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COMPARE-MOD 1 Code Addendum

R. G. Gido
G. J. E. Willcutt, Jr.
J. L. Lunsford
J. S. Gilbert

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COMPARE-MOD 1 CODE ADDENDUM

by

R. G. Gido, G. J. E. Willcutt, Jr., J. L. Lunsford, and J. S. Gilbert

ABSTRACT

The COMPARE-MOD 1 code has been extended to incorporate an accounting for loss coefficient detail, calculation of forces and moments, and plotting of calculated results. The loss coefficient detail feature includes a complete breakdown of the loss coefficient components, which facilitates checking the input, the calculation of the friction component, and the summation of the components to provide the total loss coefficient. The force-moment capability is based on a general orthogonal cartesian coordinate system that allows pressure-bearing surfaces of arbitrary orientation and location. Plotting is based on the DISSPLA system and features the convenient plotting of key parameters such as pressures, forces and moments, and plotting of any code variable by means of special plotting procedures.

I. INTRODUCTION

The purpose of this report is to describe COMPARE-MOD 1 and to provide input procedures for several recently developed capabilities for the code.[1] The capabilities are (1) accounting for loss coefficient details, (2) calculation of force-moment results, and (3) plotting. The capabilities are described in Sec. II with the required input variables and data formats described in Sec. III. Section IV is a sample problem.

II. NEW CAPABILITY DESCRIPTION

A. Loss Coefficient Detail

This feature provides for inputting and subsequent printing of loss coefficient component details. Such detailing is not required input and is only expected for the junctions appropriately identified by the user. The junctions for which loss coefficient details are not expected will use the loss coefficients as before.[1] This detailing capability was developed to facilitate model evaluation. The details include an accounting for the (1) flow path segments (that is, the upstream-node to junction and the junction to downstream-node segments), (2) the two possible flow directions, and (3) various types of losses, such as those caused by contraction, expansion, friction, and miscellaneous factors such as turning losses. This feature includes the calculation and appropriate

summation of the loss coefficient components by the code. In addition, the display of the details facilitates input checking.

B. Forces and Moments

The force-moment calculations are based on an orthogonal cartesian coordinate system with arbitrary origin and orientation. However, the procedures were formulated with the primary application to nuclear power plant reactor cavity subcompartment analysis anticipated. Thus, a resultant x-y force magnitude and direction is determined to provide pressure vessel lateral load information. For such an analysis, the preferred coordinate system orientation would have the z-axis in the vertical direction.

The force-moment calculation is accomplished by the identification of individual planar surfaces upon which a pressure acts. For a cylindrical surface, these would be the corresponding projected areas. Each surface is identified by its resulting force vector direction in terms of direction cosines and the coordinate system location of the surface area centroid. Forces and moments are thus calculatable for each surface and total component forces and moments are obtained by summation of the appropriate surfaces.

The input requires the identification of the number of force-moment surfaces on the second input card. In addition, user-to-SI conversion factors for the surface area, coordinate length, and force must be included.

Detailed force-moment input takes place after all other input data have been read and before plotting input occurs. At this point, the number of force-moment surfaces will already have been read. To compute forces and moments for each of these surfaces, the user must associate each surface with a pressure. This is done by relating each surface to one of the nodal volumes being carried along in the calculation; that is, by inputting the number assigned to the nodal volume in physical contact with the surface in question. In addition, for each surface, the user must specify its projected area, the three direction cosines for the resulting force vector, and the three rectangular components of the radius arm from the center of the coordinate system to the centroid of the projected area. As a convenience to the user, the code will also accept angles instead of direction cosines. (The area is a positive quantity, whereas both the direction cosines and the radius arm projections may be positive or negative.)

Standard force-moment output includes components and totals for forces and moments for all the force-moment surfaces in the problem. Additional output can be obtained for certain combinations, or subsets, of the surfaces defined in the input phase. In the terminology of COMPARE, these subsets are called force or moment references. Each such reference is specified by enumerating the surfaces making up the subset. The user must also specify the type of component desired; that is, x or y for the horizontal components, z for the vertical component, r for the resultant x-y components, or d for the direction of the r component in the x-y plane. Each subset is computed as an algebraic summation over the elements in the subset. A reference to surface number zero is taken to refer to the total force-moment surface area in the problem. As an example, an output force request for the x-component of the subset "0 15 -17" will produce the force that is the total x-force resulting from the pressures on all of the force-moment surfaces in the problem plus the x-force resulting from the pressure on surface number 15 minus the x-force resulting from the pressure on surface number 17. The user may specify as many as 100 references, with each reference limited to 20 surfaces.

As the code is presently written, the user may specify printed ouput for both thermodynamic and heat sink data with variable print intervals. The force-moment output data are printed with the thermodynamic output data. At the problem end, maximum total (all surfaces) forces, moments, and their time of occurrence are given for the x-, y-, and z-components, along with the maximum total x-y resultant force and its time of occurrence.

COMPARE can plot the 4 variables—pressure, temperature, junction flow rate, and differential pressure as a function of time, with as many as 5 plots per graph, 10 graphs per variable. The force-moment plotting capabilities are related to the force-moment references defined above, and will allow plotting of references in a manner completely analogous to plotting of other variables in the code. To obtain force-moment output plots as a function of time, the user must have specified references in the force-moment phase of input. During the plotting phase, the user has normal plotting control over any of the references previously defined. This will allow the user to plot references as variables—with as many as 5 plots per graph, 10 graphs per variable.

C. Plotting

The plotting capability was developed to facilitate the presentation and understanding of calculated results such as figures and slides. The capability includes convenient plotting of frequently used standard output quantities such as volume pressures and temperatures, junction mass flow rates, pressure differences between volumes and force-moment results. In addition, user-specified plots of any variable vs any other variable selected, by programming modifications in one subroutine, is provided.

Standard plots include volume pressures, volume temperatures, junction mass flow rates, pressure differences between volumes, and force-moment results as a function of time. Up to five curves can be specified per plot and either linear or log time can be used. Minimum and maximum times for plotting are also specified in the input data. Thus, a plot can begin in the middle of a run and finish before the end of the run. Provision is made for skipping time steps between plotted points to permit storage savings for cases with large numbers of time steps. In addition, it is possible to choose a plot symbol frequency so that it is not necessary to have a symbol drawn at each data point plotted. For each standard plot, the user can specify minimum and maximum ordinate values, or these values can be determined from the data values by the program.

User-specified plots are done by programming in a single subroutine (SUSPEC) to set up labels and data for another subroutine that writes the plot data in the proper format on a disk file. The only input data related to user-specified plots is the NSPEC variable on Card Type V1 (see Sec. III). If this variable is zero, then the routine that sets up user-specified plots isn't called. Up to five curves may be used on each user-specified plot with either the same abscissa data for all curves (time) or different abscissa data for each curve (as for five mass flow rates vs five pressure drops). Appendix A describes the use of user-specified plots in detail. It also includes a sample data listing for user-specified plotting and the resulting plots.

Plotting data are written on disk file TAPE2 by the COMPARE program and then read in by the GENPLT program (see Appendix B). GENPLT calls the DISSPLA plotting routines to set up and produce the plots on the CALCOMP plotter. We have tested the plot package at the Los Alamos Scientific Laboratory (LASL) using CALCOMP paper output, Tektronix screen and hard copy output, and FR80 slides output. The sample plots included here were made by the Tektronix hard copy unit and are reduced in scale from those that will be made on the NRC CALCOMP device.

III. INPUT REQUIREMENTS

In this section, the input changes resulting from the COMPARE-MOD 1 (Ref. 1) code modifications discussed in this report are first identified. Then, the complete code input description, which incorporates the modifications, is presented in Appendix C. Section IV presents a sample problem that uses the new code features.

Using the Card Type reference system of Ref. 1, the specific input changes are
(1) old Card Type B expansion to specify the number of force-moment surfaces and the existence of plotting,
(2) old Card Type E expansion to flag possible inputting of loss coefficient detailing,
(3) new Card Type F1 through F8 for inputting loss coefficient details,
(4) old Card Type M expansion to include force-moment user to SI conversion information,
(5) new Card Types U1, U2, etc., for force-moment information, and
(6) new Card Types V1, V2, etc., for plotting input description.

IV. SAMPLE PROBLEM

Figure 1 describes the sample problem geometry, which resembles a nuclear power plant reactor cavity, and specifies the model nodes. Figure 2 specifies the node-junction arrangement, whereas Fig. 3 identifies the force-moment surface designations used. Note that the coordinate system orientation allows the use of fewer pressure nodes because of the symmetry. However, the force-moment surface designation must represent the complete geometry. The complete problem description with its use of the new code additions and results follows.

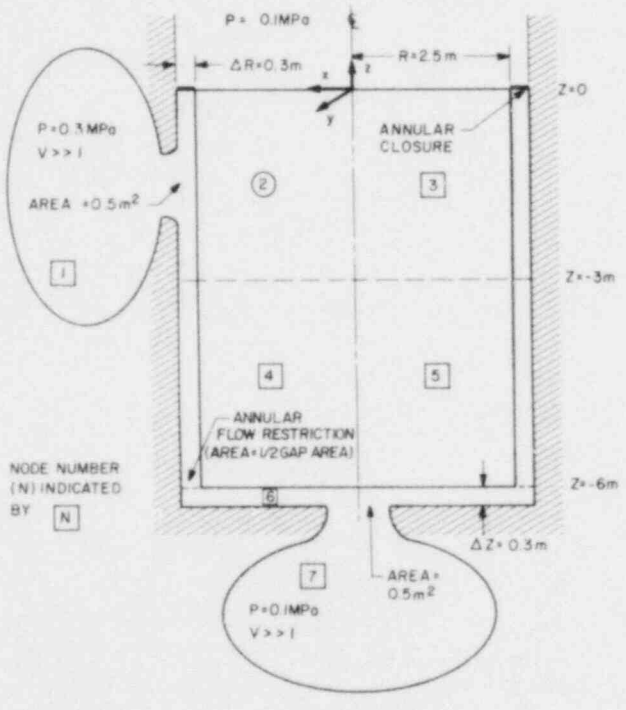

Fig. 1.
Sample problem geometry. (Note that symmetry is assumed. The flow area between nodes 2 and 3 and between nodes 4 and 5 is reduced to one-half of the gap area).

To facilitate the sample problem formulation, the input and output are presented in Appendix D and Figs. 4-9. Appendix D is the problem listing, which includes the input cards, the interpretation and labeling of the input, and the output. Figures 4 through 9 are the standard plots obtained. The special plots obtained are in Appendix A. Our discussion concentrates on the Listing of Input Cards section of Appendix D and will use the column 73-80 input card identification and the Card Type designation (Appendix C). The interpretation and labeling of the input section of the listing provides further information.

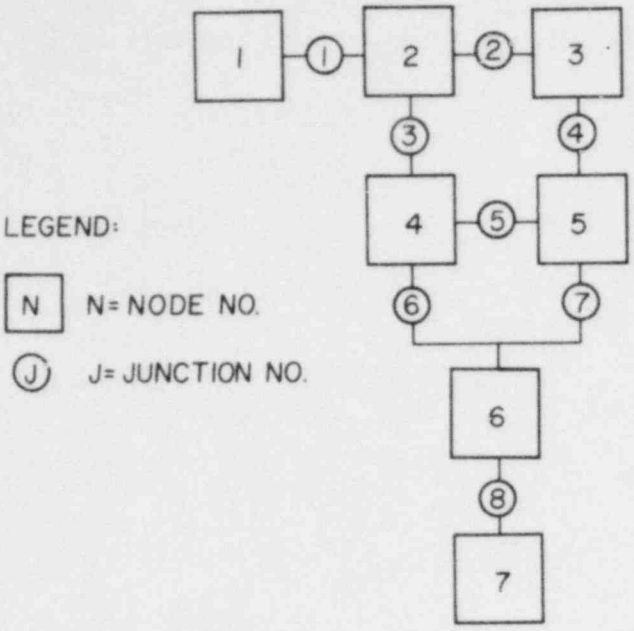

Fig. 2.
Sample problem. Node-junction arrangement.

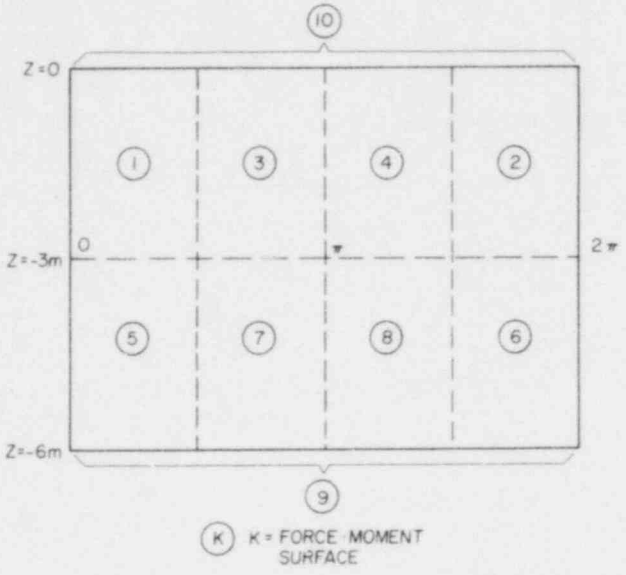

Fig. 3.
Unwrapped cylinder showing force-moment surfaces (angle shown is measured from the x-axis).

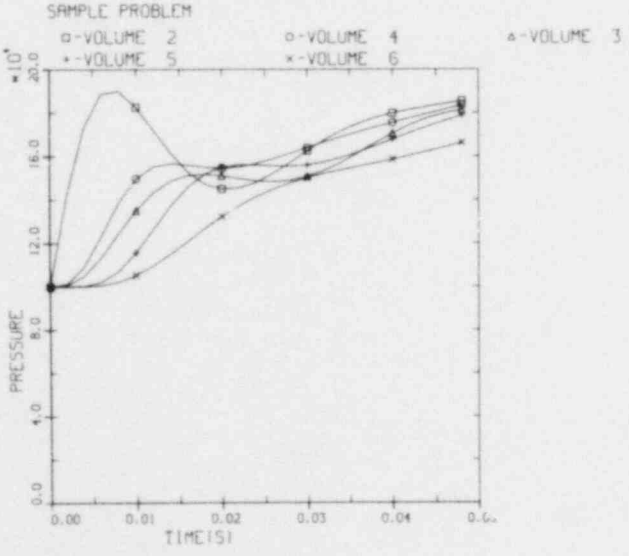

Fig. 4.
Sample problem. Pressure vs time plots for volumes (nodes) 2 through 6. See Fig. 1.

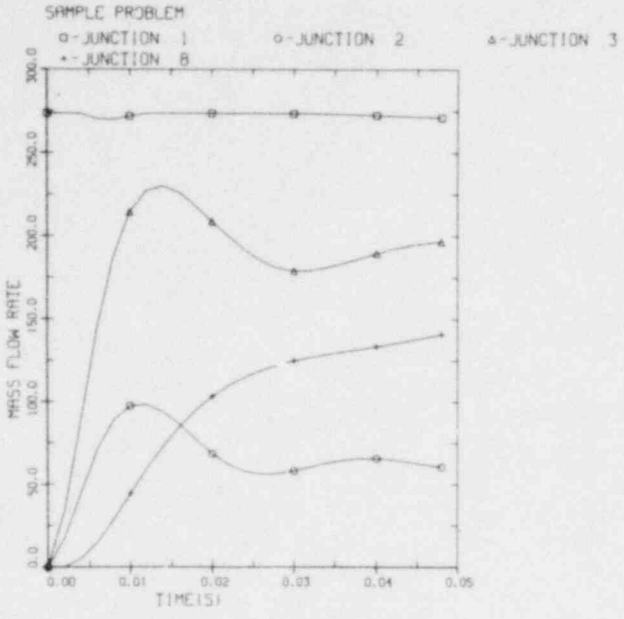

Fig. 5.
Sample problem. Mass flow rate vs time for junctions 1, 2, 3, and 8. See Fig. 2 for junction locations.

