```
L.0001 /*FTC
L.0002 C      REGENERATION OF THE OUTPUT CURVE FOR MODEL 1
L.0003 C      ********************************************************************
L.0004        DOUBLE PRECISION CGF(500),TT(500)
L.0005        DOUBLE PRECISION DA(50),UA(50),BMA(50),AKA(50),A(50),P(50),Q(50),B(50),UO(50),VO(50),WA(50)
L.0006        DOUBLE PRECISION W,D,U,X,BM,AK,FF,SS,Z,Y,BE,UU,V,THETA,RR,AL,F1,F2
L.0007      2 FORMAT(5E20.8)
L.0008      3 FORMAT(4I5,2E20.8)
L.0009      4 FORMAT(I3,2020.8)
L.0010      1 FORMAT(4Y)
L.0011     10 FORMAT(//)
L.0012     11 FORMAT(' REGENERATION OF THE OUTPUT CURVE USING MODEL 1 .'//)
L.0013     12 FORMAT(' CO=',F10.3,5X,' UO=',F10.3,5X,' MO=',F10.3,5X,' KO=',F10.3//)
L.0014     13 FORMAT(' START POINT NUMBER =',I4,5X,'FINISH POINT NUMBER =',I4,5X,'TIME AXIS INTERVAL =',F5.3///)
L.0015     18 FORMAT(' CONCENTRATION PROFILE.'/)
L.0016     14 FORMAT(6D20.8)
L.0017 C      READING OF DATA
L.0018 C      ********************************************************************
L.0019         READ(9,1)NCO
L.0020        READ(5,2)X,FG,FL,ACOL,TOR
L.0021        READ(5,3)JI1,JI2,JF1,JF2,DELT1,DELT2
L.0022        READ(5,1)AREA
L.0023        READ(5,14)(P(I),Q(I),DA(I),UA(I),BMA(I),AKA(I),I=1,NCO)
L.0024        READ(9,1)DA(1),UA(1),BMA(1),AKA(1)
L.0025        READ(9,1)FAC
L.0026        WRITE(6,10)
L.0027        WRITE(6,11)
L.0028        WRITE(6,12)DA(1),UA(1),BMA(1),AKA(1)
L.0029        WRITE(6,13)JI2,JF2,DELT2
L.0030        WRITE(6,18)
L.0031        NN=1
L.0032        FF=FL/FG
L.0033        PI=DATAN(1.)*4.
L.0034        T=DELT2*JI2
L.0035        TF=DELT2*JF2
L.0036 C      EVALUATION OF THE FOURIER COEFFICIENTS
L.0037 C      ********************************************************************
L.0038        DO 7 I=2,NCO
L.0039        C1=I-1
L.0040        D=DA(I)
L.0041        U=UA(I)
L.0042        BM=BMA(I)
L.0043        AK=AKA(I)
L.0044        AK=AK*ACOL/FL
L.0045        WA(I)=PI*C1/TOR
L.0046        W=WA(I)
L.0047        SS=U*X/(2.*D)
L.0048        Z= SS*SS
L.0049        Y=1.D+00/DSQRT((BM*W/AK)**2+1.)
L.0050        BE=-DATAN(BM*W/AK)
L.0051        UU=Z-X*X*AK/D*(Y*DCOS(BE)-1.)*FF
L.0052        V=X*X/D*(W-AK*Y*DSIN(BE)*FF)
L.0053        THETA=DATAN(V/UU)/2.
L.0054        RR=DSQRT(DSQRT(UU*UU+V*V))
```

```
L.0055        AL=SS-RR*DCOS(THETA)
L.0056        F1=DEXP(AL)
L.0057        F2=-RR*DSIN(THETA)
L.0058        A(I)=-F1*DSIN(F2)/TOR
L.0059        B(I)=F1*DCOS(F2)/TOR
L.0060        VO(I)=(B(I)*Q(I)-A(I)*P(I))*TOR
L.0061      7 UO(I)=(A(I)*Q(I)+B(I)*P(I))*TOR
L.0062        DO 100 J=2,NCO
L.0063    100 WRITE(9,101)P(J),Q(J),A(J),B(J),UO(J),VO(J)
L.0064    101 FORMAT(6E20.8)
L.0065        TEMP=0.
L.0066      9 CG=0.5*Q(1)
L.0067 C      EVALUATION OF PROFILE
L.0068 C      ***********************************************************************
L.0069        DO 6 I=2,NCO
L.0070      6 CG=CG+UO(I)*DSIN(WA(I)*T)+VO(I)*DCOS(WA(I)*T)
L.0071        CGF(NN)=CG
L.0072        TT(NN)=T
L.0073        IF(CG.GT.TEMP)TEMP=CG
L.0074        NN=NN+1
L.0075        IF(T.GT.TF)GO TO 99
L.0076        T=T+DELT2
L.0077        GO TO 9
L.0078        99 NN=NN-1
L.0079        Z=FAC/TEMP
L.0080        DO 102 K=1,NN
L.0081    102 CGF(K)=Z*CGF(K)
L.0082        DO 141 L=1,NN,16
L.0083    141 WRITE(6,140)(CGF(L+I),I=1,16)
L.0084    140 FORMAT(16F6.1)
L.0085        READ(9,1)DUMMY
L.0086        END
L.0087 /DATA

END OF PRINT * NO OF LINES PRINTED-     87
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BUTANE.

REGENERATION OF THE OUTPUT CURVE USING MODEL 1 . (PARAMETERS = FUNCTION OF FREQUENCY)

A0= .601 U0= 8.489 M0= 64.282 K0= 488.578

START POINT NUMBER = 722 FINISH POINT NUMBER = 953 TIME AXIS INTERVAL = .144

CONCENTRATION PROFILE.

-2.1	-2.1	-2.2	-2.2	-2.1	-2.1	-2.1	-2.0	-1.9	-1.8	-1.6	-1.5	-1.3	-1.1	-.8	-.5
-.2	.1	.5	.9	1.3	1.7	2.2	2.8	3.3	3.9	4.5	5.2	5.9	6.6	7.4	8.1
9.0	9.8	10.7	11.6	12.5	13.5	14.5	15.5	16.5	17.5	18.6	19.7	20.8	21.9	23.0	24.1
25.3	26.4	27.6	28.7	29.9	31.0	32.1	33.3	34.4	35.5	36.6	37.6	38.7	39.7	40.7	41.7
42.7	43.6	44.5	45.3	46.2	47.0	47.7	48.4	49.1	49.7	50.3	50.8	51.3	51.7	52.1	52.5
52.8	53.0	53.2	53.4	53.5	53.5	53.5	53.4	53.3	53.2	53.0	52.8	52.5	52.1	51.8	51.4
50.9	50.4	49.9	49.3	48.7	48.1	47.4	46.7	46.0	45.2	44.4	43.6	42.8	42.0	41.1	40.3
39.4	38.5	37.6	36.7	35.8	34.9	34.0	33.1	32.2	31.3	30.4	29.5	28.6	27.8	26.9	26.1
25.3	24.4	23.7	22.9	22.1	21.4	20.7	20.0	19.3	18.6	18.0	17.4	16.8	16.2	15.7	15.1
14.6	14.2	13.7	13.2	12.8	12.4	12.0	11.7	11.3	11.0	10.7	10.4	10.1	9.8	9.6	9.3
9.1	8.9	8.7	8.5	8.3	8.1	7.9	7.7	7.6	7.4	7.2	7.1	6.9	6.8	6.6	6.5
6.3	6.2	6.0	5.9	5.7	5.6	5.4	5.2	5.1	4.9	4.8	4.6	4.4	4.3	4.1	3.9
3.7	3.6	3.4	3.2	3.0	2.8	2.7	2.5	2.3	2.1	1.9	1.8	1.6	1.4	1.2	1.1
.9	.8	.6	.5	.3	.2	.0	-.1	-.2	-.3	-.5	-.6	-.7	-.8	-.8	-.9
-1.0	-1.1	-1.1	-1.2	-1.2	-1.3	-1.3	-1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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L.0001 /FTC
L.0002 C     REGENERATION OF THE OUTPUT CURVE FOR MODEL 3
L.0003 C     **********************************************************
L.0004       DOUBLE PRECISION CGF(500),TT(500)
L.0005       DOUBLE PRECISION DA(50),UA(50),BMA(50),AKA(50),A(50),P(50),Q(50),B(50),UO(50),VO(50),WA(50)
L.0006       DOUBLE PRECISION W,D,U,X,BM,AK,FF,SS,Z,Y,BE,UU,V,THETA,RR,AL,F1,F2
L.0007     2 FORMAT(5E20.8)
L.0008     3 FORMAT(4I5,2E20.8)
L.0009     4 FORMAT(I3,2D20.8)
L.0010     1 FORMAT(4Y)
L.0011    10 FORMAT(//)
L.0012    11 FORMAT(' REGENERATION OF THE OUTPUT CURVE USING MODEL 3 .'//)
L.0013    12 FORMAT(' DO=',F10.3,5X,' UO=',F10.3,5X,' MO=',F10.3 //)
L.0014    13 FORMAT(' START POINT NUMBER =',I4,5X,'FINISH POINT NUMBER =',I4,5X,'TIME AXIS INTERVAL =',F5.3/)
L.0015    18 FORMAT(//' CONCENTRATION PROFILE.'/)
L.0016    14 FORMAT(6D20.8)
L.0017 C     READING OF DATA
L.0018 C     **********************************************************
L.0019       READ(9,1)NCO
L.0020       READ(5,2)X,FG,FL,ACOL,TOR
L.0021       READ(5,3)JI1,JI2,JF1,JF2,DELT1,DELT2
L.0022       READ(5,1)AREA
L.0023       READ(5,14)(P(I),Q(I),DA(I),UA(I),BMA(I),AKA(I),I=1,NCO)
L.0024       READ(9,1)DA(1),UA(1),BMA(1)
L.0025       READ(9,1)FAC
L.0026       WRITE(6,10)
L.0027       WRITE(6,11)
L.0028       WRITE(6,12)DA(1),UA(1),BMA(1)
L.0029       WRITE(6,13)JI2,JF2,DELT2
L.0030       WRITE(6,18)
L.0031       NN=1
L.0032       FF=FL/FG
L.0033       PI=DATAN(1.)*4.
L.0034       T=DELT2*JI2
L.0035       TF=DELT2*JF2
L.0036       DO 7 I=2,NCO
L.0037       C1=I-1
L.0038       D=DA(I)
L.0039       U=UA(I)
L.0040       BM=BMA(I)
L.0041       AK=AKA(I)
L.0042       AK=AK*ACOL/FL
L.0043       WA(I)=PI*C1/TOR
L.0044       W=WA(I)
L.0045       THETA=DATAN(4.*W*D*(BM*FF+1.)/(U*U))/2.
L.0046       SS=U*X/(2.*D)
L.0047       RR=DSQRT(DSQRT(U**4/(16.*D**4)+W*(BM*FF+1.)**2*W/(D*D)))
L.0048       AL=SS-X*RR*DCOS(THETA)
L.0049       F1=DEXP(AL)
L.0050       F2=-RR*X*DSIN(THETA)
L.0051       A(I)=-F1*DSIN(F2)/TOR
L.0052       B(I)=F1*DCOS(F2)/TOR
L.0053       VO(I)=(B(I)*Q(I)-A(I)*P(I))*TOR
L.0054     7 UO(I)=(A(I)*Q(I)+B(I)*P(I))*TOR
```

```
L.0055          DO 100 J=2,NCO
L.0056      100 WRITE(9,101)P(J),Q(J),A(J),B(J),UO(J),VO(J)
L.0057      101 FORMAT(6E20.8)
L.0058          TEMP=0.
L.0059        9 CG=0.5*Q(1)
L.0060          DO 6 I=2,NCO
L.0061        6 CG=CG+UO(I)*DSIN(WA(I)*T)+VO(I)*DCOS(WA(I)*T)
L.0062          CGF(NN)=CG
L.0063          TT(NN)=T
L.0064          IF(CG.GT.TEMP)TEMP=CG
L.0065          NN=NN+1
L.0066          IF(T.GT.TF)GO TO 99
L.0067          T=T+DELT2
L.0068          GO TO 9
L.0069          99 NN=NN-1
L.0070          Z=RAD/TEMP
L.0071          DO 102 K=1,NN
L.0072      102 CGF(K)=Z*CGF(K)
L.0073          DO 141 L=1,NN,16
L.0074      141 WRITE(6,140)(CGF(L+I),I=1,16)
L.0075      140 FORMAT(16F6.1)
L.0076          READ(9,1)DUMMY
L.0077          END
L.0078 /DATA

END OF PRINT * NO OF LINES PRINTED-      78
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BUTANE.

REGENERATION OF THE OUTPUT CURVE USING MODEL 3 . (PARAMETERS = FUNCTION OF FREQUENCY)

G0= .988 U0= 8.489 M0= 64.304

START POINT NUMBER = 722 FINISH POINT NUMBER = 953 TIME AXIS INTERVAL = .144

CONCENTRATION PROFILE.

-3.6	-3.6	-3.6	-3.7	-3.7	-3.6	-3.6	-3.6	-3.5	-3.4	-3.2	-3.1	-2.9	-2.7	-2.5	-2.2
-1.9	-1.6	-1.2	-.8	-.4	.0	.5	1.1	1.6	2.2	2.9	3.5	4.2	5.0	5.7	[illegible]
7.4	8.2	9.1	10.0	11.0	12.0	13.0	14.0	15.1	16.2	17.2	18.4	19.5	20.6	21.8	23.0
24.1	25.3	26.5	27.7	28.9	30.1	31.2	32.4	33.6	34.7	35.9	37.0	38.1	39.1	40.2	41.2
42.2	43.2	44.1	45.0	45.8	46.7	47.4	48.2	48.9	49.5	50.1	50.7	51.2	51.6	52.1	52.4
52.7	53.0	53.2	53.3	53.4	53.5	53.5	53.4	53.3	53.2	53.0	52.7	52.4	52.1	51.7	51.3
50.8	50.3	49.7	49.1	48.5	47.9	47.2	46.4	45.7	44.9	44.1	43.3	42.4	41.5	40.7	39.8
38.9	37.9	37.0	36.1	35.1	34.2	33.2	32.3	31.4	30.4	29.5	28.6	27.7	26.8	25.9	25.0
24.2	23.4	22.5	21.7	21.0	20.2	19.5	18.7	18.0	17.4	16.7	16.1	15.5	14.9	14.3	13.8
13.2	12.7	12.3	11.8	11.4	11.0	10.6	10.2	9.9	9.5	9.2	8.9	8.6	8.3	8.1	7.8
7.6	7.4	7.2	7.0	6.8	6.6	6.4	6.2	6.1	5.9	5.7	5.6	5.4	5.3	5.1	5.0
4.9	4.7	4.6	4.4	4.3	4.1	4.0	3.8	3.7	3.5	3.4	3.2	3.1	2.9	2.8	2.6
2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.3	1.2	1.0	.9	.7	.6	.4	.3	.1
.0	-.1	-.2	-.4	-.5	-.6	-.7	-.8	-.9	-1.0	-1.1	-1.1	-1.2	-1.3	-1.3	-1.4
-1.4	-1.4	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

