```
//BURN EXEC FORTGCLG
//FORT.SYSIN DD *
C     THIS IS A ONE-DIMENSIONAL Q-CODE ADAPTED FROM ONE WRITTEN BY
C     JOHN O. ERKMAN OF SRI, WHO MODELED AFTER ONE WRITTEN BY
C     MARK WILKINS OF LRL.  AN APPROXIMATE DESCRIPTION CAN BE FOUND
C     IN "COMPUTATIONAL PHYSICS.  VOL. III," EDITED BY ALDER AND
C     FERNBACH AND ROTENBERG
C     THE PROBLEM IS SET UP IN SUBROUTINE "DECIDE."
C     THE MEANING OF KEY SYMBOLS IS DESCRIBED THERE.
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C3CTRL/ COUNTS,JSTAR,JPE,JPB,JQUIT,LAST,CYCLES
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1MASS(300),CSP(300)
      COMMON /C7GNRL/ ALP,OPTION,CONA,CQ,LEFTP
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
C
     1  BURNS,HS2
      REAL  L,MASS,LINEAR,LEFTP
C
      CALL DECIDE
C     THE FOLLOWING DO LOOPS ENDING AT STATEMENT 9 CALCULATE THE
C     POSITION OF THE J'TH CELL IN CM AND ITS MASS IN GRAMS.  RHO(S)=
C     DENSITY OF REGION S IN GRAMS/CC.
      DO 9 S=2,S1
      HS1=H(S-1)+1
      HS2=H(S)
      DO 9 J=HS1,HS2
      X(J+1)=X(J)+DX(S)
    9 MASS(J)=(X(J+1)**ALP-X(J)**ALP)*RHO(S)
C
C     THE VARIABLES IN THE FOLLOWING FOUR WRITE STATEMENTS HAVE BEEN
C     DEFINED IN SUBROUTINE DECIDE.
      WRITE(6,951)ALP,DELT,DTMX,CONA,CQ
      WRITE(6,952)CYCLES,COUNTS,JQUIT
  952 FORMAT('0','CYCLES',6X,'COUNTS',6X,'JQUIT'/I6,4X,I6,6X,I6)
      WRITE(6,957)S1,(BURN(S),S=2,S1)
      WRITE(6,961)TAU,LEFTP,U(1),OPTION
C
      IF (OPTION.EQ.6) CALL FLIER
      IF (OPTION.NE.6) JSTAR=5
C
      CALL WRITE1
C
      CQSQ=CQ**2
      CQSQ4=4.0*CQSQ
      LINEAR=1.0+CONA+CONA
C     "TIMES"=T, THE TIME VARIABLE, MEASURED FROM ZERO.
      TIMES=0.0
      CYCLE=0
C     "JCRIT"=NO. OF SPACE CELL FOR WHICH TLIMA(J) HAD ITS MINIMUM
C     VALUE IN THE PREVIOUS CYCLE.
      JCRIT=0
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C      "LAST" IS AN INTEGER CONTROL PARAMETER WHICH DIRECTS THE
C      SUBROUTINE "WRITE" TO PERFORM A TERMINAL COMPUTATION AFTER THE
C      INTEGRATION HAS BEEN COMPLETED.
       LAST=0
C      "DTN" IS THE VALUE OF "DELT" CALCULATED IN THE CYCLE BEFORE LAST.
       DTN=DELT
       DELTI=DELT+DELT
C-----START OF TIME LOOP
C      PPEAK=MAXIMUM VALUE OF PRESSURE CALCULATED IN PREVIOUS CYCLE.
   40  PPEAK=0.0
C      TLIMB=TLIMA(JCRIT)=MINIMUM VALUE OF TLIMA(J).