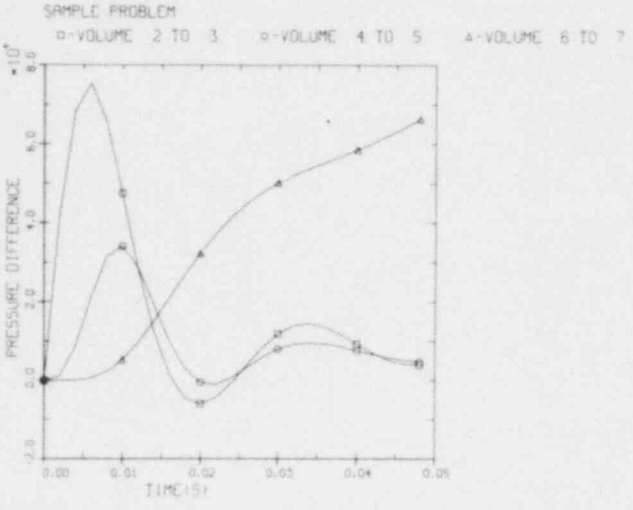

Fig. 6.
Sample problem. Pressure differences between volumes (nodes) specified vs time. See Fig. 1 for volume locations.

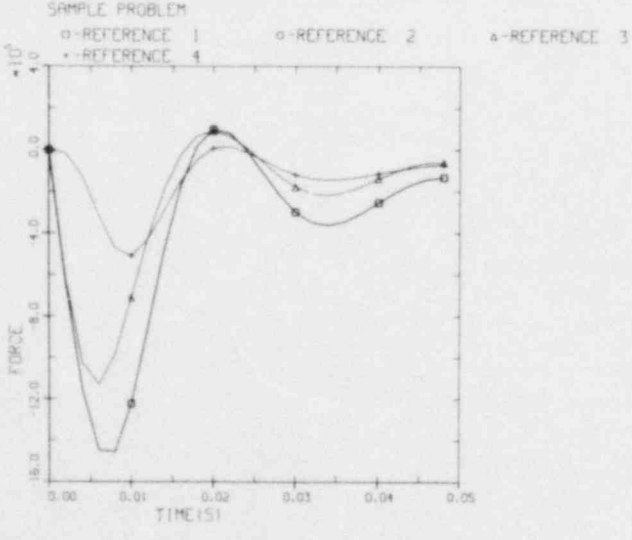

Fig. 7.
Sample problem. Forces vs time for force references 1 through 4. See Appendix C (input section) for reference specification.

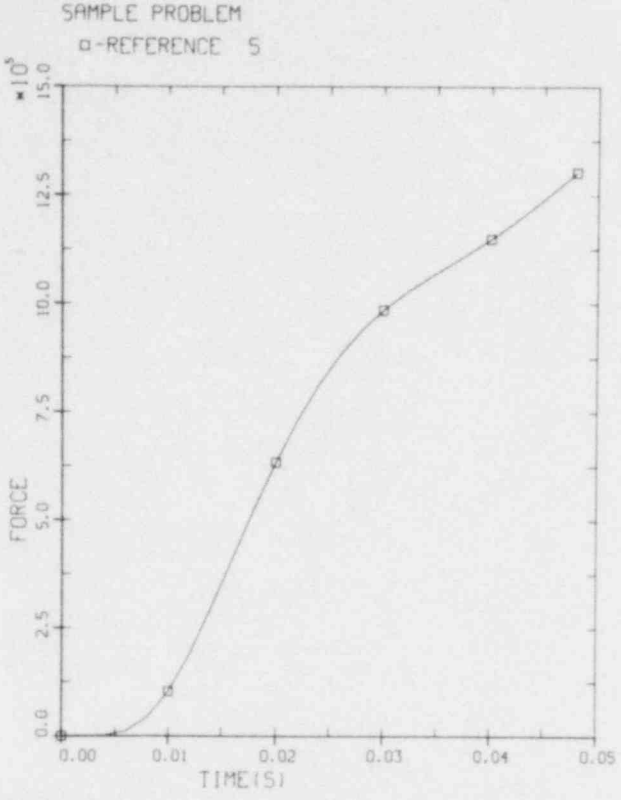

Fig. 8.
Sample problem. Force vs time for force reference 5. See Appendix C (input section) for reference specification.

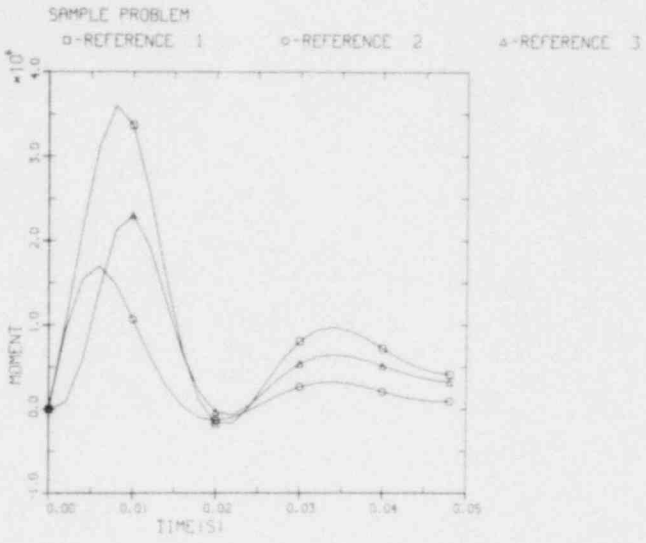

Fig. 9.
Sample problem. Moment vs time for moment references 1 through 3. See Appendix C (input section) for reference specification.

The major portion of the input is that for the basic COMPARE-MOD 1 as described in Ref 1. Items of interest regarding the new additions to the code include

(1) GEN INT (Card Type B) Card. Specification of 10 force-moment surfaces, the use of SI input units, and that there will be plotting.

(2) J(nj)-I (Card Type E) Cards. Flagging of detailing for some of the junctions, where nj is the junction index, is called for. For these junctions, the loss coefficients presented on the J(nj)-F (Card Type F) cards will be overridden.

(3) V1JLC (Card TYpe F1), V1JFR (Card Type F2), etc., Cards. The values are typical for the problem geometry. Of particular interest is the detail listing in the input interpretation section of the listing where the loss coefficient summation is shown.

(4) Unit Conversion Factors. No Card Type M input cards are required because the control flag on Card Type B was set to −1. This caused the code to generate the factors for input in SI units, which are given in the input interpretation section of the listing.

(5) Force-Moment (Card Types U1-U7) Cards. The NSURFS (10 in this case) sets of U1 and U2 cards are first. Note that the surface force-direction vector angle, and not the direction cosine, was used. The NFR-NMR (Card Type U3) then specifies five force and three moment references. These references are then described on the five sets of Card Types U4 and U5 for forces and three sets of Card Types U6 and U7 for moments.

(6) Plotting (Card Types V1-V8) Cards. The necessary Card Types V1 (PLT INFO) and V2 (TI SCALE) are given first followed by the V3, etc., cards as specified on the V1 card. Note that Card Type V1 calls for special plotting of four variables, the procedures for which are explained in Appendix A.

REFERENCE

1. R. G. Gido, J. S. Gilbert, R. G. Lawton, and Walton L. Jensen, "COMPARE-MOD 1: A Code for the Transient Analysis of Volumes with Heat Sinks, Flowing Vents, and Doors," Los Alamos Scientific Laboratory report LA-7199-MS (March 1978).

APPENDIX A

USER-SPECIFIED PLOTS

User-specified plots of any variable in COMPARE vs any other variable are set up by user programming in subroutine SUSPEC (Set Up Special). The user is required to provide internal programming for labeling and the storage of data into a variable array. The variable values will correspond to the problem times specified for the standard plots. After the plot data for the NSPEC special plotting variables have been stored, the code calls PLSPEC once for each user-specified plot. PLSPEC writes the plot data on a disk storage file (TAPE2 at LASL) to be used as input to the GENPLT program (see Appendix B), which actually does the plotting.

The use of SUSPEC is best seen by reviewing the argument list for PLSPEC given in TABLE A-I and by an example setting up two user-specified plots described below. The plots produced are given in Fig. A-1 for total x-force vs two pressure differences and in Fig. A-2 for total y-moment vs the two pressure differences.

Table A-II gives a listing of the SUSPEC routine for a case with no user-specified plots. SUSPEC is not called if NSPEC=0 on input. Table A-III shows the listing of the SUSPEC routine below the C100 card where the changes are made to produce the example plots. The discussion below refers to the material in the Table A-III listing following the comment card indicated.

TABLE A-I

ARGUMENT LIST DESCRIPTION FOR PLSPEC ROUTINE

PLSPEC writes plotting data on TAPE2 for one user-specified plot with up to five curves.

Argument	Description
NC	Number of curves.
NXVAR	Number of sets of x-variables, either 1 or equal to NC.
NP	Number of data points to be plotted on each curve (Same for all curves.)
NPLSKP	Plot symbol frequency (+i indicates points connected and symbol every ith point. −i indicates points not connected and a symbol every ith point. To have symbols only at start and end of curve make NPLSKP > NP).
KP	1 for linear x-axis, 3 for log x-axis.
IGRID	0 to get only tick marks along borders of plot; 1 to get full grid.
TITLE1	Title for plot with maximum of 59 characters.
BXLAB	X-axis label with maximum of 20 characters.
EYLAB	Y-axis label with maximum of 20 characters.
LCURV1	Label for first curve with maximum of 19 characters.
LCURV2	Label for second curve with maximum of 19 characters (or dummy variable if not used).
LCURV3	Label for third curve with maximum of 19 characters (or dummy variable if not used).
LCURV4	Label for fourth curve with maximum of 19 characters (or dummy variable if not used).
LCURV5	Label for fifth curve with maximum of 19 characters (or dummy variable if not used).
XMIN	Minimum value for x-axis. (See XINTVL below).
XMAX	Maximum value for x-axis. (See XINTVL below).
XINTVL	Length of x-axis, if 0.0, plot package calculates x-limits (2. ≤ XINTVL ≤ 8.).
YMIN	Minimum value for y-axis. (See YINTVL below.)
YMAX	Maximum value for y-axis. (See YINTVL below.)
YINTVL	Length of y-axis, if 0.0, plot package calculates y-limits (2. ≤ YINTVL ≤6.).
VX1	X-values for first curve (or all curves if NXVAR=1).
VX2	X-values for second curve (or dummy variable if not used).
VX3	X-values for third curve (or dummy variable if not used).
VX4	X-values for fourth curve (or dummy variable if not used).
VX5	X-values for fifth curve (or dummy variable if not used).
VY1	Y-values for first curve.
VY2	Y-values for second curve (or dummy variable if not used).
VY3	Y-values for third curve (or dummy variable if not used).
VY4	Y-values for fourth curve (or dummy variable if not used).
VY5	Y-values for fifth curve (or dummy variable if not used).

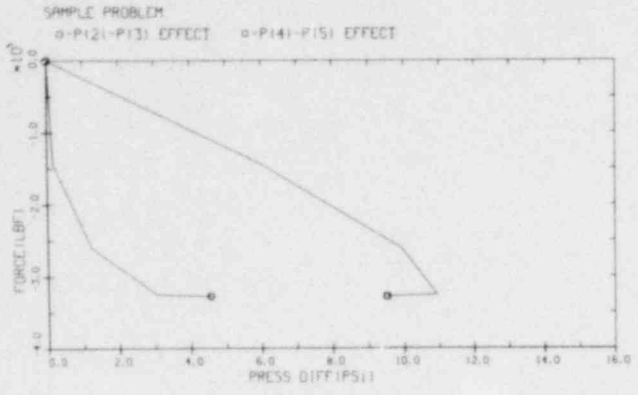

Fig. A-1.
Sample problem. Special plot (in engineering units) of total x-force vs pressure differences between nodes 2 and 3 and between nodes 4 and 5. Plotting is stopped after maximum force is reached.

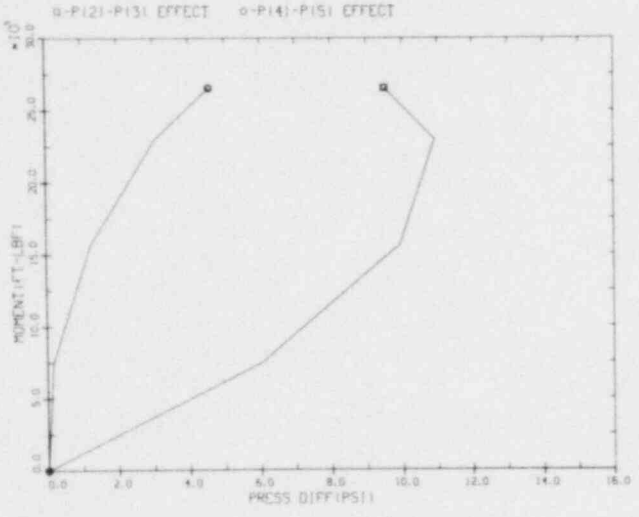

Fig. A-2
Sample problem. Special plot (in engineering units) of total y-moment vs pressure differences between nodes 2 and 3 and between nodes 4 and 5. Plotting is stopped after maximum moment is reached.

C100

Axis labels are dimensioned length 2 (to accommodate 20 characters on CDC systems). If the same label is used for more than one plot, it only needs to be dimensioned once.

C200

Curve labels are dimensioned length 2.