```
L.0001 /FTC  BCD
L.0002 IMPLICIT REAL*8(A-H,O-Z)
L.0003       INTEGER OUTPUT
L.0004  COMMON TO(11,10),P(50),TA(10),E(10,10),A(10),T(10),UU(11),TX(11)
L.0005 COMMON UO,TL,ACTA,ACTB,M,L,ID,N,JJ,IN,IS,NN,INN
L.0006 C
L.0007 C  ********** **********
L.0008 C
L.0009 C                              DOCUMENTATION
L.0010 C
L.0011 C     DEFINITION OF PROGRAM VARIABLES
L.0012 C      N=NUMBER OF VARIABLES
L.0013 C      M=DIMENSIONALITY OF THE SEARCH ,M $ESS THAN OR EQUAL TO N   THE P
L.0014 C     WILL SEARCH THROUGH THE FIRST M VARIABLES
L.0015 C     TA(I)=ITH. COMPONENT OF THE STARTING POINT
L.0016 C     TO(J,I)=THE ITH. COMPONENT OF THE (J-1)END POINT. I.E. TO(3,I) MAR
L.0017 C            THE END  OF THE SEARCH ALONG THE SECOND VECTOR E(2,I)
L.0018 C     E(J,I)=THE ITH.COMPONENT OF THE JTH. SEARCH VECTOR
L.0019 C     ID=THE CUMMULATIVE NUMBER OF FUNCTIONAL EVALUATIONS
L.0020 C      L=THE TOTAL NUMBER OF STAGES
L.0021 C     A(J)=THE STEP SIZE IN THE JTH. DIRECTION
L.0022 C     T(I)=THE WORKING VECTOR THAT CARRIES THE VALUES OF THE VARIABLES
L.0023 C     P(50)=A ROW VECTOR OF SEARCH CONSTANTS AND PARAMETERS
L.0024 C     UU(11)=A WORKING VARIALE
L.0025 C     THE USER MAY MAKE USEMOF THE FOLLOWING VARIABLE. THIS LIST MAY BE
L.0026 C        ADDED TO OR SUBTRACTED FROM SO LONG AS THE COMMON IS KEPT THE
L.0027 C        SAME IN ALL THE SUBROUTINES.
L.0028 C        UO,TL,JJ,IN,NN,INN,TX(11),ACTA,ACTB.
L.0029 C
L.0030 C
L.0031 C  **********
L.0032 C
L.0033 C              FORMAT STATEMENTS
L.0034 C
L.0035  1001 FORMAT(3Y)
L.0036  1002 FORMAT(10Y)
L.0037  1003 FORMAT(10Y)
L.0038  1004 FORMAT(10Y)
L.0039  1005 FORMAT(10Y)
L.0040 1006 FORMAT(1H,1X,' ROSENBROCK SEARCH WITH ',I3,' VARIABLES ',I3,I2)
L.0041  1007 FORMAT(/,1X,' THE P-VECTOR IS ',/,(/,5(F8.3,2X)))
L.0042  1008 FORMAT(1X,/,1X,'THE INTIAL SEARCH MATRIX ',(/,10(F8.4,2X)))
L.0043  1009 FORMAT(/,1X,'THE STEP SIZES ',/1X,10(F8.4,2X))
L.0044  1010 FORMAT(/,1X,' THE INTIAL VALUES FOR EACH OF THE VARIABLES ',/5(/,1X,'T(',I2,')=',F8.3,5X,'T(',I2,')=',F8.3))
L.0045  1011 FORMAT(/,1X,'THIS IS THE END OF SEARCH',I2,/,1X,'THE MINIMUM VALUEOF THE OBJECTIVE FUNCTION IS',E14.7,/1X,'THE TERMINAL
CONT.   VALUES OF THE VARIABLES ARE' ,5(/,1X,'T(',I2,')=',E14.7,5X,'T(',I2,')=',E14.7))
L.0046  1012 FORMAT(////,1X,'THIS IS THE END OF STAGE',  I3,/1X,'THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS',I6,/1X,'THE VALUE OF
CONT.   THE OBJECTIVE FUNCTION IS',E14.7,/1X,'THE COORDINATES OF THE END POINT ARE',/1X,4(E14.7,5X))
L.0047  1013 FORMAT(/1X,'THE NEW SEARCH MATRIX')
L.0048  1014 FORMAT(/1X,'THE TOTAL NUMBER OF STAGES IS ',I3,'AND THIS HAS EXCEDED THE DESIRED NUMBER')
L.0049  1015 FORMAT(/,1X,'THE SEARCH ROUTINE HAS CONVERGED WITH IN THE DESIREDLIMITS')
L.0050  1016 FORMAT(5(1X,E14.7,5X))
L.0051 C
L.0052 C     DEFINITION OF THE LOGICAL INPUT/OUTPUT UNITS
```

