,"DBD",    S1350
     8T51,"DB",/)                                                           S1360
  200 FORMAT (T3,F8.2,T15,F7.3,3(4X,F7.2))                                  S1370
  210 FORMAT (1H1,T24,"VALUES OF INTEGRAND FOR VARIOUS VALUES OF X",/)      S1380
  220 FORMAT (/,5X,"FREQUENCY = ",F8.2,5X,"OMEGA = ",E15.7,//,T15,"X",T2    S1390
     18,"INTEGRAND 1",T48,"INTEGRAND 2",/)                                  S1400
  230 FORMAT (11X,F10.6,5X,E15.7,5X,E15.7)                                  S1410
      END                                                                   S1420-
```

```
*DECK FCT
      FUNCTION FCT(X)                                                    T  10
      REAL L1,LT,K                                                       T  20
      COMMON/CON/ A0,VJ,XC,K,A1,B1,C1,A2,B2,C2,D2,A3,B3,RJ,WP,           T  30
     1 A4,A5,XLIMIT,INTFLG                                               T  40
      DATA PI,RTP / 3.141593,0.797885 /                                  T  50
      R12=RJ                                                             T  60
      IF (X.LE.XLIMIT) GO TO 10                                          T  70
      L1=A1*X+B1                                                         T  80
      LT=A3*X+B3                                                         T  90
      GO TO 20                                                           T 100
   10 L1=A4*X                                                            T 110
      LT=A5*X                                                            T 120
   20 CONTINUE                                                           T 130
      D1=1.0                                                             T 140
      T0=K*X**D1                                                         T 150
      IF (INTFLG.EQ.1) GO TO 50                                          T 160
      PART1=R12*X*L1*LT**2*T0                                            T 170
      PART=-(WP*T0)**2/8.0                                               T 180
      IF (PART.LT.147.5.AND.PART.GT.-146.5) GO TO 30                     T 190
      PART2=0.0                                                          T 200
      GO TO 40                                                           T 210
   30 PART2=EXP(PART)                                                    T 220
   40 FCT=PART1*PART2*EXP(-.0016*X*X)                                    T 230
      RETURN                                                             T 240
   50 PART1=R12*X*L1*LT**2*T0                                            T 250
      PART=-(L1*WP)**2/(8.0*PI*0.63*0.63*VJ*VJ)                          T 260
      IF (PART.LT.147.5.AND.PART.GT.-146.5) GO TO 60                     T 270
      PART2=0.0                                                          T 280
      GO TO 70                                                           T 290
   60 PART2=EXP(PART)                                                    T 300
   70 PART3=RTP*PI/4.0/(1.0+(WP*T0)**2/4.0)**1.5                         T 310
      FCT=PART1*PART2*PART3*EXP(-.0016*X*X)                              T 320
      RETURN                                                             T 330
      END                                                                T 340-
```

```
*DECK QG10
      SUBROUTINE QG10 (XL,XU,FCT,Y)                                    U  10
      A=0.5*(XU+XL)                                                    U  20
      B=XU-XL                                                          U  30
      C=0.4869533*B                                                    U  40
      Y=0.03333567*(FCT(A+C)+FCT(A-C))                                 U  50
      C=0.4325317*B                                                    U  60
      Y=Y+0.07472567*(FCT(A+C)+FCT(A-C))                               U  70
      C=0.3397048*B                                                    U  80
      Y=Y+0.1095432*(FCT(A+C)+FCT(A-C))                                U  90
      C=0.2166977*B                                                    U 100
      Y=Y+0.1346334*(FCT(A+C)+FCT(A-C))                                U 110
      C=0.07443717*B                                                   U 120
      Y=B*(Y+0.1477621*(FCT(A+C)+FCT(A-C)))                            U 130
      RETURN                                                           U 140
      END                                                              U 150-
```

```
*DECK FQA6
      FUNCTION FQA6(XP)                                                  V  10
      REAL L1,LT,K                                                       V  20
      COMMON/CON/ A0,VJ,XC,K,A1,B1,C1,A2,B2,C2,D2,A3,B3,RJ,WP,           V  30
     1 A4,A5,XLIMIT,INTFLG                                               V  40
      X=SQRT(8.0*XP/(WP**2*K**2))                                        V  50
      R12=RJ                                                             V  60
      IF (X.LE.XLIMIT) GO TO 10                                          V  70
      L1=A1*X+B1                                                         V  80
      LT=A3*X+B3                                                         V  90
      GO TO 20                                                           V 100
   10 L1=A4*X                                                            V 110
      LT=A5*X                                                            V 120
   20 CONTINUE                                                           V 130
      T0=K*X                                                             V 140
      PART1=SQRT(XP)*R12*L1*LT*LT*T0                                     V 150
      PART2=(WP**2*K**2)/4.0                                             V 160
      FQA6=PART1/PART2*EXP(-.0016*X*X)                                   V 170
      RETURN                                                             V 180
      END                                                                V 190
```