TABLE A-II

SUSPEC ROUTINE WITH NO USER-SPECIFIED PLOTS

```
      SUBROUTINE SUSPEC (ILAST,PLDATA,TITLE1)
C
C     SUSPEC STORES DATA FOR USER-SPECIFIED PLOTS AND CALLS PLSPEC
C          AT END TO DO PLOTTING.
C
      COMMON /BLDOWN/NBDVOL,NVOLBD(5),NBDPTS(5),BDTIME(50,5),
     1 BDMASS(50,5),BDENGY(50,5),BDMSIN(5),BDENIN(5)
      COMMON /CMPRES/DSJ(1,1),DWJ(1,1),DGJ(1,1),DEJ(1,1),
     1 SONC(1,1)
      COMMON /DOOR/KD,NJD(10),DH(10),DW(10),DMD(10),SPRGC1(10),
     1 SPRGC2(10),DACD(10),THI(10),OMI(10),CDN(10),CTB(10),CGR(10)
      COMMON /FOMO/NSURFS,NCREFS,NGREFS,NSVOL(100),SURF(100),
     1 ANGLI(3,100),DIRC(3,100),RADV(3,100),FORC(3,100),
     2 TORQ(3,100),FORCE(3),RESULT,TORQUE(3),FORCMAX(2,3),
     3 RESTMAX(2),TORQMAX(2,3),ICTYPE(100),IQTYPE(100),
     4 NCCOMP(100),NQCOMP(100),NCSUR(20,100),NQSUR(20,100),
     5 FOR(100),TOR(100)
      COMMON /GENERL/MVOL,NJUN,RGAS(3),CSP(3),NPRTPD,TITLE(8),
     1 NPUNCH,NUPROB,K1DIAG,K2DIAG,NFLAG,NPRTSV
      COMMON /GRAFIN/NSTEP,NTPOIN,MCURVE,MPOINT,MSKIP,IFIRPT,
     1 NPLSKP,IGRID,IRUNOV,KP,TPLMIN,TPLMAX,TPINTV,PMINPL(10),
     2 PMAXPL(10),TMINPL(10),TMAXPL(10),FMINPL(10),FMAXPL(10),
     3 DPMNPL(10),DPMXPL(10),CMINPL(10),CMAXPL(10),QMINPL(10),
     4 QMAXPL(10),PAXISP(10),TAXISP(10),FAXISP(10),QAXISP(10),
     5 CAXISP(10),QAXISP(10)
      COMMON /JUNCON/NV1(2000),NV2(2000),AREA(2000),ENLK12(2000),
     1 EXLK12(2000),ENLK21(2000),EXLK21(2000),SMD(2000),WMD(2000),
     2 AMD(2000),GMD(200,3),EDT(2000),SONIC(2000),FLOA(2000),NO(2000),
     3 DPOLD(2000),ND(2000),FRIC(2000),KJUN(2000),XMM(2000),NKDET(100),
     4 IJEDCT
      COMMON /PLOTIN/IFPLOT,NPPLOT,NTPLOT,NFPLOT,NDPPLT,NCPLOT,
     1 NQPLOT,NSPEC,IPTOT,ITTOT,IFTOT,IDPTOT,ICTOT,IQTOT,
     2 NPVOL(50),NTVOL(50),NFJC(50),NDPVOL(100),NCSUB(50),
     3 NQSUB(50),NPCURV(10),NTCURV(10),NFCURV(10),NDPCUR(10),
     4 NCCURV(10),NQCURV(10),NCTYPE(10),NQTYPE(10)
      COMMON /SNK/NSINK,KEYS(5),NVOLL(5),NVOLR(5),AREAL(5),
     1 TFUSN(5),NHTL(5),NHTR(5),NSEG(5),EFUS(5),XN(1000),TN(1000),
     2 COND(1000),DENSI(1000),SKSH(1000),QTP(1000),SKMSLI(5),
     3 SKMSRI(5),SKENLI(5),SKENRI(5),NNODI(5),NNODF(5),HTLFT(5),
     4 TBLFT(5),HTRGT(5),BRGT(5)
      COMMON /SV/RTX,RT,TZ,TOTX,TOTY
      COMMON /TIME/NTIA,TINC,NTCARD,TIME,TIMEMX,TINCMX,RATIO,
     1 TINEND(10),TSTEP(10),IPRINT(10),IPRHS(10),IOUTPT,TINC,NT,
     2 TINCPU,NPRT,NPRH,KOUNTT,KOUNTH,KINTVL,INTEND
      COMMON /VENTS/SV(5,1),SE(1,1,1),SP(4,1),ST(1,1),SB(3,6),
     1 NINC(25),VLNG(25),NJV,NJCO,ENLK(25,2),EXLK(25,2),NVJC(25),
     2 VNTDX(25),CODX(25),NJSTMX(25),MJSTMI(25),MJSTMX(25),NJCORE
      COMMON /VOLUME/V(100),P(100),T(100),RELHUM(100),SM(100),
     1 WM(100),AM(100),GM(100,3),EN(100),ESM(100),DWM(100),
     2 DAM(100),DGM(100,3),DEN(100),IKV(100)
C
C     DATA IS STORED AFTER STANDARD PLOT DATA IN PLDATA VECTOR.
C     FIRST POINT OF FIRST VARIABLE IS STORED AT
C         M1=(1+MCURVE)*MPOINT+1.
C     FIRST POINT OF NTH VARIABLE IS STORED AT MN=N1+N*MPOINT.
C     BE CAREFUL THAT DIMENSION OF PLDATA GIVEN IN PLOTSV IS
C       NOT LESS THAN (1+MCURVE+NSPEC)*MPOINT.
C     NSPEC=NUMBER OF SPECIAL VARIABLES SAVED FOR USER-SPECIFIED
C         PLOTS.
C
      DIMENSION PLDATA(1),TITLE1(1)
C
C100  DIMENSION AXIS LABELS FOR ALL USER-SPECIFIED PLOTS.
C200  DIMENSION CURVE LABELS FOR ALL USER-SPECIFIED PLOTS.
C300  SET UP X AND Y LABELS FOR ALL USER-SPECIFIED PLOTS.
C400  SET UP CURVE LABELS FOR ALL USER-SPECIFIED PLOTS.
C
      IF (ILAST.EQ.1) GO TO 1000
C
C500  SAVE USER-SPECIFIED DATA IN PLDATA VECTOR.
C
      RETURN
C
 1000 CONTINUE
C
C600  PLOT SPECIAL CASES WITH ONE PLSPEC CALL FOR EACH PLOT.
C
      RETURN
      END
```

TABLE A-III

EXAMPLE OF USER-SPECIFIED PLOTTING. CODING IN SUBROUTINE SUSPEC

```
C100  DIMENSION AXIS LABELS FOR ALL USER-SPECIFIED PLOTS.
      DIMENSION BXLAB1(2),BYLAB1(2),BYLAB2(2)
C200  DIMENSION CURVE LABELS FOR ALL USER-SPECIFIED PLOTS.
      DIMENSION LCURV1(2),LCURV2(2)
C300  SET UP X AND Y LABELS FOR ALL USER-SPECIFIED PLOTS.
      DATA BXLAB1/2HPRESS DIFF(PSI)      /
      DATA BYLAB1/2HFORCE(LBF)           /
      DATA BYLAB2/2HMOMENT(FT-LBF)       /
C400  SET UP CURVE LABELS FOR ALL USER-SPECIFIED PLOTS.
      DATA LCURV1/2HP(2)-P(3) EFFECT     /
      DATA LCURV2/2HP(4)-P(5) EFFECT     /
C
      IF (ILAST.EQ.1) GO TO 1000
C
C500  SAVE USER-SPECIFIED DATA IN PLDATA VECTOR.
C
C *****NOTE*****
C     FORCES AND MOMENTS ARE TESTED SO THAT PLOTS
C     ONLY INCLUDE VALUES TO THE MAXIMUMS OF EACH.
C
      IF(NT .EQ. 0) GO TO 500
C
      P2MP3N = (P(2) - P(3))/ 6894.757
      P4MP5N = (P(4) - P(5))/ 6894.757
      FORNEW = FORCE(1) / 4.44822
      TORNEW = TORQUE(2. / 1.35582
      IF(ABS(FORNEW) .GT. ABS(FOROLD)) GO TO 300
      FORNEW = FOROLD
      P2MP3N = P2MP30
  300 IF(TORNEW .GT. TOROLD) GO TO 500
      TORNEW = TOROLD
      P4MP5N = P4MP50
  500 P2MP30 = P2MP3N
      P4MP50 = P4MP5N
      FOROLD = FORNEW
      TOROLD = TORNEW
      NTPM1 = NTPOIN - 1
      M1 = (1 + MCURVE) * MPOINT + 1
      PLDATA(M1 + NTPM1) = P2MP3N
      M2 = M1 + MPOINT
      PLDATA(M2 + NTPM1) = P4MP5N
      M3 = M2 + MPOINT
      PLDATA(M3 + NTPM1) = FORNEW
      M4 = M3 + MPOINT
      PLDATA(M4 + NTPM1) = TORNEW
C
      RETURN
C
C600  PLOT SPECIAL CASES WITH ONE PLSPEC CALL FOR EACH PLOT.
C
 1000 CONTINUE
C PLSPEC CALLS
C
C PLOT xFORCE VS (P2-P3) AND P4-P5)
      CALL PLSPEC(2,2,NTPOIN,NPLSKP,1,IGRID,TITLE1,
     1BXLAB1,BYLAB1,LCURV1,LCURV2,DUM,DUM,DUM,
     20.,16.,8.,0.,0.,0.,
     3PLDATA(M1),PLDATA(M2),DUM,DUM,DUM,
     4PLDATA(M3),PLDATA(M3),DUM, DUM,DUM)
C PLOT Y MOMENT VS (P2-P3) AND ( 4-P5)
      CALL PLSPEC(2,2,NTPOIN,NPLSKP,1,0,TITLE1,BXLAB1,BYLAB2,
     1LCURV1,LCURV2,DUM,DUM,DUM,
     20.,16.,8.,0.,0.,0.,
     3PLDATA(M1),PLDATA(M2),DUM,DUM,DUM,
     4PLDATA(M4),PLDATA(M4),DUM,DUM,DUM)
C
  RETURN
  END
```

C300

Data statements are provided for 20-character axis labels.

C400

Data statements are provided for curve labels. In the plot package, a — (dash) is written between the symbol and the first 19 characters of each label.

C500

User-specified data are saved at each plot time in the same PLDATA array used to save all variables. In the example, M1 is the location of the first point saved for the pressure difference between nodes 2 and 3 (Fig. 1), M2 is the location of the first point saved for the pressure difference between nodes 4 and 5, etc. As seen in the example, the nth special variable is saved at a point MPOINT plus the storage location of the (n-1) variable. MPOINT is the maximum number of points on each curve as specified by input. Note that time plot data are always saved automatically beginning with PLDATA(1) in another routine so it need not be saved in this routine. The number of variables saved in this routine should be entered as NSPEC on card V1 of the input cards. It indicates to the program how much data are saved and checks storage requirements.

C600

This region is used to call PLSPEC once for each user-specified plot desired, as shown in Table A-III. Note the DUM entry wherever an argument is not needed because of the fewer than five curves entered. Also note that NTPOIN, NPLSKP, IGRID, and TITLE1 are set up by other parts of the program so they need not be provided for the user in this routine. In setting up other special plots, it will be useful to go through the argument lists given for these examples along with Table A-I, for their meaning, and Figs. A-1 and A-2, to see the results.

APPENDIX B

GENPLT PLOTTING PACKAGE

The modified COMPARE-MOD 1 code prepares the plotting data, as described in Table B-I, on the disk file TAPE2. The code GENPLT reads the TAPE2 data and calls the DISSPLA plotting routines to set up and produce the plots on the CALCOMP plotter. We have tested the plotting capability at LASL and have created CALCOMP paper output, Tektronix screen and hard copy output, and FR 80 slide output. The sample plots included in this report were made by the Tektronix hard copy unit and are reduced in scale relative to that produced on, for example, the NRC CALCOMP. Note that additional curves could be included (for example, data) by the addition of information on TAPE2 according to the format described in Table B-I.

TABLE B-I

INPUT DATA FOR GENPLT

Data should be on file named TAPE2.

Plot Summary Information (8I5) -Card Type A

One card required at start of data for each plot plus one at end of all data to indicate no more plot information to be read.

Word/Last Column	Variable	Description
1/5	IEND	0 if additional set of data is to be read; 1 if all data have been read.
2/10	KP	1 indicates linear x, 3 indicates log x.
3/15	NC	Number of curves on plot.
4/20	NXVAR	Number of sets of x-variables, either 1 or NC.
5/25	NTYPE	1 for pressure vs time plot; 2 for temperature vs time plot; 3 for mass flow rate vs time plot; 4 for pressure difference vs time plot; 5 for force vs time plot; 6 for moment vs time plot; 7 for direction vs time plot; 8 for user-specified plot.
6/30	NP	Number of points on curve.
7/35	NPLSKP	Plot symbol location on curve, +i indicates points connected and symbol every ith point (symbols at start and end if NPLSKP ≥ NP); -i indicates points not connected and a symbol every ith point.
8/40	IGRID	1 to get full grid; 0 to get only tick marks along borders.

Location Information for Standard Plots (10I5) -Card Type B

One card required if NTYPE is not equal to 8.

For NTYPE=1, a volume number is supplied for each volume pressure.
For NTYPE=2, a volume number is supplied for each volume temperature.
For NTYPE=3, a junction number is supplied for each junction flow.

For NTYPE=4, two volume numbers are supplied for each pressure difference. The pressure difference data input below should be the pressure of the first volume number minus the pressure of the second volume number.

For NTYPE =5, a number is supplied for each force reference.

For NTYPE=6, a number is supplied for each moment reference.

For NTYPE=7, a number is supplied for each direction reference.

Word/Last Column	Variable	Description
1/5	NLOCAT(1)	First volume, junction, or reference number.
2/10-10/60	NLOCAT(2) -NLOCAT(10)	Additional volume. junction, or reference numbers as needed.

Title Information (6A10) ---------- Card Type C

One card required.

Word/Last Column	Variable	Description
1/60	TITLE1	Title of up to 60 characters.

X Axis Label (2A10) ---------- Card Type D

One card required if NTYPE = 8.

Word/Last Column	Variable	Description
1/20	XLABEL	Up to 20 character x-axis label.

Y-Axis Label (2A10) ---------- Card Type E

One card required if NTYPE = 8.

Word/Last Column	Variable	Description
1/20	YLABEL	Up to 20 character y-axis label.

Curve Labels-1 (6A10) ---------- Card Type F

One card required if NTYPE = 3.

Word/Last Column	Variable	Description
1/19	LABCV1	Up to 19 character label for first curve (left adjusted).
2/39	LABCV2	Up to 19 character label for second curve (left adjusted).
3/59	LABCV3	Up to 19 character label for third curve (left adjusted).

Curve Labels-2 (4A10) ---------- Card Type G

One card required if NTYPE=8 and NC ≥ 4.

Word/Last Column	Variable	Description
1/19	LABCV4	Up to 19 character label for fourth curve (left adjusted).
2/39	LABCV5	Up to 19 character label for fifth curve (left adjusted).

X Limits (3E12.0) ---------- Card Type H

One card required.

Word/Last Column	Variable	Description
1/12	XMIN	Minimum x-value plot limit.
2/24	XMAX	Maximum x-value plot limit.
3/36	XINTVL	Length of x-axis in inches, 2. to 8., and also equal to number of intervals that will be labeled. 0. indicates limits and intervals calculated by the code.

Y Limits (3E12.0) - Card Type I

One card required.

Word/Last Column	Variable	Description
1/12	YMIN	Minimum y-value plot limit.
2/24	YMAX	Maximum y-value plot limit.
3/36	YINTVL	Length of y-axis in inches, 2. to 6., and number of intervals that will be labeled. 0. indicates limits and intervals will be calculated by the code.

X Arrays (6E12.0) - Card Type J

NXVAR sets of x arrays each with NP points are read in with six per card. Each x array begins on a new card.

Y Arrays (6E12.0) - Card Type K

NC sets of y arrays each with NP points are read in with six per card. Each y array begins on a new card.

APPENDIX C

INPUT DESCRIPTION

This appendix presents the complete description of the input format for the newly modified COMPARE-MOD 1 code. As such, this input description replaces that provided by Table IV of Ref. 1.

REQUIRED INPUT ----------Card Type A

Title (18A4)

One card required.

General Integer Information (1115,L5) ..... Card Type B

One card required.