```
C
      INPUT=5
      OUTPUT=1
      UO=0.D0
C
C                                DATA DEFINITION
C
C        THE FOLLOWING VARIABLES MUST BE DEFINED ON INPUT
C     N
C     M,LESS THAN OR EQUAL TO N
C     P(1),A(J)/P(1)=MINIMUM STEP SIZE
C     P(2)=10.
C     P(3)=MINMUM DESIRED VALUE OF THE OBJECTIVE FUNCTION
C     P(4)=MAXIMUM ALLOWABLE CHANGE IN EACH VARIABLE FOR CONVERGENCE
C     P(5) MAY NOT BE USED
C     P(6)=MAXIMUM NUMBER OF STAGES DESIRED
C     P(7)=STEP SIZE REDUCTION AT THE END OF EACH STAGE
C     P(8-29),FREE FOR USERS BENIFIT
C     P(31-40)=MAXIMUM VALUE FOR EACH OFTHE VALIABLES
C     P(41-50)=MINIMUM VALUES FOR EACH OF THE VARIABLES
C     E(N,N)=SEARCH MATRIX
C     USER CAN USE 1 0 0
C                  0 1 0
C                  0 0 1
C     A(J)=STEP SIZE  (.1)
C     TA(I)=THE COORDINATE OF A FEASIBLE STARTING POINT
C
C     DATA INPUT
C
      READ(INPUT,1001)N,M,JJ
      READ(INPUT,1002)(P(I), I=1,50)
      READ(INPUT,1003)((E(I,J),J=1,10),I=1,10)
      READ(INPUT,1004)(A(I),I=1,10)
      READ(INPUT,1005)(TA(I),I=1,10)
      WRITE(OUTPUT,1006)N,M,JJ
      WRITE(OUTPUT,1007)(P(I),I=1,50)
      WRITE(OUTPUT,1008)((E(I,J),J=1,10),I=1,10)
       WRITE(OUTPUT,1009)(A(I),I=1,10)
      WRITE(OUTPUT,1010)(I,TA(I),I=1,10)
      DO 115 I=1,N
      T(I)=TA(I)
  115 TO(M+1,I)=T(I)
      CALL U (P(5))
      ID=0
      L=0
      WRITE(OUTPUT,1012)L,ID,P(5),(TO(M+1,I),I=1,N)
      L=1
      ID=1
C
C     MINIMIZIATION CYCLE
C
  110 CALL COSER
      WRITE(OUTPUT,1012)L,ID,P(5),(TO(M+1,I),I=1,N)
C
C     CONVERGENCE TESTS
C
      IF(P(5)-P(3))100,100,101
  101 DO 102 I=1,N
  102 TA(I)=TO(M+1,I)
```