       TLIMB=1.0
       TIMES=TIMES+DELT
       CYCLE=CYCLE+1
   50  J=1
       S=2
       J1=2
       JT=3
       PLEFT=0.0
C      COMMENT EVALUATE P FOR FIRST CELL AND U AND X ON LEFT BOUNDARY
       GO TO (51,52,53,54,60,60),OPTION
   51  IF(TIMES .LE. TAU) PLEFT=LEFTP
       GO TO 60
   52  IF(TIMES .LE. TAU) PLEFT=((-TIMES/TAU)+1.0)*LEFTP
       GO TO 60
   53  PLEFT=LEFTP*EXP(-0.46*TIMES)
   54  CONTINUE
   60  IF(ALP.EQ.1)U(1)=-((P(1)+Q(1)-PLEFT)/(X(2)-X(1)))*V(1)*DELTI+U(1)
       XA=U(1)*DELT+X(1)
C-----START OF J-LOOP
   70  IF(J.GT.H(S)) S=S+1
   78  DENU=(X(JT)-X(J1))/V(J1)+(X(J1)-X(J))/V(J)
   79  U(J1)=(DELTI*(P(J)-P(J1)+Q(J)-Q(J1)))/DENU+U(J1)
   80  X(J)=XA
       XA=DELT*U(J1)+X(J1)
       IF(J .EQ. H(S1)) X(J1)=XA
       IF(ABS(U(J1)) .LT. 5.0E-5) U(J1)=0.0
       VN=(XA**ALP-X(J)**ALP)/MASS(J)
       DELU=U(J1)-U(J)
       DELX=XA-X(J)
C
C-----GET Q FOR SHOCK
C      "QA"=NEW VALUE OF ARTIFICIAL VISCOUS STRESS; Q(J) IS "OLD" VALUE.
   87  QA=-DELU*(CQSQ*ABS(DELU)+CONA*CSP(J))/VN
       IF(QA .LT. 0.0) QA=0.0
C      "TLIMA(J)=TIME PARAMETER USED IN CALCULATING THE VALUE OF DELT
C      FOR THE NEXT TIME STEP.  AT THIS POINT VN, THE NEW VALUE OF
C      SPECIFIC VOLUME, AND QA ARE AVAILABLE, SO THE INFORMATION REQUIRED
C      FOR CALCULATING PRESSURE IN CELL J,P(J),ENERGY,F(J), ETC. IS AT
C      HAND.  THESE CALCULATIONS ARE MADE IN SUBROUTINES B_EQST(S,J),
C      WHICH ARE ENTRY POINTS IN B_INIT(S).  CONTROL IS TRANSFERRED TO
C      SUBROUTINE EQST(S,J), AND FROM THIS IT IS TRANSFERRED TO THE
C      APPROPRIATE B_EQST(S,J).
       TLIMA(J)=DELX/(LINEAR*CSP(J)+CQSQ4*ABS(DELU))
       CALL EQST(S,J)
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      IF(ABS(P(J)) .LE. 1.0E-5) P(J)=1.0134E-6
      V(J)=VN
      Q(J)=QA
      IF(TLIMA(J).GE.TLIMB) GO TO 129
      JCRIT=J
      TLIMB=TLIMA(J)
  129 IF(P(J)+Q(J).LE.PPEAK) GO TO 131
      PPEAK=(P(J)+Q(J))
C     "JPMAX" IS THE VALUE OF J FOR WHICH PPEAK TAKES ITS MAXIMUM VALUE.
      JPMAX=J
  131 J=J+1
      J1=J+1
      JT=J1+1
C     "JSTAR" IS A VALUE OF J AHEAD OF THE WAVE FRONT AT WHICH COMPUTING
C     STOPS PREPARATORY TO ADVANCING TIME BY ANOTHER INCREMENT.  JSTAR
C     IS ADVANCED BY UNITY WHENEVER PARTICLE VELOCITY, U(JSTAR),
C     BECOMES NON-NEGLIGIBLE.
      IF(J.LE.JSTAR+1) GO TO 70
C-----TEST TO ADVANCE JSTAR
      IF(ABS(U(JSTAR+1)).GT.1.0E-5) JSTAR=JSTAR+1
      IF((CYCLE.EQ.CYCLES).OR.(TIMES.GE.TQUIT).OR.(J.EQ.JQUIT))GO TO 169
      IF(CYCLE.GT.10)COUNTS=20
C     TO CHANGE FREQUENCY OF PRINT-OUT, A STATEMENT CAN BE INSERTED
C     HERE:  "IF (CYCLE.GT. K) COUNTS=MN" WHERE "K" AND "MN" ARE
C     INTEGERS TO BE CHOSEN BY THE PROGRAMMER.