Word/Last Column	Variable	Description
1/5	NVOL	Number of volumes (100 max, 1 min).
2/10	NJUN	Number of junctions between volumes (200 max).
3/15	NJCO	Not used. Must be zero.
4/20	NSINK	Number of heat sinks (20 max).
5/25	NBDVOL	Number of blowdown data sets (5 max).
6/30	NSURFS	Number of force-moment surfaces (100 max).
7/35	NPRTPD	Control on whether or not volume pressure differentials are to be printed at each volume and junction (thermodynamic) information printing: 0 = No, nonzero = yes.
8/40	NPUNCH	Not used. Must be zero.
9/45	NVOLDP	Number of maximum pressure differences and their times of occurrence desired to be determined (10 max).
10/50	NUPROB	Not used. Must be zero.
11/55	NFLAG	Type of gas and unit conversion control. 0 = User-supplied gas constants (Card Type K), gas/constant pressure specific heats (Card Type L) and unit conversion factors (Card Type M) will be required input; 1 = Card Types K,L,M are not to be input. Air properties and traditional engineering units, identified with an * in Table III (Ref. 1) will be used; −1 = Card Types K,L,M are not to be input. Air properties and SI units will be used.
12/60	IFPLOT	A logical variable (T = true, F = false) to indicate whether plotting will be performed. If there is plotting, card types V will be required.

Time Information (3I10, 4E10.0) ----------Card Type C1

One card required.

Word/Last Column	Variable	Description
1/10	NTINC	Maximum number of time increments.
2/20	KTINC	Time increment control, see Sec. III.A.2 of Ref. 1. 0 ≡ volume mass fractional change limited by RATIO, 1≡ User-specified variable time increment, 2≡ Volume pressure fractional change limited by RATIO and other considerations.
3/30	NTCARD	Number of time interval cards of type C2. 1 for KTINC = 0 or 2, up to 10 for KTINC = 1.
4/40	TIME	Initial time, s.
5/50	TIMEMX	Maximum problem time, s.
6/60	TINCMX	Maximum allowable time increments, s.
7/70	RATIO	Fraction used to select variable time increment for KTINC = 0 or 2.

Time Interval Information (2E10.0, 2I10) ----------Card Type C2

NTCARD cards required in order of increasing interval end times.

I is time interval.

Word/Last Column	Variable	Description
1/10	TIMEND (I)	END time for interval, s.
2/20	TSTEP (I)	Time increment for interval, s.
3/30	IPRINT (I)	Print frequency for volume and junction thermodynamic information.
4/40	IPRHS (I)	Print frequency for heat sinks.

Volume Specification (6E10.0) - Card Type D

NVOL cards required in numerical order (N is volume sequence number).

Word/Last Column	Variable	Description
1/10	V (N)	Volume.
2/20	P (N)	Pressure.
3/30	T (N)	Temperature
4/40	RELHUM (N)	Relative humidity.*
5/50	SM (N)	Steam mass.*
6/60	WM (N)	Water mass.**

*If SM(N) ≠ 0., RELHUM(N) not used.
If SM(N) = 0., SM(N) is determined from RELHUM(N).

**If WM(N) ≠ 0. and P(N) < P_{sat} for T(N), P(N) is set to P_{sat}.
If WM(N) = 0. and P(N) < P_{sat} indicates a superheated condition and SM(N) is based on the saturated vapor specific volume.

NONREQUIRED INPUT (Depends on other specifications).

Junction (Vent) Specification, see Sec. III.D. of Ref. 1.
NJUN sets of Card Types E and F required (J is junction sequence number).

Integers (5I5) - Card Type E

Word/Last Column	Variable	Description
1/5	KJUN (J)	Vent flow option. 1 = Homogeneous equilibrium compressible flows, 2 = Moody, 3 = Flow with inertia.
2/10	NV1 (J)	One of the volumes associated with this junction.
3/15	NV2 (J)	The other volume.
4/20	ND (J)	Variable area door flag, see Sec. III.D.4 of Ref. 1. 0 ≡ no door, 1 ≡ a door exists and door information will be required below (see Card Type G) in the same sequence as this flag is set.
5/25	IJED	Loss coefficient detail flag, 0 ≡ no detail to be given and the loss coefficients specified on Card Type F will be used, 1 ≡ loss coefficients will be determined from the input on the F1-F8 type cards, which are read after the E and F type cards and before reading the G type cards.

Floating Point (7E10.0) - Card Type F

Word/Last Column	Variable	Description
1/10	AREA (J)	Junction flow area.
2/20	ENLK12 (J)	Entrance loss coefficient for flow from the NV1(J) to the NV2(J) volume.
3/30	EXLK12 (J)	Ditto, but exit loss coefficient.
4/40	ENLK21 (J)	Entrance loss coefficient for flow from the NV2(J) to the NV1(J) volume.
5/50	EXLK21 (J)	Ditto, but exit loss coefficient.
6/60	XMM (J)	MOODY flow multiplier. Also used to obtain variations on flow options 1 and 3. If XMM(J) = 0., the flow with inertia option will use the homogeneous compressible flow model to establish critical flow. If XMM(J) < 0., the compressible homogeneous flow model will be isentropic when critical flow exists, regardless of the entrance loss coefficients that may have been specified.
7/70	FLOA (J)	Flow length/area term when inertia effects are to be calculated. See Sec. III.D.3 of Ref. 1.

Loss Coefficient Detail (K is detail flagging sequence). One set of Card Types F1 through F8 required for each junction flagged (on Card Type E). Each set is expected in the sequence flagged. In the description below: V1 and V2 refer to the upstream and downstream nodes, respectively; J refers to the junction; the friction factor is the Weisbach or Darcy value (which is four times the Fanning value); and the length and diameter have the same units. A hydraulic diameter input value ≤0. will be converted to a value of 1.E20.

V1 to J Entrance and Exit Losses (4E10.0) - Card Type F1

Word/Last Column	Variable	Description
1/10	CLV1J (K)	Contraction loss.
2/20	CMV1J (K)	Contraction loss multiplier.
3/30	ELV1J (K)	Expansion loss.
4/40	EMV1J (K)	Expansion loss multiplier.

V1 to J Friction Information and Miscellaneous Losses (5E10.0) - - - - - - - - - - - - Card Type F2

Word/Last Column	Variable	Description
1/10	FRV1J (K)	Friction factor.
2/20	XLV1J (K)	Flow path length.
3/30	DHV1J (K)	Flow path mean hydraulic diameter.
4/40	X1V1J (K)	Miscellaneous loss 1.
5/50	X2V1J (K)	Miscellaneous loss 2.

J to V2 Entrance and Exit Losses (4E10.0) - Card Type F3

Word/Last Column	Variable	Description
1/10	CLJV2 (K)	Contraction loss.
2/20	CMJV2 (K)	Contraction loss multiplier.
3/30	ELJV2 (K)	Expansion loss.
4/40	EMJV2 (K)	Expansion loss multiplier.

J to V2 Friction Information and Miscellaneous Losses (5E10.0) - - - - - - - - - - - - - Card Type F4

Word/Last Column	Variable	Description
1/10	FRJV2 (K)	Friction factor.
2/20	XLJV2 (K)	Flow path length.
3/30	DHJV2 (K)	Flow path mean hydraulic diameter.
4/40	X1JV2 (K)	Miscellaneous loss 1.
5/50	X2JV2 (K)	Miscellaneous loss 2.

V2 to J Entrance and Exit Losses (4E10.0) - Card Type F5

Word/Last Column	Variable	Description
1/10	CLV2J (K)	Contraction loss.
2/20	CMV2J (K)	Contraction loss multiplier.
3/30	ELV2J (K)	Expansion loss.
4/40	EMV2J (K)	Expansion loss multiplier.

V2 to J Friction Information and Miscellaneous Losses (5E10.0) - - - - - - - - - - - - Card Type F6

Word/Last Column	Variable	Description
1/10	FRV2J (K)	Friction factor.
2/20	XLV2J (K)	Flow path length.
3/30	DHV2J (K)	Flow path mean hydraulic diameter.
4/40	X1V2J (K)	Miscellaneous loss 1.
5/50	X2V_J (K)	Miscellaneous loss 2.

J to V1 Entrance and Exit Losses (4E10.0) - Card Type F7

Word/Last Column	Variable	Description
1/10	CLJV1 (K)	Contraction loss.
2/20	CMJV1 (K)	Contraction loss multiplier.
3/30	ELJV1 (K)	Expansion loss.
4/40	EMJV1 (K)	Expansion loss multiplier.

J to V1 Friction Information and Miscellaneous Losses (5E10.0) - - - - - - - - - - - - Card Type F8

Word/Last Column	Variable	Description
1/10	FRJV1 (K)	Friction factor.
2/20	XLJV1 (K)	Flow path length.
3/30	DHJV1 (K)	Flow path mean hydraulic diameter.
4/40	X1JV1 (K)	Miscellaneous loss 1.
5/50	X2JV1 (K)	Miscellaneous loss 2.

Variable Area Door Specification (K is door sequence number).

One set of Card Types G and H required in the sequence in which a door was indicated on Card Type E.

First Door Card (6E10.0) ---------- Card Type G

Word/Last Column	Variable	Description
1/10	DH (K)	Door height.
2/20	DW (K)	Door width.
3/30	DMD (K)	Door mass/area.
4/40	SPRGC1 (K)	Constant C1 (force/area) in the equation $P_s = C1 + C2 * \theta$ where P_s is a pressure acting on the door to prevent its opening and θ is the door angle in rad.
5/50	SPRGC2 (K)	Constant C2 (force/area/angle) in the above equation.
6/60	DACO (K)	Viscous damping coefficient DC (force · time/angle) in the Equation $F_v = DC * \dot{\theta}$ where F_v is a force acting on the door to prevent its opening and $\dot{\theta}$ is the door angular velocity.

Second Door Card (3E10.0) ---------- Card Type H

Word/Last Column	Variable	Description
1/10	CDN (K)	Number of the doors described on Card Type G.
2/20	CTB (K)	Number of door tops and bottoms to be included in the flow area, see Sec. III.D.4 of Ref 1.
3/30	CGR (N)	Gravity force multiplier, see Sec. III.D.4 of Ref. 1.

Blowdown Volume and the Number of Blowdown Points (14I5) - - - - - - - - - - - - - - Card Type I

Only for NBDVOL > 0, total number words = 2 x NBDVOL, see Sec. IV.E of Ref. 1.

Word/Last Column	Variable	Description
1/5	NVOLBD (1)	Volume number in which first set of blowdown data applies.
2/10	NBDPTS (1)	Number of blowdown data times for set 1 (2 min, 50 max).
3/15	NVOLBD (2)	Volume number in which second set of blowdown data applies.
4/20	NBDPTS (2)	Number of blowdown data times for set 2.
5/25	NVOLBD (3)	For third set of blowdown data.
6/30	NBDPTS (3)	
etc.		etc.

Blowdown Data (6E10.0) - Card Type J

Only for NBDVOL > 0. The time unit in the following must be s.

One set of NBDPTS(I) required for each volume with blowdown specified on card type I.*

Word/Last Column	Variable	Description
1/10	BDTIME (1,1)	First time for first set of blowdown data.
2/20	BDMASS (1,1)	Water mass flow rate for the above.
3/30	BDENGY (1,1)	Water energy flow rate for the above.
4/40	BDTIME (1,2)	Second time for first set of blowdown data.
5/50	BDMASS (1,2)	Water mass flow rate for second time.
6/60	BDENGY (1,2)	Water energy flow rate for second time.
etc., on next card.		

*Subsequent blowdown data sets always start on a new Card Type J card.

Gas Constants (6E10.0) - Card Type K

Only if NFLAG = 0, values = 0. gives air value, see Sec. III.C of Ref. 1, one card.

Word/Last Column	Variable	Description
1/10	RGAS (1)	Gas No. 1 gas constant.
2/20	RGAS (2)	Ditto for 2.
3/30	RGAS (3)	Ditto for 3.

Constant Pressure Specific Heats (6E10.0) - Card Type L

Only if NFLAG = 0, values = 0. gives air values, see Sec. III.C of Ref. 1, one card.

Word/Last Column	Variable	Description
1/10	CSP (1)	Gas No. 1 constant pressure specific heat.
2/20	CSP (2)	Ditto for 2.
3/30	CSP (3)	Ditto for 3.

User to SI Conversion (7E10.0) - Card Type M

Only if NFLAG = 0, four cards with 22 conversion factors as described below. Each of the first three cards has seven conversion factors and the fourth card has one. Conversion factors not of importance to a model can be any value. See Table III of Ref. 1 for conversion factors.

First user to SI conversion card.

Word/Last Column	Variable	Parameter Converted
1/10	CVMASS	Mass.
2/20	CVAREA	Area.
3/30	CVVOLM	Volume.
4/40	CVPRES	Pressure.
5/50	CVENGY	Energy.
6/60	CVRGAS	Gas constant.
7/70	CVCPGS	Specific heat.

Second user to SI conversion card.

Word/Last Column	Variable	Parameter Converted
1/10	CVTEM1	Reference temperature shift.
2/20	CVTEM2	Temperature scale.
3/30	CVFLOA	L/A term.
4/40	CVDORL	Door dimensions.
5/50	CVDODC	Door damping coefficients.
6/60	CVHSAR	Heat sink area.
7/70	CVHSLE	Heat sink coordinate.

Third user to SI conversion card.

Word/Last Column	Variable	Parameter Converted
1/10	CVHSCO	Heat sink thermal conductivity.
2/20	CVHSDE	Heat sink density.
3/30	CVHSQT	Heat sink internal heat generation.
4/40	CVHTLE	Heat sink boundary condition option 1 length-parameter (all options).
5/50	CVHTHC	Heat sink boundary condition heat transfer coefficient (all options).
6/60	CVFMFO	Force-moment force.
7/70	CVFMAR	Force-moment area.

Fourth user to SI conversion card.

Word/Last Column	Variable	Parameter Converted
1/10	CVMLEN	Moment length.

Maximum Pressure Differences (14I5) - Card Type N

Only for NVOLDP > 0.

Word/Last Column	Variable	Description
1/5	NVDP1 (1)	First volume for first pressure difference.
2/10	NVDP2 (1)	Second volume for first pressure difference.
3/15	NVDP1 (2)	First volume, second pressure difference.
4/20	NVDP2 (2)	Second volume, second pressure difference.
	etc.	

Heat Sink, etc., Information (M is the sink sequence number).

NSINK sets of the following cards required, see Sec. III.B.2 of Ref. 1.

Heat Sink Title Card (18A4) ---------- Card Type O

Heat Sink Integer Card(6I5) ---------- Card Type P

Word/Last Column	Variable	Description
1/5	KEYS (M)	Type of one-dimensional geometry. 1 ≡ cartesian, 2 ≡ cylindrical, 3 ≡ spherical.
2/10	NSEG (M)	Number of segments.
3/15	NVOLL (M)	Volume to the left.
4/20	NHTL (M)	Heat transfer boundary condition number on the left side.
5/25	NVOLR (M)	Volume to the right.
6/30	NHTR (M)	Heat transfer boundary condition number on the right.

Heat Sink Floating Point Card (3E10.0) ---------- Card Type Q

Word/Last Column	Variable	Description
1/10	AREAL (M)	Area of the left side.
2/20	XLEFT (M)	Coordinate at the left side. Must not be zero for cylindrical or spherical option because then there could be no area.
3/30	TFUSN (M)	Heat sink temperature limit. Heat sink temperature distributions will not be calculated if either heat sink surface temperature is ≥ this value. This feature will be ignored for values ≥ 10 000K.