```
L.0112          DO 103 I=1,M
L.0113          IF(DABS(TO(M+1,I)-TO(1,I))-P(4))103,103,104
L.0114   103    CONTINUE
L.0115   100    CONTINUE
L.0116          GOTO 112
L.0117 C
L.0118 C        MATRIX ROTATION BY THE GRAM-SCHMIT PROCESS
L.0119 C
L.0120   104     CALL COPIP(N,E,TO)
L.0121          L=L+1
L.0122          DO 201 I=1,N
L.0123   201      A(I)=A(I)*P(7)
L.0124 C
L.0125 C        TEST TO SEE THAT THE COMPONENTS OF THE NEW MATRIX DO NOT EXCEDE 1.
L.0126 C
L.0127          DO 105 J=1,N
L.0128          DO 105 I=1,N
L.0129          IF(DABS(E(I,J))-1.DD)105,105,106
L.0130   105     CONTINUE
L.0131          GOTO 107
L.0132   106    DO 108 I=1,N
L.0133          DO 108 J=1,N
L.0134   108    E(I,J)=0.DD
L.0135          DO 109 I=1,N
L.0136   109    E(I,I)=1.DD
L.0137   107    WRITE(OUTPUT,1013)
L.0138          DO 114 J=1,N
L.0139   114    WRITE(OUTPUT,1016)(E(J,I),I=1,N)
L.0140          IF(L-P(6))110,110,111
L.0141   111    WRITE(OUTPUT,1014)L
L.0142          GOTO 113
L.0143   112    WRITE(OUTPUT,1015)
L.0144   113    STOP
L.0145          END
L.0146 /FTC    BCD
L.0147           SUBROUTINE CQSER
L.0148 IMPLICIT REAL*8(A-H,O-Z)
L.0149 C
L.0150 C        THIS IS A FIBONACCI SEARCH ROUTINE
L.0151 C
L.0152          REAL*8 AJ(21)
L.0153          REAL*8 TI(10)
L.0154           DIMENSION AA1(10),AT(10),BT(10),TMIN(10),TMAX(10)
L.0155 COMMON TO(11,10),P(50),TA(10),E(10,10),A(10),T(10),UU(11),TX(11)
L.0156 COMMON UC,TL,ACTA,ACTB,M,L,ID,N,JJ,IN,IS,NN,INN
L.0157          DO 191 I=1,N
L.0158          AA1(I)=A(I)/P(1)
L.0159          AT(I)=A(I)
L.0160          BT(I)=A(I)/P(2)
L.0161           TO(1,I)=TA(I)
L.0162          LL=30+I
L.0163          LM=LL+10
L.0164          TMAX(I)=P(LL)
L.0165          TMIN(I)=P(LM)
L.0166           TI(I)=T(I)
L.0167   191     T(I)=TA(I)
L.0168          DO 350 J=1,M
L.0169          P(5)=AA1(J)
L.0170          IF (DABS(AT(J))-DABS( (5))) 340,1801,1801
```

```
 1801 CONTINUE
      CALL U(ANS)
      UU(1)=ANS
      ID=ID+1
      K=1
      LLL=0
      AJ(1)=1.D0
      AJ(2)=1.D0
      DO 961 I=1,M
  961 T1(I)=T(I)
      CALL GRAD(T,J ,IG)
      ID=ID+2
      DO 962 I=1,M
  962  T(I)=T1(I)
      GO TO(200,190,190,200,212),IG
  190 AT(J)=-AT(J)
      BT(J)=-BT(J)
  200 CONTINUE
      CA=AT(J)
      IDD=0
  210 DO 221 I=1,N
       T(I)=TO(J,I )+CA*E(J,I)
      IF( T(I)-TMAX(I))2101,2102,2102
 2102  T(I)=TMAX(I)-.001D0
      GO TO 220
 2101 IF( T(I)-TMIN(I))2104,2104,221
 2104  T(I)=TMIN(I)+.001D0
  220  CONTINUE
  221 CONTINUE
        LLL=LLL+1
      CALL U(ANS)
      U11=ANS
      ID=ID+1
      IF(U11-UU(J))270,2701,2701
 2701 GOTO(250,5205,260),K
 5205 IF(LLL-2)320,320,5206
 5206 CA=CA-AT(J)*AJ(LLL-1)+AT(J)
      LLL=0
      AJ(1)=1.D0
      AJ(2)=1.D0
      GOTO 210
  250 K=3
      U11P=U11
      CA=CA-BT(J)
      GO TO 210
  260 CA=CA-BT(J)
      IF(U11-U11P)211,212,212
  211 U11P=U11
      IDD=IDD+1
      IF(IDD-11)210,212,212
  212   CA=.00001D0*A(J)
      GO TO 32
  270 GO TO (280,290,300),K
  280 K=2
  290  UU(J)=U11
      IF(LLL-20)5203,5204,5204
 5204 AJ(1)=AJ(LLL-2)
      AJ(2)=AJ(LLL-1)
      LLL=3
```