      IF(MOD(CYCLE,COUNTS).NE.0) GO TO 180
      GO TO 170
  169 LAST=1
  170 JPB=1
      JPE=JSTAR+2
      CALL WRITE
  180 DTNH1=0.6*TLIMB
      IF(DTNH1/DELT.GT.1.1) DTNH1=1.1*DELT
      IF(DTNH1.GT.DTMX) DTNH1=DTMX
      DTN=DELT
      DELT=DTNH1
      DELTI=DTN+DELT
      GO TO 40
C
  951 FORMAT(1H1,6X,3HALP,9X,4HDELT,11X,4HDTMX,11X,4HCONA,12X,2HCQ/7X,I1
     -,4F15.6)
  957 FORMAT(1HO,8X,2HS1,5X,8HBURN()../8X,I2,9X,9I5/2X)
  961 FORMAT(1HO,5X,3HTAU,16X,5HLEFTP,14X,4HU(1),15X,6HOPTION/3E19.8,I8)
      END
      SUBROUTINE DECIDE
C
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C3CTRL/ COUNTS,JSTAR,JPE,JPB,JQUIT,LAST,CYCLES
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
      COMMON /C7GNRL/ ALP,OPTION,CONA,CQ,LEFTP
      DIMENSION ZON(9)
C
```

```
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
      REAL  L,MASS,LINEAR,LEFTP
C
C     CHOOSE GEOMETRY.  ALP IS AN INTEGER LABEL WHICH IS TO BE SET
C     ACCORDING TO THE GEOMETRY OF THE PROBLEM.
C     X IS THE EULERIAN SPACE COORDINATE.  THE INITIAL VALUE AT T=0
C     OF THE LEFT BOUNDARY OF CELL 1 IS SET HERE.  THE POSITIONS OF
C     OTHER CELL BOUNDARIES ARE CALCULATED IN MAIN FROM THE NUMBER OF
C     ZONES AND THE DIMENSIONS OF THE PROBLEM.
C     FOR CYLINDRICAL AND SPHERICAL PROBLEMS, LEFT BOUNDARY IS
C     INTERPRETED AS INNER BOUNDARY.
C         ALP = 1 FOR PLANE GEOMETRY
C         ALP = 2 FOR CYLENDRICAL GEOMETRY
C         ALP = 3 FOR SPHERICAL GEOMETRY
      ALP=1
C-----CHOOSE COORDINATES OF FIRST CELL
      X(1)=0.0
C-----NUMBER OF REGIONS PLUS ONE (NOT TO EXCEED 9)
C     THIS PROGRAM CAN BE RUN WITH SEVERAL REGIONS OF DIFFERENT
C     MATERIALS.  THE NUMBER OF SUCH REGIONS IS DENOTED BY AN INTEGER
C     S1-1.  THIS PECULIAR CONVENTION ARISES BECAUSE OF A CHARACTERISTIC
C     OF FORTRAN--ZERO INDICES ARE NOT ALLOWED.  EACH DISTINCT REGION IS
C     DENOTED BY AN INTEGER LABEL S.  S=2 IS THE LEFT-MOST REGION, S=3
C     THE NEXT TO THE RIGHT, ETC. UP TO S1.
C     EACH REGION IS DIVIDED INTO A NUMBER OF SPACE ZONES OR CELLS,
C     ZON(S).  THE NUMBER OF CELLS UP TO AND INCLUDING REGION S
C     (STARTING WITH THE LEFTMOST REGION) IS H(S)=SUM(ZON(K)),
C     K=2 TO S, INCLUSIVE.
      S1=2
C-----MATERIAL IN REGIONS
C     "BURN(S)" IS AN INTEGER LABEL WHICH DEFINES THE MATERIAL OF
C     REGION S.