Heat sink segment information cards.

NSEG (M) sets of the following two types of cards are required for each heat sink.

General Segment Information (2I5, 3E10.0) ----------Card Type R

Word/Last Column	Variable	Description
1/5	NEL	Number of increments.*
2/10	MATL	Must be zero.
3/20	XRGT	The right-hand coordinate.**
4/30	TINI	Initial temperature.
5/40	QPP	Internal heat generation rate.

Segment Thermal Properties (3E10.0) ----------Card Type S

Word/Last Column	Variable	Description
1/10	THCO	Thermal conductivity or contact conductance.
2/20	DENS	Density.
3/30	EOMT	Specific heat.

*The total number of heat sink elements is limited by $\sum_{i=1}^{NSINK} (NEL_i + 1) \leq 500$.

**A segment can be made to act as a contact resistance by making its right-hand coordinate equal to that for the previous segment and specifying the contact conductance as THCO on the associated Card Type S.

Heat Sink Boundary Condition Card (I is boundary condition number).

(3I5, 5E10.0) ----------Card Type T

The number of these cards required, and expected to be given, is the largest value of the boundary condition identifier given on Card Type P.

Table V of Ref. 1 explains the variables below in greater detail.

Word/Last Column	Variable	Description
1/5	NHTO (I)	Boundary condition option.
2/10	NHTJ1 (I)	Index for use in boundary condition determination.
3/15	NHTJ2 (I)	Another index.
4/25	HTC1 (I)	First constant for use in boundary condition determination.
5/35	HTC2 (I)	Second constant.
6/45	HTC (I)	Third constant.
7/55	HTC4 (I)	Fourth constant.
8/65	HTC5 (I)	Fifth constant.

Force-Moment General Input (I5, E12.4) ..... Card Type U1

NSURFS sets of U1 and U2 cards required.

Word/Last Column	Variable	Description
1/5	NSVOL (N)	Volume node associated with surface N.
2/17	SURF (N)	Surface area associated with surface N.

Force-Moment Floating-Point Input (6E12.4) ..... Card Type U2

NSURFS card(s) required.

Word/Last Column	Variable	Description
1/12	DIRC(1,N)	Surface N force-vector angle or angle direction cosine relative to the +x-axis.
2/24	DIRC(2,N)	Same, but relative to the +y-axis.
3/36	DIRC(3,N)	Same, but relative to the +z-axis.
4/48	RADV(1,N)	Surface N force-vector location, x-coordinate.
5/60	RADV(2,N)	Same, but y-coordinate.
6/72	RADV(3,N)	Same, but z-coordinate.

Force-Moment Reference(s) Input (2I5) ..... Card Type U3

One card required.

Word/Last Column	Variable	Description
1/5	NCREFS	Number of force references to be defined (100 max).
2/10	NQREFS	Number of moment references to be defined (100 max).

Force Reference(s) Input (A1,I5) ..... Card Type U4

NCREFS card(s) required.

Word/Last Column	Variable	Description
1/5	ICTYPE(I)	Component of the force desired for force reference I. Input must be x, y, or z for the force components, r for the result of the x-y components, or d for the direction of r in the x-y plane.
2/10	NCCOMP(I)	Number of elements in the force reference I to be defined (20 max).

Force Reference Surface(s) (20I4) ..... Card Type U5

NCREFS card(s) required.

Word/Last Column	Variable	Description
1/4	NCSUR(1,I)	Surface number of element 1 of force reference I.
2/8	NCSUR(2,I)	Surface number of element 2 of force reference I.
etc.		etc.

Moment Reference(s) Input (A1, I5) ..... Card Type U6

NQREFS card(s) required.

Word/Last Column	Variable	Description
1/5	IQTYPE(I)	Component of the moment required for moment reference I. Input must be x or y for the moment components in the horizontal plane, z for the moment component in the vertical direction, r for the result of the x-y components, or d for the direction of r in the x-y plane.
2/10	NQCOMP(I)	Number of elements in the moment reference I to be defined (20 max).

Moment Reference Surface(s) (20I4) ..... Card Type U7

NQREFS card(s) required.

Word/Last Column	Variable	Description
1/4	NQSUR(1,I)	Surface number of element 1 of moment reference I.
2/8	NQSUR(2,I)	Surface number of element 2 of moment reference I.
etc.		etc.

Plotting Input

Only if Card Type B variable IFPLOT = T.

Plot Summary Information (10I5) ..... Card Type V1

One card required.

Word/Last Column	Variable	Description
1/5	NPPLOT	Number of volume pressure vs time plots (≤ 10).
2/10	NTPLOT	Number of volume temperature vs time plots (≤ 10).
3/15	NFPLOT	Number of junction mass flow rate vs time plots (≤ 10).
4/20	NDPPLT	Number of pressure difference vs time plots (≤ 10).
5/25	NCPLOT	Number of force reference vs time plots (≤ 10).
6/30	NQPLOT	Number of moment reference vs time plots (≤ 10).
7/35	NSPEC	Number of special variables saved for user-specified plots.
8/40	MPOINT	Maximum number of points on each plot.
9/45	KP	1 for linear time, 3 for log time.
10/50	MSKIP	Number of time steps skipped between plotted points (0 for every time step).
11/55	NPLSKP	Plot symbol location on curve. +i indicates points connected and symbol every ith point (symbols at start and end if NPLSKP ≥ MPOINT). −i indicates points no connected and a symbol every ith point.
12/60	IGRID	0 to get only tick marks along borders of plot; 1 to get full grid.

NOTE: (MPOINT) * (MCURVE + 1 + NSPEC) must be ≤ 10 000.

Plot Time Information (3F10.0) - Card Type V2

One card required.

Word/Last Column	Variable	Description
1/10	TPLMIN	Minimum time for plot (should be greater than 0 for KP=3).
2/20	TPLMAX	Maximum time for plot.
3/30	TPINTV	Time axis length in inches and also number of numbered subintervals along time axis (2. ≤ TPINTV ≤ 8.).

Volume Pressure Plotting Information (I1,F5.0,2F7.0,5I5) - - - - - - - - - - - - - - - - Card Type V3

NPPLOT cards required.

Word/Last Column	Variable	Description
1/1	INP	1 indicates a volume pressure card.
2/6	PAXISP(I)	Length of pressure axis in inches, and also number of numbered subintervals along pressure axis (2. ≤ PAXISP(I) ≤ 6.). If 0.0 is entered, limits and intervals will be calculated by the code.
3/13	PMINPL(I)	Minimum pressure axis value.
4/20	PMAXPL(I)	Maximum pressure axis value.
5/25	NINP(1)	Number of first volume on this plot (required).
6/30	NINP(2)	Number of second volume on this plot (optional).
7/35	NINP(3)	Number of third volume on this plot (optional).
8/40	NINP(4)	Number of fourth volume on this plot (optional).
9/45	NINP(5)	Number of fifth volume on this plot (optional).

Volume Temperature Plotting
Information (I1,F5.0,2F7.0,5I5) ---------- Card Type V4
NTPLOT cards required.

Word/Last Column	Variable	Description
1/1	INP	2 indicates a volume temperature plot card.
2/6	TAXISP(I)	Length of temperature axis in inches and also number of numbered subintervals along temperature axis (2. ≤ TAXISP(I) ≤ 6). If 0.0 is entered, limits and intervals will be calculated by the code.
3/13	TMINPL(I)	Minimum temperature axis value.
4/20	TMAXPL(I)	Maximum temperature axis value.
5/25	NINP(1)	Number of first volume on this plot (required).
6/30	NINP(2)	Number of second volume on this plot (optional).
7/35	NINP(3)	Number of third volume on this plot (optional).
8/40	NINP(4)	Number of fourth volume on this plot (optional).
9/45	NINP(5)	Number of fifth volume on this plot (optional).

Junction Mass Flow Information (I1,F5.0,2F7.05I5) ---------- Card Type V5
NFPLOT cards required.

Word/Last Column	Variable	Description
1/1	INP	3 indicates a junction flow plot card.
2/6	FAXISP(I)	Length of flow axis in inches and also number of numbered subintervals along flow axis (2. ≤ FAXISP(I) ≤ 6). If 0.0 is entered, limits and intervals will be calculated by the code.
3/13	FMINPL(I)	Minimum flow axis value.
4/20	FMAXPL(I)	Maximum flow axis value.
5/25	NINP(1)	Number of first junction on this plot (required).
6/30	NINP(2)	Number of second junction on this plot (optional).
7/35	NINP(3)	Number of third junction on this plot (optional).
8/40	NINP(4)	Number of fourth junction on this plot (optional).
9/45	NINP(5)	Number of fifth junction on this plot (optional).

Pressure Difference Plotting
Information (I1,F5.0,2F7.0,10I5) - Card Type V6

NDPPLT cards required.

Word/Last Column	Variable	Description
1/1	INP	4 indicates a pressure difference plot card.
2/6	DAXISP(I)	Length of pressure drop axis in inches and also number of numbered subintervals along pressure difference axis (2. ≤ DAXISP(I) ≤ 6.). If 0.0 is entered, limits and intervals will be calculated by the code.
3/13	DPMNPL(I)	Minimum pressure drop axis value.
4/20	DPMXPL(I)	Maximum pressure drop axis value.
5/25	NINP(1)	First volume number for first pressure difference (required).
6/30	NINP(2)	Second volume number for first pressure difference (required).
7/35	NINP(3)	First volume number for second pressure difference (optional).
8/40	NINP(4)	Second volume number for second pressure difference (optional).
9/45	NINP(5)	First volume number for third pressure difference (optional).
10/50	NINP(6)	Second volume number for third pressure difference (optional).
11/55	NINP(7)	First volume number for fourth pressure difference (optional).
12/60	NINP(8)	Second volume number for fourth pressure difference (optional).
13/65	NINP(9)	First volume number for fifth pressure difference (optional).
14/70	NINP(10)	Second volume number for fifth pressure difference (optional).

Force Reference Plotting Information (I1,F5.0,2F7.0,5I5) - - - - - - - - - - - - - - - - Card Type V7

NC PLOT cards required.

Word/Last Column	Variable	Description
1/1	INP	5 indicates a force reference plot.
2/6	CAXISP(I)	Length of force reference axis in inches and also number of subintervals along force reference axis (2. ≤ CAXISP(I) ≤ 6.). If 0.0 is entered, limits and intervals will be calculated.
3/3	CMINPL(I)	Minimum force reference axis value.
4/20	CMAXPL(I)	Maximum force reference axis value.
5/25	NINP(1)	Number of first force reference on this plot (required).
6/30	NINP(2)	Number of second force reference on this plot (optional).
7/35	NINP(3)	Number of third force reference on this plot (optional).
8/40	NINP(4)	Number of fourth force reference on this plot (optional).
9/45	NINP(5)	Number of fifth force reference on this plot (optional)

Moment Reference Plotting Information (I1,F5.0,2F7.0,5I5 - - - - - - - - - - - - - - - - Card Type V8

NQPLOT cards required.

Word/Last Column	Variable	Description
1/1	INP	6 indicates a moment reference plot.
2/6	QAXISP(I)	Length of moment reference axis in inches and also number of subintervals along moment reference axis (2. ≤ QAXISP(I) ≤ 6.). If 0.0 is entered, limits and intervals will be calculated.
3/13	QMINPL(I)	Minimum moment reference axis value.
4/20	QMAXPL(I)	Maximum moment reference axis value.
5/25	NINP(1)	Number of first moment reference on this plot (required).
6/30	NINP(2)	Number of second moment reference on this plot (optional).
7/35	NINP(3)	Number of third moment reference on this plot (optional).
8/40	NINP(4)	Number of fourth moment reference on this plot (optional).
9/45	NINP(5)	Number of fifth moment reference on this plot (optional).

APPENDIX D

SAMPLE PROBLEM
OUTPUT LISTING

The sample problem is discussed in Sec. IV. Additional output in the form of plots is provided by Figs. 4 through 9 and the special plots of Figs. A-1 and A-2. Note that the list is composed of three parts, the listing of input cards, an interpretation and labeling of the input, and the calculated results. Calculated results for times >0.01 s and <0.1 s are omitted.

```
LISTING OF INPUT CARDS

COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80

SAMPLE PROBLEM
    7    8    0    0    0   10    0    0    0    0   -1    T              GEN INT
       100         1         1    0.         1.          .001        .05  GEN TIME
.05         .001              10                                        FXTM 1
     1.E6          3.E5  300.          0.          0.          0.         V 1
1.499              1.E5  300.          0.          0.          0.         V 2
1.499              1.E5  300.          0.          0.          0.         V 3
1.499              1.E5  300.          0.          0.          0.         V 4
1.499              1.E5  300.          0.          0.          0.         V 5
7.389              1.E5  300.          0.          0.          0.         V 6
     1.E6          1.E5  300.          0.          0.          0.         V 7
    1    1    2    0    0                                               J 1-I
.5        .5        1.        .5        1.        0.        0.         J 1-F
    3    2    3    0    1                                               J 2-I
.45       0.        0.        0.        0.        0.        4.633      J 2-F
    3    2    4    0    1                                               J 3-I
1.249     0.        0.        0.        0.        0.        2.402      J 3-F
    3    3    5    0    1                                               J 4-I
1.249     0.        0.        0.        0.        0.        2.402      J 4-F
    3    4    5    0    1                                               J 5-I
.45       0.        0.        0.        0.        0.        4.633      J 5-F
    3    4    6    0    1                                               J 6-I
.625      0.        0.        0.        0.        0.        1.201      J 6-F
    3    5    6    0    1                                               J 7-I
.625      0.        0.        0.        0.        0.        1.201      J 7-F
    1    6    7    0    0                                               J 8-I
.5        .5        1.        .5        1.        0.        0.         J 8-F
.5        1.        0.        0.                                        V1JLC J2
.02       2.085     .545      0.        0.                              V1JFR J2
0.        0.        1.        1.                                        JV2LC J2
.02       2.085     .545      0.        0.                              JV2FR J2
.5        1.        0.        0.                                        V2JLC J2
.02       2.085     .545      0.        0.                              V2JFR J2
0.        0.        1.        1.                                        JV1LC J2
.02       2.085     .545      0.        0.                              JV1FR J2
0.        0.        0.        0.                                        V1JLC J3
.02       1.5       .6        0.        0.                              V1JFR J3
0.        0.        0.        0.                                        JV2LC J3
.02       1.5       .6        0.        0.                              JV2FR J3
0.        0.        0.        0.                                        V2JLC J3
.02       1.5       .6        0.        0.                              V2JFR J3
0.        0.        0.        0.                                        JV1LC J3
.02       1.5       .6        0.        0.                              JV1FR J3
0.        0.        0.        0.                                        V1JLC J4
.02       1.5       .6        0.        0.                              V1JFR J4
0.        0.        0.        0.                                        JV2LC J4
.02       1.5       .6        0.        0.                              JV2FR J4
0.        0.        0.        0.                                        V2JLC J4
.02       1.5       .6        0.        0.                              V2JFR J4
0.        0.        0.        0.                                        JV1LC J4

COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

LISTING OF INPUT CARDS