```
L.0230        GOTO 5002
L.0231   5203 IF(LLL-2)5001,5001,5002
L.0232   5001 CA=CA+AT(J)
L.0233        GOTO 210
L.0234   5002 AJ(LLL)=AJ(LLL-1)+AJ(LLL-2)
L.0235        CA=CA+AT(J)*AJ(LLL)
L.0236        GOTO 210
L.0237    300 DO 310 I=1,N
L.0238    310 TO(J+1,I)= T(I)
L.0239        UU(J) =U11
L.0240        UU(J+1)=UU(J)
L.0241        GO TO 350
L.0242    320 CA=CA-AT(J)
L.0243    321 DO 330 I=1,N
L.0244         T(I)=TO(J,I)+CA*E(J,I)
L.0245        IF( T(I)-TMIN(I))5100,5100,5101
L.0246   5100   T(I)=TMIN(I)+.00100
L.0247        GOTO 330
L.0248   5101  IF( T(I)-TMAX(I))330,5102,5102
L.0249   5102   T(I)=TMAX(I)-.00100
L.0250    330 TO(J+1,I)= T(I)
L.0251        UU(J+1)=UU(J)
L.0252        GO TO 350
L.0253    340 CA=0.00
L.0254        DO 5004 I=1,N
L.0255   5004   TO(J+1,I)=TO(J,I)
L.0256        UU(J+1)=UU(J)
L.0257    350     CONTINUE
L.0258        P(  = UU(M+1)
L.0259              DO 2000        I=1,N
L.0260   2000        T(I)=TO(N+1,I)
L.0261              CALL U(ANS)
L.0262        RETURN
L.0263        END
L.0264 /FTC   BCD
L.0265        SUBROUTINE GRAD(A,J,IG)
L.0266 IMPLICIT REAL*8(A-H,O-Z)
L.0267  REAL*8 A(10)
L.0268        DIMENSION A(10),X(10),AB(10),AO(10)
L.0269 COMMON TO(11,10),P(50),TA(10),E(10,10),Z(10),T(10),UU(11),TX(11)
L.0270 COMMON UC,TL,ACTA,ACTB,M,L,ID,N,JJ,IN,IS,NN,INN
L.0271        DO 182 I=1,N
L.0272    182  X(I)=E(J,I)*Z (J)
L.0273        DO 31 I=1,M
L.0274        AO(I)=A(I)
L.0275    31  AB(I)=AO(I)
L.0276        DO 101 I=1,M
L.0277   101  T(I)=AB(I)
L.0278        CALL U(ANS)
L.0279        V=ANS
L.0280        V1=V
L.0281        DO 32 I=1,M
L.0282    32  AB(I)=AO(I)+X(I)*.0010
L.0283        DO 102 I=1,M
L.0284   102  T(I)=AB(I)
L.0285        CALL U(ANS)
L.0286        V=ANS
L.0287        V2=V
L.0288        IF(V2-V1)33,34,35
```

```
C      THE FIRST DERIVATI   IS NEGATIVE
 33    IG=1
       RETURN
C      THE FIRST DERIVATIVE IS POSITIVE
 35    IG=2
       RETURN
 34    DO 36 I=1,M
  36   AB(I)=AO(I)-X(I)*.001D0
       DO 103 I=1,M
 103   T(I)=AB(I)
       CALL U(ANS)
       ID=ID+1
       V=ANS
       VO=V
       IF(V1-VO)37,38,39
C      THE SECOND DERIVATIVE IS NEGATIVE
 39    IG=3
       RETURN
C      THE SECOND DERIVATIVE IS POSITIVE
 37    IG=4
       RETURN
 38    N2=1
  2     DO 1 I=1,M
  1    AB(I)=AO(I)-.001D0*X(I)*(-1.D0)**(N2+1)*2.D0**(N2)
       DO 104 I=1,M
 104   T(I)=AB(I)
       CALL U(ANS)
       ID=ID+1
       V=ANS
       VO=V
       IF(V1-VO)3:,3,39
  :    N2=N2+1
       IF(N2-5 )2,40,40
C      BOTH THE FIRST AND SECOND DERIVATIVES ARE ZERO
 40    IG=5
       RETURN
       END
/FTC   BCD
       SUBROUTINE CQPIP(N,E,TO)
IMPLICIT REAL*8(A-H,O-Z)
 REAL*8 E(10,10),TO(11,10)
C      *
C       THIS IS ROSENBROCK@S METHOD OF FORMING AN N DIMENSIONAL ORTHOGONA
C      SET E(J,I). THE INTIAL VECTOR E(1,I) IS THE UNIT VECTOR IN THE
C      DIRECTION TO(1,I) TO TO(J+1,I).
C      *
       REAL*8       C(10,10),TO(11,10),A(10,10),B(10,10),MODB(10),E(10,10)
       REAL*8 MOD,F(10,10)
       DO 1 J=1,N
       DO 1 I=1,N
  1    C(J,I)=TO(J+1,I)-TO(J,I)
       DO 16 J=1,N
       DO 16 I=1,N
       SUM=0.DO
       DO 2 K=J,N
  2    SUM=SUM+C(K,I)
C      *
C       THE SET OF VECTORS A(J,I) REPRESENTS THE VECTORS TO(1,I) TO
C      TO(J+1,I), TO(2,I) TO TO(J+1,2),...,TO(J,I) TOTO(J+1,I)
```

```
C      *
  16   A(J,I) =SUM
       DO 3 I=1,N
  3    B(1,I)=A(1,I)
       MOD=0.DO
       DO 4 I=1,N
  4    MOD=MOD+(B(1,I))**2
C      *
C      MODB(J) IS THE SQUARE ROOT OF THE SUM OF SQUARES I.E. THE NOR-
C      MALISING FACTOR
C      *
       MODB(1)=DSQRT(MOD)
       IF(MODB(1).LE.0.DO) GOTO 13
       DO 5 I=1,N
  5    E(1,I)=B(1,I)/MODB(1)
       SUM=0.DO
       DO 6 I=1,N
  6    SUM=SUM+A(2,I)*E(1,I)
       DO  8 I=1,N
  8    B(2,I)=A(2,I)-SUM*E(1,I)
       SUM=0.DO
       DO 9 I=1,N
  9    SUM=SUM+B(2,I)**2
       MODB(2)=DSQRT(SUM)
       IF(MODB(2).LE.0.DO) GOTO 13
       DO 10 I=1,N
C      *
C      E(2,I) IS THE UNIT VECTOR IN THE DIRECTION TO(1,I) TO TO(J+1,I)
C      E(2,I) IS THE UNIT VECTOR ORTHOGONAL TO E(1,I)
C      *
  10   E(2,I)=B(2,I)/MODB(2)
C      *
C      IF N IS LESS THAN 3 THE SUBROUTINE OPTS OUT
C      *
       IF(N-3)7,11,11
  11   DO 14 K=3,N
       DO 15 I=1,N
       SOM=0.DO
       DO 12 J=2,K
       SUM=0.DO
       DO 18 L=1,N
  18   SUM=SUM +A(K,L)*E(J-1,L)
  12   SOM=SOM+SUM*E(J-1,I)
  15   F(K,I) = SOM
       DO 21 I=1,N
  21   B(K,I)=A(K,I)-F(K,I)
       MOD=0.DO
       DO 17 I=1,N
  17   MOD=MOD+B(K,I)**2
       MODB(K)=DSQRT(MOD)
       IF(MODB(K).LE.0.DO) GOTO 13
C      *
C      A SET OF UNIT VECTORS E(J,I) (J=3,...) IS FORMED MUTUALLY
C      ORTHOGONAL AND ORTHOGONAL TO E(1 AND 2,I)
C      *
       DO 14 I=1,N
  14   E(K,I)=B(K,I)/MODB(K)
       GOTO 7
  13   DO 22 J=1,N
```