C         BURN(S) = 1 FOR EXPLOSIVE
C         BURN(S) = 2 FOR VOID
C         BURN(S) = 3 FOR LIQUID
C         BURN(S) = 4 FOR SOLID
C         BURN(S) = 5 FOR PHASE TRANSITION
      BURN(2)=5
C-----SET OPTION
C     "OPTION" IS AN INTEGER LABEL WHICH DESCRIBES THE TYPE OF PROBLEM
C     TO BE SOLVED.  IF OPTION=1,2, OR 3, THE PROBLEM IS ONE IN WHICH
C     A SPECIFIED PRESSURE IS APPLIED TO THE LEFT HAND BOUNDARY.  IF
C     OPTION=5, AN EXPLOSIVE REGION IS INCLUDED AND ITS DETONATION
C     PROVIDES THE DRIVING FORCE.  OPTION=6 MEANS THAT THE FIRST REGION
C     (S=2) IS A FLYER PLATE WHICH HAS JUST COLLIDED WITH THE SECOND
C     REGION (S=3) AT THE START OF THE PROBLEM.  WHEN THIS HAPPENS,
C     EACH CELL IN REGION 1 (S=2) IS GIVEN THE FLYER PLATE VELOCITY
C     U(1), EXCEPT THE ONE ADJACENT TO REGION 2(S=3) THIS CELL AND THE
C     FIRST CELL IN REGION 2 (S=3) ARE GIVEN VELOCITIES U(1)/2 FOR
C     SMOOTHING PURPOSES.  WHEN OPTION=1, THE TIME DURATION, TAU, OF
C     THE APPLIED PRESSURE MUST BE SET.  FOR A CONSTANT PRESSURE APPLIED
C     AT T=0, SET TAU EQUAL TO A LARGE NUMBER, SAY 500 (MICROSECONDS).
C     FOR OPTION=2, TIME TAU IS THE TIME AT WHICH THE APPLIED PRESSURE
C     EQUALS ZERO IN A LINEAR RAMP.  OPTION=3 HAS A BUILT-IN TIME
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C      CONSTANT.  THE PEAK APPLIED PRESSURE IN EACH CASE IS "LEFTP" IN
C      MEGABARS.
C          OPTION = 1 GIVES SQUARE PULSE
C          OPTION = 2 GIVES LINEAR PULSE
C          OPTION = 3 GIVES EXPONENTIAL
C          OPTION = 4 UNASSIGNED
C          OPTION = 5 GIVES NO PULSE (FOR EXPLOSION)
C          OPTION = 6 GIVES NO PULSE (FOR FLYER PLATE)
       OPTION=1
C-----IF OPTION = 1 OR 2, SET TAU
       TAU=500.0
C-----IF OPTION = 6, SET U(1) (FOR FLYER PLATE)
       U(1)=0.0
C-----IF OPTION = 1,2, OR 3, SET LEFTP (PRESSURE ON LEFT BOUNDARY)
       LEFTP=0.200
C-----VISCOSITY COEFFICIENT (CQ FOR QUADRATIC AND CONA FOR LINEAR)
       CONA=0.1
       CQ=2.0
C-----LENGTH OF RUN MAY BE DETERMINED BY SETTING ANY OR ALL OF NEXT
C      WHEN CYCLE=CYCLES OR TIMES=TQUIT OR J=JQUIT, COMPUTATION WILL
C      STOP, WHICH EVER OCCURS FIRST.
C      J IS THE INTEGER LABEL OF THE SPACE CELLS.  J=1 AT THE LEFTMOST
C      CELL OF THE LEFTMOST REGION AND RUNS TO H(S1), THE RIGHTMOST CELL
C      OF THE RIGHTMOST REGION.
C               CYCLES= NUMBER OF INCREMENTS IN TIME
C          TQUIT (PROPAGATION TIME)
C          JQUIT (NUMBER OF LAST CELL)
       CYCLES=100
       TQUIT=260
       JQUIT=25
       JQUIT=250
C-----THE NUMBER OF ZONES IN REGION K IS ZON(K)
       ZON(2) =50
C-----THE THICKNESS OF REGION K IN CM. IS L(K)
       L(2)=5.0
C-----DELT IS STARTING VALUE FOR DELTAT
C      "DELTAT" IS THE TIME-INCREMENT FROM ONE CYCLE TO THE NEXT,
C      MICROSECONDS.
       DELT=.05
C-----DTMX IS UPPER LIMIT FOR DELTAT
       DTMX=.05
C-----PRINTOUTS OF CYCLES IS MODULO COUNTS
C      "COUNTS" CONTROLS PRINTING.  IF COUNTS=5, THE STANDARD FLOW
C      VARIABLES U,P,Q,E,V, ETC. ARE PRINTED OUT EVERY FIFTH CYCLE, ETC.
C      FREQUENTLY "COUNTS" IS SET =1 IN "DECIDE", THEN AFTER THE FIRST
C      FEW CYCLES INCREMENTED TO 10 OR 20.