```
COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
.02        1.5        .6         0.         0.                                  JV1FR J4
.5         1.         0.         0.                                             V1JLC J5
.02        2.085      .545       0.         0.                                  V1JFR J5
0.         0.         1.         1.                                             JV2LC J5
.02        2.085      .545       0.         0.                                  JV2FR J5
.5         1.         0.         0.                                             V2JLC J5
.02        2.085      .545       0.         0.                                  V2JFR J5
0.         0.         1.         1.                                             JV1LC J5
.02        2.085      .545       0.         0.                                  JV1FR J5
0.         0.         0.         0.                                             V1JLC J6
.02        1.5        .6         0.         0.                                  V1JFR J6
0.         0.         1.         1.                                             JV2LC J6
0.         0.         1.         .5         0.                                  JV2FR J6
.5         1.         0.         0.                                             V2JLC J6
0.         0.         1.         .5         0.                                  V2JFR J6
0.         0.         1.         1.                                             JV1LC J6
.02        1.5        .6         0.         0.                                  JV1FR J6
.5         1.         0.         0.                                             V1JLC J7
.02        1.5        .6         0.         0.                                  V1JFR J7
0.         0.         1.         1.                                             JV2LC J7
0.         0.         1.         .5         0.                                  JV2FR J7
.5         1.         0.         0.                                             V2JLC J7
0.         0.         1.         .5         0.                                  V2JFR J7
0.         0.         1.         1.                                             JV1LC J7
.02        1.5        .6         0.         0.                                  JV1FR J7
    2   10.607
225.          135.          90.          +1.250       +1.250       -1.5          FM  1-1
    2   10.607                                                                   FM  1-2
135.          45.           90.          +1.250       -1.250       -1.5          FM  2-1
    3   10.607                                                                   FM  2-2
45.           135.          90.          -1.250       -1.250       -1.5          FM  3-1
    3   10.607                                                                   FM  3-2
45.           45.           90.          -1.250       -1.250       -1.5          FM  4-1
    4   10.607                                                                   FM  4-2
225.          135.          90.          +1.250       +1.250       -4.5          FM  5-1
    4   10.607                                                                   FM  5-2
135.          45.           90.          +1.250       -1.250       -4.5          FM  6-1
    5   10.607                                                                   FM  6-2
45.           135.          90.          -1.250       +1.250       -4.5          FM  7-1
    5   10.607                                                                   FM  7-2
45.           45.           90.          -1.250       -1.250       -4.5          FM  8-1
    6   19.635                                                                   FM  8-2
90.           90.           0.           0.           0.           -6.           FM  9-1
    7   19.635                                                                   FM  9-2
90.           90.           180.         0.           0.           0.            FM 10
    5    3                                                                       FM 10-2
   X     1                                                                       NFR-NMR
   0                                                                            FR1
   X     8                                                                       R1 SURF
   1    2    3    4    5    6    7    8                                         FR2
                                                                                R2 SURF
COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

LISTING OF INPUT CARDS

```
COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
   X     4                                                                       FR3
   1    2    3    4                                                            R3 SURF
   X     4                                                                       FR4
   5    6    7    8                                                            R4 SURF
   2    2                                                                       FR5
   9   10                                                                       R5 SURF
   Y     1                                                                       MR1
   0                                                                            R1 SURF
   Y     4                                                                       MR2
   1    2    3    4                                                            R2 SURF
   Y     4                                                                       MR3
   5    6    7    8                                                            R3 SURF
   1    0    1    1    2    1    4  200    1    1    5    0                     PLT INFO
0.          .05          5.                                                    TI SCALE
1   0.   0.        0.   2    4    3    5    6                                  PRES PLT
3   0.   0.        0.   1    2    3    8                                       FLOW PLT
4   0.   0.        0.   2    3    4    5    6    7                            DPRS PLT
5   0.   0.        0.   1    2    3    4                                       FORC1PLT
5   0.   0.        0.   5                                                      FORC2 PLT
6   0.   0.        0.   1    2    3                                            MOM  PLT
COL=5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

```
SAMPLE PROBLEM

NUMBER OF VOLUMES.....                7
NUMBER OF JUNCTIONS.....              8
NUMBER OF COMPRESSIBLE JUNCTIONS...   0
NUMBER OF HEAT SINKS.....             0
NUMBER OF BLOWDOWN VOLUMES.....       0
NUMBER OF FORCE-MOMENT SURFACES....  10
PRINT PRESSURE DIFFERENCES.....       0
PUNCH CARDS FOR RESTART.....          0
NUMBER OF MAXIMUM PRESSURES.....      0
NEW PROBLEM OR PROBLEM NUMBER.....    0
UNIT CONVERSION + GAS FLAG.....      -1
PLOTTING FLAG.....                    T

MAXIMUM NUMBER OF TIME INCREMENTS..  100
TIME INCREMENT CONTROL.....           1
NUMBER OF TIME INTERVAL CARDS.....    1
STARTING TIME..................... 0.
MAXIMUM TIME..................... 1.000000E+00
MAXIMUM ALLOWABLE TIME INCREMENT... 1.000000E-03
MASS OR PRESSURE FRACTION.....      5.000000E-02

INTERVAL      END TIME     TIME STEP    THERMODYNAMICS      HEAT SINKS
                                        PRINT FREQUENCY     PRINT FREQUENCY
    1          .0500       .001000           10                99999

VOLUME INFORMATION

 NV      VOLUME          PRESSURE       TEMPERATURE  REL. HUMIDITY     STEAM MASS      WATER MASS I*V

 1    1.000000E+06    3.000000E+05    3.000000E+02    0.              0.              0.              0
 2    1.499000E+00    1.000000E+05    3.000000E+02    0.              0.              0.              0
 3    1.499000E+00    1.000000E+05    3.000000E+02    0.              0.              0.              0
 4    1.499000E+00    1.000000E+05    3.000000E+02    0.              0.              0.              0
 5    1.499000E+00    1.000000E+05    3.000000E+02    0.              0.              0.              0
 6    7.389000E+00    1.000000E+05    3.000000E+02    0.              0.              0.              0
 7    1.000000E+06    1.000000E+05    3.000000E+02    0.              0.              0.              0

TOTAL VOLUME IS =          .2000013385000E+07

GENERAL JUNCTION INFORMATION

   NJ  JUN  NV1  NV2   ND  IJEO
      AREA          ENLV 1-2        EXLV 1-2        ENLV 2-1        EXLV 2-1        MOODY MULT.       L/A

    1    1    1    2    0    0
 5.000000E-01    5.000000E-01    1.000000E+00    5.000000E-01    1.000000E+00    0.              0.
    2    3    2    3    0    1
 4.500000E-01    0.              0.              0.              0.              0.              4.633000E+00
    3    3    2    4    0    1
 1.249000E+00    0.              0.              0.              0.              0.              2.402000E+00
    4    3    3    5    0    1
 1.249000E+00    0.              0.              0.              0.              0.              2.402000E+00
    5    3    4    5    0    1
 4.500000E-01    0.              0.              0.              0.              0.              4.633000E+00
    6    3    4    6    0    1
 6.250000E-01    0.              0.              0.              0.              0.              1.201000E+00
    7    3    5    6    0    1
 6.250000E-01    0.              0.              0.              0.              0.              1.201000E+00
    8    1    6    7    0    0
 5.000000E-01    5.000000E-01    1.000000E+00    5.000000E-01    1.000000E+00    0.              0.
```

Interpretation and Labelling of Input (cont)

```
TOTAL JUNCTION AREA IS -        .564800000000E+01

THE NUMBER OF DOOR SETS EXPECTED IS  0

NO. OF JUNCS. REQUIRING LOSS COEFF. DETAILS IS   6

JUNCTION LOSS COEFFICIENT DETAIL
 NJ   WHERE       SUM   =  CONTR   +  MULTC   +  EXPAN   +  MULTE   +  FRIFA   +  LENGT   /  DIAHY   +  MISC1   +  MISC2

  2   2- J      .57651     .50000    1.00000    0.00000    0.00000     .02000    2.08500     .54500    0.00000    0.00000
  2 J - 5      1.07651    0.00000    0.00000    1.00000    1.00000     .02000    2.08500     .54500    0.00000    0.00000
  2 J - 3      1.07651    0.00000    0.00000    1.00000    1.00000     .02000    2.08500     .54500    0.00000    0.00000
  2   3- J      .57651     .50000    1.00000    0.00000    0.00000     .02000    2.08500     .54500    0.00000    0.00000

  3   2- J      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  3 J - 2      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  3 J - 4      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  3   4- J      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000

  4   3- J      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  4 J - 3      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  4 J - 5      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  4   5- J      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000

  5   4- J      .57651     .50000    1.00000    0.00000    0.00000     .02000    2.08500     .54500    0.00000    0.00000
  5 J - 4      1.07651    0.00000    0.00000    1.00000    1.00000     .02000    2.08500     .54500    0.00000    0.00000
  5 J - 5      1.07651    0.00000    0.00000    1.00000    1.00000     .02000    2.08500     .54500    0.00000    0.00000
  5   5- J      .57651     .50000    1.00000    0.00000    0.00000     .02000    2.08500     .54500    0.00000    0.00000

  6   4- J      .05000    0.00000    0.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  6 J - 4      1.05000    0.00000    0.00000    1.00000    1.00000     .02000    1.50000     .60000    0.00000    0.00000
  6 J - 6      1.55000    0.00000    0.00000    1.00000    1.00000    0.00000    0.00000    1.00000     .50000    0.00000
  6   6- J      1.00000     .50000    1.00000    0.00000    0.00000    0.00000    0.00000    1.00000     .50000    0.00000

  7   5- J      .55000     .50000    1.00000    0.00000    0.00000     .02000    1.50000     .60000    0.00000    0.00000
  7 J - 5      1.05000    0.00000    0.00000    1.00000    1.00000     .02000    1.50000     .60000    0.00000    0.00000
  7 J - 6      1.50000    0.00000    0.00000    1.00000    1.00000    0.00000    0.00000    1.00000     .50000    0.00000
  7   6- J      1.00000     .50000    1.00000    0.00000    0.00000    0.00000    0.00000    1.00000     .50000    0.00000

GAS INFORMATION/
 GAS       CONSTANT        C SUB P

  1        0.              0.
  2        0.              0.
  3        0.              0.

UNITS CONVERSION FACTORS(USERS UNITS TO SI UNITS)

   PARAMETER(SI UNITS)                                    VALUE

MASS(KG)..........................................  1.0000000E+00
AREA(M**2)........................................  1.0000000E+00
VOLUME(M**3)......................................  1.0000000E+00
PRESSURE(PA=N/M**2)...............................  1.0000000E+00
ENERGY(J).........................................  1.0000000E+00
GAS CONSTANT(J/KG/K)..............................  1.0000000E+00
GAS C SUB P(J/KG/K)...............................  1.0000000E+00
TEMP. TO ABS. (DEG R OR F)........................  0.
TEMP. RATIO, E.G., DEG. F /DEG. C = ?)............  1.0000000E+00
1/ACM -1).........................................  1.0000000E+00
DOOR LENGTH(S)....................................  1.0000000E+00
DOOR DAMP. COEFF.(NXS)............................  1.0000000E+00
HEAT SINK AREA(M**2)..............................  1.0000000E+00
```

Interpretation and Labelling of Input (cont)

```
HEAT SINK COORDINATE(M)..............................  1.0000000E+00
HEAT SINK CONDUC.(W/M/K).............................  1.0000000E+00
HEAT SINK DENS.(KG/M**3).............................  1.0000000E+00
HEAT SINK HEAT GEN.(W/M**3)..........................  1.0000000E+00
ICE H. T. COEFF. COND. LAYER LENGTH(M)...............  1.0000000E+00
ICE H. T. COEFF. REF. VALUE(J/S/M**2/K)..............  1.0000000E+00
FORCE(N).............................................  1.0000000E+00
FORCE-MOMENT AREA(M**2)..............................  1.0000000E+00
MOMENT LENGTH(M).....................................  1.0000000E+00

THE NUMBER OF BOUNDARY CONDITION CARDS EXPECTED IS-   0
```

FORCE-MOMENT SURFACE DATA

ANGLES ARE THOSE FROM EACH POSITIVE COORDINATE AXIS TO THE SURFACE FORCE VECTOR.
DIRECTION COSINES ARE THOSE FOR THE ANGLES.
MOMENT ARMS ARE THE SURFACE AREA CENTROID X-Y-Z COORDINATE LOCATION.

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	ANGLES X	ANGLES Y	ANGLES Z	DIRECTION COSINES X	DIRECTION COSINES Y	DIRECTION COSINES Z	MOMENT ARMS X	MOMENT ARMS Y	MOMENT ARMS Z
1	2	1.0607E+01	225.00	135.00	90.00	-.70711	-.70711	-.00000	1.2500E+00	1.2500E+00	-1.5000E+00
2	2	1.0607E+01	135.00	45.00	90.00	-.70711	.70711	-.00000	1.2500E+00	-1.2500E+00	-1.5000E+00
3	3	1.0607E+01	45.00	135.00	90.00	.70711	-.70711	-.00000	-1.2500E+00	1.2500E+00	-1.5000E+00
4	3	1.0607E+01	45.00	45.00	90.00	.70711	.70711	-.00000	-1.2500E+00	-1.2500E+00	-1.5000E+00
5	4	1.0607E+01	225.00	135.00	90.00	-.70711	-.70711	-.00000	1.2500E+00	1.2500E+00	-4.5000E+00
6	4	1.0607E+01	135.00	45.00	90.00	-.70711	.70711	-.00000	1.2500E+00	-1.2500E+00	-4.5000E+00
7	5	1.0607E+01	45.00	135.00	90.00	.70711	-.70711	-.00000	-1.2500E+00	1.2500E+00	-4.5000E+00
8	5	1.0607E+01	45.00	45.00	90.00	.70711	.70711	-.00000	-1.2500E+00	-1.2500E+00	-4.5000E+00
9	6	1.9635E+01	90.00	90.00	0.00	-.00000	-.00000	1.00000	0.	0.	-6.0000E+00
10	7	1.9635E+01	90.00	90.00	180.00	-.00000	-.00000	-1.00000	0.	0.	0.