```
L.0407          DO 22 I=1,N
L.0408    22    E(I,J)=0.DO
L.0409          DO 23 I=1,N
L.0410    23    E(I,I)=1.DO
L.0411    7     CONTINUE
L.0412          RETURN
L.0413          END

END OF PRINT * NO OF LINES PRINTED-    413
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```
L.0001 /FTC
L.0002       SUBROUTINE U(ANS)
L.0003 IMPLICIT REAL*8(A-H,O-Z)
L.0004  REAL*8 ANS
L.0005 COMMON TO(11,10),P(50),TA(10),E(10,10),A(10),T(10),UU(11),TX(11)
L.0006 COMMON UO,TL,ACTA,ACTB,M,L,ID,N,JJ,IN,IS,NN,INN
L.0007 REAL*8 WA(50),AD(50),BD(50),AC(50),BC(50)
L.0008 900 FORMAT(Y)
L.0009 901 FORMAT(5E20.8)
L.0010 902 FORMAT(40X,2E20.8)
L.0011 IF(UO.GT.0.)GO TO 910
L.0012 READ(5,900)NCO
L.0013 NCC=NCO+1
L.0014 PI=4.*DATAN(1.)
L.0015 READ(5,901)XX,FG,FL,ACOL,TOR
L.0016 FF=FL/FG
L.0017 READ(5,902)(AD(I),BD(I),I=1,NCO)
L.0018 910 UO=UO+1.
L.0019 DD=T(1)
L.0020 U=T(2)
L.0021 BM=T(3)
L.0022 AK=T(4)
L.0023       AK=AK*ACOL/FL
L.0024 C     EVALUATION OF THE FOURIER COEFFICIENTS
L.0025 C     ***************************************************************
L.0026       DO 970 I=2,NCC
L.0027       C1=I-1
L.0028       WA(I)=PI*C1/TOR
L.0029       W=WA(I)
L.0030       SS=U*XX/(2.*DD)
L.0031       Z= SS*SS
L.0032       Y=1.D+00/DSQRT((BM*W/AK)**2+1.)
L.0033       BE=-DATAN(BM*W/AK)
L.0034       UUU=Z-XX*XX*AK/DD*(Y*DCOS(BE)-1.)*FF
L.0035       V=XX*XX/DD*(W-AK*Y*DSIN(BE)*FF)
L.0036       THETA=DATAN(V/UUU)/2.
L.0037       RR=DSQRT(DSQRT(UUU*UUU+V*V))
L.0038       AL=SS-RR*DCOS(THETA)
L.0039       F1=DEXP(AL)
L.0040       F2=-RR*DSIN(THETA)
L.0041 AC(I)=-F1*DSIN(F2)/TOR
L.0042 970 BC(I)=F1*DCOS(F2)/TOR
L.0043 SSQ=0.
L.0044 AC(1)=0.
L.0045 BC(1)=0.5/TOR
L.0046 DO 971 I=1,NCO
L.0047 971 SSQ=SSQ+(AC(I)-AD(I))**2+(BC(I)-BD(I))**2
L.0048 ANS=SSQ
L.0049 RETURN
L.0050 END
```

END OF PRINT * NO OF LINES PRINTED- 50

REMOTE PRINT/DISPLAY FOR USER NO 20 FILE NAME MG61 DEPT OF CHEM ENG DATE= 69-339 TIME= 18-04-31 V1-1

```
L.0001 ,  ROSENBROCK SEARCH WITH   4 VARIABLES   4 1
L.0002
L.0003    THE P-VECTOR IS
L.0004
L.0005 *000.000     10.000      0.000       .001      0.000
L.0006
L.0007    50.000     1.000      0.000      0.000      0.000
L.0008
L.0009     0.000      0.000      0.000      0.000      0.000
L.0010
L.0011     0.000      0.000      0.000      0.000      0.000
L.0012
L.0013     0.000      0.000      0.000      0.000      0.000
L.0014
L.0015     0.000      0.000      0.000      0.000      0.000
L.0016
L.0017     1.000     10.000     65.000   1000.000      0.000
L.0018
L.0019     0.000      0.000      0.000      0.000      0.000
L.0020
L.0021      .500      8.000     64.000    400.000      0.000
L.0022
L.0023     0.000      0.000      0.000      0.000      0.000
L.0024
L.0025  THE INTIAL SEARCH MATRIX
L.0026   1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0027
L.0028   0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0029
L.0030   0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0031
L.0032   0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0033
L.0034   0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0035
L.0036   0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000
L.0037
L.0038   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000
L.0039
L.0040   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000
L.0041
L.0042   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000
L.0043
L.0044   0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000
L.0045
L.0046  THE STEP SIZES
L.0047     .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000
L.0048
L.0049   THE INTIAL VALUES FOR EACH OF THE VARIABLES
L.0050
L.0051  T( 1)=     .698      T( 2)=    8.489
L.0052  T( 3)=   64.304      T( 4)=  522.478
L.0053  T( 5)=    0.000      T( 6)=    0.000
L.0054  T( 7)=    0.000      T( 8)=    0.000
```

```
T( 5)    0.000      T(10)=    0.000


 THIS IS THE END OF STAGE  0
 THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS      0
 THE VALUE OF THE OBJECTIVE FUNCTION IS  .5340823D-05
 THE COORDINATES OF THE END POINT ARE
   .6978891D+00        .8488784D+01        .6430408D+02        .5224785D+03


 THIS IS THE END OF STAGE  1
 THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS     48
 THE VALUE OF THE OBJECTIVE FUNCTION IS  .5052007D-05
 THE COORDINATES OF THE END POINT ARE
   .5978891D+00        .8488785D+01        .6425408D+02        .4847785D+03

 THE NEW SEARCH MATRIX
  -.2652508D-02         .2652508D-07        -.1326254D-02        -.9999956D+00
   .9999965D+00         .7035825D-10        -.3517912D-05        -.2652506D-02
   .1975226D-06       -1.0000000D+00        -.3903128D-10        -.3197442D-07
  -.8115646D-12         .4108754D-05         .9999991D+00        -.1326259D-02


 THIS IS THE END OF STAGE  2
 THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS    100
 THE VALUE OF THE OBJECTIVE FUNCTION IS  .5038686D-05
 THE COORDINATES OF THE END POINT ARE
   .6024779D+00        .8488784D+01        .6430137D+02        .4902784D+03

 THE NEW SEARCH MATRIX
   .8343094D-03        -.1784565D-06        .8598740D-02         .9999627D+00
  -.2425478D+00        -.2026673D-04        .9701053D+00        -.8139627D-02
   .9701391D+00        -.5066803D-05        .2425320D+00        -.2894974D-02
   .4336809D-11        1.0000000D+00        .2089127D-04        -.1182106D-08