       COUNTS=1
C      H(S) IS AN INTEGER LABEL EQUAL TO THE NUMBER OF SPACE CELLS TO
C      THE LEFT OF AND INCLUDING REGION S.
       H(1) = 0
       DO 12 S=2,S1
       DX(S) = L(S)/FLOAT(ZON(S))
   12  H(S)=H(S-1) + ZON(S)
C-----CALL ROUTINES TO SET INITIAL REGIONS
C      AT THIS POINT CONTROL IS TRANSFERRED TO B_INIT(S) FOR S=2 TO S1,
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C     WHERE _ IS AN INTEGER FROM 1 TO 5, CORRESPONDING TO THE VALUE
C     OF BURN(S).  FOR EXAMPLE IF S1=4 AND BURN(2)=1, BURN(3)=4, AND
C     BURN(4)=3, THEN B1INIT(2), B4INIT(3), B3INIT(4) ARE CALLED IN
C     TURN; I.E., THE NEXT THREE STATEMENTS WOULD BE:  "CALL B1INIT(2)",
C     "CALL B4INIT(3)", "CALL B3INIT(4)".
      CALL B5INIT(2)
C
      RETURN
  102 FORMAT (10I4)
  906 FORMAT(23I3)
  907 FORMAT(7(14F5.2/))
      END
      SUBROUTINE EQST(S,J)
C
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
C
      BURNS=BURN(S)
      GO TO (101,102,103,104,105,106,107,108,109),BURNS
  101 CALL B1EQST(S,J)
  102 RETURN
  103 CALL B3EQST(S,J)
      RETURN
  104 CALL B4EQST(S,J)
      RETURN
  105 CALL B5EQST(S,J)
      RETURN
  106 RETURN
  107 RETURN
  108 RETURN
  109 RETURN
      END
      SUBROUTINE FLIER
C
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C3CTRL/ COUNTS,JSTAR,JPE,JPB,JQUIT,LAST,CYCLES
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
C
      REAL  L,MASS,LINEAR,LEFTP
C
      JSTAR=H(2)+2
      H2=H(2)
      DO 43 J=1,H2
   43 U(J+1)=U(1)
      U(H2+1)=0.5*U(H2+1)
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      RETURN
      END
      SUBROUTINE B1INIT (S)
C     THIS SUBROUTINE IS A DUMMY WHICH ALLOWS FOR FUTURE EXPANSION
      GO TO 12
      ENTRY B1EQST(S,J)
      GO TO 101
   12 CONTINUE
  101 CONTINUE
      RETURN
      END
      SUBROUTINE B3INIT (S)
C     THIS SUBROUTINE IS A DUMMY WHICH ALLOWS FOR FUTURE EXPANSION
      GO TO 14
      ENTRY B3EQST(S,J)
      GO TO 121
   14 CONTINUE
  121 CONTINUE
      RETURN
      END
      SUBROUTINE B4INIT (S)
C     THIS SUBROUTINE IS A DUMMY WHICH ALLOWS FOR FUTURE EXPANSION
      GO TO 13
      ENTRY B4EQST(S,J)
      GO TO 90
   13 CONTINUE
   90 CONTINUE
      RETURN
      END
      SUBROUTINE B5INIT(S)
C     THIS SUBROUTINE IS WRITTEN SPECIFICALLY FOR IRON WITH A SHOCK-
C     INDUCED PHASE TRANSITION.
C     THE PARAMETERS ARE DEFINED IN APPENDIX II OF "EQUATION OF STATE
C     IN SOLIDS," BY G. E. DUVALL, G. R. FOWLES, AND Y. HORIE, SUMMARY
C     REPORT ON CONTRACT NO. DA-04-200-AMC-1702(X), BALLISTICS RESEARCH
C     LABORATORY, ABERDEEN PROVING GROUND, MD., FEB., 1967.