```
NUMBER OF FORCE REFERENCES.....    5
NUMBER OF MOMENT REFERENCES.....   3
```

```
FORCE-MOMENT REFERENCE INFO -
  SURFACE ELEMENT NO.(NE) IDENTIFIES SURFACE NO.(NS) FORCE-MOMENT ACCOUNTING
  FOR REFERENCES WHERE, +NE=+NS, -NE=-NS AND NE=0 MEANS + ALL NS.
```

FORCE REFERENCE INFORMATION

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	ELEMENT NUMBER(S)
1	X	1	0
2	X	8	1 2 3 4 5 6 7 8
3	X	4	1 2 3 4
4	X	4	5 6 7 8
5	Z	2	9 10

MOMENT REFERENCE INFORMATION

MOMENT REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	ELEMENT NUMBER(S)
1	Y	1	0
2	Y	4	1 2 3 4
3	Y	4	5 6 7 8

AREA INPUT CHECK

TOTAL AREA RESIDUES X	TOTAL AREA RESIDUES Y	TOTAL AREA RESIDUES Z	TOTAL AREA	FRACTIONAL AREA RESIDUES X	FRACTIONAL AREA RESIDUES Y	FRACTIONAL AREA RESIDUES Z
-2.0080E-10	-5.0742E-10	-4.3360E-10	1.2413E+02	-1.6177E-12	-4.0879E-12	-3.4932E-12

```
PLOT CONTROL = T
```

Interpretation and Labelling of Input (cont)

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                PLOTTING DATA


NUMBER OF VOLUME PRESSURE PLOTS.........      1
NUMBER OF VOLUME TEMPERATURE PLOTS......      0
NUMBER OF JUNCTION MASS FLOW RATE PLOTS.      1
NUMBER OF PRESSURE DIFFERENCE PLOTS.....      1
NUMBER OF FORCE PLOTS...................      2
NUMBER OF MOMENT PLOTS..................      1
NUMBER OF SPECIAL VARIABLES SAVED.......      4
MAXIMUM NUMBER OF POINTS TO BE PLOTTED..    200
TYPE OF TIME PLOT, 1-LINEAR, 3-LOG......      1
POINTS SKIPPED PER POINT PLOTTED........      1
PLOT SYMBOL FREQUENCY...................      5
GRID TYPE INDICATOR.....................      0


MINIMUM TIME FOR PLOTS..................  0.
MAXIMUM TIME FOR PLOTS..................  .5000E-01
TIME AXIS LENGTH........................  .5000E+01


          VOLUME PRESSURE PLOTS
PLOT NUMBER   VOLUMES TO BE PLOTTED       YMIN          YMAX          YAXIS LENGTH
     1          2   4   3   5   6
                                          0.            0.            0.

          JUNCTION MASS FLOW RATE PLOTS
PLOT NUMBER   JUNCTIONS TO BE PLOTTED     YMIN          YMAX          YAXIS LENGTH
     1          1   2   3   8
                                          0.            0.            0.

          PRESSURE DIFFERENCE PLOTS
PLOT NUMBER   FIRST DP     SECOND DP     THIRD DP      FOURTH DP     FIFTH DP
              BETWEEN      BETWEEN       BETWEEN       BETWEEN       BETWEEN
              VOLUMES      VOLUMES       VOLUMES       VOLUMES       VOLUMES     YMIN          YMAX          YAXIS LENGTH
     1          2   3        4   5         6   7                                 0.            0.            0.

          FORCE PLOTS
PLOT NUMBER   REFERENCES TO BE PLOTTED    YMIN          YMAX          YAXIS LENGTH
     1          1   2   3   4
                                          0.            0.            0.
     2          5
                                          0.            0.            0.

          MOMENT PLOTS
PLOT NUMBER   REFERENCES TO BE PLOTTED    YMIN          YMAX          YAXIS LENGTH
     1          1   2   3
                                          0.            0.            0.

 SAMPLE PROBLEM

 TIME=       0.000000  TOTAL INCREMENTS=     0
 TIME INC.=   .001000 , COMPARED WITH -

VOL     TEMP        PRESSURE    STEAM MASS   FRAC   WATER MASS   FRAC    GAS MASS     FRAC   TOTAL MASS   INT ENERGY    VOLUME
  1  3.0000E+02  3.0000E+05  0.           0.0000  0.           0.0000  3.4884E+06  1.0000  3.4884E+06  6.7100E+10  1.0000E+06
  2  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  1.7430E+00  1.0000  1.7430E+00  3.3528E+04  1.4990E+00
  3  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  1.7430E+00  1.0000  1.7430E+00  3.3528E+04  1.4990E+00
  4  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  1.7430E+00  1.0000  1.7430E+00  3.3528E+04  1.4990E+00
  5  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  1.7430E+00  1.0000  1.7430E+00  3.3528E+04  1.4990E+00
  6  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  8.5920E+00  1.0000  8.5920E+00  1.6527E+05  7.3890E+00
  7  3.0000E+02  1.0000E+05  0.           0.0000  0.           0.0000  1.1628E+06  1.0000  1.1628E+06  2.2367E+10  1.0000E+06

 TOT. MASS-    4.65123E+06, TOT. ENERGY-    8.94670E+10
 TOTAL BLW DWN MASS-    0.          , TOTAL BLW DWN ENERGY-    0.
```

JUN	VI	VJ	AREA	ENT LOSS K	EXT LOSS K	CHOKE	STEAM(M/S)	WATER(M/S)	GAS(M/S)	TOTAL(M/S)	ENERGY(EN/S)
1	1	2	5.0000E-01	5.0000E-01	1.0000E+00	YES	0.	0.	2.7368E+02	2.7368E+02	2.8800E+07
2	2	3	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	0.	0.	0.
3	2	4	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	0.	0.	0.
4	3	5	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	0.	0.	0.
5	4	5	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	0.	0.	0.
6	4	6	6.2500E-01	5.0000E-02	1.5000E+00	NO	0.	0.	0.	0.	0.
7	5	6	6.2500E-01	5.0000E-01	1.5000E+00	NO	0.	0.	0.	0.	0.
8	6	7	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	0.	0.	0.

COMPONENT FORCE-MOMENT DATA

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	FORCES X	FORCES Y	FORCES Z	MOMENTS X	MOMENTS Y	MOMENTS Z
1	2	1.0607OE+01	-7.5003E+05	-7.5003E+05	-5.4207E-06	-1.1250E+06	1.1250E+06	-1.9163E-05
2	3	1.0607OE+01	-7.5003E+05	7.5003E+05	-5.4207E-06	1.1250E+06	1.1250E+06	-9.5814E-06
3	4	1.0607OE+01	7.5003E+05	-7.5003E+05	-5.4207E-06	-1.1250E+06	-1.1250E+06	9.5814E-06
4	5	1.0607OE+01	7.5003E+05	7.5003E+05	-5.4207E-06	1.1250E+06	-1.1250E+06	0.
5	4	1.0607OE+01	-7.5003E+05	-7.5003E+05	-5.4207E-06	-3.3751E+06	3.3751E+06	-1.9163E-05
6	4	1.0607OE+01	-7.5003E+05	7.5003E+05	-5.4207E-06	3.3751E+06	3.3751E+06	-9.5814E-06
7	5	1.0607OE+01	7.5003E+05	-7.5003E+05	-5.4207E-06	-3.3751E+06	-3.3751E+06	9.5814E-06
8	5	1.0607OE+01	7.5003E+05	7.5003E+05	-5.4207E-06	3.3751E+06	-3.3751E+06	0.
9	6	1.9635OE+01	-1.0035E-05	-1.0035E-05	1.9635E+06	-6.0207E-05	6.0207E-05	0.
10	7	1.9635OE+01	-1.0035E-05	-1.0035E-05	-1.9635E+06	0.	0.	0.

TOTAL FORCE-MOMENT DATA

FORCES X	FORCES Y	FORCES Z	RESULTANT R	MOMENTS X	MOMENTS Y	MOMENTS Z
-2.0058E-05	-5.0721E-05	-4.3362E-05	5.4543E-05	-1.5215E-04	6.0132E-05	-3.8326E-05

FORCE REFERENCE DATA

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE FORCE	REFERENCE ANGLE
1	X	1	-2.00578E-05	
2	X	8	1.11759E-08	
3	X	4	5.72529E-09	
4	X	4	3.72529E-09	
5	Z	2	0.	

MOMENT REFERENCE DATA

MOMENT REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE MOMENT	REFERENCE ANGLE
1	Y	1	6.01325E-05	
2	Y	4	-2.23517E-08	
3	Y	4	-4.47035E-08	

Output

```
TIME=        .001000  TOTAL INCREMENTS=    1
TIME INC.=   .001000  , COMPARED WITH -
             .000318  , BASED ON VOLUME      1  DMASS/MASS=RATIO
             .001000  , BASED ON VOLUME      0  DPRES/PRES=RATIO
             .001000  , BASED ON JUNCTN      0  .5XDL/SONIC SPEED
             .001000  , BASED ON JUNCTN      0  COMPRESSION WAVE
```

VOL	TEMP	PRESSURE	STEAM MASS	FRAC	WATER MASS	FRAC	GAS MASS	FRAC	TOTAL MASS	INT ENERGY	VOLUME
1	3.0000E+02	3.0000E+05	0.	0.0000	0.	0.0000	3.4884E+06	1.0000	3.4884E+06	6.7100E+10	1.0000E+06
2	3.1628E+02	1.2198E+05	0.	0.0000	0.	0.0000	2.0167E+00	1.0000	2.0167E+00	6.2328E+06	1.4990E+00
3	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.7430E+00	1.0000	1.7430E+00	3.3528E+06	1.4990E+00
4	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.7430E+00	1.0000	1.7430E+00	3.3528E+06	1.4990E+00
5	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.7430E+00	1.0000	1.7430E+00	3.3528E+06	1.4990E+00
6	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	8.5920E+00	1.0000	8.5920E+00	1.6527E+05	7.3890E+00
7	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.1628E+06	1.0000	1.1628E+06	2.2367E+10	1.0000E+06

```
CHG IN TOTAL MASS     0.          , TOTAL ENERGY     0.
TOTAL BLW DWN MASS=   0.          , TOTAL BLW DWN ENERGY=   0.
```

JUN	VI	VJ	AREA	ENT LOSS K	EXT LOSS K	CHOKE	STEAM(M/S)	WATER(M/S)	GAS(M/S)	TOTAL(M/S)	ENERGY(EN/S)
1	1	2	5.0000E-01	5.0000E-01	1.0000E+00	YES	0.	0.	2.7368E+02	2.7368E+02	2.8800E+07
2	2	3	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	7.0756E+00	7.0756E+00	8.6020E+05
3	2	4	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	1.3725E+01	1.3725E+01	1.6686E+06
4	3	5	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	0.	0.	0.
5	4	5	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	0.	0.	0.
6	4	6	6.2500E-01	5.0000E-02	1.5000E+00	NO	0.	0.	1.1632E-12	1.1632E-12	1.2241E-07
7	5	6	6.2500E-01	5.5000E-01	1.5000E+00	NO	0.	0.	1.1632E-12	1.1632E-12	1.2241E-07
8	6	7	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	-2.6888E-05	-2.6888E-05	-2.8295E-00

COMPONENT FORCE-MOMENT DATA

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	FORCES X	FORCES Y	FORCES Z	MOMENTS X	MOMENTS Y	MOMENTS Z
1	2	1.0607OE+01	-9.1490E+05	-9.1490E+05	-6.6123E-06	-1.3723E+06	1.3723E+06	-2.3380E-05
2	5	1.0607OE+01	-9.1490E+05	9.1490E+05	-6.6123E-06	1.3723E+06	1.3723E+06	-1.1697E-05
3	3	1.0607OE+01	7.5003E+05	-7.5003E+05	-5.4207E-06	-1.1250E+06	-1.1250E+06	9.5814E-06
4	3	1.0607OE+01	7.5003E+05	7.5003E+05	-5.4207E-06	1.1250E+06	-1.1250E+06	0.
5	4	1.0607OE+01	-7.5003E+05	-7.5003E+05	-5.4207E-06	-3.3751E+06	3.3751E+06	-1.9163E-05
6	4	1.0607OE+01	-7.5003E+05	7.5003E+05	-5.4207E-06	3.3751E+06	3.3751E+06	-9.5814E-06
7	5	1.0607OE+01	7.5003E+05	-7.5003E+05	-5.4207E-06	-3.3751E+06	-3.3751E+06	9.5814E-06
8	5	1.0607OE+01	7.5003E+05	7.5003E+05	-5.4207E-06	3.3751E+06	-3.3751E+06	0.
9	6	1.9635OE+01	-1.0035E-05	-1.0035E-05	1.9635E+06	-6.0207E-05	6.0207E-05	0.
10	7	1.9635OE+01	-1.0035E-05	-1.0035E-05	-1.9635E+06	0.	0.	0.

TOTAL FORCE-MOMENT DATA

FORCES X	FORCES Y	FORCES Z	RESULTANT R	MOMENTS X	MOMENTS Y	MOMENTS Z
-3.2973E+05	-5.2416E-05	-4.5761E-05	3.2973E+05	-1.5470E-04	4.9460E+05	-4.4659E-05

FORCE REFERENCE DATA

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE FORCE	REFERENCE ANGLE
1	X	1	-3.29734E+05	
2	X	8	-3.29734E+05	
3	X	4	-3.29734E+05	
4	X	4	3.72529E-09	
5	Z	2	-1.49012E-08	

MOMENT REFERENCE DATA

MOMENT REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE MOMENT	REFERENCE ANGLE
1	Y	1	4.94602E+05	
2	Y	4	4.94602E+05	
3	Y	4	-4.47035E-08	

Output (cont)

```
TIME=        .002000  TOTAL INCREMENTS=    2
TIME INC.=   .001000 , COMPARED WITH -
             .000599 , BASED ON VOLUME      1  DMASS/MASS=RATIO
             .001000 , BASED ON VOLUME      0  DPRES/PRES=RATIO
             .001000 , BASED ON JUNCTN      2  .5XDL/SONIC SPEED
             .001000 , BASED ON JUNCTN      0  COMPRESSION WAVE
```

VOL	TEMP	PRESSURE	STEAM MASS	FRAC	WATER MASS	FRAC	GAS MASS	FRAC	TOTAL MASS	INT ENERGY	VOLUME
1	3.0000E+02	3.0000E+05	0.	0.0000	0.	0.0000	3.4884E+06	1.0000	3.4884E+06	6.7100E+10	1.0000E+06
2	3.2763E+02	1.4220E+05	0.	0.0000	0.	0.0000	2.2696E+00	1.0000	2.2696E+00	8.8599E+04	1.4990E+00
3	3.0058E+02	1.0060E+05	0.	0.0000	0.	0.0000	1.7501E+00	1.0000	1.7501E+00	3.4388E+04	1.4990E+00
4	3.0112E+02	1.0116E+05	0.	0.0000	0.	0.0000	1.7568E+00	1.0000	1.7568E+00	3.5196E+04	1.4990E+00
5	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.7430E+00	1.0000	1.7430E+00	3.3528E+04	1.4990E+00
6	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	8.5920E+00	1.0000	8.5920E+00	1.6527E+05	7.3890E+00
7	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.1628E+06	1.0000	1.1628E+06	2.2367E+10	1.0000E+06

```
CHG IN TOTAL MASS   -2.98023E-08, TOTAL ENERGY    0.
TOTAL BLW DWN MASS-    0.       , TOTAL BLW DWN ENERGY-    0.
```

JUN	VI	VJ	AREA	ENT LOSS K	EXT LOSS K	CHOKE	STEAM(M/S)	WATER(M/S)	GAS(M/S)	TOTAL(M/S)	ENERGY(EN/S)
1	1	2	5.0000E-01	5.0000E-01	1.0000E+00	YES	0.	0.	2.7368E+02	2.7368E+02	2.8800E+07
2	2	3	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	1.7894E+01	1.7894E+01	2.3792E+06
3	3	4	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	3.4766E+01	3.4766E+01	4.6223E+06
4	3	5	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	3.7416E-01	3.7416E-01	3.9591E+04
5	4	5	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	3.7618E-01	3.7618E-01	4.0008E+04
6	4	6	6.2500E-01	5.0000E-02	1.5000E+00	NO	0.	0.	1.4486E+00	1.4486E+00	1.5406E+05
7	5	6	6.2500E-01	1.0000E+00	1.0500E+00	NO	0.	0.	-5.4719E-07	-5.4719E-07	-5.7583E-02
8	6	7	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	1.3031E-02	1.3031E-02	1.3713E+03

COMPONENT FORCE-MOMENT DATA

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	FORCES X	FORCES Y	FORCES Z	MOMENTS X	MOMENTS Y	MOMENTS Z
1	2	1.0607OE+01	-1.0666E+06	-1.0666E+06	-7.7084E-06	-1.5998E+06	1.5998E+06	-2.7262E-05
2	3	1.0607OE+01	-1.0666E+06	-1.0666E+06	-7.7084E-06	1.5998E+06	1.5998E+06	-1.3635E-05
3	3	1.0607OE+01	7.5452E+05	-7.5452E+05	-5.4532E-06	-1.1318E+06	-1.1318E+06	9.6448E-06
4	3	1.0607OE+01	7.5452E+05	7.5452E+05	-5.4532E-06	1.1318E+06	-1.1318E+06	0.
5	4	1.0607OE+01	-7.5875E+05	-7.5875E+05	-5.4837E-06	-3.4144E+06	3.4144E+06	-1.9394E-05
6	4	1.0607OE+01	-7.5875E+05	7.5875E+05	-5.4837E-06	3.4144E+06	3.4144E+06	-9.7307E-06
7	5	1.0607OE+01	7.5003E+05	-7.5003E+05	-5.4207E-06	-3.3751E+06	-3.3751E+06	9.5814E-06
8	5	1.0607OE+01	7.5003E+05	7.5003E+05	-5.4207E-06	3.3751E+06	-3.3751E+06	0.
9	6	1.9635OE+01	-1.0035E-05	-1.0035E-05	1.9635E+06	-6.0207E-05	6.0207E-05	0.
10	7	1.9635OE+01	-1.0035E-05	-1.0035E-05	-1.9635E+06	0.	0.	0.