 THIS IS THE END OF STAGE  3
 THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS    157
 THE VALUE OF THE OBJECTIVE FUNCTION IS  .5028925D-05
 THE COORDINATES OF THE END POINT ARE
   .6006432D+00        .8488784D+01        .6428246D+02        .4880785D+03

 THE NEW SEARCH MATRIX
  1.0000000D+00         .0000000D-75         .0000000D-75         .0000000D-75
   .0000000D-75        1.0000000D+00         .0000000D-75         .0000000D-75
   .0000000D-75         .0000000D-75        1.0000000D+00         .0000000D-75
   .0000000D-75         .0000000D-75         .0000000D-75        1.0000000D+00
```

```
L.0114  THIS IS THE END OF STAGE  4
L.0115  THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS   209
L.0116  THE VALUE OF THE OBJECTIVE FUNCTION IS  .5028913D-05
L.0117  THE COORDINATES OF THE END POINT ARE
L.0118    .6006432D+00        .8488785D+01        .6428246D+02        .4885785D+03
L.0119
L.0120  THE NEW SEARCH MATRIX
L.0121   -.5551115D-16         .2000000D-05         .0000000D-75        1.0000000D+00
L.0122   1.0000000D+00         .7629395D-05         .0000000D-75         .0000000D-75
L.0123    .2775558D-10       -1.0000000D+00         .0000000D-75         .1999984D-05
L.0124    .2775558D-10       -1.0000000D+00         .0000000D-75         .3366857D-05
L.0125
L.0126
L.0127
L.0128
L.0129  THIS IS THE END OF STAGE  5
L.0130  THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS   258
L.0131  THE VALUE OF THE OBJECTIVE FUNCTION IS  .5028913D-05
L.0132  THE COORDINATES OF THE END POINT ARE
L.0133    .6006432D+00        .8488783D+01        .6428246D+02        .4885785D+03
L.0134
L.0135  THE SEARCH ROUTINE HAS CONVERGED WITH IN THE DESIREDLIMITS

END OF PRINT * NO OF LINES PRINTED-   135
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L.0001 ,  ROSENBROCK SEARCH WITH   3 VARIABLES   3 1
L.0002
L.0003    THE P-VECTOR IS
L.0004
L.0005 *000.000     10.000      0.000       .001      0.000
L.0006
L.0007    50.000     1.000      0.000      0.000      0.000
L.0008
L.0009     0.000     0.000      0.000      0.000      0.000
L.0010
L.0011     0.000     0.000      0.000      0.000      0.000
L.0012
L.0013     0.000     0.000      0.000      0.000      0.000
L.0014
L.0015     0.000     0.000      0.000      0.000      0.000
L.0016
L.0017     1.000    10.000     65.000   1000.000      0.000
L.0018
L.0019     0.000     0.000      0.000      0.000      0.000
L.0020
L.0021      .500     8.000     64.000    400.000      0.000
L.0022
L.0023     0.000     0.000      0.000      0.000      0.000
L.0024
L.0025    THE INTIAL SEARCH MATRIX
L.0026     1.0000    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0027
L.0028     0.0000    1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0029
L.0030     0.0000    0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0031
L.0032     0.0000    0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0033
L.0034     0.0000    0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000     0.0000
L.0035
L.0036     0.0000    0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000     0.0000
L.0037
L.0038     0.0000    0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000     0.0000
L.0039
L.0040     0.0000    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000     0.0000
L.0041
L.0042     0.0000    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     0.0000
L.0043
L.0044     0.0000    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     1.0000
L.0045
L.0046    THE STEP SIZES
L.0047       .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000      .1000
L.0048
L.0049     THE INTIAL VALUES FOR EACH OF THE VARIABLES
L.0050
L.0051    T( 1)=     .698      T( 2)=    8.489
L.0052    T( 3)=   64.304      T( 4)=  522.478
L.0053    T( 5)=    0.000      T( 6)=    0.000
L.0054    T( 7)=    0.000      T( 8)=    0.000
L.0055    T( 9)=    0.000      T(10)=    0.000
L.0056
L.0057
L.0058
L.0059
L.0060    THIS IS THE END OF STAGE  0
L.0061    THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS      0
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L.0062  THE VALUE OF THE OBJECTIVE FUNCTION IS  .1379424D-04
L.0063  THE COORDINATES OF THE END POINT ARE
L.0064    .6978892D+00          .8488781D+01          .6430408D+02
L.0065
L.0066
L.0067
L.0068
L.0069  THIS IS THE END OF STAGE  1
L.0070  THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS    39
L.0071  THE VALUE OF THE OBJECTIVE FUNCTION IS  .4776596D-05
L.0072  THE COORDINATES OF THE END POINT ARE
L.0073    .9978891D+00          .8488785D+01          .6430408D+02
L.0074
L.0075  THE NEW SEARCH MATRIX
L.0076   1.0000000D+00          .3333333D-05          .3333333D-05
L.0077   -.4714045D-05          .7071068D+00          .7071068D+00
L.0078    .2284785D-20         -.7071068D+00          .7071068D+00
L.0079
L.0080
L.0081
L.0082
L.0083  THIS IS THE END OF STAGE  2
L.0084  THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS    81
L.0085  THE VALUE OF THE OBJECTIVE FUNCTION IS  .4774412D-05
L.0086  THE COORDINATES OF THE END POINT ARE
L.0087    .9878891D+00          .8488786D+01          .6430408D+02
L.0088
L.0089  THE NEW SEARCH MATRIX
L.0090  -1.0000000D+00          .6737734D-04          .6737734D-04
L.0091    .9523595D-04          .7071068D+00          .7071068D+00
L.0092   -.1995133D-12         -.7071068D+00          .7071068D+00
L.0093
L.0094
L.0095
L.0096
L.0097  THIS IS THE END OF STAGE  3
L.0098  THE TOTAL NUMBER OF FUNCTIONAL EVALUATIONS IS   116
L.0099  THE VALUE OF THE OBJECTIVE FUNCTION IS  .4774412D-05
L.0100  THE COORDINATES OF THE END POINT ARE
L.0101    .9878881D+00          .8488786D+01          .6430408D+02
L.0102
L.0103  THE SEARCH ROUTINE HAS CONVERGED WITH IN THE DESIREDLIMITS
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L.0001 /FTC
L.0002 C      REGENERATION OF THE OUTPUT CURVE FOR MODEL 1
L.0003 C      ********************************************************************
L.0004        DOUBLE PRECISION CGF(500),TT(500)
L.0005        DOUBLE PRECISION DA(50),UA(50),BMA(50),AKA(50),A(50),P(50),Q(50),B(50),UO(50),VO(50),WA(50)
L.0006        DOUBLE PRECISION W,D,U,X,BM,AK,FF,SS,Z,Y,BE,UU,V,THETA,RR,AL,F1,F2
L.0007      2 FORMAT(5E20.8)
L.0008      3 FORMAT(4I5,2E20.8)
L.0009      4 FORMAT(I3,2D20.8)
L.0010      1 FORMAT(4Y)
L.0011     10 FORMAT(//)
L.0012     11 FORMAT(' REGENERATION OF THE OUTPUT CURVE USING MODEL 1 .'//)
L.0013     12 FORMAT(' DO=',F10.3,5X,' UO=',F10.3,5X,' MO=',F10.3,5X,' KO=',F10.3//)
L.0014     13 FORMAT(' START POINT NUMBER =',I4,5X,'FINISH POINT NUMBER =',I4,5X,'TIME AXIS INTERVAL =',F5.3///)
L.0015     18 FORMAT(' CONCENTRATION PROFILE.'/)
L.0016     14 FORMAT(6D20.8)
L.0017 C      READING OF DATA
L.0018 C      ********************************************************************
L.0019         READ(9,1)NCO
L.0020        READ(5,2)X,FG,FL,ACOL,TOR
L.0021        READ(5,3)JI1,JI2,JF1,JF2,DELT1,DELT2
L.0022        READ(5,1)AREA
L.0023        READ(5,14)(P(I),Q(I),DA(I),UA(I),BMA(I),AKA(I),I=1,NCO)
L.0024        READ(9,1)DA(1),UA(1),BMA(1),AKA(1)
L.0025        READ(9,1)FAC
L.0026        WRITE(6,10)
L.0027        WRITE(6,11)
L.0028        WRITE(6,12)DA(1),UA(1),BMA(1),AKA(1)
L.0029        WRITE(6,13)JI2,JF2,DELT2
L.0030        WRITE(6,18)
L.0031        NN=1
L.0032        FF=FL/FG
L.0033        PI=DATAN(1.)*4.
L.0034        T=DELT2*JI2
L.0035        TF=DELT2*JF2
L.0036 C      EVALUATION OF THE FOURIER COEFFICIENTS
L.0037 C      ********************************************************************
L.0038        DO 7 I=2,NCO
L.0039        C1=I-1
L.0040        D=DA(1)
L.0041        U=UA(1)
L.0042        BM=BMA(1)
L.0043        AK=AKA(1)
L.0044        AK=AK*ACOL/FL
L.0045        WA(I)=PI*C1/TOR
L.0046        W=WA(I)
L.0047        SS=U*X/(2.*D)
L.0048        Z= SS*SS
L.0049        Y=1.D+00/DSQRT((BM*W/AK)**2+1.)
L.0050        BE=-DATAN(BM*W/AK)
L.0051        UU=Z-X*X*AK/D*(Y*DCOS(BE)-1.)*FF
L.0052        V=X*X/D*(W-AK*Y*DSIN(BE)*FF)
L.0053        THETA=DATAN(V/UU)/2.
L.0054        RR=DSQRT(DSQRT(UU*UU+V*V))
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L.0055          AL=SS-RR*L...(THETA)
L.0056          F1=DEXP(AL)
L.0057          F2=-RR*DSIN(THETA)
L.0058          A(I)=-F1*DSIN(F2)/TOR
L.0059          B(I)=F1*DCOS(F2)/TOR
L.0060          VO(I)=(B(I)*Q(I)-A(I)*P(I))*TOR
L.0061        7 UO(I)=(A(I)*Q(I)+B(I)*P(I))*TOR
L.0062          DO 100 J=2,NCO
L.0063      100 WRITE(9,101)P(J),Q(J),A(J),B(J),UO(J),VO(J)
L.0064      101 FORMAT(6E20.8)
L.0065          TEMP=0.
L.0065        9 CG=0.5*Q(1)
L.0067 C        EVALUATION OF PROFILE
L.0068 C        ************************************************************************
L.0069          DO 6 I=2,NCO
L.0070        6 CG=CG+UO(I)*DSIN(WA(I)*T)+VO(I)*DCOS(WA(I)*T)
L.0071          CGF(NN)=CG
L.0072          TT(NN)=T
L.0073          IF(CG.GT.TEMP)TEMP=CG
L.0074          NN=NN+1
L.0075          IF(T.GT.TF)GO TO 99
L.0076          T=T+DELT2
L.0077          GO TO 9
L.0078          99 NN=NN-1
L.0079          Z=FAC/TEMP
L.0080          DO 102 K=1,NN
L.0081      102 CGF(K)=Z*CGF(K)
L.0082          DO 141 L=1,NN,16
L.0083      141 WRITE(6,140)(CGF(L+I),I=1,16)
L.0084      140 FORMAT(16F6.1)
L.0085          READ(9,1)DUMMY
L.0086          END
L.0087 /DATA