C
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
      COMMON /C5THER/ TMP(300),ENT(300)
      COMMON /C6TEMP/ ET,PT
      COMMON /B5DATA/ VO(9),A1,A2,A3,DV(9),TAUO,NSA(300),PM,GAMM1(9),
     1  FRACT2(300),V1(300),XEQ(300),VP,V2
C     VP = SPECIFIC VOLUME AT WHICH HUGONIOT INTERSECTS PHASE BDRY
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
      REAL  L,M,LINEAR,LEFTP
C
      GO TO 14
      ENTRY B5EQST(S,J)
      GO TO 121
```

```
C
C  ENTRY POINT TO INITIALIZE BURN 5************************************
C
C
   14 RHO(S)=7.84
      A1=1.667
      A2=3.4
      A3=0.0
      DV(S)=-.004
      PM=.130
      CV1=.45E-05
      CVMIX=.46E-05
      GAMM1(S)=1.6
      EO=0.0
      TO=300.0
      DPDTMX=-6.5E-05
      TAUO=3.0
C
      VO(S)=1.0/RHO(S)
      VP=VO(S)/(1.0+(-A1+SQRT(A1**2.+4.0*A2*PM))/(2.0*A2))
      V2=VP+DV(S)
      WRITE(6,960) RHO(S),A1,A2,A3,DV(S),PM,CV1,DX(S),CVMIX,GAMM1(S),EO,
     1 TO,DPDTMX,TAUO,H(S),L(S)
      CSPS=.5
      HS1=(H(S-1)+1)
      HS2=H(S)+2
      DO 39 J=HS1,HS2
      V(J)=VO(S)
   33 U(J+1)=0.0
      Q(J)=0.0
      P(J)=1.0134E-6
      TLIMA(J)=DELT
      CSP(J)=CSPS
      V1(J)=VO(S)
      FRACT2(J)=0.0
      E(J)=0.0
      ENT(J)=0.0
      TMP(J)=TO
      NSA(J)=1
      XEQ(J)=0.0
   39 CONTINUE
      RETURN
C
C  ENTRY POINT TO SET EQUATIONS OF STATE FOR BURN5**********************
C
  121 NSW=NSA(J)
      GO TO (220,222),NSW
C-----MATERIAL IS IN PHASE 1
  220 ETAM1=(VO(S)/VN)-1.0
      PT=A1*ETAM1+A2*ETAM1**2
      CSP(J)=(A1*VO(S)+2.*A2*VO(S)*(VO(S)/VN-1.)+3.*A3*VO(S)*(VO(S)/VN-
     1 1.)**2.)**.5
      ET=E(J)-0.5*(P(J)+PT+QA+Q(J))*(VN-V(J))
      IF(ABS(PT).LT.1.0E-5)PT=0.0
      IF(PT.GE.PM)CALLZMIX(S,J)
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```
      P(J)=PT
      E(J)=ET
      RETURN
  222 CALL ZMIX(S,J)
      E(J)=ET
      P(J)=PT
      RETURN
C
  960 FORMAT(1HO,5X,3HRHO,12X,2HA1,12X,2HA2,12X,2HA3,12X,2HDV,12X,2HPM,
     1 11X,3HCV1,12X,5HDX(S),/1X,8E14.6,/1HO,4X,5HCVMIX,9X,5HGAMM1,11X,
     2 2HEO,12X,2HTO,10X,6HDPDTMX,11X,4HTAUO,11X,4HH(S),11X,4HL(S),/
     3 6E14.6,4X,I7,3X,E14.6)
      END
      SUBROUTINE ZMIX(S,J)
C
C     THIS SUBROUTINE SUITABLE FOR COMPRESSION PHASE ONLY
C
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
      COMMON /C6TEMP/ ET,PT
      COMMON /B5DATA/ VO(9),A1,A2,A3,DV(9),TAUO,NSA(300),PM,GAMM1(9),
     1  FRACT2(300),V1(300),XEQ(300),VP,V2
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
      REAL  L,MASS,LINEAR,LEFTP
C
C
      NSA(J)=2
      XO=FRACT2(J)
      XEQO=XEQ(J)
      CA=TAUO*DELT
      IF(VN.GT.VP) GO TO 2
      IF (VN.GT.V2) GO TO 3
      XEQN=1.0
      GO TO 6
    2 XEQN=0.0
      GO TO 6
    3 XEQN=1.0+(VN-V2)/DV(S)
    6 CONTINUE
      XN=(XO*(1.0-CA/2.0)+0.5*(XEQO+XEQN)*CA)/(1.+CA/2.0)
      IF(XN.LT.0.0) XN=0.0
      VT= VN-XN*DV(S)
      EMU1=(VO(S)/VT)-1.0
      PT=A1*EMU1+A2*EMU1**2.