```
*DECK QA6
      SUBROUTINE QA6 (FCT,Y)                                          W  10
      X=15.12996                                                      W  20
      Y=.5317103E-6*FCT(X)                                            W  30
      X=9.124248                                                      W  40
      Y=Y+.0001714737*FCT(X)                                          W  50
      X=5.196153                                                      W  60
      Y=Y+.007810781*FCT(X)                                           W  70
      X=2.552590                                                      W  80
      Y=Y+.1032160*FCT(X)                                             W  90
      X=.8983028                                                      W 100
      Y=Y+.5209846*FCT(X)                                             W 110
      X=.09874701                                                     W 120
      Y=Y+1.140270*FCT(X)                                             W 130
      RETURN                                                          W 140
      END                                                             W 150-
```

```
*DECK FCD
      FUNCTION FCD(X)                                                    X  10
      REAL L2,LT,K                                                       X  20
      COMMON/CON/ A0,VJ,XC,K,A1,B1,C1,A2,B2,C2,D2,A3,B3,RJ,WP,           X  30
     1 A4,A5,XLIMIT,INTFLG                                               X  40
      DATA PI,RTP / 3.141593,0.797885 /                                  X  50
      L2=(A2/X+B2)**D2                                                   X  60
      LT=(A3/X+B3)**D2                                                   X  70
      T0=K/X                                                             X  80
      IF (INTFLG.EQ.1) GO TO 30                                          X  90
      PART1=L2*LT*LT*XC**4*EXP(-.0016*XC*XC)*T0                          X 100
      PART=-(WP*T0)**2/8.0                                               X 110
      IF (PART.LT.147.5.AND.PART.GT.-146.5) GO TO 10                     X 120
      PART2=0.0                                                          X 130
      GO TO 20                                                           X 140
   10 PART2=EXP(PART)                                                    X 150
   20 FCD=PART1*PART2                                                    X 160
      RETURN                                                             X 170
   30 PART1=L2*LT**2*XC**4*EXP(-.0016*XC*XC)*T0                          X 180
      VC=0.63*VJ                                                         X 190
      PART=-(L2*WP)**2/(8.0*PI*VC*VC)                                    X 200
      IF (PART.LT.147.5.AND.PART.GT.-146.5) GO TO 40                     X 210
      PART2=0.0                                                          X 220
      GO TO 50                                                           X 230
   40 PART2=EXP(PART)                                                    X 240
   50 PART3=RTP*PI/4.0/(1.0+(WP*T0)**2/4.0)**1.5                         X 250
      FCD=PART1*PART2*PART3                                              X 260
      RETURN                                                             X 270
      END                                                                X 280-
```

```
*DECK DQG32
      SUBROUTINE DQG32 (XL,XU,FCT,Y)                                    Y  10
      A=.5*(XU+XL)                                                      Y  20
      B=XU-XL                                                           Y  30
      C=.4986319309247407 8*B                                           Y  40
      Y=.0035093050047350 48*(FCT(A+C)+FCT(A-C))                        Y  50
      C=.4928057557726341 *B                                            Y  60
      Y=Y+.0081371973654528 35*(FCT(A+C)+FCT(A-C))                      Y  70
      C=.4823811277937532 2*B                                           Y  80
      Y=Y+.0126960326546310 30*(FCT(A+C)+FCT(A-C))                      Y  90
      C=.4674530379688698 4*B                                           Y 100
      Y=Y+.0171369314565107 17*(FCT(A+C)+FCT(A-C))                      Y 110
      C=.4481605778830260 6*B                                           Y 120
      Y=Y+.0214179490111133 40*(FCT(A+C)+FCT(A-C))                      Y 130
      C=.4246838068662849 9*B                                           Y 140
      Y=Y+.0254990296311880 88*(FCT(A+C)+FCT(A-C))                      Y 150
      C=.3972418979839712 0*B                                           Y 160
      Y=Y+.0293420467392677 74*(FCT(A+C)+FCT(A-C))                      Y 170
      C=.3660910593701448 4*B                                           Y 180
      Y=Y+.0329111113881809 23*(FCT(A+C)+FCT(A-C))                      Y 190
      C=.3315221334651076 0*B                                           Y 200
      Y=Y+.0361728970544242 53*(FCT(A+C)+FCT(A-C))                      Y 210
      C=.2938578786203811 6*B                                           Y 220
      Y=Y+.0390969478935351 53*(FCT(A+C)+FCT(A-C))                      Y 230
      C=.2534499544661147 0*B                                           Y 240
      Y=Y+.0416559621134733 78*(FCT(A+C)+FCT(A-C))                      Y 250
      C=.2106756380653176 7*B                                           Y 260
      Y=Y+.0438260465022019 06*(FCT(A+C)+FCT(A-C))                      Y 270
      C=.1659343011410638 2*B                                           Y 280
      Y=Y+.0455869393478819 42*(FCT(A+C)+FCT(A-C))                      Y 290
      C=.1196436811260685 4*B                                           Y 300
      Y=Y+.0469221995404022 83*(FCT(A+C)+FCT(A-C))                      Y 310
      C=.0722359807913982 5*B                                           Y 320
      Y=Y+.0478193600396374 30*(FCT(A+C)+FCT(A-C))                      Y 330
      C=.0241538328438691 58*B                                          Y 340
      Y=B*(Y+.0482700442573639 00*(FCT(A+C)+FCT(A-C)))                  Y 350
      RETURN                                                            Y 360
      END                                                               Y 370-
```


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