END OF PRINT * NO OF LINES PRINTED-     87
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TIME.

GENERATION OF THE OUTPUT CURVE USING MODEL 1 .

.001 U0= 8.439 M0= 64.282 K0= 488.576

START POINT NUMBER = 722 FINISH POINT NUMBER = 953 TIME AXIS INTERVAL = .144

CENTRATION PROFILE.

-.1	-.7	-.7	-.6	-.5	-.4	-.2	-.1	.1	.3	.5	.7	.8	1.2	1.5	1.8
.0	2.5	2.9	3.4	3.8	4.3	4.8	5.3	5.8	6.5	7.1	7.7	8.4	9.1	9.8	10.5
.3	13.1	13.7	14.3	14.9	15.5	16.1	17.1	17.8	18.5	19.3	20.1	20.9	21.7	22.5	23.4
.8	27.5	28.5	29.6	30.6	31.7	32.7	33.8	34.9	35.9	36.9	37.9	38.8	39.8	40.7	41.7
.4	43.4	44.3	45.1	45.9	46.6	47.4	48.1	48.7	49.3	49.9	50.4	50.9	51.4	51.8	52.2
.6	52.8	53.0	53.2	53.3	53.4	53.5	53.5	53.5	53.4	53.3	53.2	53.0	52.8	52.5	52.1
.8	51.1	50.6	50.1	49.6	49.0	48.4	47.7	47.0	46.3	45.5	44.8	44.0	43.2	42.4	41.5
.7	40.6	39.8	37.9	37.0	36.1	35.1	34.2	33.2	32.3	31.3	30.3	29.3	28.3	27.3	26.3
.7	24.7	23.8	22.9	22.1	21.2	20.3	19.5	18.7	17.9	17.2	16.4	15.7	15.0	14.2	13.5
.9	12.2	11.6	11.0	10.4	9.8	9.3	8.8	8.3	7.8	7.4	7.0	6.6	6.2	5.8	5.4
.1	5.0	4.5	4.2	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.1	1.9	1.8
.6	1.5	1.4	1.3	1.2	1.1	1.0	.9	.8	.7	.7	.6	.5	.5	.4	.4
.3	.3	.2	.0	-.0	-.1	-.2	-.3	-.4	-.4	-.5	-.6	-.6	-.7	-.7	-.8
-.8	-.9	-.9	-1.0	-1.0	-1.1	-1.1	-1.1	-1.2	-1.2	-1.3	-1.3	-1.3	-1.4	-1.4	-1.4
-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0