TOTAL FORCE-MOMENT DATA

FORCES X	FORCES Y	FORCES Z	RESULTANT R	MOMENTS X	MOMENTS Y	MOMENTS Z
-6.4149E+05	-5.4114E-05	8.5543E-03	6.4149E+05	-1.5754E-04	1.0145E+06	-5.0765E-05

FORCE REFERENCE DATA

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE FORCE	REFERENCE ANGLE
1	X	1	-6.41494E+05	
2	X	8	-6.41494E+05	
3	X	4	-6.24060E+05	
4	X	4	-1.74339E+04	
5	Z	2	8.60246E-03	

MOMENT REFERENCE DATA

MOMENT REFEPENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE MOMENT	REFERENCE ANGLE
1	Y	1	1.01454E+06	
2	Y	4	9.36089E+05	
3	Y	4	7.84528E+04	

Output (cont)

```
TIME=        .010000  TOTAL INCREMENTS=   10
TIME INC.=   .001000 , COMPARED WITH -
             .001773 , BASED ON VOLUME      1  DMASS/MASS=RATIO
             .001000 , BASED ON VOLUME      1  DPRES/PRES=RATIO
             .001000 , BASED ON JUNCTN      2  .5XDL/SONIC SPEED
             .001000 , BASED ON JUNCTN      0  COMPRESSION WAVE
```

VOL	TEMP	PRESSURE	STEAM MASS	FRAC	WATER MASS	FRAC	GAS MASS	FRAC	TOTAL MASS	INT ENERGY	VOLUME
1	3.0000E+02	3.0000E+05	0.	0.0000	0.	0.0000	3.4884E+06	1.0000	3.4884E+06	6.7100E+10	1.0000E+06
2	3.2385E+02	1.8252E+05	0.	0.0000	0.	0.0000	2.9470E+00	1.0000	2.9470E+00	1.0706E+05	1.4990E+00
3	3.3164E+02	1.3501E+05	0.	0.0000	0.	0.0000	2.1288E+00	1.0000	2.1288E+00	8.9221E+04	1.4990E+00
4	3.4163E+02	1.4968E+05	0.	0.0000	0.	0.0000	2.2911E+00	1.0000	2.2911E+00	1.1242E+05	1.4990E+00
5	3.1485E+02	1.1559E+05	0.	0.0000	0.	0.0000	1.9197E+00	1.0000	1.9197E+00	5.7356E+04	1.4990E+00
6	3.0564E+02	1.0527E+05	0.	0.0000	0.	0.0000	8.8773E+00	1.0000	8.8773E+00	2.0666E+05	7.3890E+00
7	3.0000E+02	1.0000E+05	0.	0.0000	0.	0.0000	1.1628E+06	1.0000	1.1628E+06	2.2367E+10	1.0000E+06

```
CHG IN TOTAL MASS   -7.96066E-08, TOTAL ENERGY   -4.88281E-04
TOTAL BLW DWN MASS=    0.          TOTAL BLW DWN ENERGY=    0.
```

JUN	VI	VJ	AREA	ENT LOSS K	EXT LOSS K	CHOKE	STEAM(M/S)	WATER(M/S)	GAS(M/S)	TOTAL(M/S)	ENERGY(EN/S)
1	1	2	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	2.7199E+02	2.7199E+02	2.8623E+07
2	2	3	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	9.7508E+01	9.7508E+01	1.2595E+07
3	3	4	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	2.1438E+02	2.1438E+02	2.7691E+07
4	3	5	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	4.4102E+01	4.4102E+01	6.0412E+06
5	4	5	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	3.8583E+01	3.8583E+01	5.6716E+06
6	4	6	6.2500E-01	5.0000E-02	1.5000E+00	NO	0.	0.	1.2727E+02	1.2727E+02	1.8708E+07
7	5	6	6.2500E-01	5.5000E-01	1.5000E+00	NO	0.	0.	2.5485E+01	2.5485E+01	3.0616E+06
8	6	7	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	4.4509E+01	4.4509E+01	4.9359E+06

COMPONENT FORCE-MOMENT DATA

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	FORCES X	FORCES Y	FORCES Z	MOMENTS X	MOMENTS Y	MOMENTS Z
1	2	1.0607OE+01	-1.3689E+06	-1.3689E+06	-9.8937E-06	-2.0534E+06	2.0534E+06	-3.4988E-05
2	5	1.0607OE+01	-1.3689E+06	1.3689E+06	-9.8937E-06	2.0534E+06	2.0534E+06	-1.7501E-05
3	3	1.0607OE+01	1.0126E+06	-1.0126E+06	-7.3186E-06	-1.5189E+06	-1.5189E+06	1.2942E-05
4	5	1.0607OE+01	1.0126E+06	1.0126E+06	-7.3186E-06	1.5189E+06	-1.5189E+06	0.
5	4	1.0607OE+01	-1.1227E+06	-1.1227E+06	-8.1139E-06	-5.0520E+06	5.0520E+06	-2.8692E-05
6	4	1.0607OE+01	-1.1227E+06	1.1227E+06	-8.1139E-06	5.0520E+06	5.0520E+06	-1.4351E-05
7	5	1.0607OE+01	8.6693E+05	-8.6693E+05	-6.2656E-06	-3.9012E+06	-3.9012E+06	1.1079E-16
8	5	1.0607OE+01	8.6693E+05	8.6693E+05	-6.2656E-06	3.9012E+06	-3.9012E+06	0.
9	6	1.9635OE+01	-1.0563E-05	-1.0563E-05	2.0669E+06	-6.3377E-05	6.3377E-05	0.
10	7	1.9635OE+01	-1.0035E-05	-1.0035E-05	-1.9635E+06	0.	0.	0.

TOTAL FORCE-MOMENT DATA

FORCES X	FORCES Y	FORCES Z	RESULTANT R	MOMENTS X	MOMENTS Y	MOMENTS Z
-1.2241E+06	-6.5301E-05	1.0338E+05	1.2241E+06	-1.9145E-04	3.3705E+06	-7.1511E-05

FORCE REFERENCE DATA

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE FORCE	REFERENCE ANGLE
1	X	1	-1.22407E+06	
2	X	8	-1.22407E+06	
3	X	4	-7.12607E+05	
4	X	4	-5.11460E+05	
5	Z	2	1.03384E+05	

MOMENT REFERENCE DATA

MOMENT REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE MOMENT	REFERENCE ANGLE
1	Y	1	3.37048E+06	
2	Y	4	1.06891E+06	
3	Y	4	2.30157E+06	

Output (cont)

```
TIME=        .100000  TOTAL INCREMENTS=  100
TIME INC.=   .001000 , COMPARED WITH -
             .017445 , BASED ON VOLUME      1  DMASS/MASS=RATIO
             .001000 , BASED ON VOLUME      1  DPRES/PRES=RATIO
             .001000 , BASED ON JUNCTN      2  .5XDL/SONIC SPEED
             .001000 , BASED ON JUNCTN      0  COMPRESSION WAVE
```

VOL	TEMP	PRESSURE	STEAM MASS	FRAC	WATER MASS	FRAC	GAS MASS	FRAC	TOTAL MASS	INT ENERGY	VOLUME
1	3.0000E+02	3.0000E+05	0.	0.0000	0.	0.0000	3.4884E+06	1.0000	3.4884E+06	6.7097E+10	1.0000E+06
2	3.0313E+02	2.1888E+05	0.	0.0000	0.	0.0000	3.7759E+00	1.0000	3.7759E+00	8.1092E+04	1.4990E+00
3	3.2515E+02	2.1451E+05	0.	0.0000	0.	0.0000	3.4497E+00	1.0000	3.4497E+00	1.2854E+05	1.4990E+00
4	3.0861E+02	2.1889E+05	0.	0.0000	0.	0.0000	3.7090E+00	1.0000	3.7090E+00	9.4218E+04	1.4990E+00
5	3.3047E+02	2.1446E+05	0.	0.0000	0.	0.0000	3.3935E+00	1.0000	3.3935E+00	1.3938E+05	1.4990E+00
6	3.4510E+02	2.0507E+05	0.	0.0000	0.	0.0000	1.5317E+01	1.0000	1.5317E+01	7.8968E+05	7.3890E+00
7	3.0000E+02	1.0000E+06	0.	0.0000	0.	0.0000	1.1628E+06	1.0000	1.1628E+06	2.2369E+10	1.0000E+06

```
CHG IN TOTAL MASS    0.          , TOTAL ENERGY    4.88281E-04
TOTAL BLW DWN MASS=  0.          , TOTAL BLW DWN ENERGY=   0.
```

JUN	VI	VJ	AREA	ENT LOSS K	EXT LOSS K	CHOKE	STEAM(M/S)	WATER(M/S)	GAS(M/S)	TOTAL(M/S)	ENERGY(EN/S)
1	1	2	5.0000E-01	5.0000E-01	1.0000E+00	NO	0.	0.	2.5311E+02	2.5311E+02	2.6636E+07
2	2	3	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	5.4860E+01	5.4860E+01	5.9453E+06
3	3	4	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	1.9007E+02	1.9007E+02	2.0598E+07
4	3	5	1.2490E+00	5.0000E-02	5.0000E-02	NO	0.	0.	4.5336E+01	4.5336E+01	5.9150E+06
5	4	5	4.5000E-01	5.7651E-01	1.0765E+00	NO	0.	0.	5.2331E+01	5.2331E+01	5.9589E+06
6	4	6	6.2500E-01	5.0000E-02	1.5000E+00	NO	0.	0.	1.2908E+02	1.2908E+02	1.4698E+07
7	5	6	6.2500E-01	5.5000E-01	1.5000E+00	NO	0.	0.	8.8068E+01	8.8068E+01	1.1960E+07
8	6	7	5.0000E-01	5.0000E-01	1.0000E+00	YES	0.	0.	1.7442E+02	1.7442E+02	2.6248E+07

COMPONENT FORCE-MOMENT DATA

SURFACE NUMBER	VOLUME NUMBER	SURFACE AREA	FORCES X	FORCES Y	FORCES Z	MOMENTS X	MOMENTS Y	MOMENTS Z
1	2	1.0607OE+01	-1.6417E+06	-1.6417E+06	-1.1865E-05	-2.4625E+06	2.4625E+06	-4.1954E-05
2	2	1.0607OE+01	-1.6417E+06	1.6417E+06	-1.1865E-05	2.4625E+06	2.4625E+06	-2.0973E-05
3	3	1.0607OE+01	1.6089E+06	-1.6089E+06	-1.1628E-05	-2.4133E+06	-2.4133E+06	2.0556E-05
4	3	1.0607OE+01	1.6089E+06	1.6089E+06	-1.1628E-05	2.4133E+06	-2.4133E+06	0.
5	4	1.0607OE+01	-1.6417E+06	-1.6417E+06	-1.1865E-05	-7.3878E+06	7.3878E+06	-4.1962E-05
6	4	1.0607OE+01	-1.6417E+06	1.6417E+06	-1.1865E-05	7.3878E+06	7.3878E+06	-2.0973E-05
7	5	1.0607OE+01	1.6085E+06	-1.6085E+06	-1.1625E-05	-7.2384E+06	-7.2384E+06	2.0564E-05
8	5	1.0607OE+01	1.6085E+06	1.6085E+06	-1.1625E-05	7.2384E+06	-7.2384E+06	0.
9	6	1.9635OE+01	-2.0577E-05	-2.0577E-05	4.0265E+06	-1.2346E-04	1.2346E-04	0.
10	7	1.9635OE+01	-1.0035E-05	-1.0035E-05	-1.9635E+06	0.	0.	0.

TOTAL FORCE-MOMENT DATA

FORCES X	FORCES Y	FORCES Z	RESULTANT R	MOMENTS X	MOMENTS Y	MOMENTS Z
-1.3209E+05	-9.7064E-05	2.0629E+06	1.3209E+05	-3.2284E-04	3.9736E+05	-8.4743E-05

FORCE REFERENCE DATA

FORCE REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE FORCE	REFERENCE ANGLE
1	X	1	-1.32087E+05	
2	X	8	-1.32087E+05	
3	X	4	-6.56776E+04	
4	X	4	-6.64094E+04	
5	Z	2	2.06294E+06	

MOMENT REFERENCE DATA

MOMENT REFERENCE NUMBER	COMPONENT	NUMBER OF ELEMENTS	REFERENCE MOMENT	REFERENCE ANGLE
1	Y	1	3.97359E+05	
2	Y	4	9.85164E+04	
3	Y	4	2.98842E+05	

Output (cont)

MAXIMUM FORCE-MOMENT DATA

FORCES/TIMES			RESULTANT/TIME	MOMENTS/TIMES		
X	Y	Z	R	X	Y	Z
-1.4859E+06	-9.7004E-05	2.0629E+06	1.4859E+06	-7.2284E-04	3.6004E+06	-8.4743E-05
7.0000E-01	1.0000E-01	1.0000E-01	7.0000E-01	1.0000E-01	8.0000E-01	1.0000E-01

NT = 100, CPU TIME = .54, TOT TIME = .57, CYC TIME = .00538

NRC FORM 335 (7-77) U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

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7. AUTHOR(S)
R.G. Gido, G.J.E. Willcutt, Jr., J.L. Lunsford, J.S. Gilbert

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Los Alamos, NM 87545

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Washington, DC 20555

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PERIOD COVERED (Inclusive dates)

15. SUPPLEMENTARY NOTES

14. (Leave blank)

16. ABSTRACT (200 words or less)

The COMPARE-MOD 1 code has been extended to incorporate an accounting for loss coefficient detail, calculation of forces and moments, and plotting of calculated results. The loss coefficient detail feature includes a complete breakdown of the loss coefficien components, which facilitates checking the input, the calculation of the friction component, and the summation of the components to provide the total loss coefficient. The force-moment capability is based on a general orthogonal cartesian coordinate system that allows pressure-bearing surfaces of arbitrary orientation and location. Plotting is based on the DISSPLA system and features the convenient plotting of key parameters such as pressures, forces and moments, and plotting of any code variable by means of special plotting procedures.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

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