      CSP(J)=(A1*VO(S)+2.*A2*VO(S)*(VO(S)/VN-1.)+3.*A3*VO(S)*(VO(S)/VN-
     1 1.)**2.)**.5
      ET=E(J)-0.5*(PT+P(J)+QA+Q(J))*(VN-V(J))
      V1(J)=VT
      FRACT2(J)=XN
      XEQ(J)=XEQN
      RETURN
```

```
      END
      SUBROUTINE WRITE
      COMMON /C1ZON/ H(9),BURN(9),L(9),DX(9),S1,RHO(9)
      COMMON /C2TIME/ TIMES,CYCLE,DELT,DTN,DTMX,TLIMA(300),JCRIT,
     1  TQUIT,TAU
      COMMON /C3CTRL/ COUNTS,JSTAR,JPE,JPB,JQUIT,LAST,CYCLES
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
      COMMON /C5THER/ TMP(300),ENT(300)
      COMMON /C7GNRL/ ALP,OPTION,CONA,CQ,LEFTP
      COMMON /B5DATA/ V0(9),A1,A2,A3,DV(9),TAU0,NSA(300),PM,GAMM1(9),
     1  FRACT2(300),V1(300),XEQ(300),VP,V2
C
      INTEGER  H,BURN,S,S1,ZON,CYCLE,COUNTS,CYCLES,ALP,OPTION,H2,HS1,HS,
     1  BURNS,HS2
C
      REAL  L,MASS,LINEAR,LEFTP
C
      GO TO 14
      ENTRY WRITE1
      GO TO 121
   14 WRITE(6,302)
      WRITE(6,304)TIMES,DELT,DTN,CYCLE,JCRIT
      WRITE(6,306)
      S=2
      IF( JPB.EQ.1 .AND. JSTAR.GT.H(2)+10 ) JPB=H(2)
      DO 330 J=JPB,JPE
      IF(J.GT.H(S)) S=S+1
  310 WRITE(6,318)J,U(J),V(J),P(J),E(J),Q(J),FRACT2(J),V1(J),X(J),TMP(J)
     1,TLIMA(J)
  330 CONTINUE
C-----NEXT TWO STATEMENTS (COMMENTS) ARE TO BE USED IF GRAPHING IS DESIRED
      CALL MANUAL(1.25*LEFTP,0.)
      CALL GRAPH1(P,JPE)
      IF(LAST.EQ.1)CALL EXIT
      RETURN
  121 WRITE(6,862)
      DO 46 J =1,2
   46 WRITE(6,962)J,U(J),V(J),P(J),E(J),Q(J),FRACT2(J),V1(J),X(J),     T
     -MP(J),TLIMA(J)
      DO 57 S=2,S1
      HS1=H(S)-1
      HS2=H(S)+2
      DO 57 J=HS1,HS2
   57 WRITE(6,962)J,U(J),V(J),P(J),E(J),Q(J),FRACT2(J),V1(J),X(J),     T
     -MP(J),TLIMA(J)
      RETURN
  302 FORMAT(1H1)
  304 FORMAT(10X,6HTIME= ,E14.8,4X,6HDELT= ,E14.8,4X,5HDTN= ,E14.8,4X,7H
     -CYCLE= ,I5,4X,7HJCRIT= ,I5/5X)
  306 FORMAT(2X,1HJ,6X,1HU,9X,1HV,9X,1HP,9X,1HE,9X,1HQ,7X,6HFRACT2,6X,
     1   2HV1,9X,1HX,9X,3HTMP,6X,5HTLIMA//5X)
  318 FORMAT(I4,8F10.6,F7.1,E13.5)
  862 FORMAT(2X,1HJ,6X,1HU,9X,1HV,9X,1HP,9X,1HE,9X,1HQ,7X,6HFRACT2,6X,
     1   2HV1,9X,1HX,9X,3HTMP,6X,5HTLIMA//2X)
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```
  962 FORMAT(I4,8F10.6,F7.1,E13.5)
    3 FORMAT(1HO,2X,6HTIME= ,E14.8,4X,5HUFS= ,E14.8,4X,5HXFS= ,E14.8,4X,
     -7HCYCLE= ,I4,3X,7HJPMAX= ,I4,3X,7HJCRIT= ,I4/2X)
      END
      SUBROUTINE GRAPH4(A,B,C,D,N)
C
      COMMON /C3CTRL/ COUNTS,JSTAR,JPE,JPB,JQUIT,LAST,CYCLES
      COMMON /C4FLOW/ U(300),V(300),X(300),Q(300),P(300),E(300),QA,VN,
     1 MASS(300),CSP(300)
      COMMON /C7GNRL/ ALP,OPTION,CONA,CQ,LEFTP
C
      REAL  L,MASS,LINEAR,LEFTP
      DIMENSION A(N), B(N), C(N), D(N), POINT(4), GRAPH(122)
      DATA POINT/1HA,1HB,1HC,1HD/
      DATA MSWTCH,BLANK,PERIOD/0,1H ,1H./
      M=4
      IF(MSWTCH.EQ.1) GO TO 50
      AMAX=D(1)
      AMIN=D(1)
      DO 1 I=1,N
      IF(AMAX.LT.D(I)) AMAX=D(I)
    1 IF(AMIN.GT.D(I)) AMIN=D(I)
      GO TO 2
      ENTRY GRAPH3(A,B,C,N)
      M=3
      IF(MSWTCH.EQ.1) GO TO 50
      AMAX=C(1)
      AMIN=C(1)
    2 DO 3 I=1,N
      IF(AMAX.LT.C(I)) AMAX=C(I)
    3 IF(AMIN.GT.C(I)) AMIN=C(I)
      GO TO 4
      ENTRY GRAPH2(A,B,N)
      M=2
      IF(MSWTCH.EQ.1) GO TO 50
      AMAX=B(1)
      AMIN=B(1)
    4 DO 5 I=1,N
      IF(AMAX.LT.B(I)) AMAX=B(I)
    5 IF(AMIN.GT.B(I)) AMIN=B(I)
      GO TO 6
      ENTRY GRAPH1(A,N)
      M=1
      IF(MSWTCH.EQ.1) GO TO 50
      AMAX=A(1)
      AMIN=A(1)
    6 DO 7 I=1,N
      IF(AMAX.LT.A(I)) AMAX=A(I)
    7 IF(AMIN.GT.A(I)) AMIN=A(I)
   50 SC=(AMAX-AMIN)/120.
      WRITE(6,100) AMIN,AMAX,SC,(PERIOD,I=1,121)
  100 FORMAT(1H1,17HRANGE OF GRAPH IS,F15.8,8H THROUGH,F15.8//1X,17HSCAL
     1ING FACTOR IS,F15.8//105X,21H111111111111111111111/15X,111H1111111
     211122222222223333333333444444444455555555556666666666777777777888
     388888899999999990000000001111111112/6X,120H1234567890123456789O
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     4123456789012345678901234567890123456789012345678901234567890123456
     5789012345678901234567890123456789012345678901234567890/5X,121A1)
      DO 8 I=1,N
      DO 17 J=1,121
   17 GRAPH(J)=BLANK
      GO TO (9,10,11,12),M
   12 K4=(D(I)-AMIN)/SC+1.
      IF(K4.LT.0.OR.K4.GT.122) K4=122
   11 K3=(C(I)-AMIN)/SC+1.
      IF(K3.LT.0.OR.K3.GT.122) K3=122
   10 K2=(B(I)-AMIN)/SC+1.
      IF(K2.LT.0.OR.K2.GT.122) K2=122
    9 K1=(A(I)-AMIN)/SC+1.
      IF(K1.LT.0.OR.K1.GT.122) K1=122
      GO TO (13,14,15,16),M
   16 GRAPH(K4)=POINT(4)
   15 GRAPH(K3)=POINT(3)
   14 GRAPH(K2)=POINT(2)
   13 GRAPH(K1)=POINT(1)
      IF(GRAPH(121).NE.BLANK) GRAPH(120)=GRAPH(121)
      WRITE(6,101) I,(GRAPH(I1),I1=1,120)
  101 FORMAT(2X,I3,1H.,120A1)
    8 CONTINUE
      MSWTCH=0
      RETURN
      ENTRY MANUAL(A1,A2)
      AMAX=A1
      AMIN=A2
      MSWTCH=1
      RETURN
      END
/*
/*
```